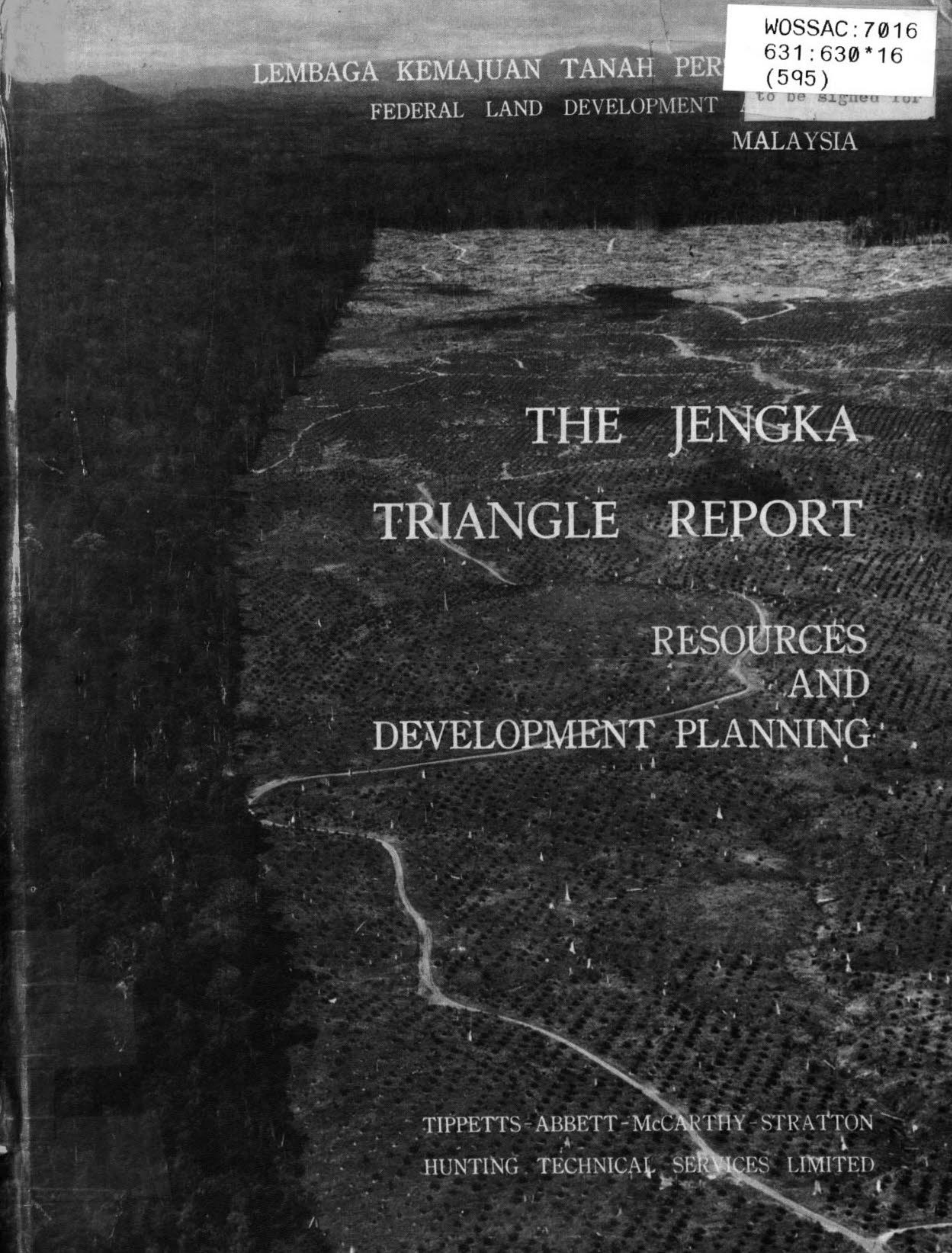

LEMBAGA KEMAJUAN TANAH PER

FEDERAL LAND DEVELOPMENT A

MALAYSIA

THE JENGKA TRIANGLE REPORT

RESOURCES AND DEVELOPMENT PLANNING

TIPPETTS-ABBETT-McCARTHY-STRATTON

HUNTING TECHNICAL SERVICES LIMITED

LEMBAGA KEMAJUAN TANAH PERSEKUTUAN

FEDERAL LAND DEVELOPMENT AUTHORITY

MALAYSIA

THE JENGKA TRIANGLE REPORT

RESOURCES AND DEVELOPMENT PLANNING

TIPPETTS - ABBETT - McCARTHY - STRATTON

HUNTING TECHNICAL SERVICES LIMITED

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25th January 1967.

Tan Sri Taib bin Haji Andak,
The Chairman,
Federal Land Development Authority,
KUALA LUMPUR.

Dear Sir,

In accordance with the Agreement dated 21st June 1965 between The Federal Land Development Authority and the consultants, we submit herewith the Jengka Triangle Report.

This report presents the findings of the varied studies made of the Jengka Triangle in the 18-month period July 1965 to December 1966 and the recommendations for its orderly development under a comprehensive regional master plan.

The Jengka Triangle project is an important element in the further economic development of Malaysia. We wish to record our appreciation of the opportunity to participate in this undertaking, and to acknowledge the considerable cooperation and support provided by the Federal Land Development Authority.

Respectfully submitted,

TIPPETTS-ABBETT-McCARTHY-STRATTON * HUNTING TECHNICAL SERVICES, LTD.

E.K. Bryant
Partner

V.C. Robertson
Director

CONTENTS

FIGURES

PART 1

RESOURCES

CHAPTER 1
INTRODUCTION

The Jengka Triangle

The Jengka Triangle is located in the State of Pahang, West Malaysia, about 120 miles northeast of Kuala Lumpur (Figure 1 - 1). The boundaries of the Triangle are the Temerloh-Maran road on the south, the Jerantut-Maran road on the north and east, and the Sungai Pahang on the west. It is connected by modern all-weather highways to East and West Coast port and urban centres. The railway passes within three miles of its western edge. The total area contained by the Triangle is approximately 470 square miles. It derives its name from the Sungai Jengka which flows through it into the Pahang.

The Jengka Forest Reserve covers the greater part of the Jengka Triangle. It comprises 132,000 acres of land gazetted under the Forest Enactment. Of this, 94,000 acres are undisturbed Lowland Dipterocarp forest, 22,000 acres are allocated for logging or settlement, and the remainder of the area is swamp or disturbed forest. The Reserve is surrounded by approximately 75,000 acres of logged forest which have been exploited in varying degrees over many years. Logging is the principal economic activity in the Triangle.

Such development as has taken place within the Triangle is entirely peripheral, stimulated by the fringing roads and the Sungai Pahang which is navigable to small craft but limited as to its inward penetration by the boundaries of the Reserve (Figure 1 - 2).

The total extent of occupied or reserved land on the periphery is approximately 112,000 acres. There is one oil palm estate and there are several smaller rubber estates; virtually all the remaining agricultural activity is carried on by smallholders who form the bulk of the total population, estimated to range from 12,000 to 15,000. Settlement is comparatively dense on the broad belt of alluvium on the east bank of the Sungai Pahang. Other settlers occupy various small land development schemes and some 600 smallholder families are already settled on Federal Land Development Authority (FLDA) schemes. There are five of these schemes under development, aggregating 25,000 acres.

The principal agricultural enterprise is rubber planting, there being about 40,000 acres devoted to this crop. The oil palm estate, located in the northeast, is a recent development. It occupies over 7,000 acres of which the 4,800 acres of young oil palms on the FLDA scheme at Ulu Jempol constitute the nucleus from which the Jengka enterprise will develop.

The FLDA smallholders are specialist producers living in organised communities with good roads, water supplies and social services and facilities. The great majority of the remaining smallholders live in more traditional circumstances, cultivating rice in the swamps, growing subsistence plots of food and fruit and grazing their buffaloes,

WEST MALAYSIA
THAILAND
PERLIS
KEDAH
ALOR STAR
GEORGE TOWN
PENANG
PROVINCE WELLESLEY
KELANTAN
KOTA BHARU
TRENGGANU
KUALA TRENGGANU
KUALA DUNGUN
PERAK
TAIPING
IPOH
SELANGOR
KUALA LUMPUR
PAHANG
KUALA LIPIS
JERANTUT
KUANTAN
TEMERLOH
MARAN
THE JENGKA TRIANGLE
NEGRI SEMBILAN
SEREMBAN
KUALA PILAH
Port Dickson
MALACCA
SEGAMAT
JOHORE
MUAR
KLUANG
BATU PAHAT
SINGAPORE
S O U T H C H I N A S E A
MILES
LEGEND
International Boundary
State Boundary
Railway
Major Road
Secondary Road
River

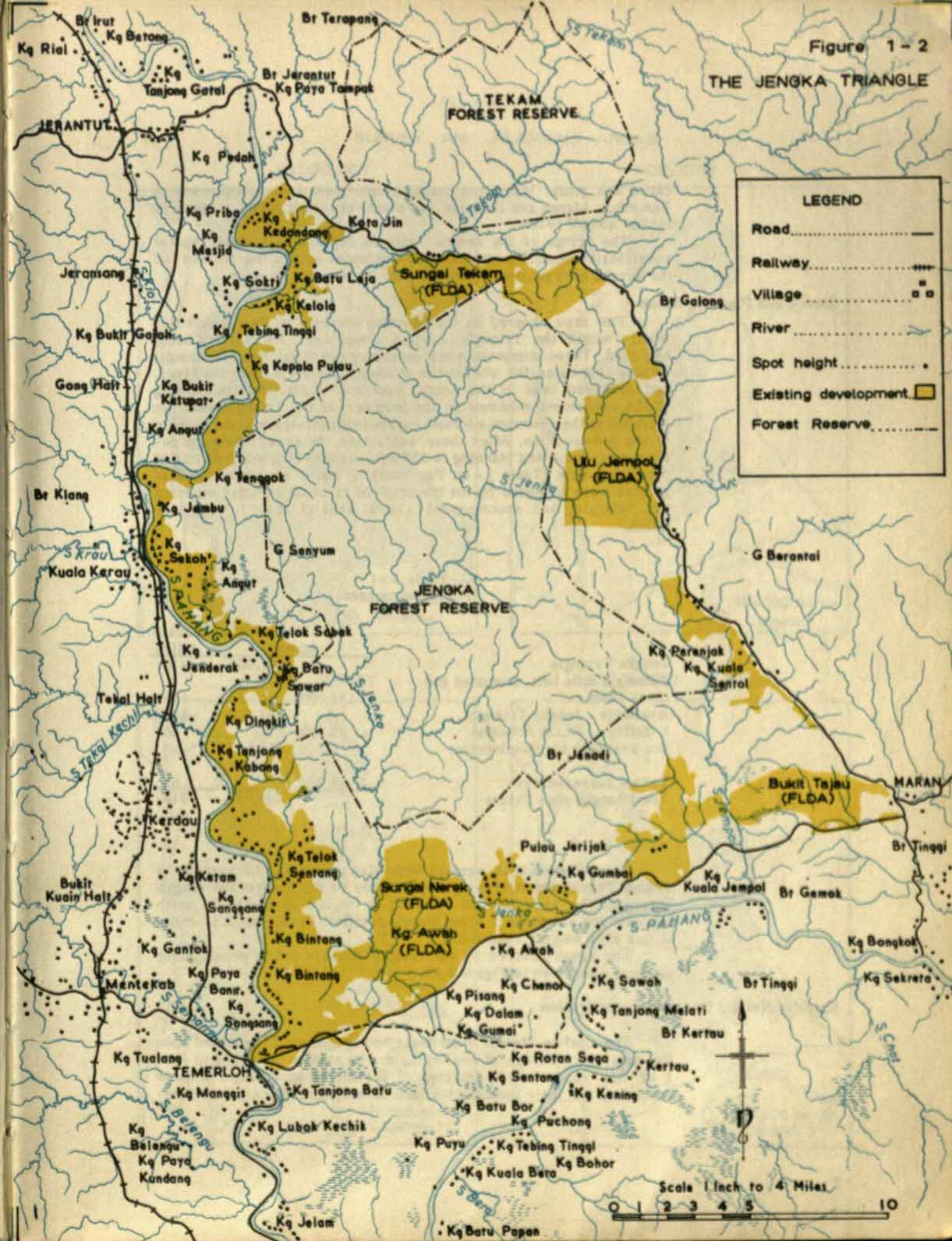


Figure 1-2
THE JENGKA TRIANGLE

cattle and goats. Many find casual employment in the local towns of Temerloh, Maran and Jerantut, and others are employed by growers of rubber and oil palms.

The fringe of the Jengka Triangle represents a fairly typical rural Malay economy with the FLDA schemes setting the pattern for the spread of organised settlement into its forested interior.

Survey and Planning Areas

The area covered by the planning sections of this Report lies wholly within the Triangle, certain areas near its margins being excluded. These comprise a belt extending two miles from the Sungai Pahang, allocated for use by the existing population along the river, and alienated land in the north, east and south. The five existing FLDA settlement schemes on the periphery of the Triangle were not included in the resource surveys, but are incorporated in some aspects of the Master Plan. After these exclusions, the area covered by resources surveys and planning is 255 square miles consisting mainly of primary jungle (Table 1 - 1). For study of water resources investigations were extended to the limits of the river catchments watering the Triangle, and encompassed a total area of about 1,000 square miles.

Table 1 - 1
Area Measurements

	Acres		Square Miles
Jengka Triangle		301,000	470
Pahang 2 mile belt, alienated and other lands	- 112,000		175
Available Jengka Triangle		189,000	295
Existing FLDA Schemes	- 25,500		40
Net available for development		163,500	255
Tekam Surveyed Area	+ 40,200		63
Total Jengka plus Tekam		203,700	318

Certain resources surveys were also undertaken for part of the Tekam Forest Reserve lying immediately to the north of the Jengka Triangle. The area covered extended to the high ground to the north and east and amounted to about 66 square miles. Development planning of this area was not required.

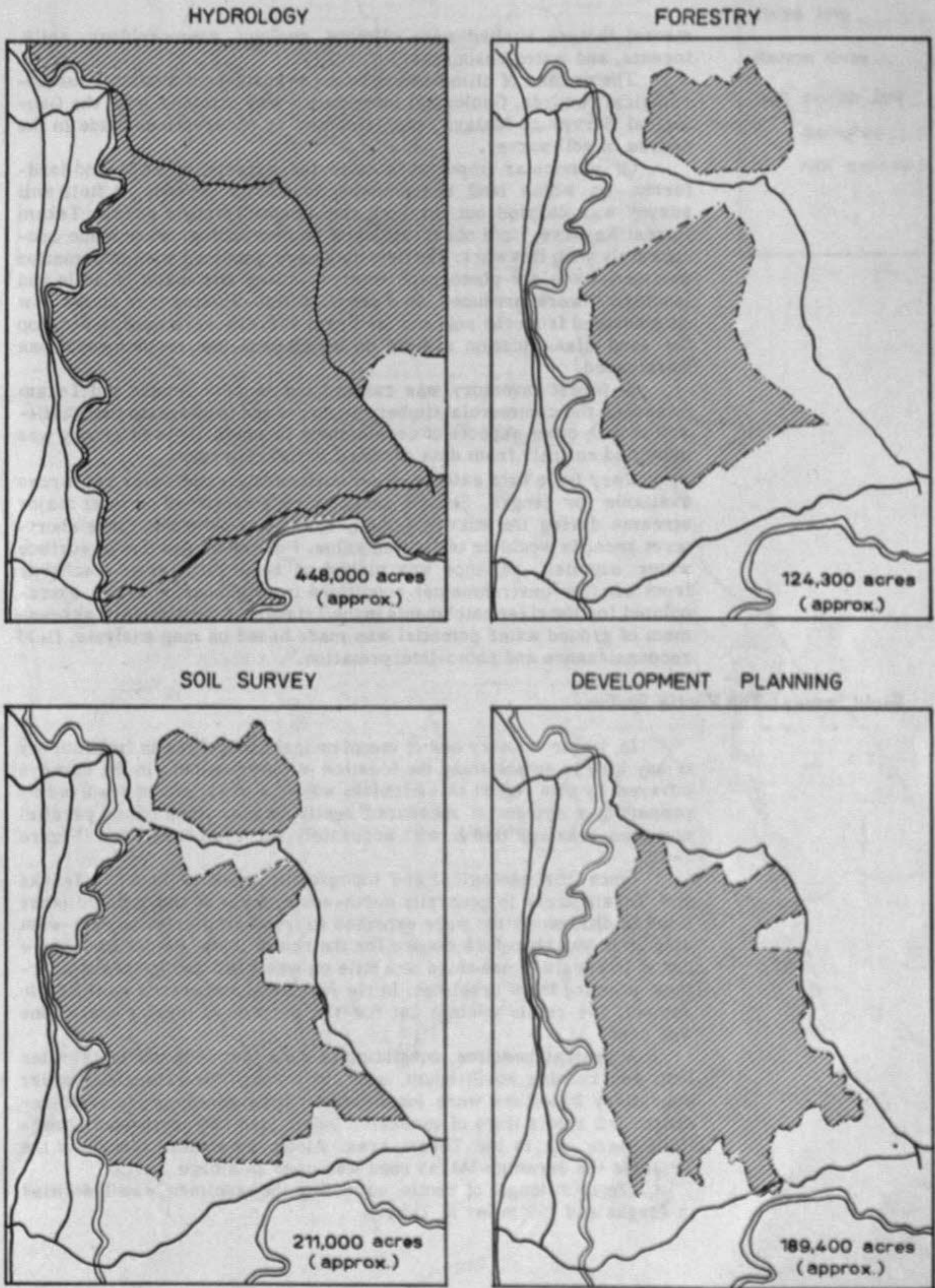
The areas covered by the various surveys and by development planning are shown in Figure 1 - 3.

Scope of Natural Resource Investigation

The Outline Master Plan described in Volume I is founded upon the natural resources of the Triangle. The studies described in Part 1 of this volume were designed to provide an assessment of these resources and their potential for land development. The main environ-

Figure 1-3

SURVEY AND PLANNING AREAS



mental factors studied were climate, geology, geomorphlogy, soils, forests, and water resources.

The studies of climate were based on analysis of available meteorological records. Geological information was obtained from the Geological Survey of Malaya, supplemented by observations made in the course of soil survey.

Of particular importance were the surveys of soils and landforms, on which land use planning primarily depends. A field soil survey was carried out for both the Jengka Triangle and the Tekam Forest Reserve; field observations of geomorphology were made concurrently with this work. The field data were combined with information obtained from air photograph interpretation, and maps of soils and landforms were produced. In Part 2 of this Volume it is shown how data derived from the soil and landform surveys were used to develop the land classification system on which land use recommendations were based.

A forest inventory was carried out in both Jengka and Tekam to assess the commercial timber resources and to integrate their utilization with other aspects of development planning. This inventory was compiled entirelv from data obtained in field survevs.

Very little data exist on either surface or ground water resources available for Jengka. Stream gauge were established on most major streams during the survey period, but it was plain that these short-term records would be of limited value. For the estimation of surface water supplies, reliance was placed on records of river discharge from similar environmental conditions in neighbouring areas, extrapolated for the river catchments in the Triangle. A preliminary assessment of ground water potential was made based on map analysis, field reconnaissance and photo-interpretation.

Field Survey : The Rentis System

In jungle country one of the principal difficulties in field survey of any kind is establishing the location of observations. In the surveys covered by this report this problem was to a great extent resolved by preparing a system of measured rentis (trace) lines cut on parallel compass bearings tied in with accurately surveyed base lines (Figure 1-4).

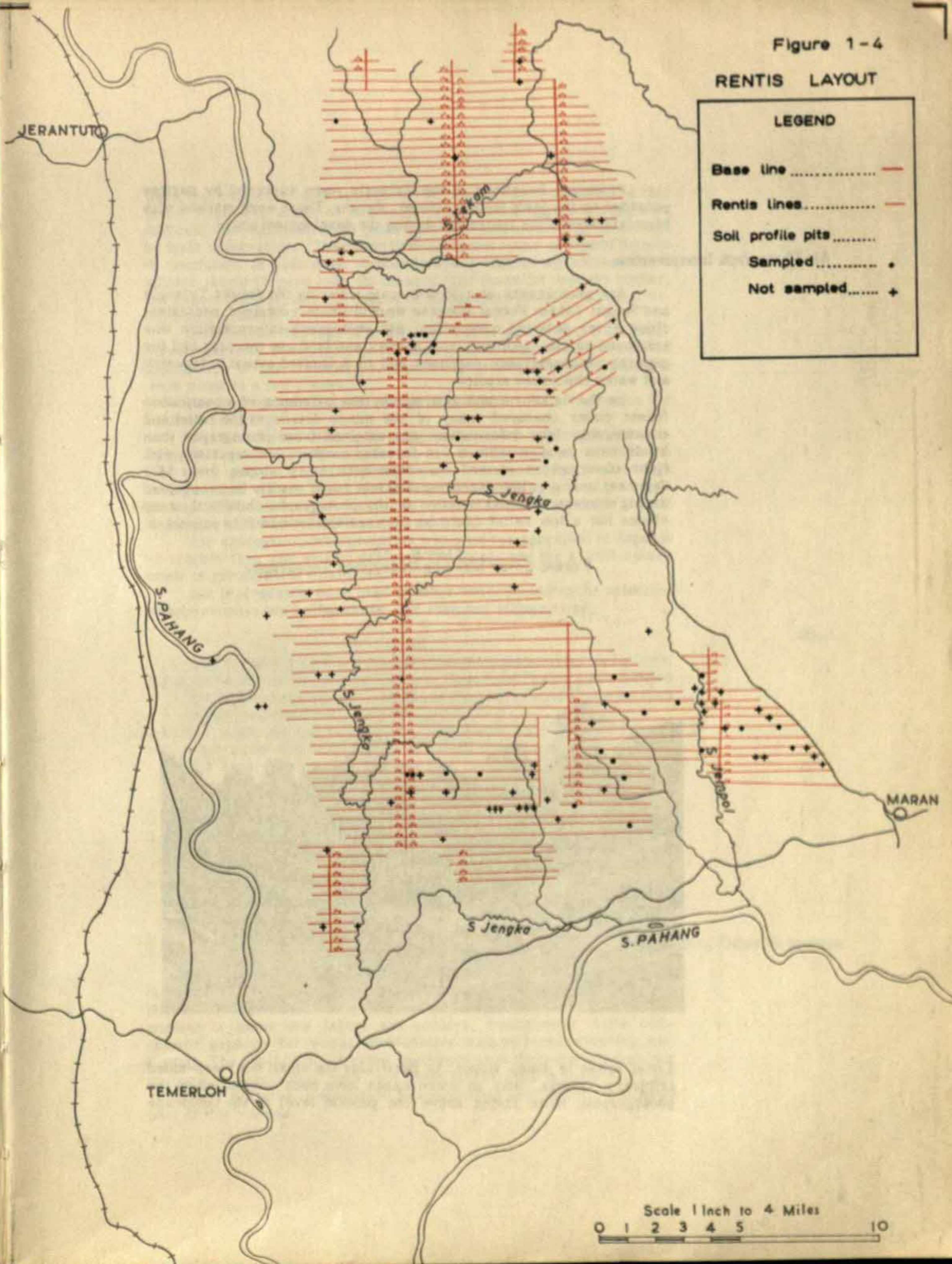
Since the geological and topographic trend of both the Jengka and Tekam areas is generally north-south, many of the soil and other lines of differentiation were expected to trend similarly. An east-west direction was therefore chosen for the rentis lines. Rentis lines were cut at intervals of one third of a mile on westward and eastward bearings, starting from baselines. In the Jerantut-Selatan area south of Ulu Jempol, the rentis system cut for the purpose of logging operations was used.

A central baseline, consisting of a six feet wide rentis 18 miles long and running north-south, was cut through the Triangle. Similar subsidiary baselines were established where necessary to avoid uncontrolled rentis lines of excessive length, and two north-south baselines were cut in the Tekam area. Along the eastern margin of the Triangle the Jerantut-Maran road was used as a base.

The total length of rentis, excluding the baselines, was 794 miles in Jengka and 189 miles in Tekam.

Figure 1-4

RENTIS LAYOUT



Principal baselines in the Triangle were surveyed by parties provided by the State Survey Officer, Pahang. These were marked with boundary stones for future use during the development phase.

Air Photograph Interpretation

Air photographs at 1:25,000 scale covering the Jengka Triangle and Sungai Tekam Forest Reserve were ultimately obtained, persistent cloud cover delaying completion. Air photograph interpretation was employed in the landform, soil survey and land use mapping and for general reconnaissance purposes and to a limited extent in forestry and water resources studies.

In the landform and soil survey the existence of a continuous forest cover obscured many of the minor details of the relief and considerably less information was obtained from photographs than would have been possible in non-forested country. A comparison with field observations showed that land with steep slopes (over 18.5 degrees) and a relief exceeding 200 feet could readily be recognised during stereoscopic examination of the photographs; land with steep slopes but a low relief could be distinguished where it is extensive.

Figure 1 - 5
Forest Cover Masking Underlying Topography

Local areas of steep slopes, in particular the small but steep-sided tributary valleys, may in some cases have been undetected on the photographs. Hills rising above the general level of the landscape were more apparent than valleys of the same steepness cut below this level. Extensive areas of moderate slopes (18.5 degrees) were with difficulty distinguished from more gently sloping country, given control by field observations. The extent to which forest cover obscured details of landforms is seen most strikingly where cleared agricultural land adjoins jungle (Figure 1-5). On cleared land the relief appears higher, the slopes steeper, and the degree of dissection by minor valleys considerably greater.

Differences between soil series, unless associated with landforms, were not identifiable on the photographs. Slight variations in the appearance of the tree canopy, apparently related to soil boundaries, were noted in a few places.

Air photographs formed the principal source of information for land use mapping.

The limitations of air photograph interpretation in making inventories in Lowland Dipterocarp forest are well recognised. Little more than very general typing is possible, and this was of small advantage in a detailed survey based on an adequate rentis system. Up to date photography was however useful in determining the limits of logged forest, in which inventory was not required.

Air photograph interpretation was used for appraisal of aspects of stream flow and swamp drainage conditions and for a preliminary study of groundwater prospects.

Air photographs were used in other ways, including the selection of approximate road alignments, and town and village sites.

Maps

The Project Area is covered by three main map series as follows;

1:253,440 scale or quarter inch series. Sheet 3C of Series L501 Edition 3-GSGS covers all the area and is the basis for the quarter inch maps presented in this report.

1:63,360 scale or one inch series. The major part of the project is covered by sheets 80 and 89 of Series L7010 Edition 1-DNMM but the base map used in the one inch series presented in the Map Annexure, comprises all of sheet 80 and parts of sheets 79, 81, 88, 89 and 90 of this series. These are 1966 Editions and became available during the latter part of the investigations.

1:25,000 scale. A special edition covering the Jengka Triangle and available as copies of the inked up compilations, was provided by the Survey Department. These maps were the basis for all the field survey and subsequent mapping. A sheet layout is given as Figure 1-6, this also shows the extent of the aerial photographic cover.

Studies of Other Resources

Development depends not only upon the physical resources contained within the Triangle itself, but also on certain other resources - human and financial - that must be introduced into it. The most important of these are labour and settlers, management skills, contractor capacity for initial development such as forest clearing, and capital. The availability of these resources is sufficiently assured not to require assessment here; but their significance in relation to development planning is discussed in appropriate sections in the second part of this volume.

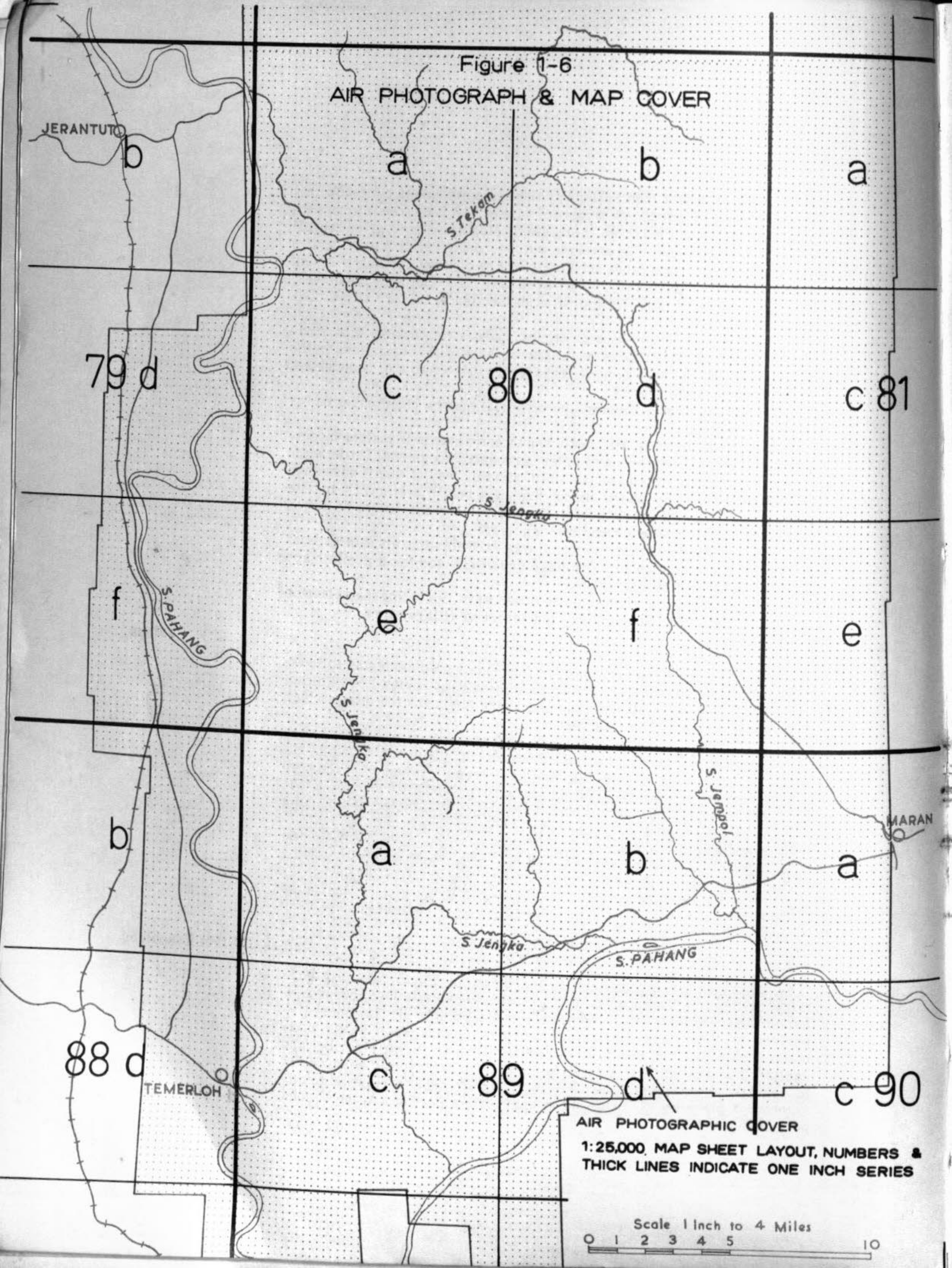


Figure 1-6
AIR PHOTOGRAPH & MAP COVER
JERANTUT
S. Tekam
S. Jengka
S. PAHANG
S. Jenggol
MARAN
TEMERLOH
79 d
80
c 81
88 d
89
c 90
b
a
b
a
c
d
f
e
f
e
b
a
b
a
c
d
AIR PHOTOGRAPHIC COVER
1:25,000 MAP SHEET LAYOUT, NUMBERS & THICK LINES INDICATE ONE INCH SERIES
Scale 1 inch to 4 Miles
0 1 2 3 4 5 10

CHAPTER 2
CLIMATE

The characteristic features of the climate of the Jengka Triangle are uniform temperature, high humidity and plentiful rainfall.

The Jengka Triangle is covered by a system of nine rainfall gauges with records at some locations available for over 30 years. Comprehensive instrumentation for rainfall, temperature, humidity, evaporation and other climatic features is maintained at Temerloh. Data used in studies for development of the Jengka Triangle were derived mainly from records of the Drainage and Irrigation Department and those of the Malayan Meteorological Service. These data are sufficiently reliable for the purposes of this report although four rainfall stations appear to have undergone minor changes in location or reading technique, or to have sustained some other alteration.

Rainfall

The mean annual rainfall is relatively uniform throughout the Jengka Triangle. It varies from 97 inches per year at Maran in the east to 84 inches at Temerloh in the west. Extreme values of 51 inches and 145 inches have been recorded.

The mean monthly rainfall is highest in October, November, December and January when it approximates 10 inches per month (Figure 2-1). These months correspond roughly to the season of the North-east Monsoon when peak monthly rainfalls are experienced on the East Coast of Malaya. A second period of relatively heavy rainfall occurs in March, April and May, corresponding approximately to the South-west Monsoon season. The low rainfall months are February, June, July and August when the monthly mean is only five inches per month. Extreme monthly values of zero and 36 inches have been recorded at Jengka Triangle rain gauges.

The rainfall of the Jengka Triangle is largely convectional and is characterised by heavy showers of small areal extent which last for periods of one to six hours. The rate of precipitation may be as high as five inches per hour during short intense storms. There is rain on about 170 - 180 days per year. The highest daily fall recorded was 9.6 inches and falls of six inches in a day are not uncommon.

Rainfall probabilities were determined to provide data for agricultural and engineering planning. Data from five rainfall stations within and adjacent to the Jengka Triangle were analysed. Those from the Sungai Tekam gauging station proved most reliable and most typical of the area and were used to derive probability data over continuous periods of one to twelve months. The results of these analyses are

Figure 2 - 1
Mean Monthly Rainfall

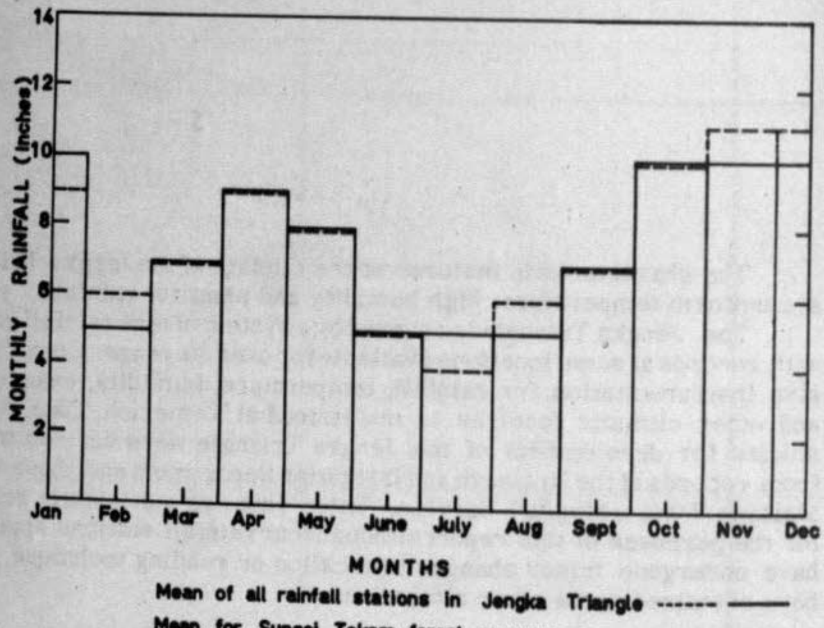
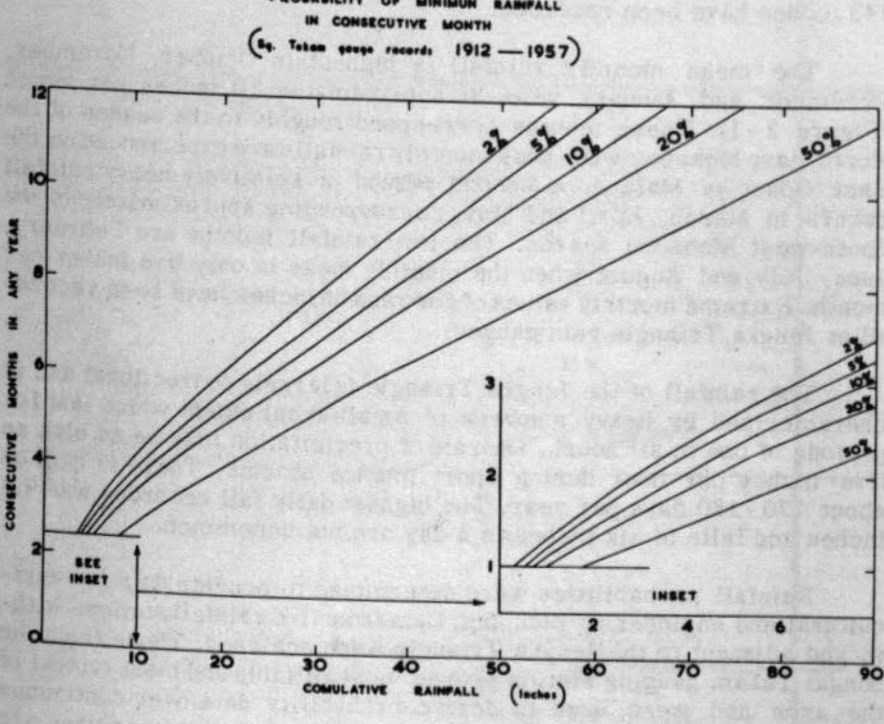


Figure 2 - 2
Probability of Minimum Rainfall in Consecutive Months



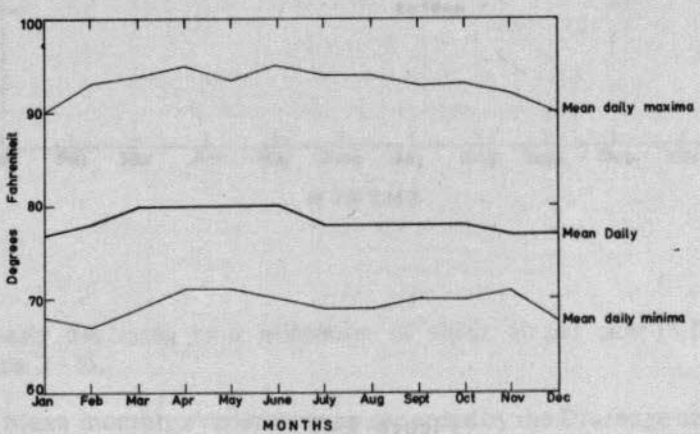
summarised in Figure 2 - 2 which shows minimum rainfall in consecutive months for probabilities ranging from two per cent (1 year in 50) to 50 per cent (1 year in 2).

Selected rainfall data and additional rainfall probability plots are given in Appendix 2-1.

Other Climatic Features

The mean daily temperature in the Jengka Triangle lies between 77° and 80° F throughout the year (Figure 2-3). The daily mean range varies between 67° at night and 95° in the early afternoons. Extreme figures lie between 64° and 98°. Temperatures tend to be highest in April and lowest in February.

Figure 2 - 3
Mean Air Temperatures - Temerloh 1939 - 41, 1951 - 52



Prevailing winds are rarely more than light breezes from the north, east and south. Infrequent local winds exceeding 30 miles per hour may sometimes be experienced; 60 per cent of the days are calm.

The mean relative humidity averages 86 per cent throughout the year. Diurnal variations, however, vary between 54 per cent during the hottest part of the day to 99 per cent at night (Figure 2 - 4).

The average monthly sunshine hours which may be experienced reach a maximum of about 60 per cent of the possible total in March,

Figure 2 - 4
Mean Relative Humidity - Temerloh 1939 - 41, 1948 - 52

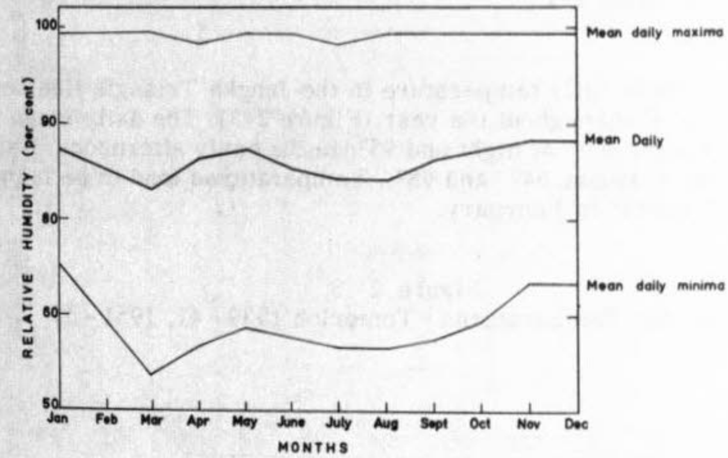


Figure 2 - 5
Possible Sunshine Hours - Temerloh 1939 - 41, 1950 - 52

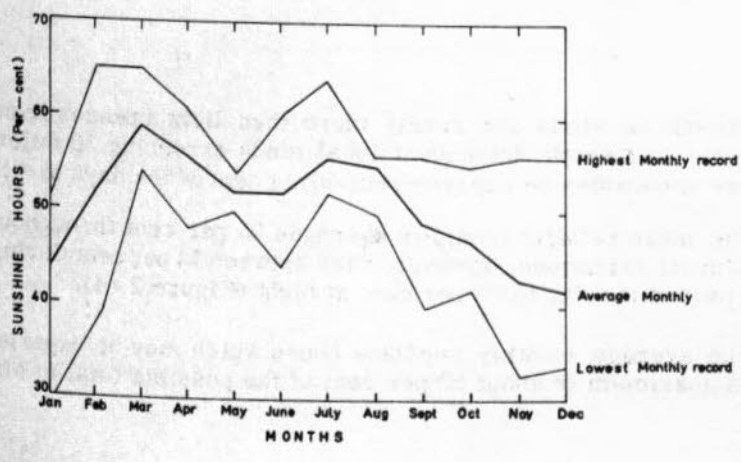
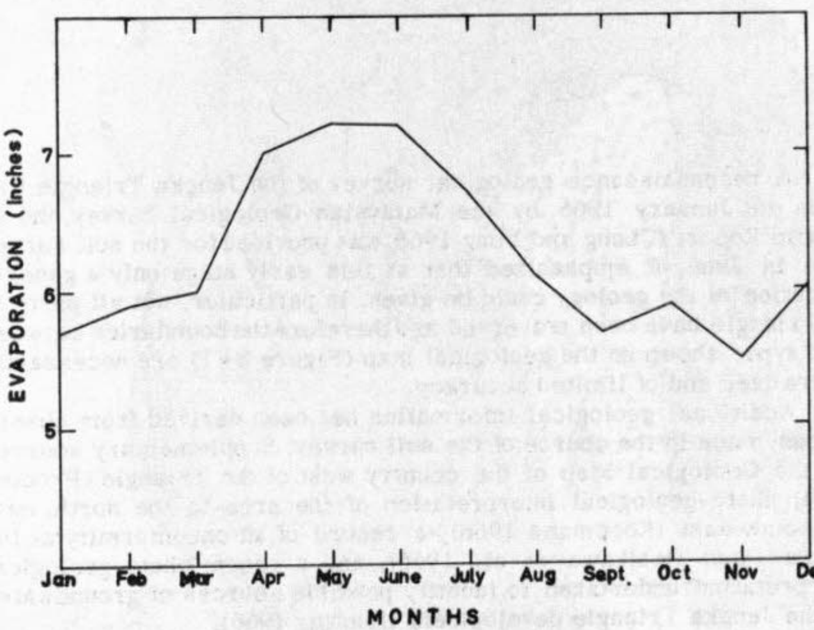


Figure 2 - 6
Mean Monthly Evaporation - Temerloh 1963 - 65



gradually declining to a minimum of about 40 per cent in December (Figure 2 - 5).

Mean monthly evaporation as recorded by the Drainage and Irrigation Department at Temerloh, using a type 'A' pan, varies from 5.5 to 7.2 inches per month (Figure 2 - 6). Lowest readings occur during November and January and the highest ones during May and June. Although the Temerloh records cover only the years 1963 - 65, the mean annual evaporation of 75.2 inches for this period compares with a 1963 mean of 70.5 inches from fourteen evaporation pans in Selangor and Perak.

CHAPTER 3
GEOLOGY AND GEOMORPHOLOGY

GEOLOGY

A reconnaissance geological survey of the Jengka Triangle was begun in January 1966 by the Malaysian Geological Survey and an Interim Report (Chong and Yong 1966) was provided for the soil survey team in June. It emphasized that at this early stage only a general indication of the geology could be given. In particular, not all parts of the Triangle have been traversed and therefore the boundaries between rock types shown on the geological map (Figure 3 - 1) are necessarily generalized and of limited accuracy.

Additional geological information has been derived from observations made in the course of the soil survey. Supplementary sources are the Geological Map of the country west of the Triangle (Procter 1964); photo-geological interpretation of the area to the north, east and south-east (Koopmans 1966); a record of an unconformity at the Jengka Pass (Ichikawa et al. 1966); and a recent photo-geological interpretation undertaken to identify possible sources of groundwater for the Jengka Triangle development (Hunting 1966).

The geological map by Chong and Yong (1966) and shown as Figure 3 - 1 is based on rock types without indication of age; the following abbreviated descriptions are based mainly upon their report, to which reference may be made for further details. Rock types of the Jengka Triangle fall into four main groups: igneous rocks, pyroclastic rocks, sedimentary rocks, and superficial deposits.

Igneous Rocks

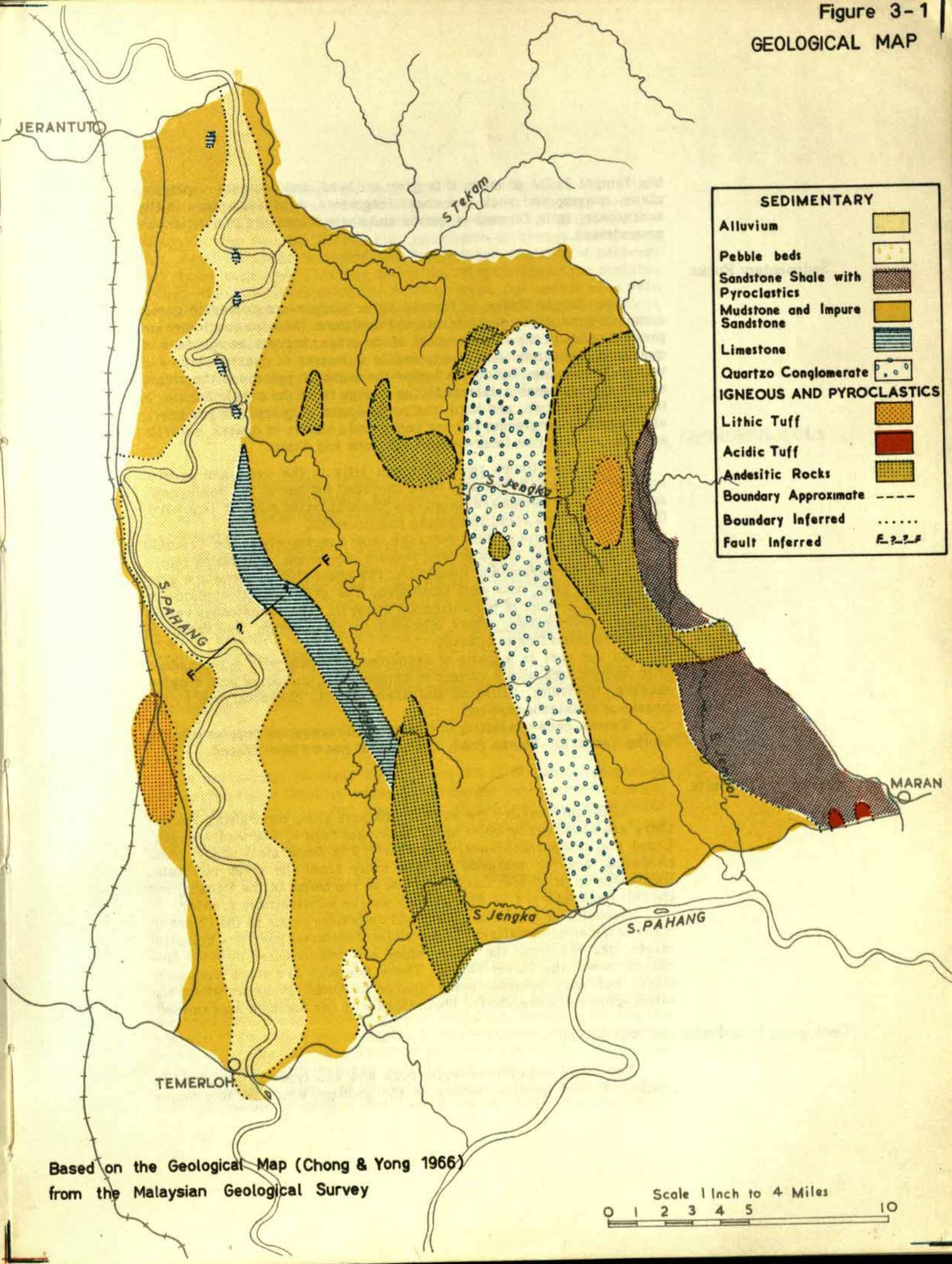
The igneous rocks present are all of andesitic composition; some have been modified subsequent to their formation by pyroclastic activity. The most extensive is a coarse-grained andesite. This is a dark, greenish-grey rock, hard, dense and even-grained. In thin section the composition is found to be plagioclase (50 per cent), pyroxene (30 per cent), secondary chlorite, derived from the pyroxene (10 per cent), opaque iron oxide (8 per cent), and interstitial quartz (2 per cent). In north-central Jengka an andesitic tuff has been found; it is dark grey, hard, and fine-grained, and is composed of approximately equal amounts of plagioclase, pyroxene, and andesitic fragments. In the south-centre porphyritic and agglomeritic andesites occur in intimate association.

Pyroclastic Rocks

Pyroclastic rocks comprise a variety of types of tuffs. Andesitic tuff has been noted above. A crystal-lithic tuff has been observed on

Figure 3-1

GEOLOGICAL MAP



Based on the Geological Map (Chong & Yong 1966) from the Malaysian Geological Survey

Ulu Jempol FLDA scheme; it is grey and hard, and consists of plagioclase, quartz, and rock and chert fragments. Acid tuff occurs in the south-east; it is formed of quartz and shale fragments in a siliceous groundmass.

Sedimentary Rocks

The Jengka Ridge is formed by a quartzo-conglomerate group containing massive conglomerate and sandstone. Massive conglomerate predominates in the southern part of the ridge. It contains boulders of quartzite, sandstone and chert, set in a matrix of quartz, clays and yellow iron-oxide. Sandstone forms the northern portion of the ridge, and may represent a lateral facies change from the conglomerate. It is yellow to brown, and hard; the composition is quartz (45 per cent), siliceous fine fragments (40 per cent), and a matrix of quartz, chlorite and clay. It contains inter-bedded siltstone and shale.

Limestone forms two prominent hills in the west, and several smaller outcrops. It has also been recorded further to the south-east, and these occurrences are tentatively joined up on the map. It is a hard, finely-crystalline rock, containing calcite veins.

The rock group which outcrops most extensively in the Triangle consists of shale, siltstone and impure sandstone, containing interbedded conglomerate and limestone. The shale and siltstone are grey to purplish grey, and well laminated. The grey variety contains an appreciable amount of carbonaceous material. The sandstone is yellow to grey, well bedded, highly siliceous in composition, and varies in grain size from fine to coarse.

In the east is a group of sandstone and shale with pyroclastics. It includes rocks with a variety of composition, including acid conglomerate, quartzite, siltstone and shale, and is characterized by the presence of interbedded tuff.

Pebble beds consisting of quartzite and sandstone pepples outcrop on the Temerloh-Maran road; their extent has not been traced.

Superficial Deposits

Alluvium overlies the solid formations along the Pahang Valley; there are also narrow belts along the Sungai Tekam, Chenerai-Jengka, Lokek and Jempol not shown in Figure 3-1. It is moderately sandy, often becoming heavier textured further away from the river channels. Exposures up to 40 feet thick are seen on the banks of the Pahang, but the full thickness of this deposit may well be substantially greater.

Deposits of mixed alluvium and colluvium occur in the floors of many of the smaller valleys. They consist of material partly of colluvial origin, derived from the valley sides and redistributed by flood discharge down the valley floors. These deposits are most frequently clays, but may become more coarse textured in areas where the valley-side soils are sandy. Their thickness has not been ascertained.

Geological Complexity and Soil Survey

The close relation between rock and soil types is discussed in Chapter 4. One general feature of the geology, which led to a major modification in soil mapping, may be noted. Within most of the rock groups described above, considerable variation in lithology occurs; this is particularly marked in both the sedimentary and the pyroclastic rocks. During the soil survey the occurrence of change in soil type over short distances indicated that frequent interbedding of different rock types occurred. This was one of the chief causes of the decision to map soil complexes made up of two or more soil series in certain areas. This decision receives support from the geological investigations and the conclusion of Chong and Yong is pertinent: "The wide variety of rock types together with their close association and the lack of clear contact areas make their subdivision into definite lithologic units difficult. These also present the problem of definite stratigraphic relationship. The various rock types and their close association may contribute to a complex soil pattern."

GEOMORPHOLOGY

The geomorphology of the Jengka Triangle was investigated to provide essential information for the construction of the land class map and to examine landform-soil relations of potential significance in soil survey.

The geomorphological characteristics which have the greatest significance in relation to land classification are slope angle and the extent of poorly-drained land. The effects of variation in altitude as such within Jengka are very slight. The principal aim was therefore to produce a landform map based on slope classes; and, for each class, to estimate the proportion of slopes at different angles and the extent of poorly-drained land.

The field data on geomorphology and soils were plotted and mapped separately, being synthesised subsequently into the land classification map.

Landform Survey Methods

A distinction is made between two kinds of geomorphological unit; major relief features which comprise the more extensive units, such as ridges, plains, and main river valleys, and landforms which reflect the characteristics of the land surface in detail, e.g. slope angle, slope form, depth and spacing of minor valleys.

Field observations of landform data were recorded on the rentis traverse sheets. At points where soil auger observations were made the landform class was also observed, using an Abney level to check slope angles where necessary; the form and width of all valley floors were likewise noted. The lengths of rentis within each landform class were marked as intercepts on the rentis lines plotted on the base map.

In order to estimate the slope frequency distribution, selected slope profiles, totalling 28,000 feet in length, were surveyed on sites chosen as representative of the landform classes. Angle and distance measurements, made with Abney level and chain, were taken along the direction of maximum slope, angles being measured to the nearest half degree. Characteristic slope and valley forms were obtained by combining these data with traverse sheet information.

A Landform Map was produced by combining information from three independently-constructed source maps, based respectively on analysis of the topographic map, on air photograph interpretation, and on field observations described above. It was prepared on a scale of 1:25,000, and subsequently reduced to 1:63,360 without loss of detail.

The 1:25,000 topographic maps were prepared from photography at a substantially smaller scale than was used for air photographic interpretation as a result it was found slopes tended to be underestimated on the maps, and that it was not possible to apply a constant factor (Appendix 3-1). Hence they were used primarily as a location control for air photograph interpretation. An analysis of slope as indicated by the contour spacing was carried out, but this was used only as a subsidiary source of information. Air photograph interpretation of landforms was carried out for the whole of the Triangle; the map based on this was the principal source for identifying steep land, and was used in conjunction with field data for mapping areas with slopes over 12 degrees.

Main Relief Features

The north-south Jengka Ridge divides the Triangle into two unequal parts (Figure 3-2). It commences in the south as a massive ridge, two miles wide and reaching 1100 feet in elevation. Northwards it narrows and falls in height, and divides into two branches. There is then a gap of nearly two miles before the ridge re-commences, rises northward with a curved course to a maximum height of 793 feet, then dies out at the Sungai Chenerai. In the south-west there are two major and several smaller ridges, trending slightly west of north. The ridges rise mainly from 200 to 500 feet above the surrounding land; there is no tendency for their crests to be concentrated within any particular altitude range.

Two limestone hills rise very steeply above their surroundings, in the west of Jengka. A third occurs outside the Triangle proper near the Sungai Tekam. They are small in area but include the highest point in the Triangle, Gunong Sinyum, 1594 feet.

The Pahang Valley consists of an alluvial terrace, in parts with shallow dissection. Low steps of slightly different heights occurring between portions of this terrace have been noted, suggesting a composite origin.

The rest of the Triangle - that part which is of particular interest from the point of view of development - comprises land with moderate relief. Viewed from above this gives the impression of an extensive, level plain. It is however, closely dissected by an intricate system of branching streams so that the greater part of the land surface consists of valleys with an average width of a quarter of a mile. The pattern is dendritic and there is some tendency for short reaches of valleys to follow the direction of geological strike. The crests of the interfluves between valleys lie mainly below 350 feet in elevation in the northern half of the Triangle, and below 300 feet in the southern half. With the exception of the ridges the elevation between interfluve crests and valley floors is less than 200 feet for the whole of the Triangle.

The great part of the Project Area, including nearly all of the land suitable for agriculture, consists of a series of valleys ranging from 300 feet to 2,500 feet wide and 50-200 feet deep.

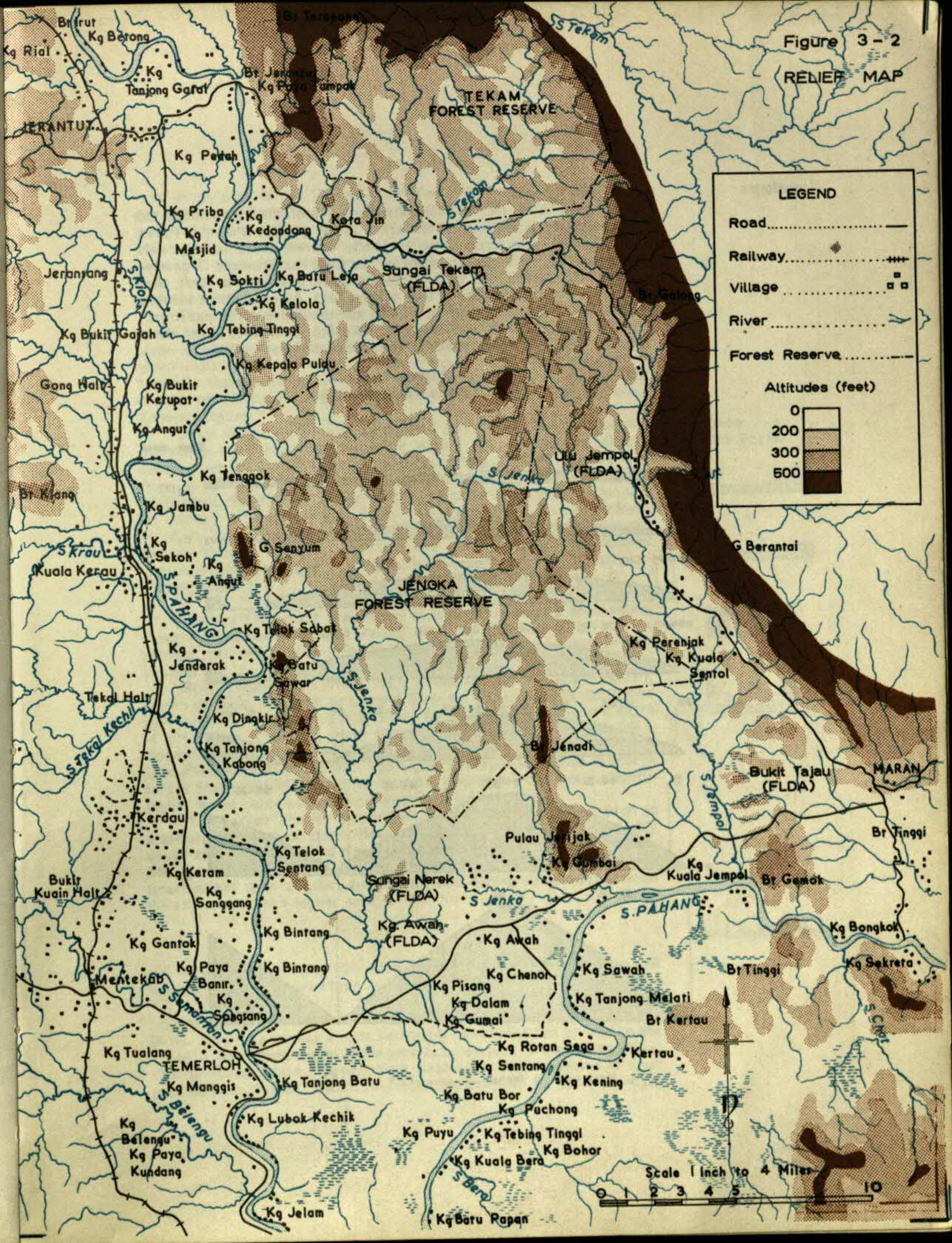
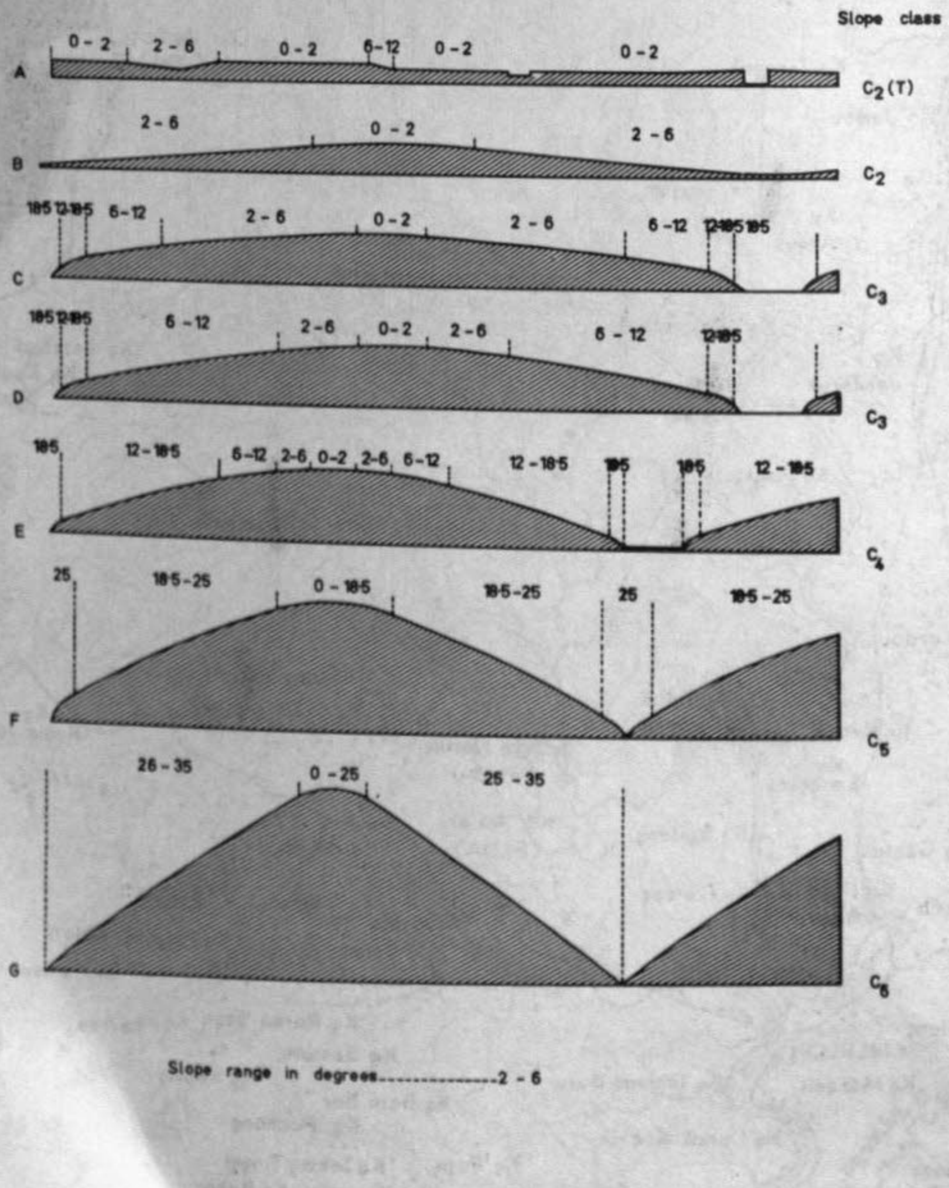


Figure 3 – 2
RELIEF MAP
LEGEND
Road
Railway
Village
River
Forest Reserve
Altitudes (feet)
0
200
300
500
Scale 1 Inch to 4 Miles
0 1 2 3 4 5 10
TEKAM FOREST RESERVE
JENGKA FOREST RESERVE
JERANTUT
TEMERLOH
MARAN
Mentekab
Kerdau
S. Tekam
S. Jenka
S. PAHANG
S. Jempol
S. Krau
S. Tekal Kechil
S. Semantan
S. Belengu
S. Bera
S. Chini
Sungai Tekam (FLDA)
Ulu Jempol (FLDA)
Bukit Tajau (FLDA)
Sungai Nerek (FLDA)
Kg. Awah (FLDA)
Kota Jin
G Senyum
G Berantai
Br Jenadi
Br Galong
Br Kiang
Br Tinggi
Br Gemok
Br Kertau
Pulau Jerijak
Kg Gumbai
Kg Kuala Jempol
Kg Perenjak
Kg Kuala Sentol
Kg Bongkok
Kg Sekreta
Kg Rial
Kg Berong
Kg Tanjong Gadai
Kg Paya Tampak
Kg Pedah
Kg Priba
Kg Kedondong
Kg Masjid
Jerantang
Kg Sokti
Kg Batu Leja
Kg Kelola
Kg Tebing Tinggi
Kg Bukit Gajah
Kg Kepala Pulau
Gong Halt
Kg Bukit Ketupat
Kg Angut
Kg Tenggok
Kg Jambu
Kg Sekoh
Kuala Kerau
Kg Telok Sabak
Kg Jenderak
Kg Batu Sawar
Tekal Halt
Kg Dingkir
Kg Tanjong Kabong
Kg Telok Sentang
Kg Ketam
Bukit Kuain Halt
Kg Sanggang
Kg Bintang
Kg Gantok
Kg Paya Banir
Kg Sangsang
Kg Tualang
Kg Manggis
Kg Tanjong Batu
Kg Lubok Kechik
Kg Belengu
Kg Paya Kundang
Kg Jelam
Kg Awah
Kg Chenor
Kg Pisang
Kg Dalam
Kg Gumai
Kg Sawah
Kg Tanjong Melati
Kg Rotan Saga
Kertau
Kg Sentang
Kg Kening
Kg Batu Bor
Kg Puchong
Kg Puyu
Kg Tebing Tinggi
Kg Bohor
Kg Kuala Bera
Kg Batu Papan

Landforms

Figure 3 - 3 shows schematic cross-sections illustrating the characteristic landforms of the area. In the profile shown at C, for example, the interfluve crest is gently convex; there is relatively little flat land, but half or more of the total surface area is gently-sloping. Below this the valley side steepens, gradually at first, then abruptly, leading to a narrow belt of steep land. An example of another type of interfluve is shown at E. The summit convexity is narrower, and the proportion of level to gently-sloping land lower. Both these types of landform are common in the area of moderate relief.

Figure 3 - 3
Schematic Cross - Sections

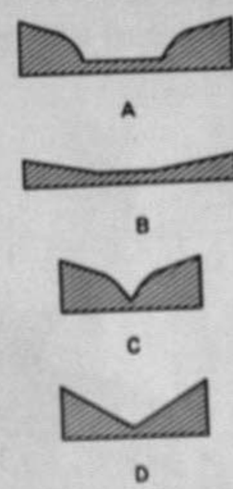


In no part of the Triangle are there substantial areas of level ground on interfluve crests. Another constant feature of the landforms is the almost complete absence of concave slopes; most of the land has convex slopes, the remainder being rectilinear in profile. As a result of these two features, nearly the whole of the surface apart from the valley floors has free site drainage, with consequent effects on soil formation.

The high and steep ridges have cross-sections similar to that shown at G in Figure 3-3, with the angle of the steepest part of the slope ranging from 25 to 35 degrees. Small streams have cut narrow, steep valleys into the ridge sides at frequent intervals. The heads of many of these valleys lower the ridge crests, so that in detail they consist of a series of hills separated by high cols, rather than continuous ridges.

Four valley forms are shown at Figure 3-4. They are defined according to whether the valley is incised, i.e. becomes markedly steeper on the lowest part of the valley side, or whether the valley floor is narrow or consists of a belt of flat land. The section A shows an incised, flat-floored valley; this is the commonest form in Jengka, on country of moderate steepness. Non-incised flat-floored valleys, as at B, occur mainly in gently-undulating country. Incised narrow-floored valleys, as at C, usually occur at valley heads. Non-incised narrow-floored valleys, as at D, are the commonest type in steeply-sloping country.

Figure 3-4
Valley Forms



Valleys frequently commence abruptly. There is a moderately steep, amphitheatre-shaped valley head, in the centre of which a narrow channel begins. Where the soils are deep the head of this channel may be a verticle drop of 2-4 feet.

Most valley floors in the Triangle consist of belts of semi-swamp, known in Malay as lopak, as in A and B above. Under normal conditions the water-table fluctuates from close to the ground surface to a depth of a few feet. Following heavy rains the whole valley floor is flooded, becoming in effect a broad river channel. On some valley floors there is no clearly-defined channel. The lopak corresponds in some respects to the floodplain of temperate-climate landforms, but has a slightly higher water-table and is more frequently inundated.

The larger rivers have valley floors built up by deposition of alluvium in times of flood. Because the surface stands substantially above the normal level of the river, these are described as terraces. The term terrace as used here does not necessarily carry the imlication that it is a relict feature formed during a past period when the river stood at a higher level.

The Landform Map

The landform map has been included in the map annexure and a generalisation is presented as Figure 3-5.

The smallest unit of landform survey was normally the interfluve. This may include slopes varying from nearly level ground on the crest to very steep angles in the incised lower part of the valley sides. The landform units mapped have been classified in terms of their predominant slopes, within which range at least 90 per cent of the surface lies. Because of convexities on interfluve crests, even the steeper landform classes include some gently sloping land, so that slopes are properly described as ranging from 0-12 degrees rather than, for example, from 6-12 degrees. It should be emphasised, however, that the proportion of steeper slopes within the range stated for each landform class increases with the general 'steepness' of the class; so that there is very little gently-sloping land in C5 and C6 classes. Figure 3-3 illustrates this feature.

The Landform Map is based on the classes for complex slopes, C1 to C6, given in the Soil Survey Manual for Malayan Conditions (Leamy and Panton 1966). The upper limit of the C4 class has been modified from 20 degrees to 18 1/2 degrees, since it is the limit of legally permitted cultivation in Malaysia. Three of the classes have been subdivided. Amplified descriptions of the slope classes shown on the landform map are as follows:

C1 (P). Permanent Swamp Land with permanent standing water; known in Malaya as paya. Such areas are usually treeless.

C1. Semi-swamp. Predominant slopes 0-2 degrees. Level to nearly level land flooded only after heavy rains, known in Malay as lopak. Except after rains, the water-table lies at or just below the ground surface. These areas are usually forested.

C2 (T). River Terrace. Formed by alluvial deposition. Much of the surface is nearly level, but there is some dissection. Floodwater channels and swamp patches occur. The range of local relief is generally less than 10 feet. This differs from the succeeding class in being of depositional origin, and in having the greater part of its area nearly level, but with limited areas of moderate and occasionally steep slopes. (Figure 3 - 3, A).

C2. Undulating. Predominant slopes 0-6 degrees. Gently-sloping land of erosional origin, with non-incised valleys. The range of local relief is generally less than 50 feet. As compared with the River Terraces, this class has a greater proportion of gentle slopes, and a smaller proportion both of level land and of slopes exceeding 6 degrees. (Figure 3-3, B).

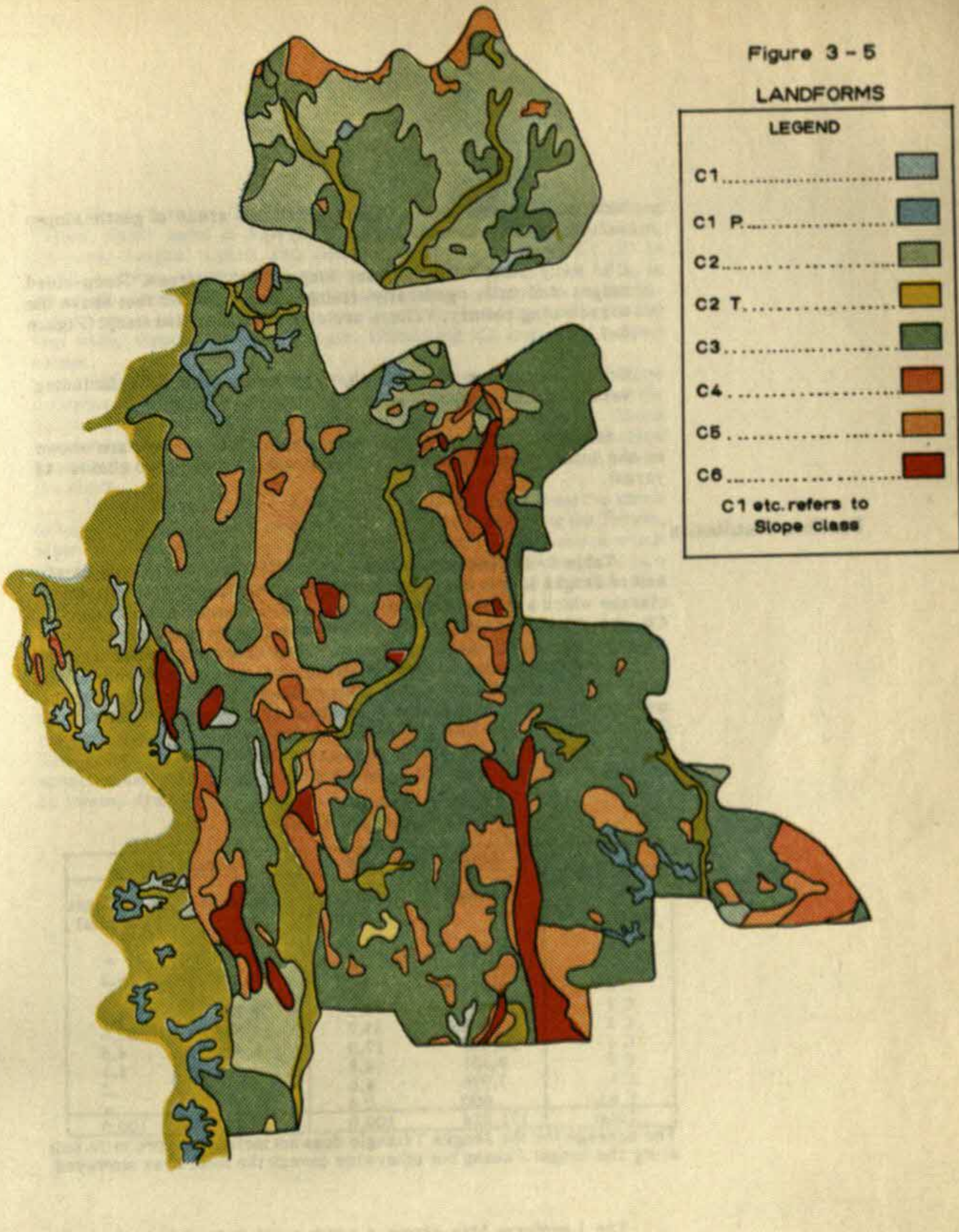
C3. Rolling. Predominant slopes 0-12 degrees. Dissected country formed of valleys with a mean spacing of a quarter of a mile, separated by interfluves with convex slopes. The range of local relief is normally 50-100 feet. Valleys are mainly incised and flat-floored, with belts of semi swamp typically 50-250 feet wide along the valley floors. Slopes may exceed 12 degrees, and frequently 18.5 degrees, on the incised lower portions of valley sides (Figure 3-3, C and D).

C4. Hilly. Predominant slopes 0-18.5 degrees. Dissected country similar to class C3 but with steeper slopes. The range of local relief is normally 50-150 feet. (Figure 3-3, E)

C5. Steep. Predominant slopes 0-25 degrees. Steeply dissected country with a range of local relief generally below 200 feet.

Figure 3 - 5

LANDFORMS



Most valleys are narrow-floored. Limited areas of gentle slopes occur on convex crests. (Figure 3 - 3, F)

C6. Very Steep. Predominant slopes 0-35 degrees. Steep-sided ridges and hills, generally rising more than 200 feet above the surrounding country. Valleys are closely-spaced and steep. (Figure 3-3, G)

C6 L. Limestone Hills. High, very steep-sided hills, including **vertical rock cliffs, with an irregular surface relief.**

Belts of semi-swamp and swamp along valley floors are shown on the landform map only where their width exceeds two chains (44 yards).

Landform Distribution

Table 3 - 1 gives the areas in each landform class. Approximately half of Jengka lies in class C3, Rolling, and one fifth in C4, Hilly. The classes which are unsuitable for agricultural use because of slopes, C5, C6 and C6 (L), together occupy about one tenth of the area. Semi-swamp and swamp as shown on the map cover nearly one tenth of the Triangle. If to this is added an estimate of that part of other land-form classes formed by valley floors less than two chains wide, the total swamp land area amounts to about 12 per cent of the total, or 22,000 acres.

Table 3 - 1
Landform Areas

Slope Class	Jengka Triangle		Sungai Tekam	
	Acreage	per cent of total	Acreage	per cent of total
C 1 p	2,022	1.2	-	-
C 1	15,932	9.3	3.730	9.2
C 2 T	8,416	4.9	-	-
C 2	5,397	3.2	21,789	54.0
C 3	91,848	53.7	12,343	30.6
C 4	30,657	17.9	1,944	4.8
C 5	8,351	4.8	451	1.1
C 6	7,996	4.6	32	.3
C 6 L	600	0.4	-	-
Total	171,214	100.0	40,247	100.0

The acreage for the Jengka Triangle does not include the two mile belt along the Sungai Pahang but otherwise covers the total area surveyed.

The Landform Map shows a north-south belt of Very Steep C6 land along the greater part of the Jengka Ridge. In its northern section this ridge is bordered by a broad zone of Steep C5 but less high country. Steep land also occurs as ridges in the south-west, as a steeply-dissected area in the extreme south-east, and as scattered hills.

River Terrace C2 (T) occurs as a broad zone along the Pahang Valley. Other belts of River Terrace occur along the Sungai Tekam, Chenerai-Jengka, Lokek and Jempol. Permanent Swamp C1 (P) is found in three areas: in the west-centre, near the limestone hills; in the south-centre; and on the tributaries of the Jempol in the south-east. Semi-swamp C1 occurs as valley-floor belts, typically 50-250 feet wide, throughout the Triangle. Undulating C2 land is of limited extent.

Hilly C4 country has an irregular distribution, but with some concentration into two broad north-south zones, one adjacent to the Jengka Ridge and the other approximately six miles to the west. These two zones divide the remaining and largest part of the Triangle, formed by Rolling C3 land, into three broad north-south zones, which join in the north.

In the surveyed part of the Sungai Tekam Forest Reserve there is very little Steep Land. Belts of River Terrace occur along the Tekam, Siam and Galong. The greater part is Undulating, in much of which the slopes do not exceed four degrees. In the west-centre there is a Rolling region with limited Hilly areas. Small areas of Permanent Swamp occur.

In summary slightly under 80 per cent of the total area of the Jengka Triangle comprises adequately drained land with slope angles less than the legal limit for agricultural use and possessing a landform potentially suitable for selective agricultural use. The closely dissected pattern of sloping valleys however makes it impossible to map the highest class of agricultural land (nearly level and freely drained). The comparable figure for potential agricultural land in Tekam is approximately 90 per cent. In both cases this total could be increased by swamp drainage.

CHAPTER 4
SOILS

The scientific study of Malaysian Soil extends over more than 40 years, and soil surveys have been in progress for the past 13 years. This work has been carried out mainly by the Department of Agriculture and the Rubber Research Institute. A bibliography of previous soil surveys, together with the first soil map of West Malaysia, is given by Panton (1964).

Classification systems for the soils of West Malaysia have been proposed by Owen (1951), Panton (1964), and Leamy (1966a, 1966b). For soil survey method, the Soil Survey for Malayan Conditions (Leamy and Panton, 1966) was available in draft form. The methods and nomenclature of this manual have been followed in most cases in this report.

A schematic reconnaisance soil map of the Jengka Triangle and Sungai Tekam Forest Reserve was produced by Panton (1963). This was based on examination of soils along rentis traverses spaced at two and a half mile intervals. The map, on 1:250,000 scale, shows soil associations.

SURVEY AREA

Field soil surveys were undertaken in the Jengka Triangle over an area of approximately 171,000 acres, and in a part of the Sungai Tekam Forest Reserve lying north of the Triangle, constituting approximately 40,000 acres. Description of the soils of the latter area will be found in Appendix 4 - 1.

In the Jengka Triangle the field survey was bounded by existing alienation and existing land development schemes, and initially by the edge of the two-mile belt adjacent to the Sungai Pahang (Figure 1 - 1). During the course of the work, the survey was extended into the two-mile belt to provide for the possibility of planning within part of this area. Mapping in this belt, however, was mainly by air photograph interpretation supplemented by selected traverses, the intensity being that of a schematic-reconnaissance survey.

In that part of the Sungai Tekam Forest Reserve surveyed, the limits of survey were the Jerantut-Maran road on the south, and the edge of the steep land (slopes exceeding 18.5 degrees) on the east, north and west. Alienated areas were excluded from survey.

SURVEY METHODS

The one-third mile interval rentis system by means of which field observations were located has been described previously. All rentis lines were traversed in their entirety by experienced professional soil surveyors. The soils were examined using a one and a half-inch diameter screw type auger; augering was to a depth sufficient to identify without doubt the soil series or, where this was not possible, to 36 inches. The main features of soil morphology in identifying series from auger inspection were colour (including mottling), texture, augering consistency, and the presence of iron concretions and weathered rock. By augering consistency is meant the stiffness of the soil in situ, that is, the force needed to pull up the auger; the roughness or smoothness of the soil on the auger head; and whether the soil broke up or formed a plastic thread on removal from the screw. Augering was supplemented by observations of logging track exposures, the roots of fallen trees, termite mounds, and the appearance of the soil surface.

Field procedures were to auger whenever a change in soil series was apparent or suspected, with an upper limit of one-third of a mile between sites. A sample check of traverse sheets showed a mean augering frequency of four and a half per mile; supplementary observations more than doubled this inspection density.

In constructing the soil map the rentis lines were drawn on the 1:25,000 scale topographic base map, and the soil series plotted along them as intercepts. Soil boundaries were then interpolated between the rentis lines, having regard where relevant to stream courses and contour lines.

Within each series, soil pits five to six feet deep were dug, and site and profile descriptions recorded. In the Jengka Triangle 109 pits were described, of which 80 were sampled for analysis. In the Sungai Tekam Forest Reserve 12 pits were described and sampled.

Methods of field soil survey and soil analysis were discussed and agreed with the Soils Division of the Ministry of Agriculture.

Accuracy

Soil survey in tropical rain forest has special problems. The first, that of locating an observation, is overcome by a rentis system. The second lies in the restricted vision possible within the undergrowth, usually 20-40 yards; because of this limitation the trend of an identifiable soil boundary apparently related to relief cannot be seen on either side of the rentis. Thirdly, the relative uniformity of the vegetation, and the difficulties of identifying the large number of species present severely restricts the use of plant indicators of soil type. The limitations of air photograph interpretation with respect to soils have been noted previously: the possible correlation between variations in the appearance of the tree canopy and soil boundaries noted in Chapter 1 would require a substantial investigation to confirm whether or not this apparent relationship could lead to improved techniques in soil mapping. As a consequence of these problems the soil map was necessarily constructed from the linear record of soils along the rentis traverses. The drawing of boundaries between traverses was normally a matter of interpolation, except for a limited number of cases where they would be expected to follow streams or steep ridges.

Limitations on the accuracy of soil mapping arise from four sources: the accuracy of the base map, the location of rentis, the position of changes in soil type along the traverse, and interpolation of boundaries between traverses. The total error from the first three of these is thought to be less than 200 yards. From the fourth source, inaccuracy in boundaries of up to the distance of the rentis separation, one third of a mile, may occur.

Three of the soil series, Malacca, Tavy and Durian, are defined partly by thickness of laterite. It was not always possible to ascertain this by auger, therefore recourse had to be made to additional soil pits. Hence the boundaries between any two of these series may be less accurate than one third of a mile.

In the nomenclature of the Malayan Soil Survey (Leamy and Panton, 1966) soil surveys in jungle traverse lines spaced between 200 yards-1 mile apart are detailed reconnaissance surveys. The present survey falls into this class, and should not be used for purposes for which a detailed survey is required. Surveys of the latter kind can only profitably be carried out after clearance of the vegetation.

SOIL FORMATION AND PRINCIPAL FEATURES

The soils have been formed under a climate with constant high temperatures and a high and evenly distributed rainfall. The soil remains moist in depth throughout the year giving, in conjunction with the high soil temperatures, optimum conditions for chemical weathering. Because of the absence of a dry season, water movement within the soil profile on freely-drained sites is downwards at virtually all times of the year, and the soils are therefore subject to intense leaching. Nevertheless on some shallow soils trees are likely to suffer from conditions of moisture stress during periods of relatively low rainfall.

These processes produce certain features that are common to most of the area. The soil is composed mainly of unweatherable minerals (principally quartz), clay minerals formed during the weathering process, and free iron and aluminium oxides. They have a very high clay content, except where formed from coarse-grained quartzitic parent materials. The soils have a strongly acid reaction, and are extremely highly leached of exchangeable bases. The clay minerals belong mainly to the kaolinitic group; and the physical properties, e.g. friability and permeability, are better than would otherwise be expected in soils with clay contents of 60-90 per cent.

The dissected relief, and in particular the convex slopes causes free site drainage over most of the area, except in valley floors. It also accounts in part for the moderate depth, typically two to eight feet, of most profiles; the preponderance of sedimentary rocks, which weather more slowly than igneous material, is another cause of this. It appears that natural erosion removes soil material at approximately the same rate as it is formed by weathering. The great profile depths frequently reported from humid tropical areas are in Jengka confined mainly to soils developed from andesite.

Under forest, the ground surface is covered by a thin leaf litter, typically one inch thick and forming a 70-90 per cent cover. Below that the upper two to three inches of soil consists of a humus-stained horizon containing abundant fine roots. There is a strong tendency towards shallow rooting. Termite mounds are common, and termite channels occur within the soil profile.

Within the group of freely drained soils derived from sedimentary rocks which covers 70 per cent of the total area, the main differentiating factor is parent material. Shales and siltstones give rise to a group of clay soils; over quartzites, sandstones and conglomerates the textures are more sandy, although even in these soils the clay content is sometimes moderately high in the lower part of the profile. In the case of quartz-conglomerates parent material acts in conjunction with the factor of relief, the resistance of the rock to weathering causing ridges with steep slopes and shallow soils. Variations in the iron content of the parent rocks may account for differences between the various shale-derived soil series, although it has not been possible to confirm this from geological evidence. Laterite is commonly found within the soil profile; its nature and origin are considered in Appendix 4 - 2.

Distinct from the soils derived from consolidated rocks is a group developed on alluvium and colluvium, in valley floor sites. These are immature soils, still subject to deposition during floods. The alluvial soils along the valleys of the larger rivers are mainly free-drained; those in the smaller river valleys lie partly below the water table and have profiles in which gleying has been the dominant process.

The relative effects of the soil-forming factors may be summarised by noting the factors which tend to produce certain common soil characteristics over the area as a whole, as compared with those which differentiate the various soil types within it. The main factor having a uniform effect is climate, since neither temperature nor rainfall variations within the area are sufficient to have a substantial effect on soil formation. The influence of vegetation is also relatively uniform. The main differentiating factor is parent material, since there is a considerable degree of correspondence between rock type and soil. Relief, through its influence on hydrological conditions in producing the poorly-drained soils and on soil maturity, is also a differentiating factor. The factor of time affects the alluvial soils with immature profiles.

The soils of the Jengka Triangle have been grouped according to the general classification of the Malayan Soil Survey which is based on the United States 7th Approximation, but with the names of the Great Soil Group modified to relate them to terminology in former use in West Malaysia (Table 4-1). A classification of soils based on parent material is given in Table 4-2.

Table 4 - 1
Soil Classification by Parent Material

Parent Material		Soil Series or Type
Igneous rocks	Andesite	Segamat
Sedimentary rocks	Shale and siltones	Munchong, Durian, Batu Anam With Laterite: Malacca
	Sandstone, siltone and shale	Bungor With Laterite: Tavy
	Quartzite, sandstone and conglomerate	Serdang, Kuala Brang, Kedah, Colluvium (miscellaneous)
	Limestone	Colluvium (limestone)
Other consolidated rocks	Ferruginous tuff and shale	Jempol, Colluvium (Jempol)
Alluvium and colluvium	River alluvium	Telemong, River alluvium
	River alluvium and colluvium	Akob

Table 4 - 2
General Classification

Order	Suborder	Great Soil Group		Soil Map of the World (FAO/UNESCO 1964) Class	Soil Series
		Common Name	U. S. Name		
OXISOL	Argox	Red Brown Oxisols	Normargox	Reddish - Brown Lateritic Soils	Munchong, Jempol
	Acrox	Yellow Red Oxisols	Normacrox	Red - Yellow Ferralsols	Segamat
	Petrox	Concretionary Oxisols	Normipetrox	Ferruginous Tropical Soils	Malacca, Tavy
ULTISOL	Udult	Red Yellow Utisols	Tropudult	Red - Yellow Podzolic Soils 1s	Serdang, Kedah
		Yellow Grey Ultisols	Plinthudult	Red - Yellow Podzolic Soils 1s	Durian, Batu Anam, Bungor, Kuala Brang
ENTISOL	Udent	Brown Entisols	Hapludent	Alluvial Soils	Telemong
	Aquent	Brown Grey Entisols	Hapluquent	Alluvial Soils 1s	Akob

Sources: Leamy (1966a, 1966b), Soil Survey Staff (1960), FAO/UNESCO (1964)

SOIL SERIES

The soil series defined by the Malayan Soil Survey have been used in this study; it has been unnecessary to propose any new series. Liaison with members of the Soil Science Division of the Department of Agriculture was maintained throughout the work; this was of value in early phases of the survey when members of the Division provided advice and assistance in field identification of established series. By these means, by frequent visits of members of the Division to inspect soil pits in Jengka, and by examination of representative soils profiles in other areas during the 1966 Malaysian Soils Conference, it has been possible to ensure that the series mapped in Jengka conform to the most recent definitions of the Malayan Soil Survey.

Thirteen soil series were identified in the area surveyed. In addition, five soil types not belonging to established series were noted: colluvium (Jempol), colluvium (limestone), colluvium (miscellaneous), undifferentiated lithosols, and undifferentiated river alluvium.

The descriptions which follow give the principal characteristics of each series and type, with particular reference to features of importance in land classification. The order is that of the classification in Table 4 - 2. Representative profile descriptions, analytical data, and a key to a series identification are given in Appendix 4 - 3. It is emphasised that the descriptions refer only to Jengka and Tekam; they do not necessarily cover the full range of characteristics of the soil series as developed in other parts of Malaya.

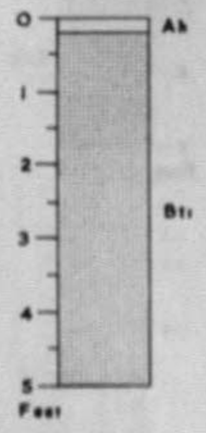
The succession and depths of horizons in typical profiles for each series have been shown alongside the relevant descriptions that follow. The horizon nomenclature is according to Leamy and Panton 1966, abbreviated as follows:

Ah	Humic A, humus-stained mineral soil
Ae	Eluvial A, relatively impoverished in clay
AB	Transitional, neither enriched nor impoverished in clay
Bt	Textural B, relatively enriched in clay
Bti	Iron-rich textural B
Bcn	Concretionary B, nodular laterite

Bcnj Weakly-developed concretionary B
Bg Gleyed B, mottled
Br Reduced B, grey
Cm Minerals of weathered rock in soil
Cmgj Minerals of weathered rock in soil, with slight gleying
Cu Unconsolidated weathered rock
Cug Gleyed unconsolidated weathered rock
Cc Consolidated weathered rock

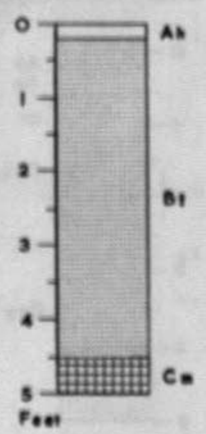
Organic horizons have been omitted.

Segamat Series



This is a deep, red or yellowish red soil derived from andesite. Despite a very high clay content throughout the profile, normally 80-90 per cent, it is friable and freely-drained. All horizons have a moderate fine to medium subangular blocky structure, which on being crushed breaks down into a stable crumb aggregation. Apart from a well-developed humus horizon in the upper two to three inches, the profile is relatively uniform with depth. Roots, although mainly concentrated in the upper three inches, are liable to pentrate freely; there is rarely any limiting horizon (laterite or weathered rock) within six feet, and soil depths of up to 30 feet have been observed. A laterite horizon is sometimes found, but is not common. Together with the Munchong series, Segamat has the highest field capacity of any soil in Jengka, but because of the strong crumb aggregations surplus water drains rapidly through the profile. The content of iron oxides is substantially above that of any other series in Jengka, a result of its derivation from parent material of basic composition.

Munchong Series

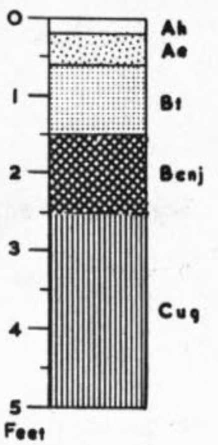


This occurs as a deep or moderately deep, strong brown to reddish yellow clay, derived from shales and siltstones. The clay content in all horizons ranges from 60 per cent (below which level the soil is classed with the Bungor series) to 90 per cent and is relatively uniform with depth. There is a moderately developed medium blocky structure, with visible clay skins. It differs from Segamat in having a firm consistency, plastic to slightly friable when moist, and moderately stiff and sticky when wet. The water-holding capacities are as high as Segamat, and again the series is freely-drained. The iron oxide content is considerably lower than Segamat, but higher than that of the other shale-derived series.

Weathered rock does not appear until a depth of 5 feet or more. A laterite horizon is present in the majority of profiles, but the depth at which it commences may be from two feet to over five feet. Where it is less than two feet the profile is classified as Malacca series. The depth of the upper surface of laterite often varies considerably over short distances, and consequently Munchong-Malacca complexes occur.

Durian Series

In contrast to the basically uniform profiles of Segamat and Munchong, the Durian series has clearly developed horizons. It is derived from shales and siltstones. In view of the wide extent of this series in Jengka, an assessment of its agricultural potential and limitations is of importance in relation to its future land use.

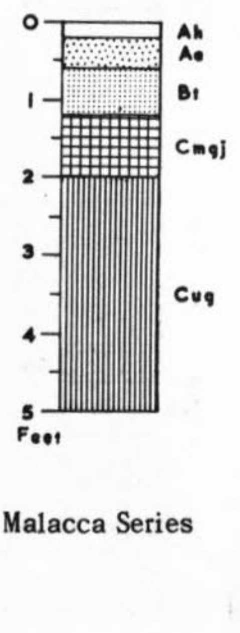


The humus horizon overlies an eluvial A horizon; this varies in texture from sandy clay loam to a clay in which some sand is present. Below about eight inches the lighter-textured topsoil passes into a heavy clay B horizon (65-85 per cent clay) with a moderately-developed medium blocky structure but firm to very firm consistency. The colour is yellow or brownish yellow in the upper part, frequently becoming redder with depth. The field capacity is substantially lower than in Munchong, the reason for this is not known. Mottling, due to patches of highly-weathered rock, commences in the lower part of this horizon.

The series has also a smaller effective depth than Segamat or Munchong. There are two horizons which may limit root development: weathered rock in all profiles, and iron concentrations in some. The C horizon, of highly-weathered shale with variegated colouring, commences at a depth of between 18 and 36 inches; the lower part is white with a prominent red mottle. Although not hard, this horizon is exceptionally stiff, and under forest cover only a few roots penetrate its upper part.

In some profiles a horizon of iron concretions set in clay separates the B horizon from the weathered shale. Hard concretions, about a quarter inch diameter, form one to two thirds of the total mass of the horizon. The depth of overlying soil varies from 10 to 30 inches and the thickness of the concretionary horizon from 6 to 18 inches; mean values are 18 inches of soil overlying 12 inches of concretions set in clay. A few tree roots normally penetrate this horizon. A lateritic variant and a non-lateritic variant of the Durian series may be distinguished.

Batu Anam Series



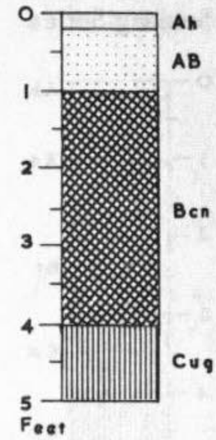
This has the same succession of horizons as Durian, except that iron concretions are few or absent. The eluvial A horizon is very pale, with the lowest iron oxide content of any of the shale-derived series. This overlies a stiff clay B horizon. Mottling appears at about 12 inches and a very stiff, variegated C horizon of highly-weathered shale commences at between 18 and 27 inches. The drainage of this series is imperfect.

The series Munchong, Durian and Batu Anam may be viewed as a sequence, having successively shallower profiles, lower iron oxide contents, paler colours, poorer physical properties, and decreasing agricultural potential.

Malacca Series

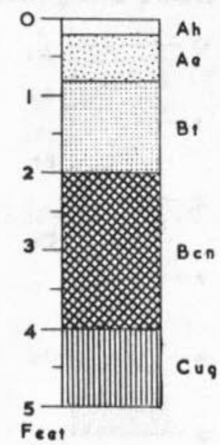
This is defined by the presence of a thick laterite horizon commencing at a depth of less than two feet. The type series of Malacca occurs under landform conditions different from those in Jengka, and it may be that the series has been given too wide a range by using it in Jengka. It is derived from shales. Most profiles belong to the nodular phase of the Malacca series. The laterite consists of hard, sub-angular to sub-rounded concretions, non-cemented or only weakly cemented together; concretionary material forms 65-80 per cent of the volume of this horizon. Ironstone boulders are occasionally found. Massive bog-iron ore has been observed in the south-east, but is not widely distributed.

The depth at which laterite commences is typically 6-18 inches. The overlying soil is a yellowish-red or red clay, often with very similar properties to the Munchong series. Where Malacca-Munchong complexes occur, the Malacca may be regarded as a shallow-laterite phase of the Munchong. Although a few tree roots penetrate between the concretions, the laterite is considered to be a limiting horizon for root development of agricultural crops.



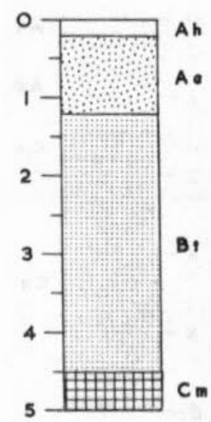
Tavy Series

The Tavy series, derived from sandstones and shales, is also characterised by the presence of nodular laterite. It differs from the Malacca series in that the laterite horizon is thinner, and the overlying soil is yellow and somewhat sandier, typically a sandy clay loam passing downwards into a sandy clay. The laterite horizon may be from 12 to 36 inches thick. With a similar composition to that described for the nodular phase of the Malacca series, it forms a limiting horizon for root development. In the west of Jengka the laterite normally commences at a depth of 20-36 inches but in the area of Tavy in the north-east there are only 8-12 inches of overlying soil.

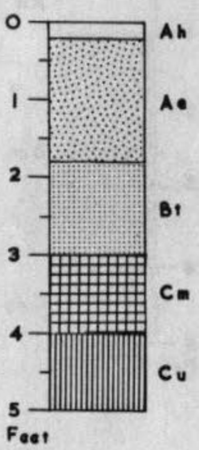


Bungor Series

This is a moderately deep, yellow, somewhat sandy soil, probably derived in Jengka from interbedded sandstones and shales. The texture is intermediate between Munchong and Serdang. A friable sandy clay loam with a weak blocky structure passes gradually downwards into a sandy clay of firm consistency. The profile is freely drained, and has no limiting horizon for four feet or more.



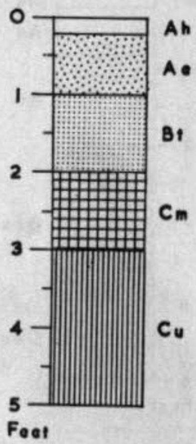
Serdang Series



This occurs as a sandy soil with a moderately deep profile, derived from quartzites, sandstones and quartz-conglomerates. There is an eluvial A horizon 15-24 inches thick, composed of a yellow to brownish yellow sandy clay loam or sandy loam, friable and almost structureless. This overlies a sandy clay B horizon (50-60 per cent sand) with a firm consistency. There is usually more coarse sand (over 0.2 mm diameter) than fine sand. Weathered rock commences at more than four feet depth. The profile has rapid permeability and a lower field capacity than the shale-derived soils.

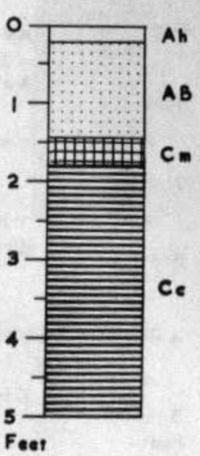
Similar but shallower soils are classified as Kuala Brang series if weathered rock commences at two to four feet and as Kedah series if at less than two feet.

Kuala Brang Series



This occurs as a sandy soil in association with the Kedah and Serdang series. A limiting horizon of weathered rock commences at between two and four feet. A yellow sandy clay loam passes downwards into a sandy clay. Coarse sand is usually common, but in the Serdang-Kuala Brang complex in south-central Jengka a fine sandy variant is found.

Kedah Series

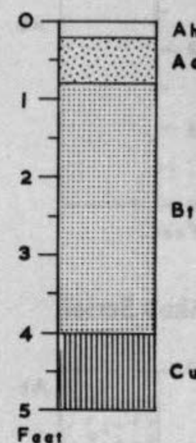


The Kedah series is a shallow, sandy soil, derived from quartzites and quartz-conglomerates, and occurring mainly on steep slopes. Rock occurs at a depth of two feet or less. Stone lines, formed of quartzite fragments or boulders, may occur.

Lithosols

The shallow clay soils which overlie shales on steep slopes do not fall within the Kedah series; they have been classed as undifferentiated lithosols.

Jempol Series



The Jempol Series is a reddish brown clay derived from either andesitic tuff or ferruginous shale. It has a moderately strong medium blocky structure and a firm consistency. It is distinguishable from the Munchong series by its darker colour, whilst it lacks the friability of the Segamat series. It has a moderately deep profile.

Colluvium (Jempol)

In addition to the typical Jempol series reddish brown clays of limited depth (two to four feet), occur mainly on steep slopes. The clay overlies a horizon of rounded boulders or rock fragments; these have a very variable lithologic composition, including ferruginous tuff, acid tuff, siltstone, quartzite and quartz. Stone lines commonly occur. These soils have not been defined as a series, but are classed as colluvium (Jempol).

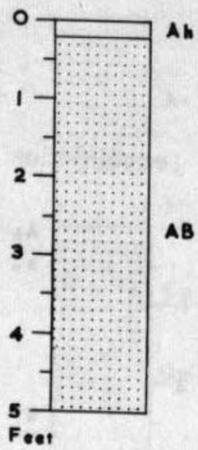
Colluvium (limestone)

A zone surrounding the base of the limestone hills in the west does not correspond to the existing Malaysian limestone-derived series, and is classed as colluvium (limestone). A brown clay loam overlies a deep, compact brown clay.

Colluvium (miscellaneous)

An area of shallow to moderately shallow sandy soils on steep slopes has been classed as colluvium (miscellaneous). Quartzite conglomerate is the main parent material. A yellow sandy clay loam overlies a reddish yellow sandy clay. Below this, commencing at between 12 and 36 inches is a stone line, often consisting of a horizon of rounded boulders overlying a band of quartz fragments.

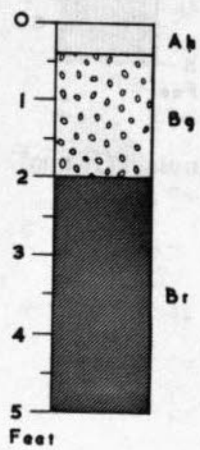
Telemong Series



The Telemong series, river alluvium, and the Akob series are soils developed on alluvial parent materials in valley-floor sites.

Telemong series occurs as a deep, freely-derived soil formed on sandy alluvium deposited by the Sungai Pahang and its larger tributaries. It is an immature soil, and in some areas deposition is still in progress; twice during the survey flooding deposited one to three inches of sand along the banks of the Sungai Tekam, and a thinner layer of finer-textured material further from the channel. Below a humic topsoil the profile consists of five feet or more of brown to dark brown loamy sand, sandy loam or sandy clay loam. Depositional bedding is sometimes apparent. It is ungleyed, structureless, and friable to loose, allowing roots to penetrate easily and deeply. The texture is usually coarser along levees, becoming finer away from the river.

Akob Series



The valley floors of the smaller rivers and streams are occupied by poorly-drained soils of the Akob series. The parent material is of mixed colluvial and alluvial origin. The water table fluctuates between the surface and a depth of one to two feet. A layer of two to four inches thick of partly decomposed organic matter overlies a mottled horizon; this passes gradually downwards into a grey horizon, as the level permanently below the water table is approached. Where Akob belts occur within areas of Segamat series or the shale-derived soils the texture is a heavy clay. Where it is associated with Serdang and Kedah a sandy variant is found.

The soils of permanently-flooded swamps have not been investigated in detail, and are mapped as Akob series. In one profile examined, 12 inches of peaty muck overlay a deep layer of gleyed plastic clay.

River Alluvium

Soils of alluvial origin which do not have the characteristics of either Telemong or Akob are mapped as river alluvium. These are usually found on low terraces no longer subject to deposition. They may have an eluvial A horizon, indicating the commencement of profile differentiation. Pale yellowish to greyish colours are normally found; the texture varies widely. These soils are mottled in the lower part of the profile, indicating imperfect drainage, either internal or external.

Intergrade Soils

A soil with the friability and other properties of Segamat but the colour of Munchong was found. This has many properties of the Katong series, but since the presence of the parent material of this series, quarts andesite, could not be confirmed it has been mapped as Segamat.

Profiles having properties intermediate between two series were occasionally observed, e.g. Jempol/Munchong intergrade, Malacca/Tavy intergrade.

SOIL DISTRIBUTION

The Soils Map

The Soils Map was compiled on a scale of 1:25,000 and subsequently reduced to 1:63,360. The latter is given in the Map Annexure, and a generalisation is presented as Fig. 4 - 1.

It was initially intended to use the soil series as the only unit of mapping. Frequently, however, it was found that changes in soil series occurred over short distances; in some cases four or more changes were recorded within a quarter of a mile. This made it necessary to use soil complexes (Soil Survey Staff 1960) as the mapping unit in some instances, whilst adhering to soil series wherever possible. The main causes of the occurrence of soil complexes are:

1. Alternations of sandstones, siltstones and shales, e.g. Bungor-Munchong complex.
2. Variations in the depth at which laterite commences, e.g. Munchong-Malacca complex; or in the thickness of the laterite horizon, e.g. Malacca-Durian complex.
3. Variations in soil depth, e.g. Serdang-Kedah complex.
4. Variations in drainage from the upper to the lower slopes e.g. Durian-Batu Anam complex.

Complexes are shown on the map by a double symbol, the upper part giving the dominant series, i.e. the series of greatest extent, and the lower symbol the principal subordinate series. Additional subordinate series may occur, e.g. a Malacca-Durian complex may also include Tavy. The colour shading of complexes on the map is that of the dominant series.

Belts of Akob series along valley floors are mapped only where their width exceeds two chains (44 yards).

Main Features of Soil Distribution: The Jengka Triangle

Serdang and Durian are the two most extensive series, between them occupying over a third of Jengka (Table 4-3). Serdang appears mainly in complexes with the other sandstone derived series: Bungor, Kuala Brang and Kedah. Durian occurs in two complexes, with Malacca and with Batu Anam. The two best agricultural soils, Segamat and Munchong, together cover just under a quarter of the area. The two series with thick laterite, Malacca and Tavy, cover over a tenth of the area, nearly always appearing in complexes with each other and with Durian and Munchong.

The principal non-agricultural series, Kedah, covers approximately a tenth of the area, Akob series belts of more than two chains width cover nine per cent; the inclusion of narrower valley floors raises the figure to 12 per cent. Batu Anam, Jempol, and the three colluvial soil types are of relatively small extent. Undifferentiated lithosols occur only in complexes with Kedah.

The pattern of boundaries on the soil map shows two main elements, associated with the principal factors causing soil different-

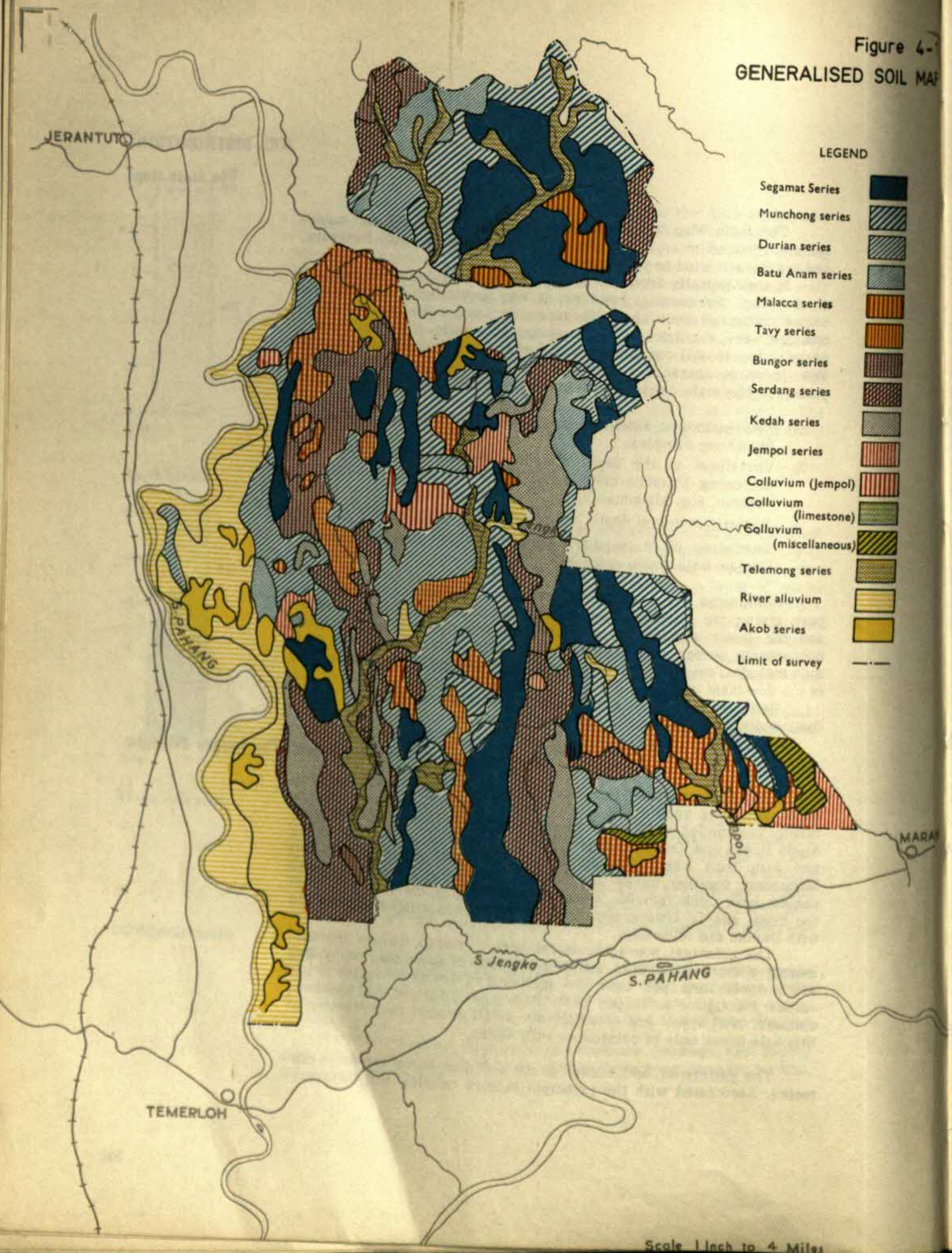


Figure 4-
GENERALISED SOIL MAP

lation in the area, parent material and relief. The north-south element, most clearly seen in southern Jengka, is a reflection of the geological strike. Superimposed on this is a dendritic element shown by the soils occupying valley floors, principally Akob series. The occurrence of laterite horizons, resulting in complexes involving Malacca and Tavy series, shows a more irregular distribution pattern.

Table 4 - 3
Soil Series Distribution

Soil Series or type	Jengka Triangle		Sungai Tekam Forest Reserve	
	Acres	per cent of total	Acres	per cent of total
Segamat	26,872	15.8	10,668	26.5
Munchong	17,315	10.1	8,497	21.1
Durian	30,436	17.9	2,708	6.7
Batu Anam	2,615	1.5	2,018	5.0
Malacca	12,199	7.1	3,274	8.2
Tavy	6,209	3.6	205	.5
Bungor	6,827	3.8	1,389	3.4
Serdang	20,737	12.1	4,472	11.1
Kedah	16,687	9.7	1,353	3.4
Jempol	786	0.5	238	.6
Colluvium (Jempol)	3,211	1.9	Not Present	-
Colluvium (limestone)	600	.4	Not Present	-
Colluvium (miscellaneous)	100	.1	Not Present	-
Telemong	6,239	3.6	2,919	7.2
River alluvium	4,642	2.7	529	1.3
Akob	15,739	9.2	1,935	4.8
Kuala Brang	-	-	42	.2
Total	171,214	100.0	40,247	100.0

The areas under soil complexes are included with the dominant series. The acreages for the Jengka Triangle exclude soils within the two mile belt adjacent to the Sungai Pahang but otherwise cover the full extent of the area surveyed.

There are two major areas of Segamat series: one commencing as a belt one and a half to two miles wide in the south-centre, narrowing and becoming discontinuous northwards; the other in the east, where the Segamat areas mapped in the north-east and east-centre are probably a continous belt across Ulu Jempol (Panton, 1963). Narrower north-south belts of Segamat occur in the west. The Munchong series is found mainly in the north-east and east-centre, and as a complex with Malacca in the north. The Durian series is widely distributed, including a broad but broken north-south belt through the centre of Jengka. Batu Anam forms the dominant series in two areas, in the north-east and south-east.

The Jengka Ridge and its northern continuation give rise to a belt dominated by Kedah series; complexes of Serdang, Kuala Brang and Kedah occupy country adjacent to these ridges. Other ridges with Kedah series occur in the south-west, again with Serdang on adjacent less steep land. The Bungor series occurs mainly in the north-west, in a complex with Munchong.

The laterite series, Malacca and Tavy, occur in all parts of the area. In some cases they form belts marginal to Segamat.

In the south-east there is a pedological unit distinct from the rest of Jengka. The geology of this unit results in different soils; the Jempol series and the soils mapped as colluvium (Jempol) and colluvium (miscellaneous) are confined to this region.

The Akob series occurs mainly as valley-floor belts, typically 25-100 yards wide. Broader areas of Akob, which are in general more swampy, occur in the west centre and on tributaries of the Sungai Kundang and Jempol in the south-east. Telemong series occupies belts, typically quarter to half a mile wide, along the Sungai Tekam, Jengka, Lokek and Jempol.

In the west is a belt one to three miles wide formed of alluvium deposited by the Sungai Pahang. The Telemong series occupies a zone adjacent to the river, including the levees; undifferentiated river alluvium occurs further from the river; shallow depressions with Akob series are common in both these zones.

APPRAISAL OF RELATIVE SOIL QUALITIES

The following is a summary of the relative qualities of the different soil series with respect to agriculture. The percentage area covered by each series is given in brackets.

The Segamat (15.8) and Munchong (10.1) series are the best agricultural soils (the Akob series forming a special case); Segamat is deep, friable, freely-drained but with good field capacity; it has a higher nutrient status than most other series. Munchong has a moderately deep profile; it is freely-drained and well structured, and probably has nutrient levels somewhat above those of the other shale-derived series.

The Durian series (17.9), the most extensive soil in Jengka, is intermediate in agricultural value. Its depth is limited by a horizon of stiff, highly-weathered shale commencing at a depth varying from 18 to 36 inches. Its physical properties and moisture retention are poorer than in Munchong. Nutrient status is medium. The Batu Anam series (1.5) is closely related pedologically to Durian, but is in all agricultural respects poorer. Drainage is imperfect, weathered shale forms a limiting horizon at less than 27 inches depth, and nutrient status is low.

The Malacca (7.1) and Tavy (3.6) series have a limiting horizon of nodular laterite, generally thicker in Malacca which has a lower agricultural value than Tavy. Apart from this, the properties of Malacca are similar to those of Munchong, whilst Tavy has somewhat poorer characteristics resembling Bungor.

The Bungor (3.8) and Serdang (12.1) series are sandy clay loams to sandy clays, in contrast to the clay textures of Segamat, Munchong, Durian, Batu Anam and Malacca. They are deep and friable. Serdang has rapid permeability and substantially lower moisture retention than the clay soils; the possibility of moisture stress in crops on this series is discussed in Chapter 7. Serdang has a low nutrient status;

Bungor is intermediate between Serdang and the clay soils in this respect. Both series have a fair to marginal status for agricultural use.

Kuala Brang (which occurs only in complexes with Serdang and Kedah) and Kedah (9.7) are sandy soils, having a limiting horizon of weathered rock, above four feet in Kuala Brang and above two feet in Kedah. In addition to their shallowness thay have a low nutrient status and lowish moisture retention. These soils are not considered to be suitable for agricultural use.

The Jempol series (0.5) which is of limited extent, has properties similar to, or somewhat poorer than, those of Munchong.

Colluvium (Jempol) and colluvium (miscellaneous) (2.0) are shallowish soils occurring mainly on steep land; they are generally unsuited for agricultural development. The small area of colluvium (limestone) (0.4) surrounding the limestone hills is probably satisfactory for crops in respect of soil properties.

The Akob series (9.2) forms a special case. Under natural conditions it is poorly drained, waterlogged in the lower horizon and subject to intermittent flooding. If drained, however, it has possibly the highest potential of any soil in Jengka, being less acid, less strongly leached and with a high nutrient status.

The Telemong series (3.6) is deep, moderately sandy, freely drained, easy to cultivate, and only subject to flooding under exceptional conditions. From the limited data available its nutrient status appears to be low. The areas mapped as river alluvium (2.7) have variable properties, intermediate between those of Akob and Telemong.

CHAPTER 5
FORESTS

The forests in the Jengka Triangle and in that part of the Tekam Forest Reserve considered in this report belong to the Lowland Dipterocarp group, the Dipterocarpaceae being the predominant family of timber trees throughout Malaysia and Southeast Asia, and covering the full range of timbers from Light Hardwoods to Heavy Hardwoods.

These forests are usually dense and composed of many hundreds of timber producing species. Their upper storey or emergent layer is normally about 100 to 150 feet high, though trees of up to 200 feet in height are not uncommon. This storey is usually characterised by a high proportion of the *Dipterocarp* genera *Anisoptera*, *Dipterocarpus*, *Hopea*, *Shorea*, *Parashorea*, *Dryobalanops* and *Balanocarpus*. Other common large trees of this storey are *Dyere costulata*, *Koompassia* spp., *Gluta* spp., *Melanorrhoea* spp., *Palaguium* spp., *Sindora* spp., and *Heritiera* spp.

The main storey or second layer of trees is found in the 70 to 100 foot height range and forms a continuous canopy, except immediately below the large emergents. This storey consists of young trees of the species normally found in the upper storey together, predominantly, with members of the families *Burseraceae*, *Guttiferae*, *Myristicaceaa*, *Myrtaceae* and *Sapotaceae*.

The understorey or third layer consists of saplings of the upper two storeys together mainly with members of such families as Anonaceae, *Euphorbiaceae*, *Flacourtiaceae* and *Anonaceae*. The density of the shrub layer is highly variable.

Although, basically, Lowland Dipterocarp forests are similar in composition, six different types of these forests are known to occur in Malaya; the most important of these is the Red Meranti-Keruing type, which is that generally found in both the Jengka Triangle and the Tekam area.

About 60 per cent of the Jengka Triangle is under high forest. Of this compact blocks amounting to approximately 75,000 acres have been logged over or are in process of exploitation, leaving a balance of about 93,600 acres of undisturbed forest within the Jengka Forest Reserve.

The Tekam area comprises about 4,000 acres of logged-over forest and approximately 30,700 acres of undisturbed forest lying wholly within the Tekam Forest Reserve.

In order to make an appreciation of the value of the timber resource in the planned development of these areas, a reliable inventory of them was required. Previously, a reconnaissance survey of both had been undertaken by the Malayan Forest Department in 1963 with the object of obtaining knowledge of the main forest and vegetation types in them. This was done by air photograph interpretation, using photographs taken prior to 1951, combined with ground sampling over limited areas. A map of the main vegetation types was produced.

The inventory covered in this report was confined to areas of virgin or undisturbed forest in the Jengka Forest Reserve and in that part of Tekam Forest Reserve north of the Jengka Triangle where the terrain appeared to be well suited to agricultural development. In the case of the Jengka Reserve the original intention was to include a large block of about 16,000 acres in the east which the Forest Department had already agreed to excise for agricultural development; but logging had begun in it by the time the field work started and it was evident that enumeration in such areas would produce virtually valueless information. It was therefore decided, with the agreement of the Federal Land Development Authority, that this and any other logged-over areas discovered subsequently, should be excluded. A logging area of 5,370 acres in the south of the Jengka Forest Reserve covered by a five year agreement was excluded in consequence.

The inventory was undertaken with a view to obtaining an estimate by species groups of the volume of standing timber, the number of trees of four feet girth and above contributing to that volume, the percentage composition of groups by species of commercial interest, and their distribution. The data are presented separately for Jengka and Tekam.

Species Groups Recorded

Over one hundred and twenty species representing eighty five genera were recorded in twenty six species groups. (Table 5 - 1). The species grouping was decided upon after consultation with officers of the Malayan Forest Department and with private timber interests. It was designed to include all species in which a commercial interest existed or could be foreseen. The arrangement of the grouping was also to some extent made to match similar groups of species covered by the dual entry volume tables used by the Forest Department. A detailed list of species occuring in each group with descriptions and suggested uses of each appears in appendix 5 - 1.

Sampling Procedure

Inventory procedures were evolved and executed in close consultation with the Malayan Forest Department and with the Commonwealth Forestry Institute, Oxford. Forest inventory field staff consisted entirely of Foresters and Woodsmen from the Malayan Forest Depart-

In general the sampling procedure followed that in use by the Malayan Forest Department for commercial enumerations, a minor modification being in the method of determining boundary line trees. The Jengka and Tekam inventories included any stem the central axis of which lay within a distance of half a chain (33 feet), measured at ground level, on either side of each line sampled. This modification was considered to be less susceptible of subjective interpretation.

The rentis pattern prepared for the soil survey determined the basic layout of the forest sampling system.

The Jengka Forest Reserve was divided on the map into four quadrants and further subdivided into thirty three contiguous blocks each normally containing a series of six rentis lines (Figure 5 - 1). The width

Table 5 - 1
List of Species Groups

Heavy Hardwoods	Medium Hardwoods
1 Merbau	5 Kempas
2 Other heavy hardwoods	6 Keruing
3 Chengal	7 Mengkulang
4 Balau, Sengkawang and Giam	8 Kelat
	9 Other medium hardwoods

Light Hardwoods	
10 Bintangor	19 White Meranti
11 Durian and Punggai	20 Mersawa
12 Jelutong	21 Yellow Meranti
13 Meranti Melantai	22 Nyatoh
14 Meranti Rambai Daun	23 Sepatir
15 Meranti Sarang Punai	24 Kedondong, Mata Ulat and Melunak
16 Meranti Tembaga	25 Medang, Penarahan and Sesendok
17 Seraya	26 Other light hardwoods
18 Other red Meranti	

of each block was thus two miles; its length varied according to the physical shape of the area, the average being two and a half miles.

The Tekam area was treated as a separate unit and divided into thirteen blocks; the average depth and length of each block was two miles (Figure 5 - 1).

In both cases the lines to be sampled were randomly selected for each block, the normal number being two out of every six, giving a constant sampling fraction of 1.25 per cent over the whole area. Along each selected line a transect half a chain on either side and running the full length of the block was treated as a single sampling unit.

In each transect all trees of four feet or more in girth at breast height, or above buttress, were measured and recorded in one foot girth classes from four feet up to thirteen feet, the latter class including all trees of larger size. The girths of trees with high buttresses were measured with a modified version of the Biltmore stick. This gave direct readings of girth and saved considerable time.

Readings of clear bole of measured trees were taken by Haga hypsometer in every tenth chain along each transect to provide data for compilation of single entry volume tables.

All measured trees were visually graded into form classes at the time of measurement. This was inevitably a somewhat subjective operation, but it was thought that the information obtained might prove useful to the trade. Six classes were recognised as follows:

FORM CLASS

A — Cylindrical in section, straight and suitable for peeling.

B — Cylindrical, with slight sweep; also suitable for peeling.

C — Not cylindrical, but straight and suitable for use as saw-logs.

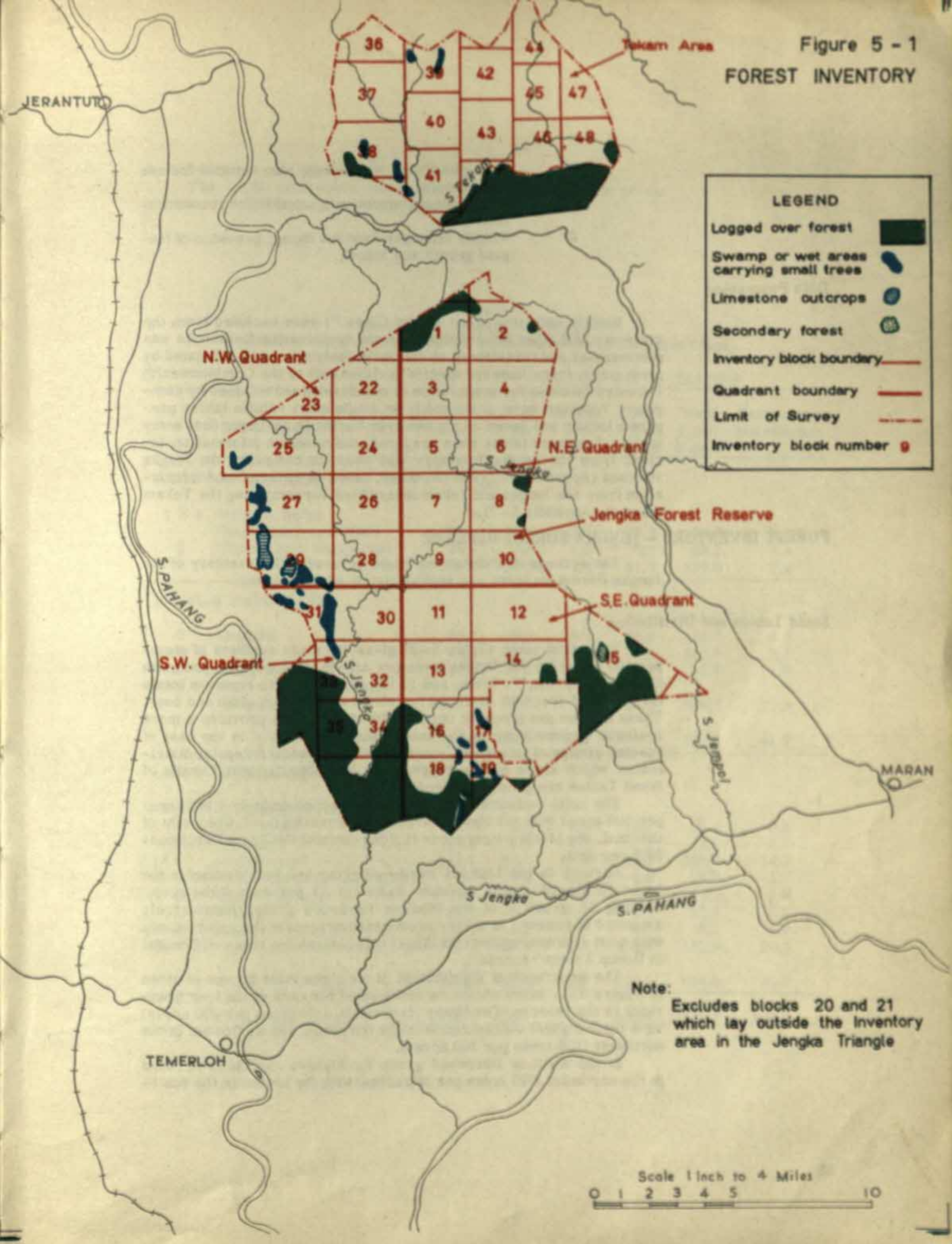


Figure 5 - 1
FOREST INVENTORY
LEGEND
Logged over forest
Swamp or wet areas carrying small trees
Limestone outcrops
Secondary forest
Inventory block boundary
Quadrant boundary
Limit of Survey
Inventory block number 9
Tekam Area
JERANTUT
N.W. Quadrant
N.E. Quadrant
S.E. Quadrant
S.W. Quadrant
Jengka Forest Reserve
S. PAHANG
S. Jengka
S. Tekam
S. Jempol
MARAN
TEMERLOH
Note:
Excludes blocks 20 and 21 which lay outside the Inventory area in the Jengka Triangle
Scale 1 Inch to 4 Miles
0 1 2 3 4 5 10

D	Not cylindrical, with sweep; also suitable for use as saw-logs.
E	Badly shaped stems only suitable for reconstitution.
F	Visibly defective (obvious decay, presence of fungoid growth and holes).

Data Processing

Visibly defective trees (Form Class F) were excluded from the inventory. All other information from the enumeration field books was summarised and transferred to specially designed cards; tabulated by girth class, form class and species; and then sent to the Commonwealth Forestry Institute for preparation of stand tables and volumes by computer. Volumes were computed from single entry volume tables prepared locally and based on the Malayan Forest Department dual entry tables. Two such tables were prepared: one based on information derived from the Jengka Inventory was used for computing the Jengka volumes (Appendix 5 - 2) and the other, based on the combined information from the Jengka and Tekam inventories, for computing the Tekam volumes (Appendix 5 - 7).

FOREST INVENTORY – JENGKA FOREST RESERVE

The acreage of undisturbed forest covered by the inventory of the Jengka Forest Reserve was approximately 93,500 acres.

Stand Tables and Distribution

The stand table (Table 5 - 2) gives the mean numbers of stems per 100 acres for the Jengka Inventory area in the three grouped girth classes; 4 - 6 feet, 7 - 9 feet, and 10 feet and over, with separate totals for stems 7 feet and over and for all stems of 4 feet girth and over. These figures are given for units of 100 acres as this provides a more realistic presentation of the stand data, particularly in the case of species groups of infrequent occurrence or markedly irregular distribution which might not be represented in a smaller unit. Details of Stand Tables are given in Appendix 5 - 3.

The total estimated stand amounts to approximately 1,885 trees per 100 acres with the Heavy Hardwoods accounting for 7.4 per cent of the total, the Medium Hardwoods 41.9 per cent and the Light Hardwoods 50.7 per cent.

Keruing in the Medium Hardwood group and Red Meranti in the Light Hardwood group together make up 23 per cent of the crop. Tualang in group 9 of the Medium Hardwood group, though rarely exploited at present, is a very prominent emergent in the upper storey with good representation in the larger size classes. No trees of Chengal in Group 3 were recorded.

The geographical distribution of the three main groups is given in Figure 5 - 2, which shows the mean stand for each of the four quadrants in the reserve. The Heavy Hardwoods, (196 trees per 100 acres) have their highest concentration in the northwest and the lowest in the northeast (108 trees per 100 acres).

In the Medium Hardwood group the highest stand is to be found in the northeast (922 trees per 100 acres) with the lowest in the southwest (687 trees per 100 acres).

The Light Hardwoods have their highest concentration in the northwest (1,020 trees per 100 acres).

Table 5-2
Stand Table - Jengka Forest Reserve
(Mean number of trees per 100 acres exclusive of defective trees)

SPECIES GROUPS		GROUPED GIRTH CLASSES 4 - 6 feet	7 - 9 feet	10 feet and over	Total 7 feet & over	Total 4 feet & over	Percentage distribution
HEAVY HARDWOODS							
1 & 4	Merbau, balau Sengkawang and Giam	51.4	19.6	3.7	23.3	74.7	4.0
2	Other Heavy Hardwoods	56.6	7.4	1.2	8.6	65.2	3.4
	Total	108.0	27.0	4.9	31.9	139.9	7.4
MEDIUM HARDWOODS							
5	Kempas	49.3	29.7	6.7	36.4	85.7	4.5
6	Keruing	84.2	56.5	19.9	76.4	160.6	8.5
7	Mengkulang	24.8	10.1	0.6	10.7	35.5	1.9
8 & 9	Kelat & Other Medium Hardwoods	455.6	38.0	15.2	53.2	508.8	27.0
	Total	613.9	134.3	42.4	176.7	790.8	41.9
LIGHT HARDWOODS							
10 & 11	Bintangor, Durian and Punggai	12.7	2.1	0.6	2.7	15.4	0.8
12	Jelutong	12.2	3.3	4.4	7.7	19.9	1.1
13 -	Red Meranti	191.4	67.6	14.7	82.3	273.7	14.5
19 & 20	White Meranti & Mersawa	19.4	4.4	2.1	6.5	25.9	1.4
21	Yellow Meranti	10.6	4.5	2.1	6.6	17.2	0.9
22	Nyatoh	29.0	3.5	0.5	4.0	33.0	1.8
23	Sepetir	12.9	3.3	0.7	4.0	16.9	0.9
24 - 26	Other Light Hardwoods	514.4	35.9	2.6	38.5	552.9	29.3
	Total	802.6	124.6	27.7	152.3	954.9	50.7
	Total All Groups	1524.5	285.9	75.0	360.9	1885.4	100.0

Volume and Distribution

The mean gross volume in cubic feet per acre for the Jengka inventory area is given in Table 5 - 3. The estimated total volume per acre is 2,508 cubic feet for trees of four feet girth and over and 1,142 cubic feet for trees of seven feet girth and over. Heavy Hardwoods account for 5.8 per cent of the total volume, Medium Hardwoods 46.5 per cent and Light Hardwoods 47.7 per cent.

Keruing and Red Meranti together make up 35 per cent of the total volume as compared with 23 per cent of the total stand, with a more or less even distribution amongst all four quadrants.

The geographical distribution of the total volume is shown in Figure 5 - 3; it bears a reasonable relation to the stand table distribution for all quadrants except for the Light Hardwoods. The volume of Light Hardwoods in the northwest quadrant is lower than that in the northeast and southwest in spite of the fact that this quadrant carries a slightly bigger stand. This is accounted for by the presence of larger size trees (seven feet and over) in the northeast and southwest with a resultant increase in volume for both these quadrants. Further details of volume by quadrants are given in Appendix 5-4.

Table 5 - 3
Timber Volume - Jengka Forest Reserve
(Mean gross volume in cubic feet per acre exclusive of defective trees)

		GROUPED GIRTH CLASSES					
	SPECIES GROUPS	4 - 6 feet	7 - 9 feet	10 feet and over	Total 7 feet & over	Total 4 feet & over	Percentage distribution
HEAVY HARDWOODS							
1 & 4	Merbau, Balau Sengkawang & Giam	33.7	38.4	16.7	55.1	88.8	3.5
2	Other Heavy Hardwoods	35.8	15.2	5.5	20.7	56.5	2.3
	Total	69.5	53.6	22.2	75.8	145.3	5.8
MEDIUM HARDWOODS							
5	Kempas	69.5	85.2	36.8	122.0	191.5	7.6
6	Keruing	116.2	163.5	113.3	276.8	393.0	15.7
7	Mengkulang	25.0	23.9	3.0	26.9	51.9	2.1
8 & 9	Kelat and Other Medium Hardwoods	359.3	86.7	84.6	171.3	530.6	21.1
	Total	570.0	359.3	237.7	597.0	1167.0	46.5
LIGHT HARDWOODS							
10 & 11	Bintangor, Durian and Punggai	10.2	4.9	2.8	7.7	17.9	0.7
12	Jelutong	12.6	9.9	24.8	34.7	47.3	1.9
13 - 18	Red Meranti	224.1	178.0	82.2	260.2	484.3	19.3
19 & 20	White Meranti and Mersawa	19.6	11.2	12.9	24.1	43.7	1.7
21	Yellow Meranti	12.8	12.6	12.4	25.0	37.8	1.5
22	Nyatoh	27.3	9.4	2.6	12.0	39.3	1.6
23	Sepetir	13.3	9.0	4.2	13.2	26.5	1.1
24 - 26	Other Light Hardwoods	406.5	79.0	13.4	92.4	498.9	19.9
	Total	726.4	314.0	155.3	469.3	1195.7	47.7
	Total All Groups	1365.9	726.92	415.2	1142.1	2508.0	100.0

Figure 5 - 2
Distribution of Stand - Jengka Triangle

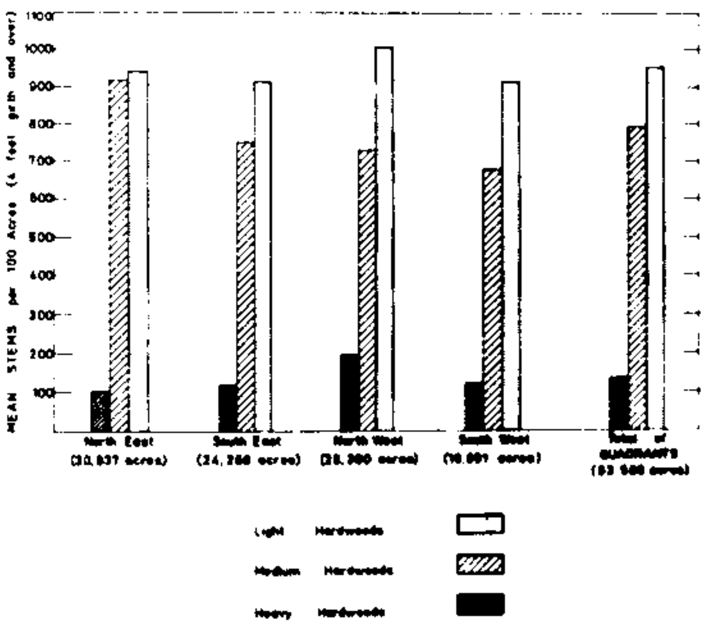
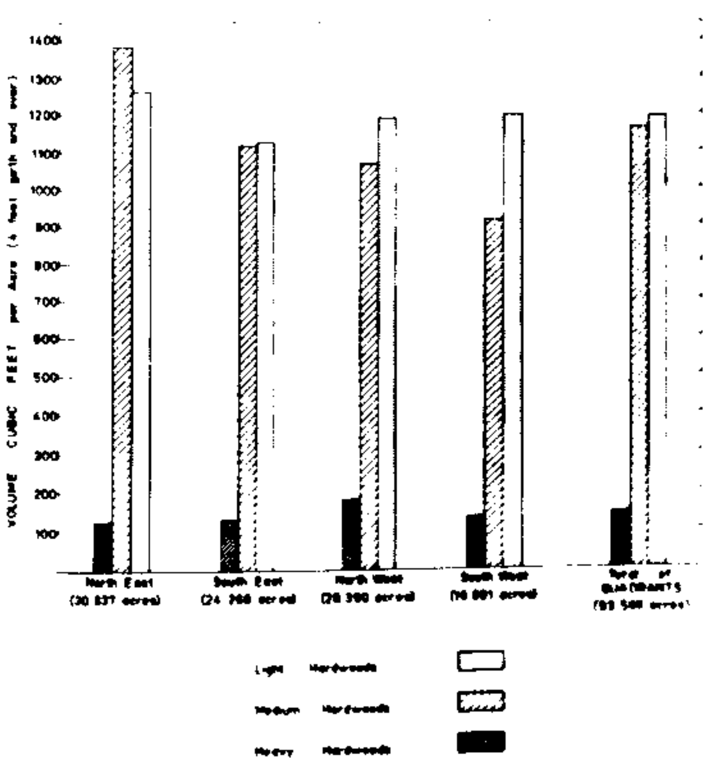


Figure 5 - 3
Distribution of Volume - Jengka Triangle



Form Class Distribution

An indication of the quality of logs that can be expected is given in the summary of inventory results by form classes and girths (Table 5-4). Over half the logs are expected to fall in the highest classes (A and B), although not all of these logs would necessarily be suitable for peeling since the Heavy Hardwoods, most of the Medium Hardwoods and some of the Light Hardwoods, may not be considered suitable for peeling by the trade.

Table 5-4
Form Class Distribution - Jengka Forest Reserve
(Number of Trees Recorded)

	Heavy Hardwoods				Medium Hardwoods				Light Hardwoods					
Form Class	4-6 feet	7-9 feet	10 and over	Total	4-6 feet	7-9 feet	10 and over	Total	4-6 feet	7-9 feet	10 and over	Total	Grand Total	Percentage distribution
A & B	967	266	47	1280	4004	1293	429	5726	5560	1155	285	7000	14006	56.2
C & D	388	69	14	471	3410	361	98	3869	4089	383	55	4527	8867	35.6
E	26	6	-	32	343	34	6	383	463	33	6	502	917	3.7
F	65	26	8	99	436	79	17	532	354	82	45	481	1112	4.5
Total	1446	367	69	1882	8193	1767	550	10510	10466	1653	391	12510	24902	100.0

Percentage Composition of Groups by Species

The percentage composition of species that make up each group or combination of groups is shown in Appendix 5-5.

Statistical Results – Jengka Inventory

A note on the statistical results of the inventory data analysis by Dr. H.C. Dawkins of the Commonwealth Forestry Institute is given in Appendix 5-6. As expected, sampling errors were inversely proportional to the regularity or otherwise of species occurrence. Over the area as a whole, populations down to as low as 0.3 stems per acre have been estimated within a 20 per cent error. This is considered to be satisfactory in inventory work of this kind.

FOREST INVENTORY – TEKAM FOREST RESERVE

The acreage of undisturbed forest covered by the inventory of part of the Tekam Forest Reserve was approximately 30,700 acres.

Stand Tables and Distribution

The mean number of trees per 100 acres for the area as a whole is shown in Table 5-5, in a form similar to that of Table 5-2 for the

Table 5-5
Stand Table - Tekam Forest Reserve
(Mean number of trees per 100 acres exclusive of defective trees)

		GROUPED GIRTH CLASSES					
	SPECIES GROUPS	4 - 6 feet	7 - 9 feet	10 feet and over	Total 7 feet & over	Total 4 feet & over	Percentage distribution
HEAVY HARDWOODS							
1 & 4	Merbau, Balau Sengkawang & Giam	17.0	10.7	3.2	13.9	30.9	1.8
2	Other Heavy Hardwoods	56.5	7.3	Nil	7.3	63.8	3.8
	Total	73.5	18.0	3.2	21.2	94.7	5.6
MEDIUM HARDWOODS							
5	Kempas	41.9	30.5	3.4	33.9	75.8	4.5
6	Keruing	55.7	32.5	5.6	38.1	93.8	5.6
7	Mengkulang	17.9	4.4	0.5	4.9	22.8	1.3
8 & 9	Kelat and other Medium Hardwoods	466.8	34.7	17.7	52.4	519.2	30.8
	Total	582.3	102.1	27.2	129.3	711.6	42.2
LIGHT HARDWOODS							
10 & 11	Bintangor, Durian and Punggai	8.7	1.0	Nil	1.0	9.7	0.6
12	Jelutong	21.1	9.7	4.1	13.8	34.9	2.1
13 - 18	Red Meranti	164.6	72.0	18.4	90.4	255.0	15.1
19 & 20	White Meranti & Mersawa	28.1	10.9	2.4	13.3	41.4	2.4
21	Yellow Meranti	12.1	7.3	4.6	11.9	24.0	1.4
22	Nyatoh	25.7	2.7	0.5	3.2	28.9	1.7
23	Sepetir	6.8	2.9	1.2	4.1	10.9	0.6
24 - 26	Other Light Hardwoods	446.0	29.1	2.2	31.3	477.3	28.3
	Total	713.1	135.6	33.4	169.0	882.1	52.2
	Total All Groups	1368.9	255.7	63.8	319.5	1688.4	100.0

Jengka area. The total stand is approximately 1,688 trees per 100 acres, or about 10 per cent less than for Jengka.

Heavy Hardwoods account for 5.6 per cent of the total, Medium Hardwoods 42.2 per cent and Light Hardwoods 52.2 per cent. This distribution is roughly similar to the comparable figures for the Jengka Reserve.

No trees of Chengal in group 3 or Seraya in group 17 were recorded.

Heavy Hardwood stands of more than 100 trees per 100 acres are to be found in six blocks with the highest at 155 trees per 100 acres in block 44 and the lowest at 60 per 100 acres in block 37. In the Medium Hardwood class, four blocks each carry more than 800 trees per 100 acres, block 41 having the highest at 914 per 100 acres and block 44 the lowest at 476 per 100 acres.

In the Light Hardwood class, five blocks each have more than 900 stems per 100 acres with the highest at 1,138 in block 40 and the lowest at 564 in block 45. (Table 5 - 6). Stand Table details are given in Appendix 5 - 8.

Table 5 - 6
Stand distribution - Tekam Forest Reserve
(exclusive of defective trees)

Block Nos.	Number of stems of 4 feet girth and over per 100 acres			
	Heavy Hardwoods	Medium Hardwoods	Light Hardwoods	Total
36	70	646	884	1600
37	60	639	1016	1715
38	73	714	936	1723
39	103	688	881	1672
40	81	750	1138	1969
41	107	914	765	1786
42	111	864	895	1870
43	75	698	830	1603
44	155	476	932	1563
45	75	543	564	1182
46	93	628	843	1564
47	144	805	735	1684
48	133	844	916	1893
ALL BLOCKS	94	712	882	1688

Volume

The mean gross volume in cubic feet per acre is given in Table 5 - 7. The total overall volume for trees of 4 feet girth and over is 2,254 cubic feet per acre compared with 2,508 cubic feet for the Jengka area. For trees of 7 feet girth and over the figure is 1,016 cubic feet per acre compared with 1,142 cubic feet per acre in Jengka.

The Heavy Hardwoods account for 4.3 per cent of the total volume, Medium Hardwoods 42.4 per cent and Light Hardwoods 53.3 per cent compared with 5.8 per cent, 46.5 per cent and 47.7 per cent respectively in Jengka.

Keruing in the Medium Hardwood group and Red Meranti in the Light Hardwood group together make up 31.1 per cent of the total volume. Further details of volumes are given in Appendix 5 - 9.

Table 5 - 7
Timber Volume - Tekam Forest Reserve
(Mean gross volume in cubic feet per acre exclusive of defective trees)

	SPECIES GROUPS	4 - 6 feet	7 - 9 feet	10 feet and over	Total 7 feet & over	Total 4 feet & over	Percentage distribution
		GROUPED GIRTH CLASSES					
HEAVY HARDWOODS							
1 & 4	Merbau, Balau, Sengkawang and Giam	12.4	19.2	13.6	32.8	45.2	2.0
2	Other Heavy Hardwoods	38.0	13.3	Nil	13.3	51.3	2.3
	Total	50.4	32.5	13.6	46.1	96.5	4.3
MEDIUM HARDWOODS							
5	Kempas	59.4	88.3	18.9	107.2	166.6	7.4
6	Keruing	76.3	94.4	30.3	124.7	201.0	8.9
7	Mengkulang	18.6	11.5	2.3	13.8	32.4	1.5
8 & 9	Kelat and other Medium Hardwoods	370.4	80.6	104.2	184.8	555.2	24.6
	Total	524.7	274.8	155.7	430.5	955.2	42.4
LIGHT HARDWOODS							
10 & 11	Bintangor, Durian and Punggai	6.9	2.0	Nil	2.0	8.9	0.4
12	Jelutong	21.9	26.9	24.4	51.3	73.2	3.2
13 - 18	Red Meranti	205.2	194.0	102.3	296.3	501.5	22.2
19 & 20	White Meranti & Mersawa	27.1	28.4	13.5	41.9	69.0	3.1
21	Yellow Meranti	14.9	20.1	27.1	47.2	62.1	2.8
22	Nyatoh	24.6	6.9	2.2	9.1	33.7	1.5
23	Sepetir	7.6	8.3	7.3	15.6	23.2	1.0
24 - 26	Other Light Hardwoods	354.6	64.5	11.7	76.2	430.8	19.1
	Total	662.8	351.1	188.5	539.6	1202.4	53.3
	Total All Groups	1237.9	658.4	357.8	1016.2	2254.1	100.0

Form Class Distribution

The percentage distribution of stems in form classes is given in Table 5 - 8; Classes A and B together make up 49.5 per cent of the total stand; C and D 41.9 per cent; Class E 4.9 per cent and Class F 3.7 per cent. This distribution is very similar to that of Jengka.

Table 5 - 8
Form Class Distribution - Tekam Forest Reserve
(Number of Trees Recorded)

Form Class	Heavy Hardwoods 4 - 6 feet	7 - 9 feet	10 feet and over	Total	Medium Hardwoods 4 - 6 feet	7 - 9 feet	10 feet and over	Total	Light Hardwoods 4 - 6 feet	7 - 9 feet	10 feet and over	Total	Grand Total	Percentage distribution
A & B	168	48	8	224	942	343	102	1387	1395	447	124	1966	3577	49.5
C & D	128	21	4	153	1327	71	9	1407	1354	104	13	1471	3031	41.9
E	8	4	1	13	134	8	1	143	192	8	1	201	357	4.9
F	9	5	6	20	117	14	1	132	90	20	7	117	269	3.7
Total	313	78	19	410	2520	436	113	3069	3031	579	145	3755	7234	100.0

Percentage Composition of Groups by Species

The percentage composition of species that make up each group or combination of groups is shown in Appendix 5 - 10.

Defect

With the assistance of the Mensuration Department of the Forest Research Institute, Kepong, a study was undertaken to assess the amount of defect in timber due to disease, breakage and excessive knots. The field work was done by two trained Foresters who examined a total of 579 trees of various species, mainly in the Medium and Light Hardwood classes, after felling and cross cutting them into log lengths. The trees were selected at random over a felling block of 2,000 acres in the Jerantut Selantan area of the Triangle. About sixty per cent of the trees were felled in undisturbed forest by the licensee; the remaining forty per cent consisted of residual stems which were selected at random and felled in nearby areas previously logged by the same licensee.

The basic data were processed at the Forest Research Institute and yielded the figures shown in Table 5 - 9.

These volumes exclude utilisable wood above the first branch, and all stumps. An appreciable but unspecified proportion of the defective volume estimated in this manner is made up of sections, of otherwise sound timber but containing knots, which can be eliminated of utilised in short lengths e.g. in the manufacture of plywood and prefabricated housing components. This would reduce considerably the volume of timber recorded as defective. Further, all trees with varying degrees of visible defect (Form Class F), although recorded, were excluded from volume computations. In an intensive logging operation the less defective stems would doubtless yield a fair volume of merchantable timber.

Table 5 - 9
Estimated Timber Defect

Main Groups	Number of trees	Defective Volume cubic feet	Merchantable volume cubic feet	Total Volume cubic feet	Percentage defect
Heavy Hardwoods	51	3,696	9,449	13,145	28.1
Medium Hardwoods	228	28,550	47,950	76,500	37.3
Light Hardwoods	579	48,283	43,100	91,383	52.8
TOTAL	579	80,529	100,499	181,028	44.5

It is considered therefore that a defect factor of approximately half that given in the "percentage defect" column in Table 5 - 9 would suffice in assessing the net volume of sound timber per acre from both the Jengka and the Tekam areas.

CHAPTER 6
VEGETATION

A summary of the main vegetation types present in the Jengka Triangle is given here to complete the account of the physical environment of the area. Consideration has also been given to soil - vegetation relations, and to potential pasture resources. The information presented was developed during the course of soil survey and forest inventory.

MAIN VEGETATION TYPES

Lowland Dipterocarp forest of the Red Meranti-Keruing type, belonging to the Indo-Malayan formation of the Tropical Evergreen Rain Forest formation-type, covers almost all freely-drained land within the Triangle. The composition of the tree layer has been determined by forest inventory procedures and is reported on separately in detail. Within the shrub layer, thorny palm (rotans) especially *Licuala Spinosa* , *Eugeneissona* sp. and *Dacmonorops* sp. are abundant. Other common plants of the undergrowth are *Pinanga* sp. and *Pandanus* sp.

Small areas on the higher parts of the Jengka Ridge are occupied by the Seraya type of Lowland Dipterocarp forest, characterized by *Shorea Curtisii* Near the crest of the northern part of the Jengka Ridge a society of oak *Quercus* or *Lithocarpus* sp.) was noted.

Semi-swamp areas in valley floors are occupied by freshwater alluvial swamp forest. There is a continuous tree canopy, of approximately the same height as on freely-drained land but somewhat more open. Stilt-roots and vertical breathing roots occur. Areas of permanently-flooded swamp are frequently non-forested. Where undisturbed, the dominants may consist almost exclusively of *Zalacca* sp.; where they have been cultivated at some past date, a sedge-fern association occurs.

Plant Succession

Following clearance of the primary forest a *Paspalum conjugatum* grassland association occurs. If there is no further disturbance this reverts via secondary forest (belukar) towards primary forest. If frequently burned, it is replaced by an *Imperata cylindrica* (lalang) grassland association. If grazed, an *Axonopus Compressus –Chrysopogon aciculatas* grassland association occurs.

SOIL VEGETATION RELATIONS

In the course of soil survey, no consistent correlations between soil series and the composition of the tree layers were observed. It is possible that statistical analysis might reveal correlations; the source material for such analysis is available in the forest inventory enumeration books and the soil survey traverse sheets for corresponding rentis lines.

A relation between soils and the forest undergrowth was noted. On the Segamat and Munchong series the undergrowth contains large numbers of young tree seedlings, one to five feet high, but relatively few rotans. In contrast, on the Durian, Serdang and Kedah series, rotans, especially *Licuala Spinosa* , are very abundant, and there are fewer tree seedlings. A sample count on areas of 200 square yards showed 21 Licuala and 23 other rotans on Durian soil, compared with one Licuala and five other rotans on Segamat soil. The probable interpretation is in terms of light availability at ground level. Rotans are moderately light-demanding plants; they will be more abundant either where the canopy is less dense, or where openings in the canopy, caused by destruction of trees by wind blow, occur more frequently. This will be the case both on sandy soils, such as Serdang, and on shallower soils, such as Durian and Kedah, as compared with the deep clay profiles of Segamat and Muchong. This relation has been found elsewhere in Malaya.

POTENTIAL PASTURE RESOURCES

In villages on the fringes of the triangle, water buffalo are kept. Land is not specifically set aside for this; they graze fallow ricefields, roadside verges and village clearings. Despite the limited acreages available they appear well-fed.

Collections of grasses, sedges and legumes have been made (Appendix 6-1). Five grassland communities have been recognised: a forest clearing association; a forest fringe association, in which *Paspalum conjugatum* is common; a fire subclimax association, dominated by I *Imperata cylindrica* (lalang); a fallow ricefield association; and a village clearing and roadside association in which *Chrysopogon aciculatas*, *Axonopus Compressus* , and *Desmodium triflorum* im are common. Grasses do not occur under forest, Within the Triangle, 42 grass species have been collected, of which 15 are considered to have good palatability. The sedges occur mainly in swamps; 23 species have been found, mainly of low palatability. Excluding cultivated legumes, 21 leguminous species have been collected, of which only 7 seem to be unpalatable.

The pasture resources within the Triangle appear promising: grasses grow well if forest regeneration is controlled, and a good variety of palatable species already occur. Forest regeneration should be controlled on improved grassland by intensive grazing or by cutting, and not by burning.

CHAPTER 7
WATER RESOURCES

Relevant hydrologic data on the surface and ground water resources of the Jengka Triangle have been assembled and assessed in relation to agricultural development and water supply. Soil infiltration rates and soil moisture deficiencies have also been considered.

STREAM DISCHARGES

The major streams of the Jengka Triangle are the Jengka, Jempol and Tekam, each having catchment areas of 200 square miles or more (Figure 7-1). The Sungai Pahang, one of the largest rivers in Malaya, which borders the Triangle on the west, is too far from the proposed villages for development as a water source.

Stage and discharge records were not available for any of the Jengka Triangle streams and it was necessary to derive stream flow data from external sources. Based on comparisons of rainfall patterns, the Jengka Triangle area is climatically similar to Selangor, most of Perak, and western Pahang, and the patterns of stream discharges (partly dependent on rainfall) within the Jengka Triangle will be similar to stream discharges in those areas. Accordingly, estimates of discharges for Jengka Triangle streams were based upon the analysis of 33 streams in Selangor, Perak and western Pahang for which the Drainage and Irrigation Department has maintained many years of stage and discharge records (Appendix 7 - 1).

Annual and Monthly Discharges

Mean annual and monthly discharges of Jengka Triangle streams have been estimated at about 50 per cent of mean annual and mean monthly rainfall (Table 7 - 1). The manner in which the annual rainfall is distributed between evapo-transpiration and total run-off, consisting of stream base flow and surface run-off, is illustrated in Figure 7 - 2.

The surface run-off in the Jengka Triangle is probably almost all derived from rain storms of one inch or more, which occur 30 times in the average year, 10 times in dry years and 50 times in the wet years where the dry and wet years have a statistical probability of occurrence of about one year in ten. The mean run-off from such storms does not exceed about 0.5 inches per storm.

Estimated monthly stream discharges follow a considerably more variable rainfall-discharge relationship than do annual values. This is largely due to evapo-transpiration which is estimated to have a mean value of about four inches per month. Thus heavy monthly rainfall may be utilized in replenishing soil moisture deficiencies caused by evapo-transpiration losses occurring in previous dry months.

Figure 7-1

SURFACE WATER RESOURCES

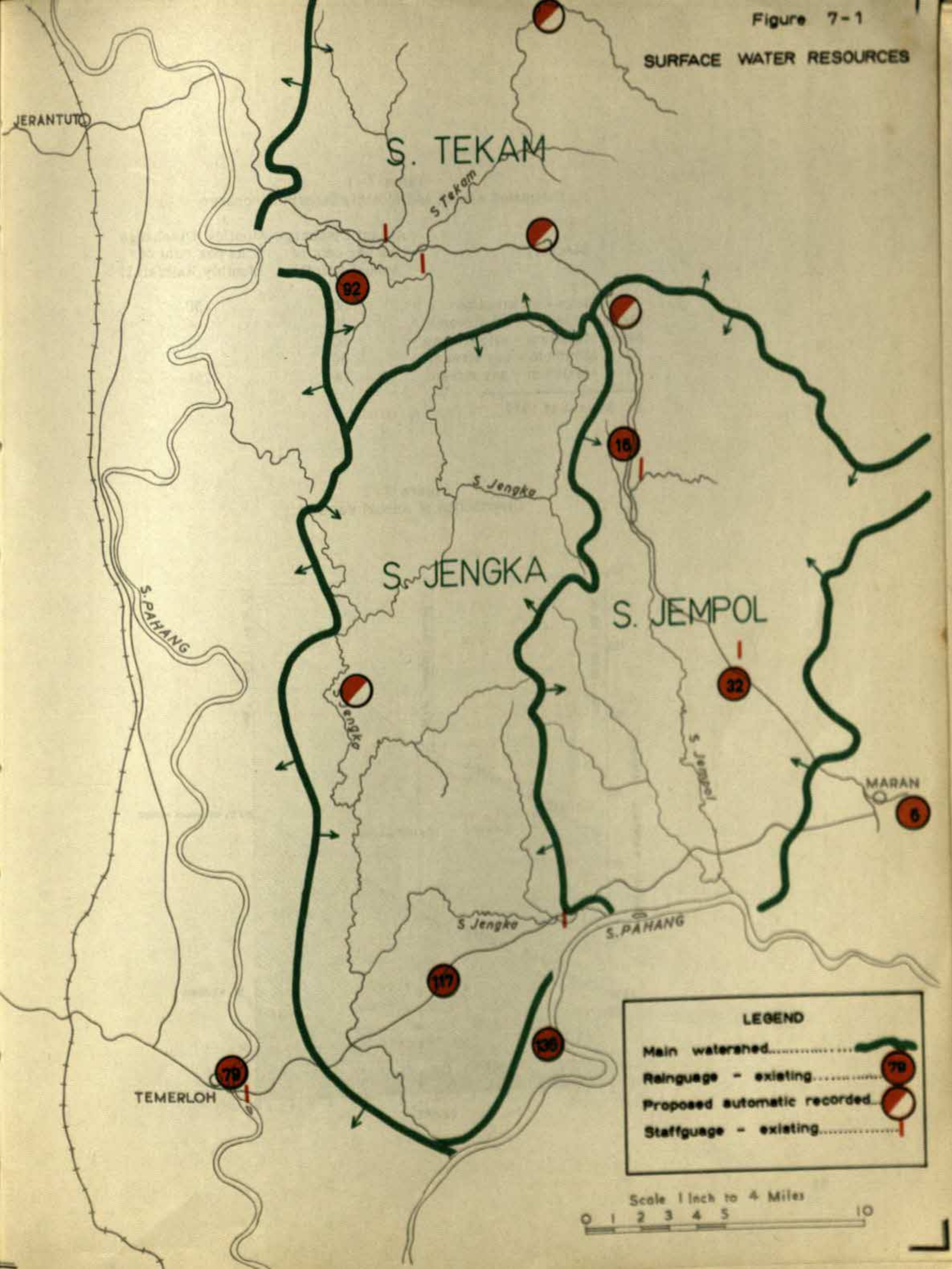
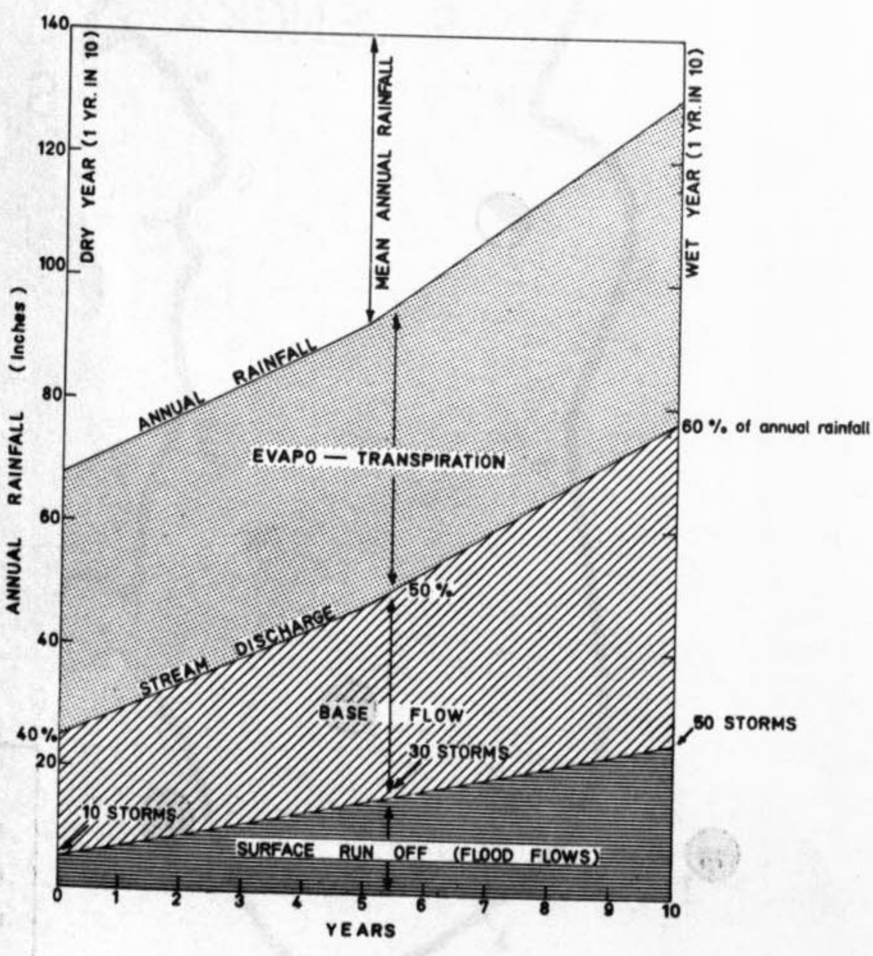


Table 7 - 1
Estimated Annual and Monthly Stream Discharge

Discharge	Annual Discharge as per cent of Annual Rainfall	Monthly Discharge as per cent of Monthly Rainfall 1)
Mean - all streams	50	50
Mean Minimum - all streams	40	-
Mean Maximum - all streams	60	-
Minimum - any stream	30	9
Maximum - any stream	74	265

1) Months of 1939

Figure 7 - 2
Distribution of Annual Rainfall

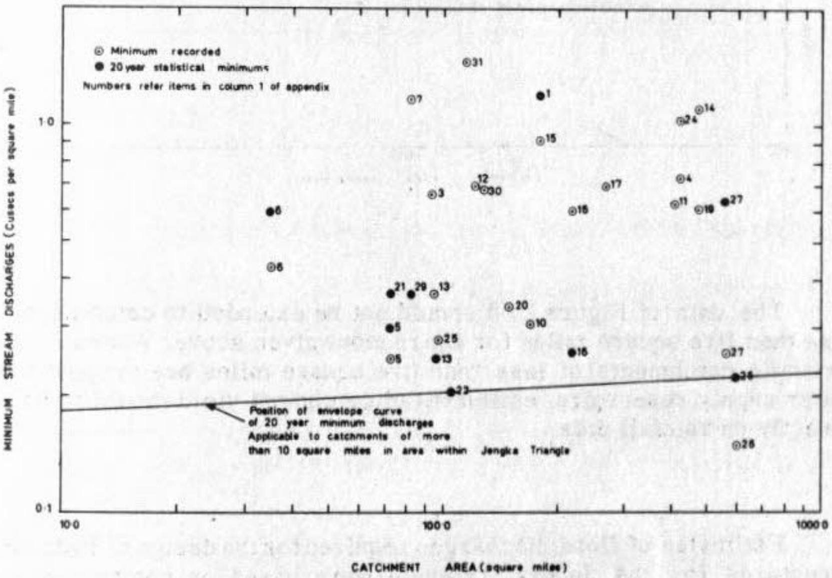


Mean monthly discharge was estimated to be lowest in June July and August, more or less in phase with the rainfall.

Absolute Minimum Stream Discharges

Absolute minimum stream discharges, using 20-year minimum flow frequencies, were estimated to range from about 0.85 cubic feet per second for catchments of five square miles to about 44 cubic feet per second for catchments of 200 square miles. Values of estimated minimum discharges on catchments of varying size are shown in Figure 7 - 3. These values may be used to design run-of-river water supply schemes where no impounding dams are planned.

Figure 7 - 3
Estimated Minimum Discharges

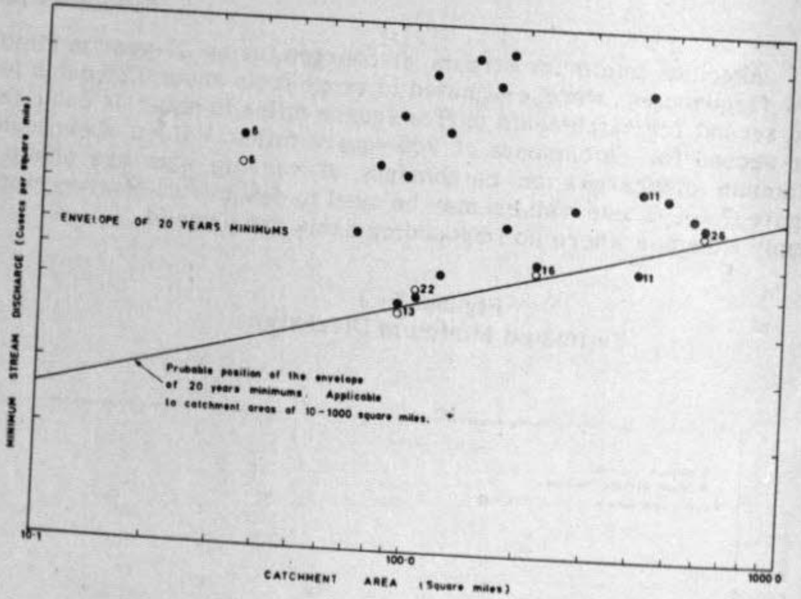


Catchments of less than five square miles cannot be relied upon for village run-of-water supplies in the Triangle because there is a possibility that rain storms of limited areal extent may miss completely catchments of such small sizes, resulting in failure of all stream discharge.

Minimum Mean Monthly Stream Discharges

The probable minimum mean monthly stream discharges in the Jengka Triangle are shown in Figure 7 - 4. These values may be used in the design of water supply systems which incorporate storage of stream flow; they are valid for catchments of 5 - 1000 square miles in area.

Figure 7 - 4
Estimated Minimum Mean Monthly Discharges



The data of Figure 7 - 4 should not be extended to catchments of less than five square miles for the reasons given above. Where Jengka Triangle catchments of less than five square miles are proposed for water supply reservoirs, estimates of catchment yield should be based directly on rainfall data.

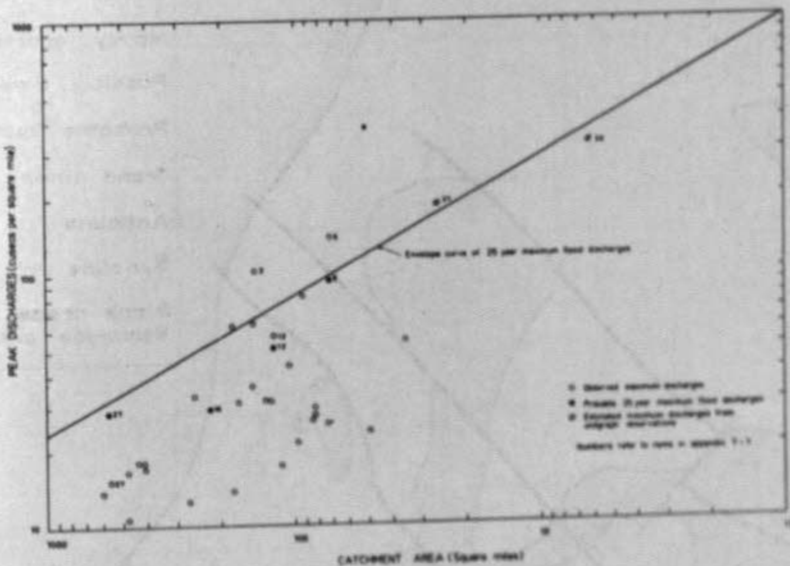
Flood Discharges

Estimates of flood discharges required for the design of hydraulic structures for the Jengka Triangle were based on comparisons of observed flood peaks and catchment areas of external streams (Appendix 7.1), with catchment areas of the streams of the Jengka Triangle. Flood frequency analyses were made for selected external streams having records of high discharges, using 25-year peak flood frequencies. The envelope of the computed 25-year peak discharges has been plotted as a straight line on Figure 7-5 expressing graphically the relationship.

$$Q^{1.85} = \frac{355000}{A}$$

where Q is the peak discharge in cubic feet per second per square mile of catchment, based on a 25-year peak flood probability, and A is the catchment area in square miles. Either the formula or the envelope curve on Figure 7 - 5 can be used to assess design peak flood discharges from catchments in the Jengka Triangle.

Figure 7-5
Estimated Maximum Flood Discharges



For catchment areas of one square mile or less, the expression

$$Q = 960A$$

can be used, where Q is the total discharge in cubic feet per second and A is the catchment area in square miles.

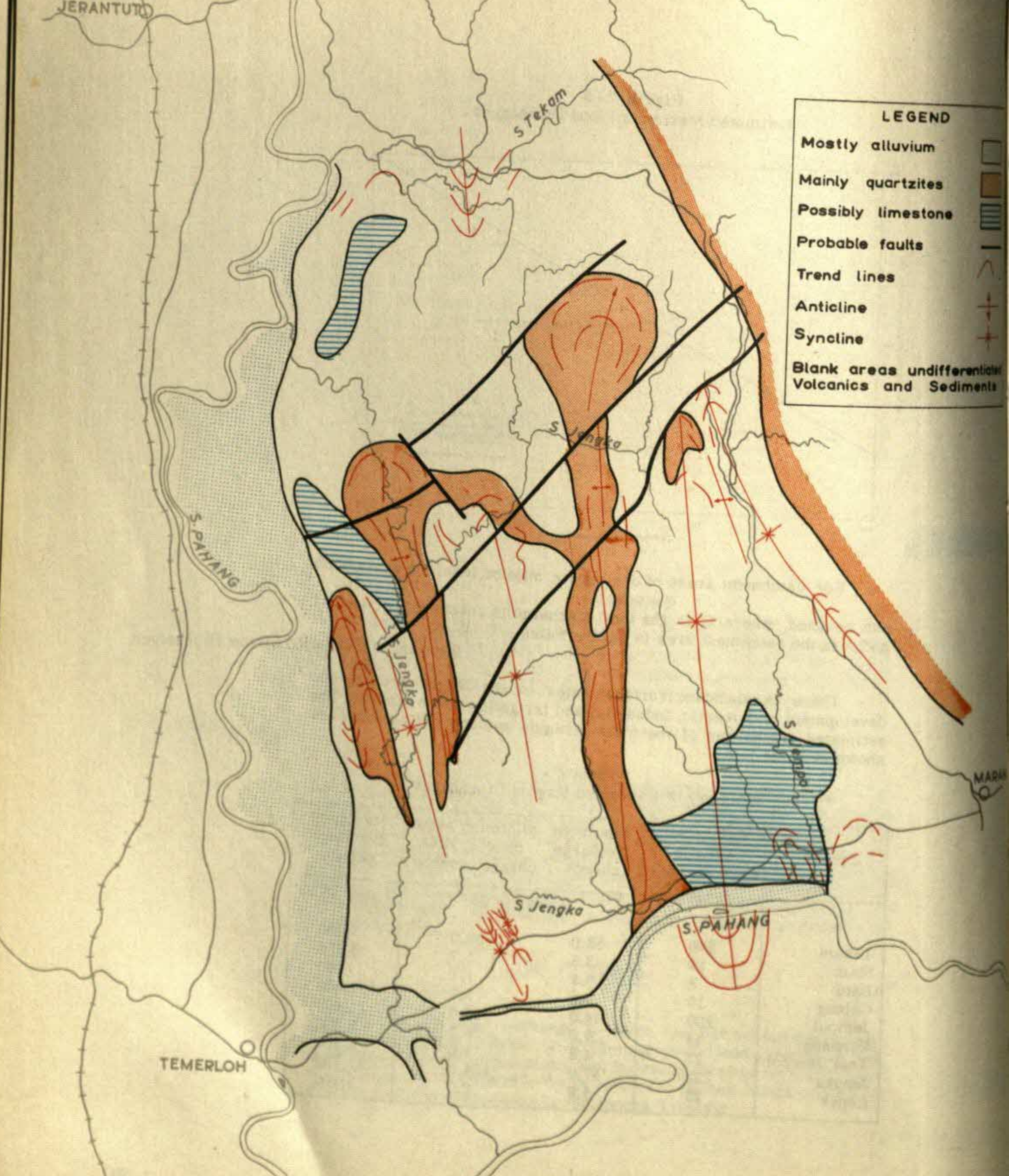
Summary of Estimated Stream Discharges

There is abundant surface water in the Jengka Triangle for development of domestic, industrial and irrigation water supplies. The estimated discharges of the main streams and their tributaries are shown in Table 7-2.

Table 7-2
Summary of Estimated Stream Discharges

Stream	Catchment Area in square miles	Minimum discharge cusecs	Minimum Mean monthly discharge, cusecs	Maximum discharge cusecs
		1 year in 20		1 year in 25
Tekam	270	58.0	160.0	13,000
Siam	19	3.6	5.7	3,800
Batu	5	0.8	1.1	200
Galong	19	3.6	5.7	3,800
Jempol	209	44.0	115.0	11,400
Kundang	44	9.0	16.3	5,800
Anak Jempol	25	4.8	8.0	3,200
Jengka	222	47.0	124.0	11,700
Lopek	25	4.8	8.0	3,200

Figure 7-
PRELIMINARY PHOTO-GEOLOGICAL



Reduced from a preliminary photo-geological map produced by Hunting Geology and Geophysics

Scale 1 Inch to 4 Miles
0 1 2 3 4 5 10

A preliminary assessment of groundwater potential in the Jengka Triangle was made. Based on map analysis, limited field reconnaissance and photo-interpretation it appears that groundwater supplies would be present in useful quantities throughout much of the Jengka Triangle and that more detailed hydrogeological investigations are warranted. It is also estimated that groundwater would be the cheapest and most flexible way of meeting domestic and industrial water requirements, providing it is available near points of consumption in the quality and quantity desired.

A programme of hydrogeological investigation was recommended to FLDA and the initial phase, a preliminary photo-interpretation and report, was undertaken by Hunting Geology and Geophysics, Ltd. (Hunting 1966). The map shown as Figure 7-6 is based on this work. The report identified four photo-geological units having variable potential for groundwater development; its preliminary findings, unchecked in the field, are summarized as follows:

1. Allucial Unit - Abundant groundwater is believed to be present in the alluvial plain bordering the Sungai Pahang. The alluvium should be a good aquifer where the lithology is suitable, possibly affording the highest potential for groundwater development of all areas examined. Several fossil river courses were identified; these should be examined in the field with a view to putting down shallow test bores.

   Most of the area termed alluvial unit is in fact within the two-mile zone along the Sungai Pahang which is not part of the Jengka Triangle development area. The groundwater in the alluvial unit, if proved, could be used for supplies of small existing villages along the Sungai Pahang, and possibly of new settlements on the westernmost edge of the Jengka Triangle.
2. Possible Quartzite Zone - The quartzites occupy the crests of the three major anticlines in the area. They show a relatively higher elevation and have a distinct high density fracture and joint system. Although the outcrop areas are relatively small it is possible that this zone underlies much of the area and, if it contains water, the water could be under pressure.

   Field checking, accompanied by drilling, is essential to prove the quartzites as a potential aquifer, both near the outcrop zone and on the buried flanks of the synclines. Initially drilling locations should be sited with reference to the joint pattern and in areas affected by major faulting.
3. Probable Limestone Unit - The probable occurrence of underlying limestone has been mapped in three widely separated zones on Figure 7-6. The two areas in the west, which include the massive outcrops of Gunong Sinyum and Gunong Jebak Puyoh, appear clearly on existing maps, but the southeastern occurrence needs to be verified. Much of the southeastern unit lies outside the area to be developed as part of the Jengka Triangle; its groundwater supplies, if proved, could be used for supplies of small existing villages in the vicinity and for new settlements on the southeastern edge of the Triangle.
4. Undifferentiated Volcanics and Sediments - Field geological investigations have revealed that much of the area is underlain

by an intimately associated series of mud-stones and impure sandstones, and this has been generally confirmed by the soil survey. In general, the limited evidence available suggests that this unit has a poor groundwater potential and should be given a low priority in future exploration.

The findings summarized above are based on an incomplete study; extensive field checking, additional final photo-interpretation in selected areas, and a programme of exploratory drilling are needed to assess definitively the location and extent of groundwater sources.

WATER QUALITY

Water samples from six of the larger streams of the Jengka Triangle have been tested physically, chemically and biologically. The results of 39 analyses indicate that the surface waters are generally of good quality (Appendix 19-1), although in some streams the following deficiencies may need correction.

1. Turbidity - A range of 14 to 85 ppm was observed. This is 3 to 15 times as high as desirable for domestic use, and also exceeds certain industrial water standards.
2. Colour - A range of 5 to 40 Hazen units was observed, or up to eight times the desirable standard for domestic use.
3. Coliform Bacteria - All streams evidenced unacceptable levels ranging from 250 ppm to "countless" B.COLI (faecal types).
4. Chemical - The iron content (0.4-1.5 ppm) may have to be reduced and the pH range (6.5-9.0) may have to be raised. The total hardness (5-50 ppm) and the dissolved oxygen content (0.5-4.7 ppm) may require correction for industrial use.

Ground water supplies obtained within the Jengka Triangle will undoubtedly be of high physical and bacteriological quality. The chemical quality cannot be predicted since this is largely dependent on the sub-strata from which the water is derived. Based on experience elsewhere in Malaya, however, it is expected that adequate supplies will be located at about 200 feet.

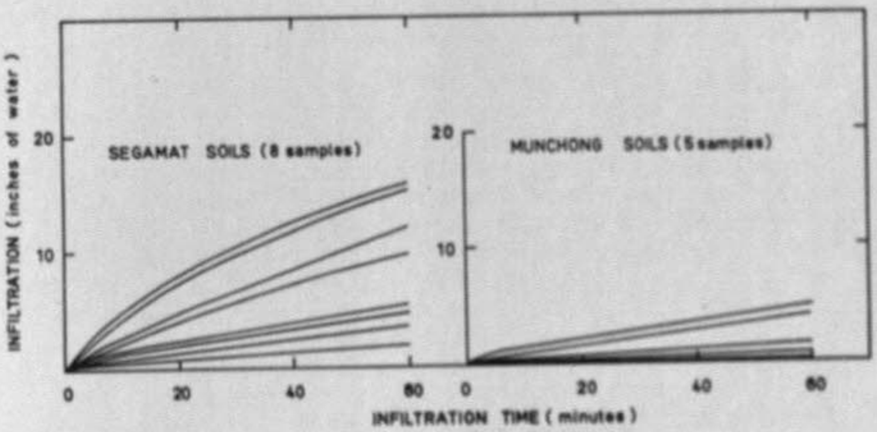
INFILTRATION STUDIES

Preliminary soil infiltration studies were undertaken to provide quantitative data which could be used to determine the rate of recharge and availability of soil moisture to plant growth; to compile water balances, and to investigate certain aspects of flood run-off and drainage. The scope of the preliminary investigations described here has not been great enough to provide conclusive data for the soil parameters treated in the study, but the findings are indicative of the general ranges of infiltration values which may be expected. Typical curves of infiltration rates for two soil series are shown on Figure 7-7.

Infiltration studies of undisturbed soils were carried out on jungle covered areas of the Jengka Triangle; assessments were made on FLDA Ulu Jempol Scheme Phase II and the adjacent Chenor Estate for cultivated soils. Thirty two infiltration tests were made using nine-inch diameter infiltrometers (Appendix 7-2). Fifty samples were tested for soil moisture. Eight samples were tested for capillary, non-capillary and total voids ratios.

It was concluded that most of the soils series investigated may be expected to absorb almost all the rainfrom all but the most violent storms.

Figure 7-7
Infiltration Rates



During the course of the infiltration studies estimates were made of the field capacities of the more important agricultural soils. No definitive studies appear to have been done in this country on this characteristic or on Permanent Wilting Points, but approximations of readily available moisture were made using fifty per cent of the field capacities (Israelsen 1965).

There is appreciable variability of available moisture content between soils. This variation was examined in relation to the rainfall deficit probabilities discussed in Chapter 2, and the general inference drawn that oil palm and rubber are unlikely to suffer from moisture deficiency on Segamat, Munchong and Malacca soils. On the other hand, deficiencies are likely to occur on the Durian, Bungor, Serdang series and on Colluvium. The effect of such deficiencies would depend upon their duration and severity.

From these preliminary studies it is evident that dry periods will occur with sufficient frequency to make their effect felt. The subject of soil, plant and moisture relationships requires considerably more detailed study.

CONTINUING HYDROLOGICAL INVESTIGATION

Additional hydrological investigations will be required to develop further the conclusions of this section, and to provide more precise information for future planning purposes. A network of automatic stream gauging stations, staff gauges and automatic and manual rainfall gauges should be established and arrangements made for continuous collection of data from them for an indefinite period. (Appendix 7-3).

PART 2
DEVELOPMENT PLANNING

CHAPTER 8

PLANNING OBJECTIVES

The physical resources of the Jengka Triangle have been described in Part I of this volume. In order to formulate a comprehensive plan for development it is necessary to examine objectives and to establish an overall aim. Certain basic planning requirements have already been laid down in the Scope of Work (Volume 1 Chapter 1), others have been identified during the study. It is now possible to identify certain overall planning criteria. Both are set out in full at the end of this chapter.

Significance of the Jengka Triangle

Establishment of an overall aim for this Master Plan is of particular significance because of the size of the Triangle enterprise. It will take up a large part of Malaysia's development effort in the public sector. It will also require a substantial share of the public investment in agriculture, which is likely to remain the principal - or at least a very major - field for large scale development for some time.

Large though Jengka is in relation to existing land settlement schemes, it is not only its size which is significant. Though requiring inputs on a large scale and producing similarly large benefits, the Triangle's contribution to the solution of West Malaysia's overall problems in the rural sector will be comparatively small. Jengka will have to be followed by a series of similar projects; and the importance of Jengka therefore lies also in the extent to which it succeeds in setting a satisfactory pattern for future development. With this prospect in view it is particularly important that the Master Plan adopted should conform with national objectives and should so far as possible be related to the needs of the country's economy as a whole, as well as to those of FLDA.

The Aim of the Master Plan

Broadly, the aim must be to plan use of the natural resources of the Triangle in a way that makes the optimum contribution to National development.

The term 'optimum' is used advisedly. Certain resources are scarce in West Malaysia at present and are likely to remain so for some time. These scarce resources are, notably, capital and management skills. Other resources, particularly land and unskilled labour, are more plentiful. It is therefore important that emphasis is placed on the best utilisation of the scarce resources of capital and management. From this, it can be argued that development of the resources of Jengka wholly or largely by private enterprise - on a commercial estate basis so far as land resources are concerned - would make the best use of these scarce resources and possibly provide the maximum economic contribution to National development.

Such an approach, however, would clearly conflict with other national objectives, such as the provision of the largest possible number of employment opportunities. (It is effectively ruled out, in any case, by one of the basic planning requirements listed below: the planning of Jengka as a settlement scheme on a smallholder basis). At present about 60 per cent of the population is employed in the agricultural sector, and disparities of income between occupations in this and the urban sector are considerable. Surveys of rural incomes indicate that up to 44 per cent of rural households may have incomes below M$1,200 per year. With population increasing at the present rate, creation of the maximum number of employment opportunities in the rural sector is clearly desirable, unless alternative employment in urban occupations can be provided much faster than now appears likely. Large-scale smallholder settlement schemes such as Jengka best provide such new rural employment.

If this objective were to over-rule all others, development of Jengka would be planned on the basis of maximum density settlement. This would however conflict seriously with proper use of the scarce resource of capital, and, to a lesser extent, with that of management. It is therefore necessary to modify the employment objective in the interest of optimum use of all resources taken together.

A further stage in this argument would be to consider maximum density settlement (e.g. very small holdings) in the early stages of development, moving to larger holdings in later years. This concept has certain attractions, allowing for the greatest possible number of job opportunities during a period when the pressure may be greatest and providing for larger holdings later which would allow settlers not only higher cash incomes but which would also provide a higher return on capital invested. Its main disadvantages are that the overall return on investment for Jengka would be so low that it could prove very difficult to attract the necessary capital, and that a large body of settlers operating close to subsistence level could be created, a group which would be likely to become very discontented when allocation of larger holdings began.

The concept of an increasing holding size, therefore, has been rejected here in favour of a standard sized larger holding. It is recognised that this would reduce the number of employment opportunities but it would allow for an acceptable standard of living coupled with a reasonable return on capital invested.

Overall Planning Criteria

Overall Planning criteria include:

1. Efficient use of management, especially those categories of management which require great administrative or technical experience.
2. Efficient use of investment funds (capital) bearing in mind their high productivity in other uses.
3. Acquisition of capital and management
   a) by encouragement of private sector savings and invest-

ment in Jengka wherever possible

b) by FLDA, or Government, achieving a cash surplus from Jengka for reinvestment elsewhere

c) by making fullest use of existing management skills of all kinds available in both public and private sectors.

4. Provision of the maximum number of employment opportunities consistent with 1 and 2 above.
5. Provision of an adequate level of cash income to the settler, consistent with the ability to repay in total, and at least the borrowing rate of interest, all investment by FLDA.

Overall Planning Requirements

The basic planning requirement, as already indicated and as set out in the introduction to the Scope of Work is that Jengka should be developed as a settlement scheme. This is fundamental to all planning undertaken.

More specific requirements include:

1. The allocation of the various categories of land in the Triangle having regard to sound land use principles and bearing in mind the aim of the First Malaysia Plan for diversification.
2. Founding the Plan on crops and land use practice of proven performance, but also providing for modification as new knowledge and circumstances develop.
3. The accommodation of settlers in a manner that provides a continuing prospect of a reasonable livelihood.
4. The aggregation of settlers into communities providing for efficient management and satisfactory welfare and utility services.
5. The maximum utilisation of the forest resources, with due regard for expeditious settlement of the land.
6. The division of the Triangle into economically viable project units capable of independent implementation and economic justification.
7. Indication of priorities for implementation of the individual projects comprising overall development of the Triangle.
8. Incorporation of sufficient flexibility in the overall Master Plan and allowance for the later adjustment of priorities (including the possible addition of the Tekam area).

The Master Plan adopted has attempted to integrate the socio-economic considerations discussed above with the proper use of the physical resources of the Triangle in such a way as to provide a pattern of development which is considered to be genuinely optimal in the context both of FLDA and the Nation.

THE ROLE OF PRIVATE ENTERPRISE

Development of the Jengka Triangle is planned basically as a land settlement scheme organised by a public (Government) agency, FLDA.

This concept requires that the main stimulus and investment would come from public rather than private enterprise. Jengka will produce, as its primary products, palm oil and rubber. Private enterprise has so far in West Malaysia provided for almost all the development of these two crops, either on commercial estates or on independent smallholdings. Only recently has the public sector (mainly FLDA) began to make a major contribution. Private enterprise has also provided the means for many other developments in West Malaysia and it does seem to be particularly responsive to investment opportunities. For all these reasons the part which private enterprise could play in the overall development of the Jengka Triangle deserves careful consideration. This section summarises possible roles which are discussed in more detail in the relevant Chapters of Volume II - notably in Chapters 10, 11, 12, 15, and 18.

For basic land development and production of the primary crops, oil palms and rubber, commercial estate-type operation has not been recommended, either by private or public (FLDA) enterprise. Estate-type operation, though undoubtedly efficient and therefore attractive from the point of view of economic return, conflicts with other objectives of development. These include the provision of as large a number of employment opportunities as possible, providing a higher return to labour, and the eventual granting of land titles to settlers.

The last point is obviously inconsistent with estate operation. It is possible, by profit-sharing and other incentive systems, to parallel high returns to labour with efficient estate operation but, particularly in the case of oil palms, smallholder development can provide a greater number of employment opportunities without diminishing returns to labour. This is because the cultivation of oil palms is relatively profitable in relation to labour requirements: estates will always use labour as fully as possible, while smallholders can achieve satisfactory incomes from an acreage of crop much below their labour capacity.

Although development of Jengka on a private estate basis has not been considered desirable, and almost certainly never will be in the case of oil palms, the situation with rubber is somewhat different. On a 10-acre holding, a size which is necessary to allow the settler an adequate cash income while still able to repay all costs to FLDA (Chapter 13), the settler's labour capacity is very fully utilised. Except for the advantage of land title, a man working as hired labour on a rubber estate need not necessarily be worse off financially than a smallholder (and might even do better), and the number of employment opportunities provided might not be very different. This subject is referred to at the end of this section in connexion with future FLDA policy in relation to private enterprise.

The opportunities for participation of private enterprise in Jengka that are considered worthwhile and desirable are summarised briefly below. They can be conveniently divided into three groups which are not necessarily, in practice, separable:

1. Capital Investment - Capital investment by private sources should obviously be encouraged wherever appropriate. The major opportunity is in the proposed forest industry complex, with other opportunities in the commercial and industrial development of the proposed new towns. Investment in planting is not considered here, at least for the immediate future and for reasons already given. Private investment in palm oil or rubber factory building and operation would not be attractive without a guaranteed minimum economic throughput - either from owned land or other means - and it is not possible to satisfy this condition on a project which is essentially a settlement scheme. Private enterprise capital might be attracted, in this connexion, if the Govern-

ment (and perhaps the Commonwealth Development Corporation also, as in the Kenya Tea Authority) took up a share and if private enterprise were responsible, under an agreement with FLDA, for management and operation.

2. Construction and provision of services by contract - There is a very considerable field for private enterprise in construction and in the provision of various services. Many opportunities develop early; logging clearly comes first, followed by, but also continuing alongside, such operations as land clearance, planting road construction, assembly of houses and offices, and a range of other development activities. All these operations are currently undertaken by private contractors.

Further early opportunities will be the provision of equipment and constructions of palm oil processing mills and rubber factories, as discussed in Chapter 15. A similar, individually larger, opportunity will be provided by the timber industry complex (Chapter 10). Concurrently with these, other opportunities will develop in connexion with produce haulage, both from farm to factory and from factory to disposal site. The role of private enterprise in the transportation field is discussed in Chapter 17.

3. Agency Services - There are several ways in which private enterprise could contribute to development through the usual services offered by existing estate agency organisations and through new services which may be obtainable for Jengka.

First, training of technical field staff and factory operating staff is likely to be a critical factor in development. The crucial importance of efficient operation in , for example, palm oil mills is emphasised in Chapter 15. Private enterprise may be able to undertake the training of certain categories of technical staff on a fee basis.

Second, it will be of great benefit to FLDA to be able to draw on existing research information for oil palms. Almost all oil palm research in Malaysia has so far been undertaken by the agency houses. Access to their output could be made available to FLDA on an annual fee basis until such time as FLDA through its own experimental unit may join the existing research consultative group of agency houses on which other research interests are also represented.

A third service which could be provided concerns planting material for oil palms. Only the best material currently available should be used in Jengka, and this can at present only be procured from agency houses. A great deal of material will be needed: annual agreements to provide forecast requirements would certainly be advisable and probably acceptable to the agencies.

Finally there is the question of market research. Agency houses operate their own intelligence service, which FLDA can hardly expect to match for some time to come. Such information could again probably be obtained on a fee basis.

Future FLDA Policy in Relation to Private Enterprise

Reference has been made, earlier in this section, to the possible role of private enterprise on rubber land in Jengka. This idea would become both more feasible and more attractive were the Tekam area, with its predominance of oil palm land, incorporated in Triangle development The suggestion that, in this case, the rubber lands of Projects V and VI could be allocated to private enterprise has been put forward in Chapter 15. This suggestion leads to a further consideration:

whether or not FLDA should consider, as a matter of policy, the deliberate incorporation of areas allocated to private enterprise in future large projects. Once the basic infrastructure is provided in large new areas private development, either by independent smallholder or estates, could quite naturally develop if permitted or encouraged. With FLDA's role as a land manager likely to become so large in the future, and the demand for investment capital so high, such developments appear worthy of serious consideration.

CHAPTER 9
LAND CAPABILITY

LAND CLASSIFICATION

Classes

The land classification adopted for the Jengka Triangle provides a basis for planning future land use and for recommending specific land use for individual crops or crop systems.

It has been based on the recently introduced Land Capability Classification for the States of Malaya. The latter defines five classes of land which accomodate certain uses of particular significance to West Malaysia, as for example mining. It is essentially a modification of the eight-class system developed by the United States Department of Agriculture, and is quoted below:

"Class I — Land possessing a high potential for mineral development and therefore best suited to mining.

Class II — Land possessing a high potential for agricultural development with a wide range of crops and therefore best suited to diversification agriculture.

Class III — Land possessing a moderate potential for agricultural development with a restricted range of crops and therefore best suited to agricultural development with crops having a wide range of soil tolerance.

Class IV — Land possessing a potential for productive forest development and therefore best suited to commercial timber exploitation.

Class V — Land possessing little or no mineral, agricultural, or forest development potential but suitable for development as protective reserves for conservation, water catchment, game, aborigine, recreation, or similar purpose, or possibly suitable in the future for productive forest plantations with introduced species."

Some specific considerations relevant to the planning of development in the Jengka Triangle have required some modification of this system, which, as it stands, relates more to the needs of overall regional planning and assessment of development priorities than to the more detailed stage of planning with which this report is concerned.

The modifications introduced are of two kinds. The first solely to the additional precision needed for the more detailed planning stage now undertaken. The main classes described above are very broad. Some subdivision has been introduced in the better land classes where agricultural development is proposed: five in Class II and two in Class III, the main factors being degree of slope, soil texture and effective depth.

The second modification relates to the two alluvial soil series Akob and Telemong. Both soils, especially Akob, are considered to have high potential for agricultural crops, but they are at present subject to waterlogging or periodic flooding. If drained, these soils would be suitable for oil palm. They occupy quite extensive areas of land, about 21,500 acres in all, and therefore warranted special consideration. It is an important principle in land classification that the limitations in any one class should be of the same order, though possibly varying in kind. The additional drainage limitation for these valley lands clearly constitutes a limitation of a different order, and they should therefore be downgraded. This would place them in Class III, defined as land possessing only a moderate potential for agricultural development. A new Class would properly be required, but in order to avoid confusion with the existing classification, a division of Class II, in which all land of high potential is placed, has been adopted.

This division, designated Class IIW, is defined as follows:

Class IIW Land possessing a high potential for agricultural development with a wide range of crops and therefore best suited to diversification agriculture, provided that it is drained.

The Jengka Triangle contains little or no land suitable for mineral development and hence no Class I lands. The land classes used therefore are Class II, Class IIW, Class III, Class IV and Class V.

Subclasses

In addition to the basic classes, five subclasses of Class II, which contains the best agricultural land, have been introduced in order to define more precisely limitations of significance to agricultural development. They are:

Subclass IIa No limitations whatever, and if sound farming methods are employed there are no erosion hazards.

The remaining subclasses of Class II (b, c, d, e) are distinguished by varying slopes and soil textures. Effective soil depth and drainage (permeability) are generally the same.

Subclass IIb Steeper permissible slope than Class IIa, up to 6°, and fairly heavy textured soils. Erosion may occur and adequate control measures will be required for annual crops for which topography is a limitation. Such measures would not necessarily be required for perennial crops.

Subclass IIc Heavier textured soils on even steeper slopes up to 12° Occasional laterite may occur. For reasons of slope the class becomes marginal for extensive cultivation of annual crops, but remains suitable for tree crops.

Subclass IId Areas in which lighter surface soil overlying heavier textured subsoil occurs on less steep slopes up to 6°. The surface soil will tend to dry out, although the subsoil will have a higher water retention. Occasional laterite may occur. In combination these conditions are regarded as fair for the cultivation of all crops although the erosion hazards will be greater than in Class IIb, where surface soil textures are heavier.

Subclass IIe Fairly heavy textured soils on steeper slopes up to 12°. Occasional laterite may be present. These conditions will be fair for perennial crops. Erosion control will be necessary, particularly if annual crops are planted.

Two subclasses of Class III have also been used; both have a main requirement of at least 20 inches of soil.

Subclass IIIa Slightly less favourable permeability, more laterite and wetness for more frequent periods. This class becomes marginal for most crops although fair for rubber and, because slope limitation is extended to 18.5°, is regarded as unsuitable for annual crops.

Subclass IIIb Areas in which shallowness and light texture of soil occur on slopes of up to 12° . These lands are, at best, marginal for agricultural crops and in certain cases may be unsuitable.

Class IIIa lands include the poorer soils such as Malacca, Batu Anam, Durian and Serdang, complexes in which they occur, and land with slopes over 12° but less than 18.5° . This class is considered marginal for oil palms but suitable for rubber. These lands are generally assigned to rubber except where their combined characteristics are well above the average of the class.

Class IIIb includes mainly Kuala Brang and the poor Colluvium in the south east corner of the Triangle. These lands are considered marginal for rubber and therefore best left under forest for the time being until there is sufficient evidence that rubber can be produced economically under these conditions.

The two remaining Classes are unsuitable for agricultural crops. Class IV lands are suited to productive natural or plantation forests. Class V lands are considered unsuitable for any productive use at present and should be left under natural forest. In some instances they should be declared protected areas for reasons of scientific interest or for worship. The limestone outcrops and the Gunong Sinyum range are of particular interest in these respects. Furthermore, certain areas dedicated to forest should be declared protected areas to ensure that catchments, and therefore water supplies, are preserved. Generally these areas coincide with Class IV and Class V categories, but in certain instances Class IIIa and Class IIIb land has been recommended for forestry for this particular reason.

Criteria used in land classes

The main criteria used in assigning land to the six basic classes and seven subclasses established are topography (slope); soil texture; effective depth of soil, in which account has been taken of limiting material; soil permeability; the presence of laterite, and wetness. The ranges of values of each of these criteria are summarized in Table 9 - 1, and are discussed below.

1. Topography. The slope class terminology of the Malayan Soil Survey Manual has been used. This provides for a range of slopes from C-1 (Flat: 0-2 degrees) to C-4 (Steep: 0-18.5 degrees) for agricultural land. Because topography is so variable over short distances in Jengka the classes applicable to complex slopes have been preferred. The slope factor is important because of erosion hazards and soil conservation needs.
2. Soil Texture. Textures have been defined for the surface and upper subsoil (A & B horizons) and for the lower subsoil (B horizon). They range from clay loam to loamy sand in the former and from clay loam to sandy loam in the lower subsoil. Characteristics of the substratum (C horizon) have also been defined. Structure and consistency have been appraised in view of their effect upon erodibility, soil management and water-

holding capacity, which is closely allied to permeability. Variations in these factors occur in both surface soil and subsoil, and their relationship may be important both in a general capability assessment and more particularly in the choice of of suitable crops. The nature of the B horizon is particularly important for tree crops in view of their deeper rooting habit.

3. Effective Depth. The effective depth of soil is assumed to be that depth of soil which can provide a medium for normal root development. In most cases it is the depth at which gravel, laterite, parent rock or other unconformable rock commences, or at which soil conditions occur which are unfavourable to downward root development. In the land class system three depths have been used; 60 inches or more; 36 inches or more; and 20 inches or more.
4. Drainage. Three conditions of drainage have been applied to Jengka; Free, Imperfect and Impeded. Free drainage includes Rapid (6), Good (5) or Slightly Restricted (4) permeability. Imperfect drainage includes Moderately Restricted (3) permeability, and Impeded drainage includes Severely Restricted (2) or very slowly permeable conditions.
5. Laterite. Lateritic horizons may occur in two forms, the first (L_1) as occasional thin open bands of uncemented nodular materials and the second (l_2) as frequent, dense thick layers of fragmentary laterite.
6. Wetness. A wetness factor is defined in terms of waterlogging. This may be for relatively short periods (W_1) for considerable periods (W_2) or for most of the year (W_3).

A general land classification of this kind depends for its reliability on the accuracy of the base data. The land classes established are sufficiently reliable for designing the Outline Master Plan and for project planning within it.

Main limitations of Soil Series

Particular limitations of the soil series found in the Jengka Triangle are as follows:

Segamat	A slight depth limitation may occur. The ascribed class is determined by slope. The series usually falls into Class IIb or IIc, but may be downgraded on hilly or steep land.
Munchong	A slight depth limitation may occur. Laterite is sometimes present at 24 inches depth or more; consequently this series usually falls into Class IIc.
Durian	A depth limitation frequently occurs when weathered rock is found at about 30 inches. Drainage may be impeded and a thin band of concretionary laterite may be present. Usually this series falls into Class IIIa.
Batu Anam	Lack of depth, with weathered rock appearing at 24 inches, and impeded drainage are frequent limitations. This soil falls into Class IIIa.
Malacca	Lack of depth and presence of a thick band of laterite are characteristic limitations. Class IIIa is usually ascribed to this soil which may however be downgraded further.

Tavy	Lack of depth sometimes occurs in this series. Non-cemented laterite is present, but in thinner bands than found in Malacca series. May fall into Class IIe, but is usually downgraded to Class IIIa by shallowness and slope.
Bungor	Minor limitations comprising lightness of texture in the topsoil and slightly impeded drainage at depth may be found. On rolling terrain this series falls into Class IId, or Class IIIa on steeper land.
Serdang	Light texture in the surface soil and sometimes in the subsoil is a minor limitation. There may also be a depth limitation. Steepness of slope combined with these factors frequently relegates this series to Class IIIa.
Kuala Brang	Light textures and shallowness combined with slope limitation usually result in this series falling into Class IIIb or Class IV.
Kedah	Shallowness of soil and steep slopes are severe limitations; consequently this series falls into Class IV and Class V.
Telemong	Texture is a minor limitation, but periodic flooding may be important. This series falls into Class IIW or IId.
Akob	Periodic flooding and waterlogging are primary limitations. Light texture may also be limiting. This series has also been assigned to Class IIW.

Table 9 - 1
Agricultural Land Classes

	CLASS II					CLASS II W	CLASS III		FORESTRY CLASSES	
									CLASS IV	CLASS V
CRITERIA TOPOGRAPHY Slopes	a $0^\circ - 2^\circ$ C_1	b $0^\circ - 6^\circ$ C_2	c $6^\circ - 12^\circ$ C_3	d $0^\circ - 6^\circ$ C_2	e $6^\circ - 12^\circ$ C_3	$0^\circ - 2^\circ$ C_1	a $0^\circ - 18.5^\circ$ $C_1 - C_4$	b $0^\circ - 12^\circ$ $C_1 - C_3$	any $C_1 - C_5$	NO LIMITATIONS
TEXTURE Surface ('A' horizon) Soil ('B' horizon)	CL or heavier	SCL or heavier	CL or heavier	SL or heavier	SCL or heavier	SL or heavier	SL or heavier	LS or heavier	any	
Subsoil ('B' horizon)	CL or heavier	CL or heavier	CL or heavier	SC or heavier	SC or heavier	SCL or heavier	SC or heavier	SL or heavier	any	
Substratum ('C' horizon)	nil	Cm, Cu	Cm, Cu	Cm, Cu	Cm, Cu	Cm, Cu, Cc	Cm, Cu	Cm, Cu	Cm, Cu	
EFFECTIVE DEPTH (inches)	at least 60	at least 36	at least 36	at least 36	at least 36	at least 36	at least 20	at least 20	at least 36	
DRAINAGE [1] Surface ('A' horizon) Soil ('B' horizon)	Free (5)	Free (5)	Free (5)	Free (4, 5, 6)	Free (4, 5)	Free (6, 5, 4)	Free (4, 5, 6)	Free (6, 5, 4)	Free (7, 6, 5, 4)	
Subsoil ('A' horizon)	Free (5)	Free (5, 4)	Free (5, 4)	Free (4, 5, 6)	Free (4, 5)	Free (5, 4)	Free Imperfect (5, 4, 3)	Free (6, 5, 4)	Not worse than Imperfect (3)	
Substratum ('C' horizon)		Imperfect (3)	Imperfect (3)	Imperfect (3)	Imperfect (3)	Imperfect (3) or Impeded (1, 2)	Imperfect (3)	Imperfect (3)	Not worse than Imperfect (3)	
LATERITE	nil	nil	l_1	l_1	l_1	l_1 or l_2 below 20"	l_1 or l_2 below 20"	l_1 or l_2 below 20"	l_1 or l_2	
WETNESS	nil	nil	nil	W_1	W_1	W_1, W_2 or W_3	W_1 or W_2	W_1 or W_2	W_1	

1) Permeability (brackets) according to United States Department of Agriculture criteria

River Alluvium Texture is primarily a limitation for this soil, which normally falls into Class IId, or Class IIW where periodic flooding occurs.

Colluvium . Where occurring on steep terrain these soils fall into Classes IV and V. On hilly terrain however they fall into Class IIIb because of their lack of depth and presence of boulders, gravel or sand. Colluvium (limestone) at the foot of the Gunong Sinyum has only a minor limitation of imperfect drainage at depth and falls into Class IIc.

Soil Complexes . For soil complexes, both soils are considered. Where a soil series in a higher Class is in a complex with another of a lower Class the complex has been downgraded by one step. Conversely, a complex containing a predominance of a lower class series has been upgraded one step.

Land Class Distribution

The distribution of land classes in the Jengka Triangle is highly complex (Figure 9 - 1). In a general sense the eastern half of the area contains better land than the western half; but there are many exceptions to this, the south-eastern corner being a notable example. Land class distribution is summarized in Table 9 - 2.

The better agricultural lands falling into Class II occupy approximately 33.7 per cent of the total area. They lie in north-south belts on either side of the Jengka ridge in the north central area and in smaller belts in the west.

The highest class of agricultural land falls into subclass IIa. It occurs however in very small areas on slope crests and is not mappable at the scale of 1:25,000.

Class IIW comprises 12.4 per cent of the total area. It is widely distributed with extensive areas in the centre and south east and follows the dendritic valley floor pattern seen on the soils and landform maps.

Class III land comprises the greatest proportion of Jengka amounting to 42.3 per cent. It lies in a broad north-south band down through the middle of the Triangle and again on the north west.

Classes IV and V account for approximately 11.6 per cent of land. They include the two main ridge formations which run north-south through the area, the Jengka ridge on the east and another, including the Gunong Sinyum, in the west.

CROP SUITABILITY

Assessment of the suitability of the land for specific crops is a further stage in general land capability classification.

The reliability of an assessment of crop suitability depends not only upon the same factors that influence land classification, but also upon specific data for crop performance. Climatic and physical data afford the means of determining what crops will grow. To decide which crops are likely to yield sufficiently well to justify recommending

Table 9-2
Land Class Distribution

	JENGKA		TEKAM	
	Acreage	Percentage	Acreage	Percentage
I	Not present	-	Not present	-
IIa	Not mappable	-	Not present	-
IIb	444	0.3	8,270	20.5
IIc	35,094	20.5	8,784	21.8
IId	12,648	7.4	615	1.5
IIe	9,354	5.5	2,294	5.7
IIW	21,169	12.4	7,768	19.3
IIIa	68,012	39.7	12,014	29.8
IIIb	4,390	2.6	Not present	-
IV	11,306	6.6	305	0.8
V	8,797	5.0	197	0.6
Total	171,214	100.0	40,247	100.0

their development requires reliable evidence from crops grown in a similar environment.

Adequate local experimental evidence is available upon which to base recommendations for rubber cultivation. Such evidence is not available to the same extent for the oil palm and a more conservative assessment is necessary. This very important crop is recommended for the better lands only at this stage; but fortunately they are extensive in the Triangle. There is evidence both from areas adjacent to Jengka and elsewhere in West Malaysia that the oil palm may yield satisfactorily on some of the poorer soils found in Jengka; but critical information over an adequate period is not yet sufficient to permit unreserved recommendation for their use under this crop. Similar reservations are necessary with a number of other crops.

The crops considered for planting in the Jengka Triangle fall into three main groups; perennial tree crops, short term perennial crops and annual crops. Table 9-3 shows the land capability for each crop in relation to the basic land classes.

In relating the conditions expressed in the land classes to the prospects for specific crop production the terms 'Good', 'Fair' and 'Marginal' have been used. The two former indicate suitability for a particular crop; 'Marginal' is the point at which suitability becomes doubtful. Future research, may show that the present assessment is conservative. Suitability for the oil palm is a case in point.

'Good' land for specific crops may be regarded as that on which these crops can be grown successfully and with potential yield levels in excess of those projected. There are no serious limitations in the establishment of them nor at any other stage of development.

The term 'Fair' indicates that the land can achieve projected levels of yield; but certain hazards or limitations reduce its suitability. These can be overcome to some extent, but variations in growth and yield are likely to occur, particularly under adverse circumstances of weather or management.

Table 9 - 3
Land Capability Related to Land Classes

		Class II					Class IIW	Class III	
		a	b	c	d	e		a	b
Perennial Tree Crops	Oil Palm	G	G	G	F	F	G	M	X
	Rubber	G	G	G	F	F	F	F	F
	Fruit trees	G	G	G	F	F	G	M	X
Short term Perennial Crops	Bananas	G	G	F	F	F	G	M	X
	Manila Hemp	G	G	F	F	F	G	M	X
Annual Crops	Cassava	G	F	M	F	M	G	X	X
	Vegetables	G	F	M	F	M	G	X	X
	Legume Crops	G	F	M	F	M	G	X	X
	Padi	X	X	X	X	X	G	X	X

G - Good
F - Fair
M - Marginal
X - Generally Unsuitable

'Marginal' land has more serious limitations and hazards; consequently levels of crop yields are likely to be more variable or reduced. This does not, however, mean that projected levels of yield may not be attained, but that greater risks are run in using such land for a particular crop and greater care in its management will be necessary. Depending upon economic conditions - and the results of further research - development of this land to the crop indicated for it may be marginal in the sense that yields, or the measures necessary to obtain good yields, may make production uneconomical.

The Classes IIa, IIb, and IIc (Table 9 - 3) include the bulk of the better Segamat and Munchong soils. Areas where these soils occur have been downgraded only where slopes exceed 12° . They can confidently be recommended for oil palms but are of course suitable for a wide range of crops.

Next in suitability are Classes IId and IIe, which include some areas of River Alluvium, Tavy, Bungor, Jempol and some soil complexes. Wherever these land classes occur in sufficiently large areas, the oil palm is again the principal recommendation.

The swamps fall invariably into Class IIW and can generally be drained for oil palms and probably to a lesser extent for rubber. With a controlled water supply Class IIW lands are also suitable for padi. Usually Class IIW lands are recommended for development with oil palms after drainage.

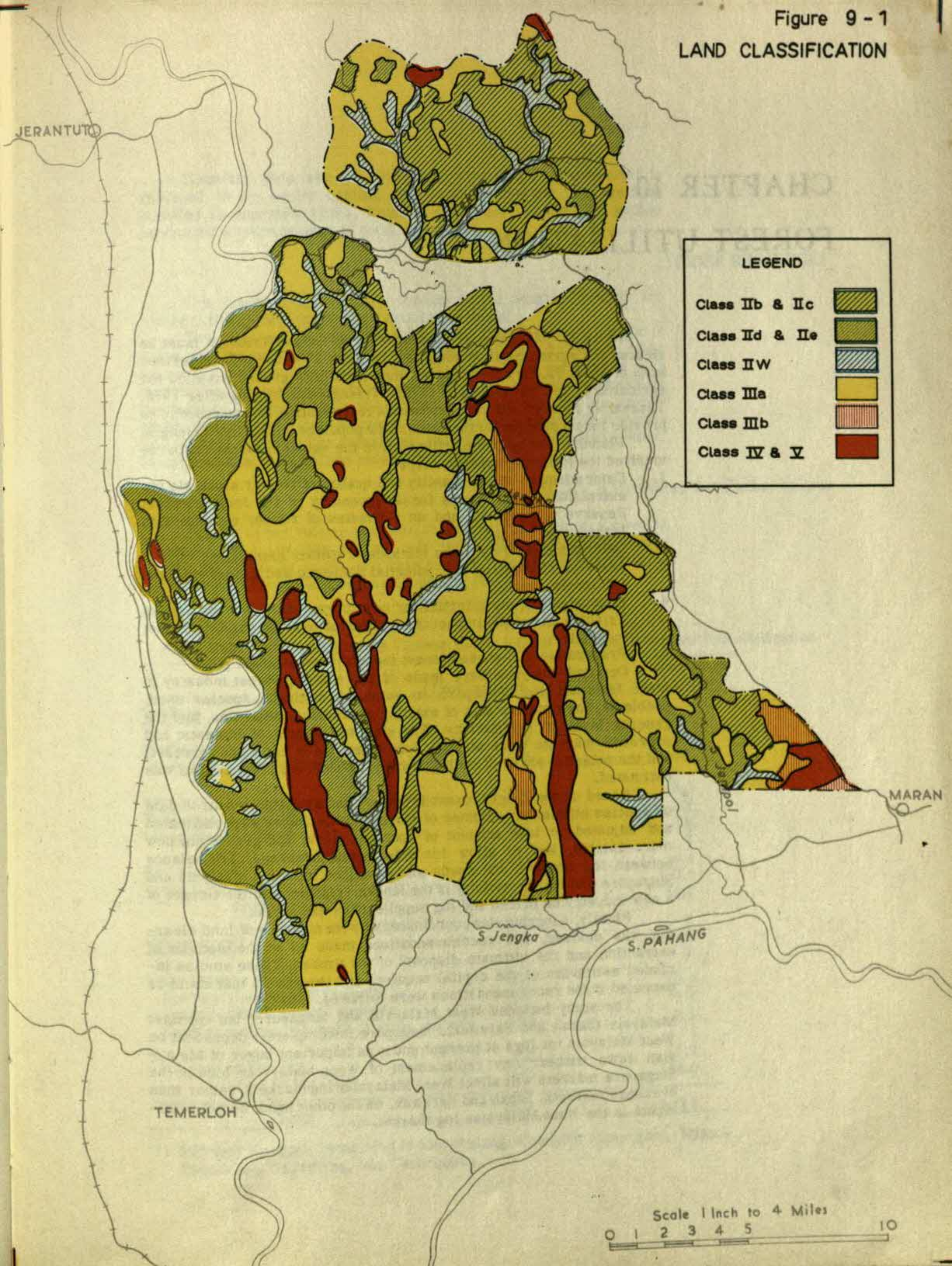


Figure 9 - 1
LAND CLASSIFICATION

CHAPTER 10

FOREST UTILISATION

About 117,000 acres of highforest in the Jengka Triangle must be cleared for agricultural development between 1966 and 1975. A further area of about 52,000 acres of forest mostly on hilly ground unsuited for agriculture, will be available in the Triangle for logging after 1975. Thereafter most of this could be held as regenerative forest reserve to provide forest produce for the needs of the populace within the Triangle.

Planning for optimum utilisation of the valuable forest resource involved the following specific steps:

1. Determination of the quantity and quality of timber available for extraction, based on the forest inventory of the Jengka Forest Reserve (Chapter 5), and on estimates of timber remaining in logged-over areas;
2. Determination of optimum methods of timber extraction;
3. Analysis of existing and potential domestic and export markets for Jengka timber;
4. Assessment of the potential for new forest industry in the Jengka Triangle and of the impact of such new industry on existing forest industries;
5. Preparation of a phased forest industry development plan.

Detailed analyses were made of the existing forest industry in West Malaysia and Singapore to establish methods, species used, problems, log requirements of existing processing industries, and the general level of profitability. The size and nature of domestic and overseas markets were studied, future demand in each was forecast, and the potential share of each that could be supplied from Jengka was estimated.

Based on the Jengka forest inventory and available research data on species utilization, volumes of merchantable timber were estimated and adjusted to take account of species, sizes, and grades not now merchantable, and to allow for defects and breakage. The balance between log supplies and needs was examined for West Malaysia and Singapore and for the vicinity of the Jengka Triangle, and the impact of a new industry on prices and log supplies was estimated.

Finally, a logging plan coordinated with the schedule of land clearing was devised, and recommendations made as to the methods of extraction and the ultimate disposal of the timber. These studies included estimates of the capital required and the profits that could be expected if the recommendations were followed.

The study included West Malaysia and Singapore, but not East Malaysia (Sabah and Sarawak). Singapore is completely dependent on West Malaysia for logs at present and is an important buyer of Malaysian sawn timber. Any replacement of West Malaysian logs in the Singapore markets will affect West Malaysian log markets, rather than overseas markets. Sabah and Sarawak, on the other hand, do not participate in the West Malaysian log market.

Monetary data are in 1966 Malaysian dollars. Investment is assumed to be equity capital, and interest charges have not been included in operating costs. Rates of return are the after-tax profits expressed as percentages of total investment.

TIMBER RESOURCES

The Lowland Dipterocarp forests in the Jengka Triangle are amongst the richest tropical forests in the world.

The total net volume of merchantable timber in the Triangle is estimated to be 3.05 million cubic tons of which 2.27 million cubic tons are in undisturbed forest. The utilisable volume per acre in such undisturbed forest varies from about 20 cubic tons in the southwest quadrant to 24 cubic tons in the northeast. Timber suitable for lumber production is estimated to comprise 1.71 million tons or 56 per cent of the total volume. The remainder, suitable for plywood and veneer, is estimated at 1.34 million cubic tons (Table 10 - 1).

Bases of Estimated Net Timber Volume

Details of net volume per acre in undisturbed forest are given in Appendix 10-1. In this report, only those species which have been peeled successfully in the past have been included in the estimates of volumes for plywood and veneer (Appendix 10-2).

Table 10 - 1

Net Volumes of Merchantable Timber in the Jengka Triangle, Based on Full Utilization

	Net Volume (Thousands of Cubic Tons)	Percentage of total volume
Sawlogs		
Merbau and Balau	124	4.0
Other heavy hardwoods	104	3.4
Keruing	555	18.3
Tualang and Simpoh	177	5.8
Other medium hardwoods	299	9.8
Red Meranti	134	4.4
Other light hardwoods	312	10.3
Sawlog Total	1705	56.0
Veneer logs		
Face veneers		
Species yielding red veneers [1]	579	19.0
Species yielding white veneers	227	7.4
Species yielding veneers of other colours	174	5.7
Core veneer species	363	11.9
Veneer log total	1343	44.0
Total	3048	100.0

1) 80% Red Meranti; remaining is Mengkulang, Kembang Semangkok, Nyatoh, Penarahan, Terentang, and Geronggang.

The forest inventory results are in cubic feet true measure (Chapter 5). After the application of defect and breakage factors a further reduction of 13 per cent was made in order to bring the true cubic volume of merchantable timber to the basis of Malayan Forest Department measure used in this chapter.

why?

Net volume excludes trees below five feet in girth, and trees in form classes E and F (Chapter 5.)

For areas of disturbed forest, which could not be included in the forest inventory, approximations were made of the volume of merchantable timber remaining after logging. These estimates ranged from 8 to 15 cubic tons per acre in the more inaccessible areas. Where logging has been intensive the remaining volume may be as little as three cubic tons per acre.

The Tekam Area

In addition to the Jengka Triangle, consideration is being given by the Federal Land Development Authority to the development of a portion of the adjacent Tekam Forest Reserve. Timber from this area would provide a further 684,000 cubic tons, of which 636,000 cubic tons or 93 per cent would be from undisturbed forest and the balance from disturbed areas. About 358,000 cubic tons, or 52 per cent is suitable for lumber production and the remainder for plywood and veneer (Table 10 - 2).

Table 10 - 2

Net Volumes of Merchantable Timber in the Tekam Area, Based on Full Utilization

Sawlogs	Net Volume (Thousands of Cubic Tons)	Percentage of Total volume
Merbau and Balau	17	2.5
Other heavy hardwoods	17	2.5
Keruing	79	11.5
Tualang and Simpoh	55	8.0
Other medium hardwoods	88	12.9
Red Meranti	32	4.7
Other light hardwoods	70	10.2
Sawlog total	358	52.3
Veneer logs		
Face Veneers		
Species yielding red veneers [1]	154	22.5
Species yielding white veneers	62	9.1
Species yielding veneers of other colours	41	6.0
Core veneer	69	10.1
Veneer log total	326	47.7
Total	684	100.0

1) 90% Red Meranti; remainder is Mengkulang, Kembang semangkok, Nyatoh, Penerahan, Terentang and Geronggang.

Other Sources of Log Supplies

H how computed?:

Based on an economic hauling distance in West Malaysia of 200 miles, all forest areas of the States of Kelantan, Trengganu and Pahang (excepting the Rompin district which is relatively isolated and lacks direct transportation connections) could be considered as additional sources of supply for forest industries in Central Pahang, including Jengka. The total supply of logs from these States is estimated at two million tons annually. The proposed mills in the Jengka Triangle after consuming all available supplies of timber in the Triangle plus such additional supplies (e.g. Tekam) as may be reserved for them, would then have to compete with other forest industries that are within economic hauling distance of these areas. A well-capitalized, highly efficient industry located in the Triangle would, however, have a competitive advantage in the log market in that it could buy logs profitably at higher prices than existing consumers and would provide a dependable market.

MARKETS

The principal markets for Jengka timber would be in logs, sawn timber and plywood. They are assessed here in terms of past and estimated future trends, acceptability of Jengka species and probable price levels.

Log Supply and Demand

Demand for sawlogs and veneer logs is directly related to the domestic production of sawn timber, plywood and veneer. The largest consumer of logs is the sawmilling industry which accounted for about 95 per cent of West Malaysia's 1965 consumption. A breakdown of sawmill inputs by species is given in Appendix 10-3.

The total sawmilling capacity in West Malaysia and Singapore is at present about 1.5 million cubic tons in terms of output of sawn timber; this requires approximately 2.5 million cubic tons of logs. Further growth to meet requirements of sawn timber for the domestic and export markets is probable and a volume of 2.6 million cubic tons of logs has been projected as an upper limit of demand for saw logs.

The plywood and veneer industry in West Malaysia and Singapore has grown rapidly since 1960. The existing capacity of this industry is estimated to be 605 million square feet (3/16 inch basis) per year. Industry expansion in response to growing domestic and export demands will probably reach a capacity of about 1000 million square feet (3/16 inch basis) by 1970, requiring approximately 0.6 million cubic tons of logs.

The total West Malaysian log production in 1965 was 2.3 million cubic tons of which 1.6 million cubic tons were produced in Pahang and the East Coast states. Pahang alone supplied 0.8 million cubic tons or 29 per cent of the total production. Most of its logs go to Selangor and Singapore.

By improving its utilisation standards and by bringing into the market some of the less well known species West Malaysia could increase its annual production by about 30 per cent to 3.0 million cubic tons by 1975. After this, dwindling log supplies from State land will bring down production to 2.3 million tons by 1980.

The combined demands of the sawmilling and plywood industries in West Malaysia and Singapore working to full capacity are expected to increase to 3.2 million cubic tons by 1970. A deficit position is envisaged from the year 1966 onwards (Table 10 - 3). Part of the deficit can, presumably, be met by imports into Singapore from external sources.

The weighted average price for Jengka Triangle logs is expected to be M$61 per cubic ton in Kuala Lumpur or Singapore and M$48 per cubic ton at Jengka, based on representative ranges of existing prices for Jengka species.

Table 10 - 3
Log Supply and Demand in West Malaysia and Singapore, 1965 - 1980
(Million cubic tons)

	Supply	Demand			
		Sawmills	Plywood Mills	Total	Defici
1965	2.3	2.2	0.1	2.3	0
1966	2.6	2.5	0.5	3.0	0.4
1970	2.8	2.6	0.6	3.2	0.4
1975	3.0	2.6	0.7	3.3	0.3
1980	2.3	2.6	0.7	3.3	1.0

Lumber Markets

Exports - Exports of sawn timber from West Malaysia and Singapore have grown from 120,000 cubic tons in 1950 to 520,000 cubic tons in 1965; slightly over half of the 1965 exports were sawn in West Malaysia. Keruing and Red Meranti currently make up about 80 per cent of all exports, although many other species are exported. Prospects for future exports are excellent; European, United States and Japanese imports are expected to increase rapidly. West Malaysia and Singapore's participation in world markets for sawn timber will be restricted mostly by a shortage of logs and to a certain extent by domestic needs. Total exports are expected to reach a peak of 980,000 cubic tons in 1970, an increase of about 88 percent over 1965, and then decline sharply (Figure 10 - 1).

Almost any species yielding satisfactory lumber can be exported. It is essential, however, to have a fairly large volume available and a steady supply, so that users can become accustomed to characteristics peculiar to various species. Operations in the Jengka Triangle, covering very large areas annually, should make even scarce species available in adequate quantity.

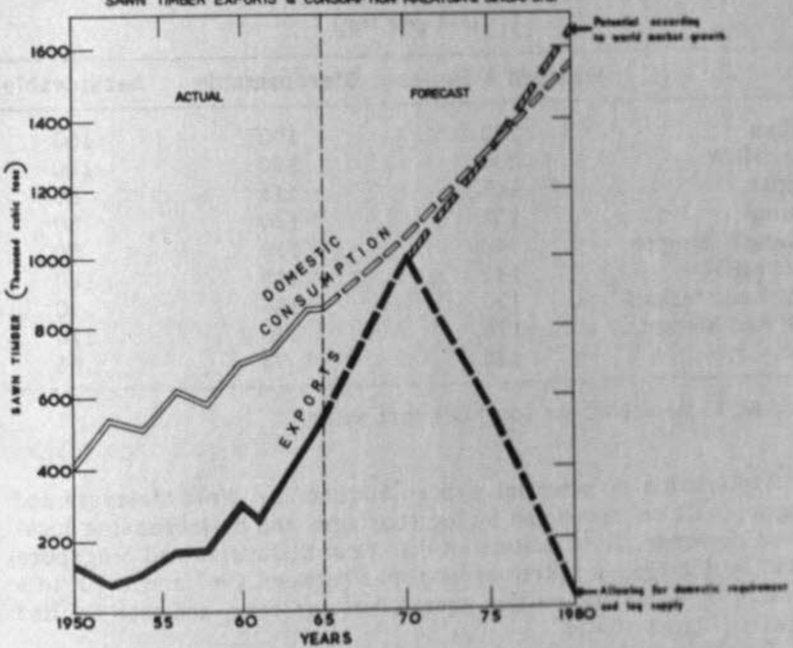
There are opportunities for increasing exports of kiln-dried timber and for applying further processing such as planing and moulding (Most exports are rough, air-dry lumber).

The most important customers for sawn timber are expected to be Australia, the United Kingdom, Western Europe and the United States. Japan is expected to become a major importer of Malaysian hardwoods.

Domestic - The domestic market for lumber accepts a wider range of species, sizes and grades, and a higher moisture content than does the export market. Much of the lumber used locally must either be

Figure 10-1

SAWN TIMBER EXPORTS & CONSUMPTION MALAYSIA & SINGAPORE



naturally durable or be treated with preservatives.

The prefabrication of housing components is growing, and currently uses about 7,000 cubic tons per year. Building components are used domestically and in East Malaysia, and are exported to Vietnam and other Southeast Asia destinations. There is an opportunity in this field to use species and grades that are not readily saleable as lumber.

Total domestic consumption is now estimated to be 850,000 cubic tons; it is expected to rise by 53 per cent to 1,310,000 cubic tons in 1975 (Figure 10 - 1).

Prices - A broad range of ex-mill prices for the species found in the Jengka Triangle is expected, ranging from M$65 per cubic ton for serviceable grade light hardwoods up to M$220 per cubic ton for standard and better grades of heavy hardwoods (Table 10 - 4).

For the probable distribution of species and grades expected from Jengka timber, average export sales prices are expected to be M$162 per cubic ton (FOB port) and domestic sales prices M$117 per cubic ton (ex-mill).

Plywood and Veneer Markets

Export - Plywood exports reached 24 million square feet in 1965, and veneer exports 110 million square feet. Substantial future increases are expected in the import requirements of the industrial areas of the world (the United States, Europe, Japan).

Table 10 - 4
Expected Ex-Mill Lumber Prices [1)]
(M$ per ton)

	Standard & Better	Merchantable	Serviceable
Merbau	220	190	160
Misc. HHW	200	170	140
Kempas	145	115	80
Keruing	150	120	80
Tualang & Simpoh	140	110	70
Misc. MHW	145	115	80
Light Red Meranti	150	120	90
Dark Red Meranti	170	140	110
Misc. LHW	125	95	65

1) add M$15 per cubic ton for FOB port sales

Exploitation of potential export markets by West Malaysia and Singapore will be restricted by log shortages and by increasing local plywood demands. It is estimated that West Malaysian and Singapore exports will increase nearly seven times between 1965 and 1970, to a maximum of about 880 million square feet per year, and then decline gradually (Figure 10 - 2).

The United States is by far the largest potential customer for Malaysian plywood and veneer (West Malaysia and Singapore currently supply about six per cent of U.S. veneer imports). Canada and the United States are the only large customers for veneer at present, but restricted log exports from Southeast Asia could bring Japan, Taiwan and Korea into the veneer market.

Quarter-inch and 3/16-inch plywood face increasing competition in the world market; they are supplied in large quantities by Japan, Korea, Taiwan and the Philippines, as well as by a few West African countries. Better opportunities may lie in manufacturing thicker panels for export and selling thinner panels locally.

Species are relatively unimportant in finished plywood, provided that technical qualities are adequate. Panels faced with species resembling Red, White or Yellow Meranti should have no market resistance; panels faced with other species will have to present an attractive appearance (e.g. Sepetir); otherwise they will have to be used where appearance is unimportant (e.g. concrete forming).

Veneer exports may initially have to be restricted to acceptable species such as Mengkulang or Meranti. New species can be introduced, but for export it is necessary to ensure consistent quality and adequate and dependable supply so that users do not have to vary production techniques frequently.

Domestic - Plywood is used locally for interior panelling, concrete forming and furniture. Total domestic consumption was 55 million square feet (3/16-inch basis) in 1965. This included about 11 million square feet of imported plywood, much of which was faced with decorative species such as teak or walnut. Forecast domestic consumption is 106 million square feet by 1975, an increase of 93 per cent (Figure 10 - 3).

Figure 10 - 2
Plywood and Veneer Exports
West Malaysia and Singapore

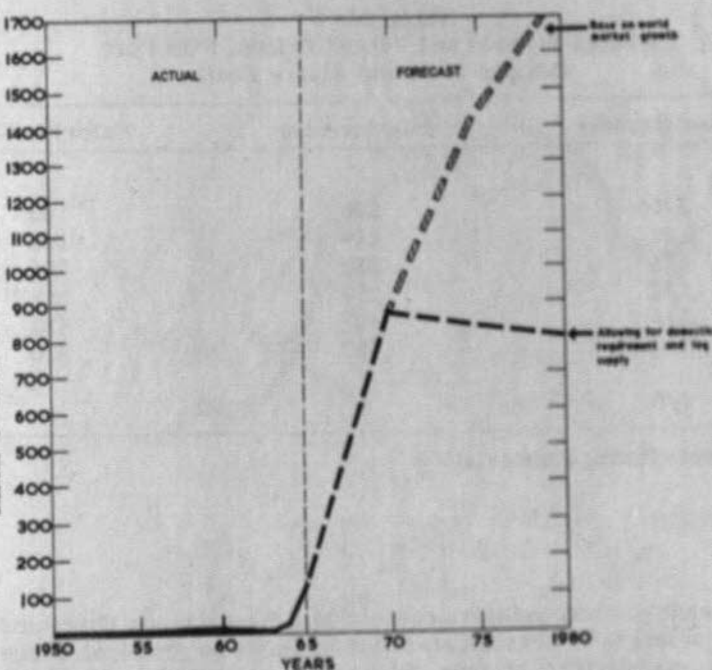
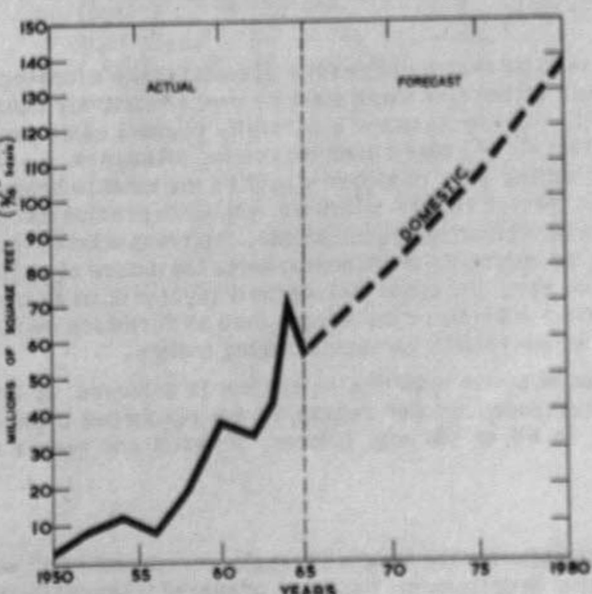


Figure 10 - 3
Plywood and Veneer Consumption
West Malaysia and Singapore



Prices - Plywood prices vary with thickness, colour, type of glue used, and grade of face and back veneers. A conservative price range, based on white species and on a low-grade face, is shown in Table 10-5.

Table 10-5
Expected Plywood and Veneer Prices, FOB Port
(M$ per Thousand Square Feet)

Thickness (inches)	Interior Glue		Exterior Glue
Panels:			
3/16	126		153
1/4	149		162
3/8	280		306
1/2	298		298 [1]
5/8	407		432
1 1/8	687		810
Veneer:			
1/6	-	90	-

1) Concrete forming material

Other Forest Products

more details!

Present market conditions, economies of plant size, and characteristics of the Jengka timber indicate that it would not be practical to consider the manufacture of pulp, fibreboard or particle board in the Jengka Triangle. Other products such as poles, charcoal, and fuel wood would consume only small quantities of logs, and sales for these uses were not included in the estimates of this report. A summary of other products and their markets is given in Appendix 10-4.

Appraisal of Market Prospects

Markets exist that could readily absorb Jengka's forest products. However, their disposal to these markets over a relatively short period (1967 to 1975) will necessitate a carefully planned sales programme under the direction of experienced marketing managers. A practicable means of achieving this objective would be the establishment of joint ventures with foreign timber interests, which can provide through their own sales and distributing organisations, captive markets overseas, or control of large segments of those markets. The nature of such captive markets would vary, but could include the diversion of sawn timber and veneer to owned-subsidiary industries such as furniture manufacture, and types of large-volume remanufacturing outlets.

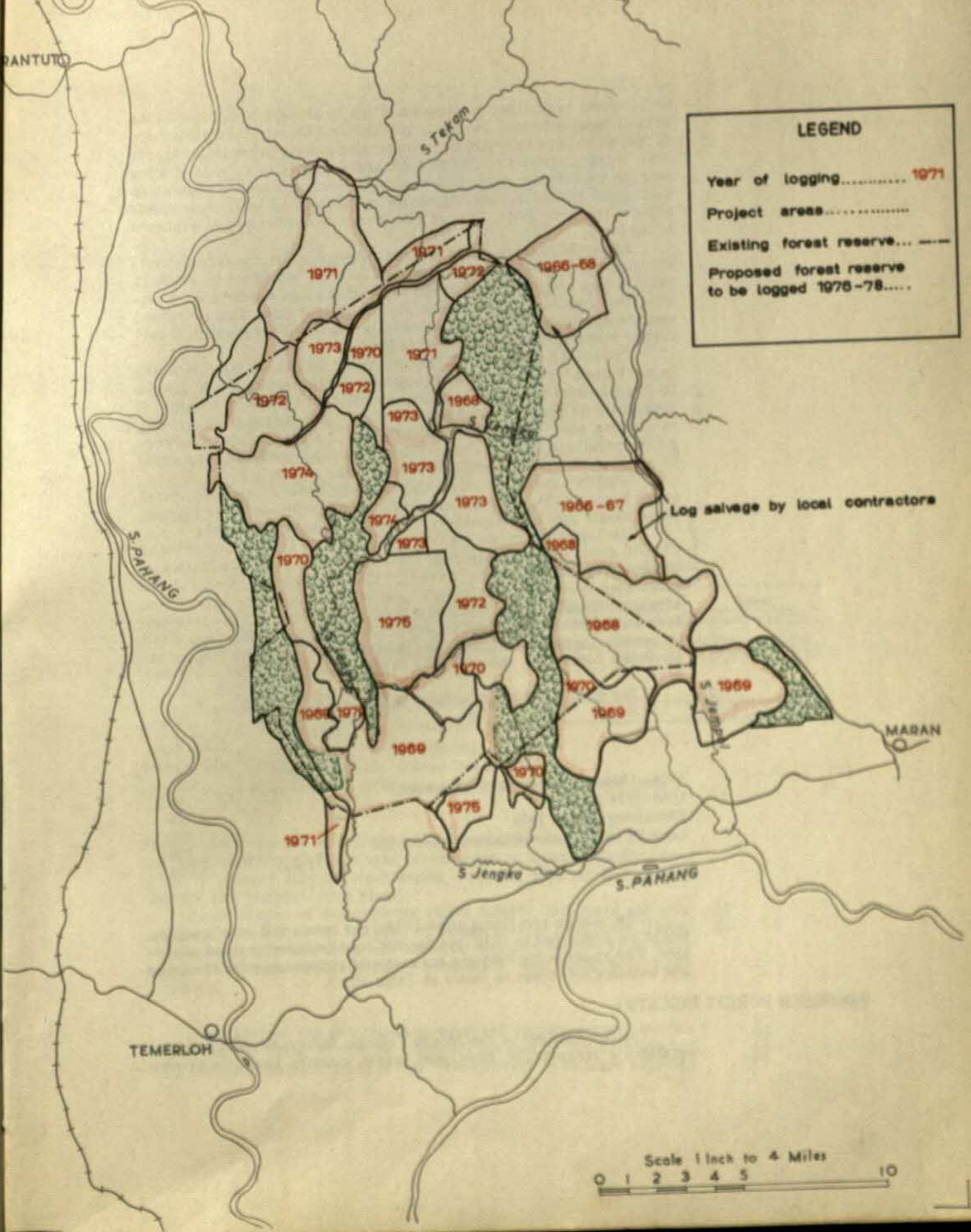
When an effective distribution system is achieved, an integrated forest industry based on the Jengka forest resources could compete successfully in all of the log, lumber, plywood and veneer markets considered.

LOGGING PLANS

A logging plan for the Jengka Triangle, coordinated with schedules for agricultural development, has been prepared (Figure 10-4). It must

Figure 10-4

LOGGING PHASING



be stressed here that this co-ordination is absolutely critical to the overall development of Jengka. Until the forest industry's facilities are in operation, logging would be concentrated mainly in areas of logged-over forest; operations in 1966-67 are expected to consist of a log salvage programme over 13,400 acres, yielding not less than three cubic tons per acre. Logging would be handled by local contractors using existing methods. Most of this timber would have to be exported in log form.

After 1967 a large-scale, modern logging operation is recommended. Since the proposed mills in the Triangle would not be ready to receive logs until mid-1968 at the earliest, all logs would be sold outside the area during the early months of that year. Due to limited species acceptability on the existing Malaysian log market, much of this timber might have to be exported in log form.

From 1968 through 1975, logging would be concentrated in areas to be cleared for agriculture or town sites. While logging would always be in advance of clearing operations it would not always be possible to accelerate its pace to such an extent that an area scheduled for clearing in any one year would be completely logged a year in advance. Very close operational control and coordination of logging and clearing would be necessary to ensure efficient performance of both.

Logging operations could continue within the Triangle for three years beyond 1975, using areas unsuited to agriculture. After logging, these should then be retained as regenerative Forest Reserves.

The logging plan has been designed to yield a steady production of 255,000 cubic tons annually after the initial years. This would consist of about 142,000 cubic tons of sawlogs (56 per cent) and about 113,000 cubic tons of veneer logs (44 per cent). To achieve this production, acreages actually logged each year vary (Table 10 - 6). The maximum area logged in one year would occur in 1969 when operations would fall in heavily logged-over forest; typical areas for logging in mainly undisturbed forest are those of 1972 - 1975, averaging 11,000 acres per year.

The disposition of log volume is summarized as follows :

	cubic tons (thousands)
1966 - 1967 logging (local contractors)	43
1968-1978 logging	2,720
Remaining after 1978	180
Loss by incomplete utilization 1967-1968	110
Total	3,053

The volume remaining after 1978, less than a full year's supply, would be consumed in 1979, but has not been included in these estimates. The relationship between acreage and tonnage logged in disturbed and undisturbed forest is shown in Table 10 - 7.

PROPOSED FOREST INDUSTRY

The development of the Jengka Triangle affords an opportunity to establish a large-scale, integrated forest industry based on proven

Table 10 - 6
Logging Plan

Year	Acres to be logged	Volume to be extracted (thousands cubic tons)		
		Sawlogs	Veneer Logs	Total
1966/7	13,400	29	14	43 [1]
1968	9,900	85	85	170
1969	20,200	142	113	255
1970	12,400	142	113	255
1971	17,400	142	113	255
1972	11,100	142	113	255
1973	9,900	142	113	255
1974	10,700	142	113	255
1975	11,800	142	113	255
1976	17,300	142	113	255
1977	17,300	142	113	255
1978	17,300	142	113	255
	168,700	1,534	1,229	2,763

1) 1966 - 1967 logging to be done by independent contractors; forest industry complex not in operation.

Table 10 - 7
Location of Volume to be Removed Under Logging Plan

	Undisturbed forest		Disturbed forest		Total	
	Thousand acres	Million tons	Thousand acres	Million tons	Thousand acres	Million tons
Area to be cleared	65.5 [1]	1.59	51.3 [2]	0.47	116.8	2.06
Area to be retained as forest	28.0	0.68	23.9 [3]	0.31	51.9	0.99
Total	93.5	2.27	75.2	0.78	168.7	3.05

1) Including about 2,800 acres of townsites.
2) Excluding 4,800 acres to be cleared late in 1966/7.
3) Including 5,200 acres to be logged outside the development area.

forest resources and on existing markets which are capable of absorbing their production. The Jengka forest industry initially should comprise a modern logging organisation, sawmill, plywood and veneer factory, and prefabrication plant.

Later stages of development might involve fibreboard and pulp and paper production if justified by future market conditions. These industries would depend on raw material supplies derived from wood waste from sawmill and plywood production, and possibly oil palm residues.

Location

The sawmill, the associated plywood and veneer factory, and the prefabrication plant, should be centrally located in the Triangle for most efficient transportation of logs from all areas. A location adjacent to the regional centre is recommended (Figure 10-5). The site is forested and without road access at present. The construction of an access road from the vicinity of the Ulu Jempol FLDA scheme on the east and a new road connection southward to join the existing Maran-Temerloh road should be begun in 1967 to serve the forest industry facilities and to assure that log haul routes are ready in time for operations in mid-1968. The southern connection to the Maran-Temerloh road is needed in 1967 - 1968 for agricultural development.

RECOMMENDED LOGGING OPERATIONS

All-weather logging operations utilizing modern methods, heavy equipment, and advanced management techniques are essential to achieve the high annual rates of production planned (255,000 cubic tons per year). Features of the recommended logging operations are as follows:

1. An all-weather road system to support logging operations through the monsoon season, except under unusually heavy mud conditions. This would make possible a 240-day working season (40 weeks of six 10-hour days).
2. Skidding and hauling to mills in full-bole lengths using medium size crawler tractors for skidding, track-mounted front-end loaders to load trucks, and very large (200,000 lb. Gross Vehicle Weight, or GVW) trucks. The trucks would exceed legal highway load and length limits; their use would be restricted to logging roads.
3. Public highway haul of logs to points outside the Triangle by largest allowable trucks (53,000 GVW).
4. Log unloading at mill by specialized lifting equipment; log sorting by heavy-duty fork lift. Chemical protection of stored logs as required.
5. Hauling and unloading on 20-hour (two-shift) working days.

Equipment requirements are extensive and include crawler tractors, loaders and log stackers, off high-way and conventional haul trucks, and a full range of road construction and quarrying equipment (Appendices 10 - 5, 10 - 6 and 10 - 7).

Road Requirements

Logging roads, comprising about 280 miles of main, secondary and spur roads, have been planned to coincide as much as possible with the alignments of equivalent classes of permanent roads needed for development of the Triangle (Figure 10 - 5). The advance construction of logging roads planned in this way would be advantageous for development and make possible savings in the construction cost of the permanent road system in the order of M$7,000,000. The coordination of logging and permanent road is discussed in Chapter 18.

The logging road system is summarised as follows:

Type	Operating Width (feet)	Miles
Main	20	26
Secondary	16	49
Spur	12	205

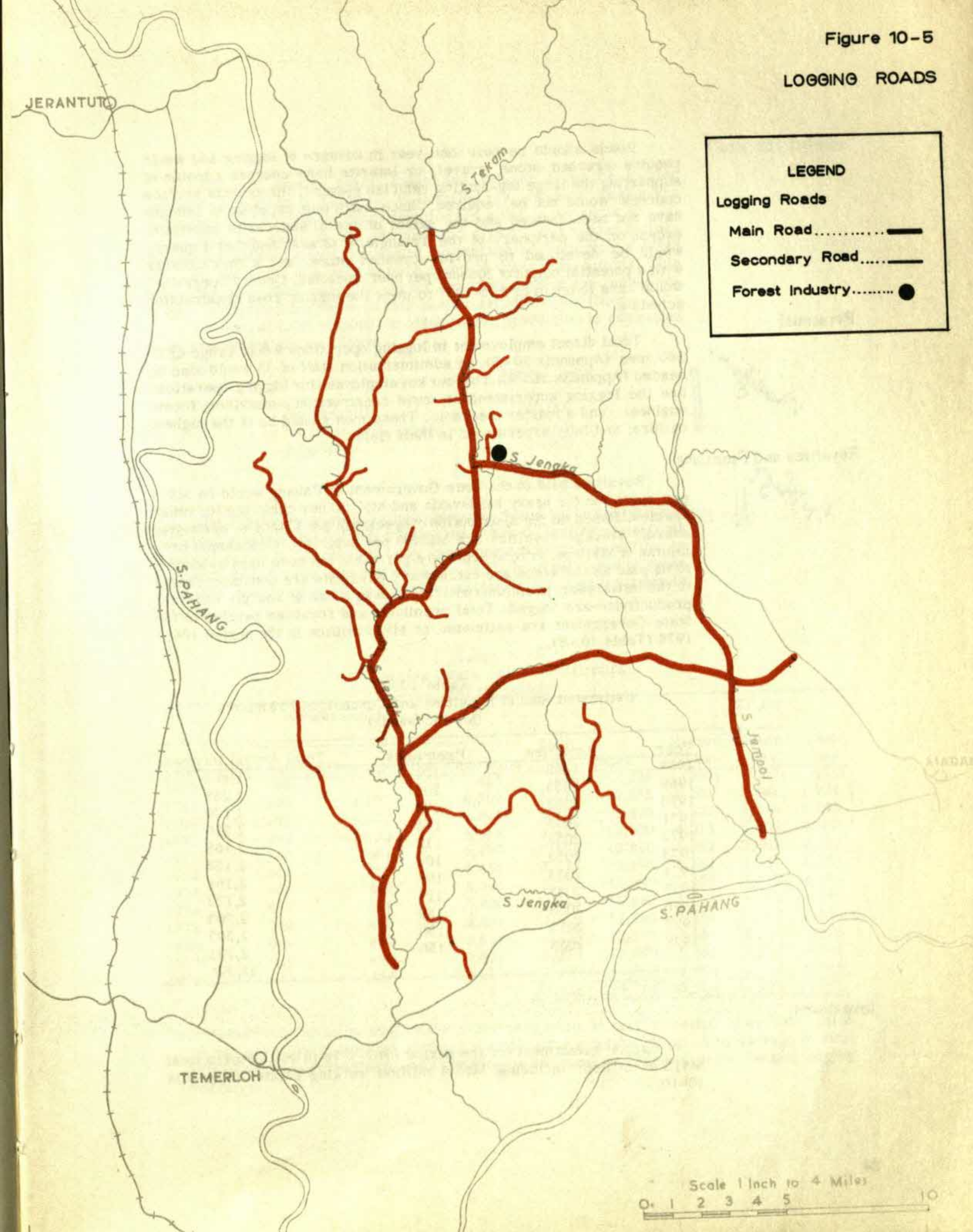


Figure 10-5

LOGGING ROADS

Roads should be built one year in advance of logging and would require crushed stone, gravel, or laterite base courses capable of supporting the large log-hauling vehicles planned. Bituminous surface courses would not be required. Since sufficient supplies of laterite have not been located and the extent of gravel sources is uncertain, except on the periphery of the Triangle, it is assumed that a quarry would be developed to provide crushed stone, and a rock crusher with a potential output of 200 tons per hour installed. Quarry operations would have to begin in mid-1967 to meet the logging road construction schedule.

Personnel

Where from?

Total direct employment in logging operations would range up to 240 men (Appendix 10 - 8); an administration staff of 33 would also be needed (Appendix 10 - 9). The four key employees for logging operations are the logging superintendent, road construction supervisor, forest engineer, and a master mechanic. These men should be of the highest calibre, and fully experienced in their fields.

Royalties and Premiums

Existing?

Royalties paid to the State Government of Pahang would be M$15 per cubic ton for heavy hardwoods and M$7.50 per cubic ton for other species. Based on the distribution of species in the Triangle, estimated overall average royalties are M$8.05 per cubic ton. Concession premiums of M$10 per acre or about 50¢ per cubic ton have been assumed, to be paid as the areas are cut. Royalty payments are constant, except in the initial year; premiums will fluctuate as areas of sharply different productivity are logged. Total premiums and royalties payable to the State Government are estimated at M$23 million in the period 1968-1978 (Table 10 - 8).

Table 10 - 8
Estimated Annual Royalties and Concession Premiums
(M$ thousands)

Year	Royalties	Premiums	Total Annual Payment
1968	1368	101	1,469
1969	2053	205	2,258
1970	2053	126	2,179
1971	2053	176	2,229
1972	2053	112	2,165
1973	2053	101	2,154
1974	2053	108	2,161
1975	2053	119	2,172
1976	2053	150	2,203
1977	2053	150	2,203
1978	2053	150	2,203
			23,396

Investment

Capital investment for the period 1967-1978 is estimated to total M$15.9 million, including M$3.4 million working capital (Appendix 10-10).

Estimated annual costs, sales and returns from the logging operation are given in Table 10-9. Detailed year-by-year breakdowns of logging cost per ton for each operation are given in Appendix 10-11.

Since log sales to the sawmill and plywood and veneer factory may be an internal industry transfer, an average market price of M$48 per ton, not cost, has been used to compute these transactions. This price has also been used for direct log sales outside the Jengka industry. Estimated log sales on this basis total M$138.8 million.

The annual total disposition of logs at full production is estimated to be approximately as follows:

	Annual Tons
To Sawmill	140,000
To plywood & veneer	65,000
Log Sales	50,000
	255,000

The Jengka Triangle logging enterprise would not be operating in 1967, and a loss of M$267,000 is expected. (1966-67 logging operations are expected to be accomplished by independent contractors selling to domestic and export log markets). In 1967, however, sale of stone from the quarry opened to provide materials for logging roads is assumed.

Table 10-9
Logging Costs, Sales, and Profits
(M$ thousands)

	Annual Costs					Profit		
Year	Depreciation	Contingencies	Operation	Total Cost	Sales [1]	Before Tax	After Tax	Cash Flow
1967	89	-	417	506	239	(267)	(267)	(178)
1968	893	1,122	6,259	8,274	9,655	1,381	841	1,734
1969	1,192	1,172	6,849	9,213	12,890	3,677	2,206	3,398
1970	1,192	1,122	6,563	8,877	12,890	4,013	2,408	3,600
1971	1,140	561	6,187	7,888	12,890	5,002	3,002	4,142
1972	1,013	459	5,857	7,329	12,890	5,561	3,337	4,350
1973	999	459	5,749	7,207	12,890	5,683	3,410	4,490
1974	937	459	5,820	7,216	12,890	5,674	3,404	4,341
1975	949	459	5,821	7,229	12,890	5,661	3,397	4,346
1976	949	459	5,821	7,229	12,890	5,661	3,397	4,346
1977	949	459	5,821	7,229	12,890	5,661	3,397	4,346
1978	949	459	5,821	7,229	12,890	5,661	3,397	4,346
				85,426	138,794	53,368	31,929	43,261

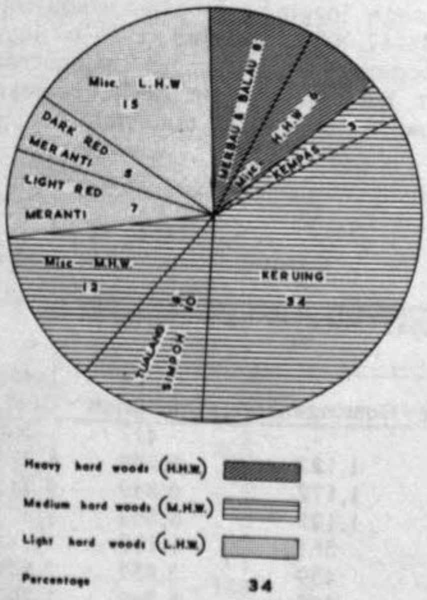
1) Includes both log sales and internal transfer to mills at market price. For 1967, sales shown are sales of crushed stone to outsiders for road-building. Log salvage in 1967 will be carried out independently and proceeds will not be credited to the Jengka logging operation.

On the bases used, logging profits are estimated to be M$3.4 million per year by 1973, and to total M$31.9 million for the full period under study. The net annual return on the total investment of M$15.9 million is expected to average about 17 per cent; cash flow from operations is expected to return the investment by 1972.

RECOMMENDED SAWMILL

If the planned schedule is met, the recommended sawmill would be able to operate for six months in 1968, and start-up inefficiency would limit the log volume that can be used to about 30,000 tons in that year. Under full year operation and normal efficiency, 140,000 tons of logs would be consumed annually. The distribution of species used is expected to follow generally the species representation in the forest (Figure 10 - 6). An important feature of the timber supply is the strong representation of heavy and medium hardwoods.

Figure 10 - 6
Planned Annual Consumption of Sawlogs by Recommended Sawmill



Production

Sawn timber production is estimated at 73,000 cubic tons per year, except in 1968 when only 16,000 tons are expected to be produced. Estimates of production are based on the following factors:

1. A recovery rate of 65 per cent for the heavy hardwoods, Keruing and miscellaneous medium hardwoods.
2. A recovery rate of 55 per cent for Kempas, Tualang and light hardwoods. This is low; it reflects the high incidence of abnormal tissue in both Kempas and Tualang and the presence of brittle heart and resin pockets in timbers of the Meranti group.

3. A volume loss of 15 per cent assumed to take place during drying, both from shrinkage and from degrade (where this renders timber unsaleable).

Average recovery including drying losses should be 52 per cent in the years covered by the logging plan.

The proportions of Standard and Better grades (which can be exported as graded timber in suitable species) are estimated to be 50 per cent for Tualang; 60 per cent for Light Red Meranti, other light hardwoods, Kempas, and heavy hardwoods; 70 per cent for Keruing; and 80 per cent for Dark Red Meranti. The remainder of the production is expected to be about evenly divided between Merchantable (suitable for ungraded exports) and Serviceable (local sales).

Probably almost all of the light hardwoods in addition to Keruing, Kempas, Merbau, and Balau can be exported in the appropriate grades, but resistance may be encountered with some miscellaneous heavy and medium hardwoods and with Tualang. Total graded exports should be 54 per cent of total production, ungraded exports 16 per cent, and local sales 30 per cent.

About 10,000 tons annually could be used for prefabricated house components. This would represent about 14 per cent of total production, and would consume nearly all of the Serviceable grades in the medium and light hardwood groups.

The United States, Australia, Japan and the United Kingdom would be major consumers of the sawmill's production. The actual volumes sold in each area would depend on the acceptability of the species involved.

Equipment and Operations

The sawmill should be based on a bandmill of 84-inch capacity, and supporting facilities consisting of a resaw, edger, and trimmer, with the necessary conveyors and a green chain. It would have a theoretical capacity of 167 cubic tons of output in an 8-hour shift. A reduced figure of 82 cubic tons per shift has been used, since the best logs would be diverted to peeling and there would be a high proportion of heavy and medium hardwoods which would tend to slow cutting and to dull saws. A sawmill equipment list appears in Appendix 10-12.

Other features of the mill include:

1. Three shift production with a working year of 300 days (150 in 1968).
2. Initial kilning capacity limited to 10,000 tons per year. As markets for kiln-dried material are more clearly identified, extra capacity can be added.
3. Planing and moulding capacity capable of handling the forecast market volume and also of performing these functions for a prefabrication plant.
4. Preservative treatment capacity in excess of the volume used in the prefabrication plant. Expansion into treated lumber markets would then be possible without extra equipment.
5. A seven-truck highway fleet consisting of 53,000-lb. GVW trucks, working two shifts per day.

An integrated forest industry has facilities used jointly by the manufacturing units. For the Jengka industry, the cost of the following facilities is assumed to be shared evenly between the sawmill and the plywood plant:

1. Boiler, using veneer clippings, sawdust, and off-cuts as fuel, and supplying steam to the dry kilns and to veneer dryers, hot press and log steaming vats on the plywood side.
2. Repair shop for mill equipment. Wheeled vehicles are assumed to be serviceable at the maintenance facility needed by the logging operation.
3. Office.
4. Power plant with a capacity of 1,500 to 2,000 KW.
5. Log deck and cut-off saw where long logs may be cut into peeler blocks or sawmill lengths and diverted appropriately.

Personnel

Total direct employment, on a three-shift basis, would be 101 men (Appendix 10-13). An administrative and sales staff of seven is also required. The key position is that of manager who would also have to be an experienced millwright. Included in this total are three foremen who may have to be recruited initially from the Philippines (Appendix 10-21).

For the integrated industry complex, a small management staff is needed, which has been charged equally to the sawmill and plywood plant. This would be headed by the general manager. He should have a thorough knowledge of plywood and lumber manufacture, and of logging. He should be an adept administrator and must stay abreast of world market trends in wood products. It would be essential to attract a person of high standing in the industry to this position.

Development of sites for workers' and supervisors' housing, communications connections, and water supply must also be undertaken promptly. The supporting facilities would be part of the system needed for the regional centre. Power would be produced by the industry for its own use.

Investment

Total capital investment in the sawmill is estimated at M$7.5 million (Appendix 10-14). It includes working capital based on 2 months' inventory of logs and other supplies, 2 months' sales (accounts receivable), and 2 months' production costs (excluding depreciation).

Costs and Returns

Sawmill sales are estimated to total about M$121 million over the full period under study and to be about M$11.8 million per year in all years except the first (Table 10-10). They are based on a forecast average export price of M$162 per cubic ton. Sales also include premiums for kiln-drying, planing and moulding, and preservative treatment amounting to about M$0.9 million per year.

Estimated sawmill profits (after tax) are about M$1.2 million one year after the initial year of operation and aggregate M$11.4 million.

Net annual return on total investment is estimated to be 13 per cent. Cash flow should return the investment by 1973.

Table 10 - 10
Sawmill Sales, Costs, and Returns

73,000 tons/yr

	Per ton (M$)		Annual and Total (M$ thousands)		
	1968	1969-78	1968 (Annual)	1969-1978 (Annual)	Total
Sales [1]	167.00	161.60	2,605	11,799	120,595
Cost of Sales					
Logs	92.30	92.30	1,440	6,720	68,640
Manufacturing costs					
Depreciation	13.10	6.10		445.3	
Insurance	3.70	1.60		116.8	
Labour	14.90	6.50		474.5	
Maintenenance & Supplies	3.20	1.40		102.2	
Lighterage & Transportation	13.50	12.60	1,342	[illegible] ~~3,151~~	32,852
Preservative	3.60	2.50		181.5	
Supervision, Administration, Sales	11.50	3.60		262.8	
Overhead (Shared with plywood plant)	14.70	4.90		357.7	
Contingencies	7.80	3.90	1,342	184.7 3,151	32,852
Total Costs	178.30	135.40	2,782	9,871	101,492
Profit Before Taxes	(11.30)	26.20	(177)	1,928	19,103
Profit After Taxes	(11.30)	10.50	(177)	1,157	11,393
		Cash Flow	28	1,605	16,078

1) Higher average sales price in start-up year reflects the fast start-up of premium-producing facilities, and consequent greater contribution to total sales than in normal year.

RECOMMENDED PLYWOOD AND VENEER FACTORY

Production

The recommended plywood and veneer factory would take 65,000 cubic tons of logs per year, except in 1968 when consumption would be 25,000 tons. Based on an average recovery of 1,500 square feet (3/16 inch basis) per cubic tons of logs, annual production would be about 100 million square feet (3/16 inch) in a normal year. In 1968, recovery is expected to be 10 per cent below normal, and production about 34 million square feet.

Production of both plywood and core veneer in varying thicknesses is recommended (Table 10 - 11). The programme is based on the estimated yields of surface veneer from the species available, and on the desirability of directing a substantial proportion of the plant's production to core veneers for export.

Core veneer, 3/16 - inch plywood panels, and 1 1/2 - inch plywood panels are assumed to be sold to the United States and would be interior grades. Half - inch exterior grade plywood is assumed to be sold for concrete forms.

Table 10 - 11
Expected Annual Plywood and Veneer Production
(Millions of square feet)

		1968	1969 - 1978
Plywood	3/16"	10.0	30.0
Plywood	1/2"	1.9	5.6
Plywood	1/2"	1.9	5.6
Plywood	1 - 1/8"	0.8	2.3
Core Veneer	1/6"	15.7	46.0

Equipment and Productivity

The factory would require one 10 - foot and one 5 - foot lathe. Main supporting equipment would include three dryers (one jet-type and two longitudinal circulation system), cold or pre-press, and a hot press with automatic loading and unloading system (Appendix 10 - 15).

Logs should be steamed in tanks of hot water; this will improve the peeling characteristics of the commonly used and softer species, and widen the range of peelable medium hardwoods. New species should be tested to broaden the range of peelable species.

Three-shift operation is assumed for the dryers and panel-making section and two-shift operation for the lathes. The length of the working year is assumed to be 300 days (150 in 1968).

Peeler cores should be sawn to produce crating material as a by-product. A hand-fed band saw will be sufficient for this operation.

Five trucks would be adequate for distribution of finished products.

Personnel

Total direct labour, on a three-shift basis, is expected to be 226 men, including truck drivers (Appendix 10 - 16). In addition fourteen people would be needed for administrative and sales positions.

Three foremen would be required per shift, or a total of eight on a three-shift basis, with the green end idle during the third shift. The costs allocated to foremen reflect the likelihood of having to recruit from the Philippines. West Malaysia and Singapore are probably rapidly developing a pool of plywood plant skills, but competition from them will continue to be keen for some time.

The manager should possess the same degree of competence as the sawmill manager and the key logging personnel. An assistant manager and a quality control supervisor would also be necessary.

Investment

Estimated total capital investment is $8.4 million, including 3.2 million working capital based on two months' inventory of logs and other supplies, two months' production costs (excluding depreciation), and two months' sales accounts receivable (Appendix 10 - 17).

Costs and Returns

Estimated costs, sales and returns for the plywood and veneer factory are given in Table 10 - 12.

Factory sales are estimated to total about M$115.5 million over the full period and to be about M$11.2 million per year in all years except the first. Sales are based on forecast average prices FOB port for panels and core veneer, reduced for quantity discounts, but not including premium for colour and pattern.

Total estimated factory profits (after tax) are about M$26.2 million.

Net annual return on total investment is estimated to average 26 per cent. Cash flow should return the investment by 1971.

Table 10 - 12
Plywood and Veneer Factory Sales, Costs and Returns

	Per Thousand Square Feet (3/16") (M$)		Annual and Total (M$ thousands)				
	1968	1969-78	1968 (annual)	1969-72 (annual)	1973 (annual)	1974-78 (annual)	Total
Sales	111.60	111.60	3,789	11,169	11,169	11,169	115,479
Costs of Sales							
Manufacturing Costs	lumber = 35.30	31.20 .397	1,200	3,120	3,120	3,120	32,400
Depreciation	7.50	5.10 .065		511			
Insurance	2.10	1.40 .017		134			
Labour	8.70	6.20 .079		621			
Maintenance and Supplies							
Supplies	3.40	2.30 .029		228			
Glue	13.00	13.20 .168		1,321			
Transportation and Lighterage	7.10	5.90 .075	2,176	590 4,746	4,746	4,746	49,636
Supervision, Administration & Sales	10.00	5.30 .067		527			
Overheads (Shared with sawmill)	6.80	3.60 .045		354 -152			
Contingencies	5.80	4.20 .053		417			
Total Costs	99.70	78.40	3,376	7,866	7,866	7,866	82,036
Profit Before Taxes	11.90	33.20	413	3,303	3,303	3,303	33,443
Profit After Taxes [1)]	11.90	19.90	413 [1)]	3,303 [1)]	2,642	1,982	26,177
Cash Flow			669	3,816	3,155	2,495	31,563

1) Assumed pioneer status for first 5 years.

RECOMMENDED PREFABRICATION PLANT

Production

It is anticipated that the prefabrication plant could consume almost all the sawmill's annual output of low-grade light and medium hardwoods.

The prefabrication plant should supply all settler housing needs in in the Jengka Triangle, or about 1,000 settler houses per year. In addition, it is most desirable that the Triangle's administrative staff housing, schools, police stations, offices, and other buildings be designed for modular prefabrication; these structures could add the equivalent of 500 settler houses annually.

The prefabrication plant should also be able to compete effectively for sales outside the Triangle, for other FLDA requirements, and for export. Possible sales could be the equivalent of 1,000 settlers houses per year, as follows:

Export (East Malaysia, Vietnam etc.)	500 houses
Other FLDA Schemes	250
Private users (estates, etc.)	250

On these bases, production of 2,500 houses annually (or their equivalent in larger structures) is planned. At an average of four cubic tons of lumber per house, this would require 10,000 cubic tons of lumber in 1968.

A successful prefabricating operation would depend heavily on skillful design of houses so that building shape, size and use could be varied without broadening the range of components needed.

Equipment and Productivity

The process would consist of four major steps: precutting, pressure treatment, assembly, erection.

1. Precutting would require joinery facilities, such as narrow-gauge band saws. It should precede treatment to avoid wasting the more valuable materials, and to avoid opening treated wood which may then need further treatment.
2. Pressure treatment would be required for all materials; the facilities for this operation, and their costs, are included in the sawmill since it is desirable to provide for outside sales of treated lumber directly by the mill.
3. Assembly would be simple and equipment can be limited to hand tools and simple jigs. For components to be bolted together, holes should be drilled prior to treatment.
4. Erection would take place on site and would require only hand tools. Some raw material should be planed, and if more elaborate structures than settler houses are to be built, mouldings would be needed. Then operations could be handled by the planer section of the sawmill. The premium for planing has been omitted from sawmill sales and prefabrication costs.

Equipment and plant requirements are summarized in Appendix 10 - 18.

Personnel

Direct labour is expected to total 136 men including 11 foremen (Appendix 10 - 19). Administration, supervision and sales would require four persons.

Investment

Investment in fixed and working capital is estimated to total M$1.5 million (Appendix 10 - 20).

Costs and Returns

The cost of lumber to the prefabrication plant, using Serviceable grade light and medium hardwoods, is taken to be M$77 per cubic ton plus the cost of treating (M$40 per cubic ton); the total of M$117 per cubic ton has been used as a transfer price from sawmill to prefabrication plant. During 1968, start-up efficiency in the sawmill would limit the availability of low-grade lumber, forcing either use of higher grades or outside purchases; M$150 per ton has been assumed for that year.

Two price levels have been assumed: M$1,330 per house for exports, and M$1,430 per house for local sales. The difference reflects erection costs.

Estimated costs, sales, and returns per house and per year are shown in Table 10 - 13.

Sales are estimated to total M$35.3 million over the full period under study and to be about M$3.4 million per year in all years except the first.

Total estimated profits after tax are about M$3.6 million.

Net return on total investment is expected to be 20 per cent. Cash flow from operations should return investment by 1972.

Table 10 - 13
Prefabrication Plant Sales, Costs and Returns

	Per house (M$)		Annual and Total (M$ thousands)		
	1968	1969-1978	1968	1969-1978	
Sales	1,430	1,370	1,072	3,425	35,322
Cost of Sales					
Lumber	600.00	468.00		1,170	
Hardware and Roofing	400.00	400.00		1,000	
Manufacturing and erection					
Depreciation	28.00	16.80		46.25	
Insurance	8.00	4.80		13.25	
Labour	254.70	152.80		420.0	
Maintenance	21.30	13.20		36.25	
Supervision	24.00	14.00		38.5	
Transportation	6.70	31.20		85.75	
Lighterage	-	6.40		17.5	
Contingencies (10%)	34.70	24.00			
Total Costs	1377.40	1131.20	1,033	2,828	29,313
Profit Before Tax	52.60	238.80	39	597	6,009
Profit After Taxes	31.60	143.30	23	358	3,603
Cash Flow			44	400	4,044

SUMMARY OF FOREST INDUSTRY OPERATIONS

Financial Summary

In the period 1967 to 1978, forest product sales are estimated to total about M$297 million excluding internal sales between one component and another of M$113 million. Total profits after tax are estimated to be M$73 million. A consolidated financial summary is

Table 10 - 14
Forest Industry Consolidated Financial Summary
(M$ Millions)

	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	Total
Sales [1]	0.2	14.0	28.3	28.3	28.3	28.3	28.3	28.3	28.3	28.3	28.3	28.3	297.2
Cost of Sales [1]	0.5	12.4	18.8	18.4	17.4	16.9	16.8	16.8	16.8	16.8	16.8	16.8	185.2
Profits Before Taxes	(0.3)	1.6	9.5	9.9	10.9	11.4	11.5	11.5	11.5	11.5	11.5	11.5	112.0
Profits After Taxes	(0.3)	1.1	7.0	7.2	7.8	8.2	7.6	6.9	6.9	6.9	6.9	6.9	73.1
Cash Flow	(0.2)	2.5	9.2	9.4	10.0	10.2	9.6	8.8	8.8	8.8	8.8	8.8	94.7
Investment	-	-	-	-	-	-	-	-	-	-	-	-	-
Fixed	5.5	8.2	1.6	-	0.5	2.8	1.1	0.1	-	2.6	0.4	-	22.8
Working Capital	0.1	6.1	4.3	-	-	-	-	-	-	-	-	-	10.5
Total	5.6	14.3	5.9	-	0.5	2.8	1.1	0.1	-	2.6	0.4	-	33.3

1) Transfer payments, consisting of intra-industry sales between components, deducted.

shown in Table 10-14. The internal industry sales referred to above, and corresponding costs of sales, have been excluded. These consist of sales of logs from the logging operation to the sawmill and the plywood and veneer factory, as well as sales of sawn timber from the sawmill to the prefabrication plant.

In an average year (the average includes the construction year 1967 and start-up inefficiencies in 1968) sales are estimated at M$34 million, derived mainly from logs, sawnwood, plywood and veneer, and to a lesser extent from prefabrication. Plywood and veneer show the highest estimated average annual rate of return (26 per cent), (Table 10 - 15).

Table 10 - 15
Forest Industry Financial Summary - Annual Average (1967-1978)
(M$ Millions)

	Logging	Sawmill	Plywood & Veneer Factory	Prefabrication Plant	Total Industry Complex
Sales	11.6	10.0	9.6	2.9	4.1
Cost of Sales	7.1	8.5	6.8	2.4	24.8
Profit Before Taxes	4.5	1.6	2.8	0.5	9.4
Profit After Taxes	2.7	1.0	2.2	0.3	6.2
Cash Flow	3.6	1.3	2.6	0.3	7.8
Investment	15.9	7.5	8.4	1.5	33.3
Average Return on Investment	17%	13%	26%	20%	19%

The recommended forest industry complex can be justified on the basis of the Jengka Triangle's timber supply alone. The addition of the timber in that part of the Tekam Forest Reserve inventoried as part of this study would further increase the financial attractiveness of the project, and is strongly recommended. Even more timber near the Jengka Triangle should, if possible, be set aside for the new industry; unlogged areas in and adjacent to the Berkelah Forest Reserve would be well suited for this purpose.

Implementation

The modern methods, organisation and equipment recommended here would require management experienced in mechanized tropical logging, inefficient methods of sawing tropical timbers, in large-scale peeling and laying up of tropical woods, and in sales and distribution. In addition, considerable capital investment would be required, and access to large captive markets overseas for as much as possible of the output would be advantageous. A practicable means of meeting all of the requirements would be to establish a joint venture between a Malaysian partner and a company from the United States, Canada, the Philippines, Japan or Australia that can supply the necessary management, capital, and captive markets (or sufficient marketing skill to obviate the need for captive overseas markets). The proposed forest industry complex might also attract capital from the International Finance Corporation or similar agencies.

Phasing

Schedules have been prepared to define initial phases in the planning and construction of the forest industry complex (Figure 10 - 7). The recommended schedule followed in this report extends from approval of the forest industry plan (January - February 1967) to the start-up of operations in May 1968, a period of 17 months. This is a finely timed schedule and if it is to be met, it will require a major organisational and promotional effort by appropriate agencies of the Malaysian Government and by prospective participants in the forest industry development. The programme must begin promptly; it will need capable and technically qualified direction and assistance.

An alternative schedule is also shown in Figure 10 - 8 extending for 28 months to a mill start-up in April 1969. This schedule represents the possible situation should formal Government approval of the development plan not be obtained as quickly as expected, or undue delays are experienced in equipment deliveries.

Delay beyond that in the alternative schedule would prejudice the viability of the industrial complex. If this happens, forest exploitation might possibly have to proceed on one of two bases:

1. A modern large-scale logging operation, but without mills.
2. A continuation of logging at current low standards of utilization, without modern logging techniques and without mills.

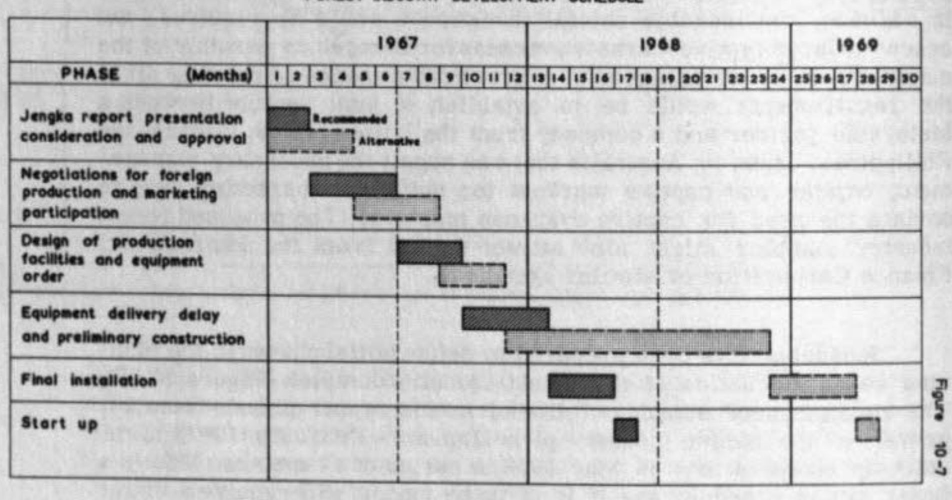
For the first case, modern logging without construction of the mills, logging operations should be organised as recommended in this report. Equipment needs would be practically the same, except that large off-highway trucks would be replaced by a larger fleet of smaller vehicles.

The volume logged would be about 175,000 cubic tons per year, or 80,000 cubic tons per year less than the volume expected under the recommended plan. This is because many species could not be sold as logs, although they could readily be used in the mills of the recommended forest industry if it were built.

A large export programme would be necessary; based on a realistic flow of logs into a sorting and rafting point at Kuantan, 58,000 cubic tons per year appears to be a maximum for export sales.

The loss in royalties to the State of Pahang is estimated at M$7.8 million, the sales value of logs not removed is estimated at M$42 million.

Figure 10 - 7
Forest Industry Development Schedule



If it proved impossible to organise a modern logging operation as recommended, so that logging continued in the Triangle at current low standards of utilization, and if no mills were built, very much larger losses would be incurred.

The volume logged would be about 90,000 cubic tons per year, only 35 per cent of the volume to be obtained under the recommended plan. This would involve a royalty loss of M$12 million to the State of Pahang, and a loss of about M$80 million in log sales.

The benefits of the recommended forest industry development are substantial. The industry can generate sales excluding internal transfers, of about M$297 million, achieve high rates of return on invested capital, and form the basis of a large modern Malaysian forest industry able to compete effectively in world markets. Regionally, it would provide an estimated total of M$23 million in royalties and concession premiums to the State of Pahang, and would provide direct employment for about 750 persons, plus considerable secondary employment in the area.

If the recommended programme is not implemented, or is delayed so that the proven resource base is eroded and the industrial complex is no longer attractive to participants, these benefits would be reduced, or lost, and very large volumes of timber which cannot be saved, and cannot be sold, would be destroyed.

A more fundamental consideration however - and one which cannot be over-emphasised - is that, without this carefully scheduled programme of logging and industrial processing, the Master Plan recommended here cannot be implemented. Much more is at stake than the loss of benefits through inefficient exploitation of the timber resources themselves.

CHAPTER 11

CROP SELECTION AND LAND USE

The assessment of the land resources of the Jengka Triangle indicates that over 150,000 acres of land are suitable for agricultural use in varying degrees. The planning of these areas must provide the optimum pattern of agricultural use under a system of smallholder settlement. To achieve this it is necessary to identify the range of possible crops, to assign each to a category of importance and to assess each in its suitability for inclusion in the Plan. Land clearance and the provision of conservation measures to accompany the recommended land use must also be considered together with opportunities for investigation and diversification in the future.

The Range of Crops

A broad range of crops and agricultural activities has been examined since agricultural diversification is a key planning requirement for Jengka. Sound land use planning however precludes consideration of crops which are environmentally unsuitable. The position of Jengka, its climate and its topography, rule out almost all annual crops for planting on a large scale. Maize and tobacco for example require a more pronounced dry season than obtains in the area. Because of the high rainfall, steep topography and soil erodibility which occur in Jengka the erosion hazard is significant in rejecting many annual crops, especially those which require relatively intensive cultivation. An exception is rice which is environmentally suitable although it must be limited to areas of flatter land. The Jengka conditions are suited to perennial or short term perennial crops, including tree crops and grasses.

The need to found a land use plan on crops of proven agronomic performance and economic potential further limits the range of crops which can be considered for immediate recommendation in the Triangle. Crops which are environmentally suitable, but of insufficiently proven performance have been considered with a view to recommending research and to their being grown on a small scale on the settlers' own initiative.

Primary Crops

Primary crops are regarded as those which are environmentally suitable and for which there are sufficient data relating to agronomic performance and economic potential to justify their consideration for Jengka. The large size of Jengka also limits crops to those whose performance is also proven on an equivalent scale.

Rubber and oil palms are the only crops which meet these requirements. They are both suitable to be grown over large areas of the Triangle. Rice also fulfills the basic requirements but the effective areas in which it could be grown, although numerous, are individually small. For this special reason rice is regarded as a secondary crop.

Secondary Crops

Secondary crops, except rice, are those for which either agronomic or economic data are incomplete; recommendations for their extensive development cannot be made at present.

Ample scientific and technical information are available for bananas, manila hemp and tapioca and these have been examined as potential secondary crops. The lack of experience in large scale processing, marketing development or distribution of these crops prevents their consideration as primary crops. Freshwater fish farming and animal husbandry also warrant consideration. Both have potential as diversification activities; both could be significant in balancing the dietary needs of the Jengka population in the future. Sufficient research and field data exist in respect of fish farming and it is regarded as a potential secondary activity for the limited areas of the Triangle in which it would be practised. Less information is available in respect of animal management, more especially of cattle. Similarly, sufficient performance data on pasture grasses for animals are not available. Studies of suitable breeds of animals for West Malaysian conditions and of appropriate pasture plants are now being undertaken in the country. As their potential is believed to be great, recommendations for studies in Jengka are made in this report.

At present neither animal husbandry nor the cultivation of pasture grasses can be included with the secondary crops and activities examined agronomically or economically in this report.

Data relevant to the secondary crops considered for inclusion in the planning of Jengka are given in Appendix 11 - 1.

In addition to the crops already mentioned, a preliminary review was made of tea, coffee, cocoa, sugar cane, coconuts, oil seeds including groundnuts and soya beans, and pineapples. Confirmation is still required that tea and coffee are environmentally suited to Jengka. The Department of Agriculture has introduced both crops into testing plots at Kampong Awah and their behaviour will be established shortly. Only Segamat soils in flat areas are recommended at present by the Department of Agriculture for cocoa: the susceptibility of cocoa to a condition known as "dieback" has not been overcome, therefore further consideration was not given to this crop. Sugar cane and coconuts were excluded on grounds of steep terrain. The low yield of oil per acre from coconuts and longer period to bearing compared with other crops were also factors in elimination of this crop. Extensive planting of groundnuts and soya beans were ruled out in view of terrain conditions and erosion hazard. Pineapples were excluded because the flat land and peat soils favourable to its cultivation do not occur in the Triangle.

System of Crop Selection

Primary and secondary crops were examined with particular reference to those aspects of establishment, production and processing of significance in the smallholder context. To establish a basis for an economic comparison of cropping systems, assessments of market prospects, future prices and profitability were made for each crop.

Market Prospects and Future Prices - Realistic estimates of future demand and prices are essential in establishing priorities and limitations in selection of different crops. The relationship between price and volume sold is a critical aspect, especially for those commodities having markets which are small in relation to the potential output.

Commodity prices for primary crops have been forecast over a 25-year period. Prices of primary crops generally are expected to decline from the relatively favourable levels of the present, and farm incomes and repayment capacities based on these price trends have therefore been assessed at relatively conservative values. By taking account of favourable prices in the immediate future, however, priority has been given in crop selection to those crops which would generate maximum income in the early stages of the Triangle development.

The potential of all markets was assessed on the basis of their expected expansion over the next 10 to 20 years. It was assumed that at present prices, supplies are sufficient to satisfy present demand and that future markets for Jengka's production would be determined by the increases in demand in the future. For a development of the size of the Jengka Triangle, and an implementation period of 10-15 years, the rate at which increases in Jengka's output occur are likely to be critical in all markets in which its output is of significance.

Crop Profitability - Oil palms, rubber and the secondary crops have been compared using the concept of discounted cash flow. This compares at a given rate of interest different patterns of income, capital and operating expenditure over similar or different periods of time. In this way the different production cycles of the crops are taken into account. To show the contribution that each crop would make to Jengka as a whole, only the revenues and costs, which can be directly attributable to the growing of the particular crops, have been included. The difference between the revenues and those costs (termed 'variable costs') is the gross margin. The gross margin measures the return generated by the crop before charging the costs of land clearance, social infrastructure and agricultural supervision. These latter costs are common to all crops and cropping patterns and have been excluded in this comparison. The cost of farm labour was also excluded since in Jengka settler labour is a common cost to all crops and systems of cropping.

The values used for each crop reflect the benefit and costs which would accrue to the economy and are termed social prices. In this way the true contribution that each crop would make to the project can be assessed.

OIL PALMS – MARKET PROSPECTS

Technical advances in the manufacture of all fats and their synthetic substitutes have made vegetable oils more open to competition with each other and with animal fats and synthetics, for any given end use. Although it is possible to identify certain groups of oils by end use in projecting future market prospects of any single oil, the position of all the substitute oils and fats must be considered. It is also important to establish the effect of large increases in output of these products such as would arise from implementation of the Jengka Triangle, and their consequent effect on future price levels.

Palm Oil

Demand for fats and oils is a function of increase in income per head and increase in population. Consequently increases in demand will be greatest in the developing countries while demand in high income countries is becoming more static. In developing countries, therefore, the proportion of domestic production which enters world trade as exports can be expected to decline because of higher levels of domestic consumption; the reverse will be true of those high income countries which are main producers. For example, groundnut production from developing countries in Africa has risen by nearly three per cent annually over the last eight years while exports have risen only one per cent. On the other hand soya bean production in the United States has risen by nearly 4.5 per cent in the same period, but exports have risen by nearly eight per cent.

Projections of demand for all fats and oils in 1970 suggest increases of 35 - 37 per cent over the period 1960 - 1970, an annual increase of about 2.5 per cent (compound) 1). It is assumed that this trend will continue into the period 1970 - 1980. It is assumed that the price mechanism and the ease of substitution of one oil for another will result in similar rates of increase in demand for each type of oil or fat.

Since 1957 production of vegetable oils which have a common end use in the production of margarine and compound cooking fat has been rising at an average rate of 3.5 per cent (compound) per annum (Table 11 - 1). These oils form the largest part of world vegetable oil production. Palm oil has remained constant while soya bean and groundnut production has risen faster than average.

Table 11 - 1

Supplies of Oils Mainly Used in Margarine and Compound Cooking Fat Production (000 tons)

	Average 1957/8-59/60	1960-1	1961-2	1962-3	1963-4	1964-5
Groundnut Oil	2653	2715	2817	2977	3078	3392
Soya Bean	3151	3232	3789	3737	3820	3892
Cotton Seed Oil	1815	1968	2005	2096	2187	2244
Palm Oil	677	682	651	698	698	704
Total	8296	8597	9262	9508	9783	10232

Annual Increases (%)

						Trend 1957-1965
Total	1.7	8.1	2.6	2.9	4.6	4.2
Groundnut Oil	1.1	3.7	5.7	3.4	10.2	4.2
Soya Bean	1.2	17.5	1.6	2.2	1.9	4.2
Palm Oil	0.3	-4.6	7.2	-	0.8	0.8

Source: Vegetable Oil and Oilseeds 1965 and 1966, Commonwealth Economic Committee.

Trade in this group of oils shows somewhat similar trends (Table 11 - 2). However the increase in soya bean oil in world trade has been substantial while groundnuts and palm oil have shown little increase, or have declined. Given present trends especially in increased production in the United States, the relative expansion of soya bean oil in world trade can be expected to continue; as soya bean oil assumes a commanding position in trade, its price performance will increasingly affect the prices of other oils, including palm oil.

Table 11 - 2
Net Exports of Vegetable Oils (000 tons)

	1957-59	1960	1961	1962	1963	1964	1965
Groundnut Oil	845	738	815	944	971	967	977
Soya Bean Oil	1060	1381	960	1359	1366	1620	1613
Cotton Seed Oil	204	287	246	262	275	366	362
Palm Oil	546	585	563	502	578	540	533
Total	2655	2991	2584	3067	3190	3493	3485

Annual Increases (%)							Trend 1957-1965
Total	6.0	-13.6	18.7	4.0	9.4	-0.2	(4.3)
Groundnut	-7.0	10.4	15.8	2.9	-0.4	1.0	(2.4)
Soya Bean	14.0	--30.5	41.6	0.5	18.6	-0.4	(8.2)
Palm Oil	3.5	- 3.8	-10.8	15.1	- 6.6	-1.3	(-0.3)

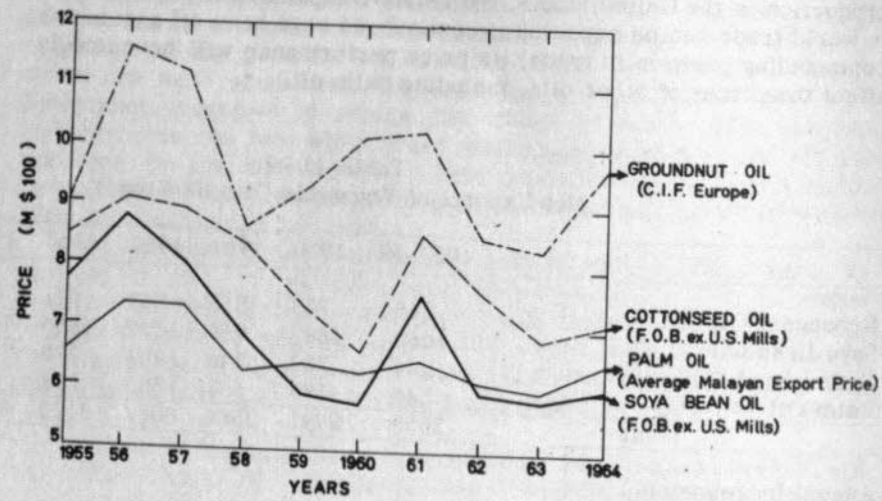
Sources: Review 1965 Commonwealth Economic Committee; Tropical Products Quarterly, June 1966.

Current Price Trends - Recent trends in prices of these oils are shown in Figure 11 - 1. These can be seen to follow long term trends similar to those of production and trade for the past 11 years, excepting 1956 and 1957. Soya bean prices however, have tended to fall faster than the others. This seems due to two factors. First, the supply of soya bean oil has been rising more rapidly than the other oils. Second, perhaps more significantly, the soya bean has a low oil content, but the processing residue which is sold as cake for live-stock feeding is in strong demand in the United States and Europe. Income from soya bean cake forms over 60 per cent of the revenue from the soya bean. Consequently the price of oil can fall significantly during periods of firm cake prices without seriously affecting farm incomes. Given continued expansion in the demand for livestock foods, soya bean oil can be expected to be very competitive in price with other oils during the next decade.

Cotton seed has similar characteristics, but groundnuts depend mainly on the oil for revenue. This is because it is produced further away from the markets for cattle cake.

Trade in palm oil while showing an absolute decline over the period also suffered from declining prices. Palm kernels form such a small proportion of oil palm revenue as to be unable to affect its competitive position.

Figure 11 - 1
Comparative Price Trends for Edible Oils



Effects of Increases in Supply of Malaysian Palm Oil - The output of Malaysian palm oil has risen by about 49,000 tons in the period 1959-1964, or by about 11 per cent per year (Table 11 - 3). Its share of world production increased from 10 to 17 per cent in the same period.

The planted acreage of oil palms in Malaysia has been rising at an annual average of about 15,000 acres over the last 3 - 4 years entirely on estates. This indicates increases in output of palm oil over the next 5 - 6 years of about 30,000 tons annually. This oil production is based on a ratio of about two tons of oil per acre which is related to the newer types of planting material being used. It is a significantly higher output than is being obtained on existing plantings. The ratio assumed could in fact be exceeded as techniques of planting and oil extraction improve. The present greater profitability of the oil palm compared with rubber is likely to accentuate this trend.

The production possible from the Jengka Triangle, which would be in addition to that from the large areas already being planted, could be very significant. Assuming a planting rate in the Triangle of 10,000 acres annually from 1968, Jengka output in 1973 would be about 18,000 tons of palm oil per annum (using 1.8 tons of oil per acre for Jengka's smallholders) and rising thereafter. Consequently by 1973 Malaysian palm oil output could be increasing by about 50,000 tons a year. This would be an increase of 10 per cent in present levels of world palm oil production. Even assuming constant production in the future by other palm oil producers, Malaysian production would increase world exports significantly, possibly by about six per cent per annum up to 1973 and by seven per cent thereafter.

Future Palm Oil Prices - Considering the projected increase in world demand of 2.5 per cent annually for all oils and fats, palm oil prices will have to fall relative to other oils if palm oil is to increase

Table 11 - 3
Planted Acreage and Production of Palm Oil
In West Malaysia (000 acres and 000 tons)

	1959	1960	1961	1962	1963	1964
Planted acreage	126	135	141	153	176	187
Producing acreage	96	99	107	114	121	128
Production in Tons	71	90	93	106	124	120 [1]
Production in tons/acre	0.74	0.91	0.87	0.93	1.02	0.94

Source: Department of Statistics, Malaysia.

1) Lower due to strikes on oil palm estates.

its share in this market and the Jengka output is to be disposed of. Furthermore, in view of the increasing share of soya bean oil in the world market, and its ability to withstand falls in price more effectively than other oils, prices of all fats and oils are likely to fall over the next two decades. In the situation where palm oil must increase its share of the market in competition with soya bean oil, palm oil prices are likely to be even further depressed.

The current and projected trend in Malaysian Palm Oil export prices are shown in Figure 11 - 2. Although prices rose sharply in 1964 and 1965 due to shortage of supplies, this in itself could have the long term effect of encouraging palm oil users to change to other oils in the same group. Price levels in 1964 and 1965 are unlikely to reflect a long term change in the trend of palm oil prices.

The trends projected in Figure 11 - 2 show that Malaysian export prices for palm oil in 1970 are estimated to be M$550 per ton f.o.b. and to fall to M$450 per ton in 1980, and to M$400 in 1995. These are price declines of considerable magnitude. Considering the expected fall in prices of all oils of the group, and of palm oil to an even greater extent (because of its increasing share of the market) they are believed reasonable as bases for the economic evaluations of large scale development of palm oil production.

Palm kernel oil, coconut oil and to a minor extent palm oil are the main vegetable oils used in soap manufacture. As such, they are open to competition from animal fats and synthetic substitutes. As all these vegetable oils are products of tree crops, output is unable to make rapid adjustments in response to changes in demand. Consequently prices have been liable to fluctuation. For the future, synthetics are in a stronger position than natural oils to satisfy short term increases in demand.

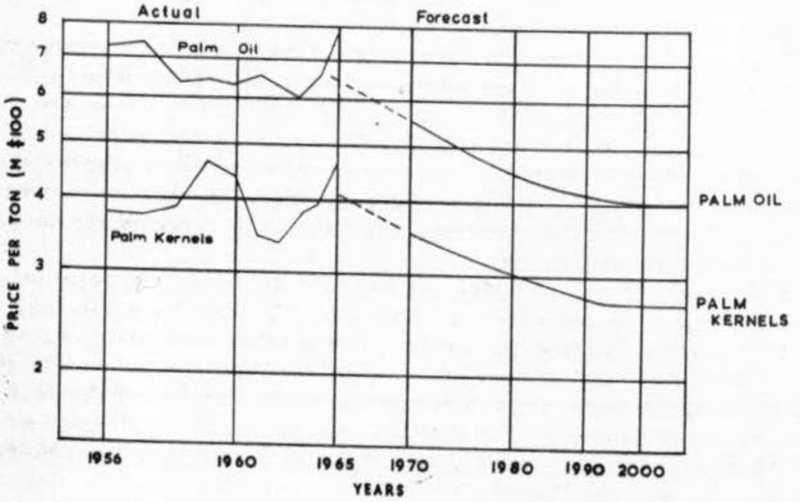
Production of palm kernel and coconut oil has risen more slowly at 2.3 per cent per annum than the edible group of oils (Table 11 - 4). Prices have fluctuated, but after discounting sudden price rises due to temporary shortages (1959 in particular) the long term trend in palm kernel prices appear to have been upward. Palm kernels being a small proportion of the market are sold at prices which conform very closely to those of coconut oil which account for about 80 per cent of this group.

Present Malaysian exports of palm kernels form a very small proportion of world exports (under 3% in oil equivalent); the main exporter is Nigeria. Increases in exports from Malaysia could not exceed 7-9,000 tons annually in the 1970's. Assuming constant export levels from other producers, rates of increase of this order would increase world export by about two per cent annually. In these circumstances it is likely that increases in Malaysian output will have a sufficient impact on world trade to affect price levels.

Table 11-4
Supplies of Oils Mainly Used in Soap Making
(000 tons oil equivalent)

	Average 1957/8-1959/60	1960-1	1961-2	1962-3	1963-4	1964-5
Coconut	1859	2065	2015	2164	2129	2150
Palm Kernel	423	412	370	389	393	402
	2282	2477	2385	2553	2522	2552
Annual Increase (%)	4.0	-3.7	7.0	-1.3	1.2	Trend (1.9)

Figure 11-2
Palm Oil Prices



Future Palm Kernel Prices - At present the short term price prospects for palm kernel and similar types of vegetable oils appear good in view of recent trends in production and prices. However, the potential of animal fats and synthetic compounds in the manufacture of soap make the long term prospects more uncertain. In this respect, high, or fluctuating prices may well drive soap manufacturers to greater reliance on non-vegetable oils which have a more stable supply and price. In the long term therefore falls in the price level of these commodities can be expected.

The current and projected trend in the Malaysian export price for palm kernels are shown in Figure 11 - 2. The trend projected shows a price for kernels of about M$ 350 per ton in 1970, falling to M$300 per ton by 1980, and to M$265 per ton by 1995. Referred to price levels of palm kernel in 1963, and thus excepting the years 1964 and 1965 when prices rose due to shortages, the drop to 1970 would be about eight per cent, and to 1995 about 30 per cent. These are somewhat lesser relative falls in price than forecast for palm oil.

OILPALMS – CULTIVATION

Technical data on oil palm culture from research stations in Malaysia are steadily increasing and adequate information is now available on oil palm management in coastal areas. Recently, investigation programmes have been developed to take account of the problems associated with the expansion of oil palm plantings to inland areas.

Aspects of oil palm cultivation significant to smallholder development schemes are treated in this section. Generally, the use of planting material of genetic potential and its sound initial development and establishment are of primary importance. Thereafter proper maintenance, correct fertiliser schedules and timely harvesting are essential to success.

Nurseries and the Supply of Planting Material

Pregerminated oil palm seedlings from selected parents are available from reliable commercial sources in Malaysia. Special facilities for supplying Jengka will not be necessary but a planting programme that maintains a reasonably consistent annual demand for seedlings and the spread of that demand among suppliers according to their capacity to provide selected planting material will secure the best that is available. Currently FLDA is planting Dura x Pisifera (DxP) seedlings. There is no evidence to suggest that this policy should be varied.

The successful rearing of seedlings will require carefully selected nursery sites and the full time skills and attention of experienced staff. For this reason a fewer number of large central nurseries are preferable to numerous scattered nurseries to which only part time and less expert supervision can be given.

Young palms may have to be transported up to two or three miles further between nursery and field, but the additional cost per palm is negligible. Nurseries should be on level ground, near ample permanent water supplies and preferably located in areas of loamy soils.

The objective in the nursery should be to produce seedlings 4.5-5 feet tall from soil level, ready for planting out in 12-15 months from the seedling stage. Regular cullings will be necessary to achieve this.

Nursery practice has been changing rapidly in West Malaysia during the last three years. The polythene bag nursery, which avoids nursery transplanting of seedlings, is replacing the traditional field nursery on many estates. The new system seems well suited to central nurseries, reducing the amount of land and labour required and the liability to setbacks following transplanting. It is recommended for use in the Jengka Triangle.

The quality of the young palm will be influenced by the soil medium used, the manurial programme adopted and the amount of water provided. Suitable levels of nitrogen, phosphorus and potassium will be required, according to soil conditions and plant growth. The use of overhead irrigation will simplify the daily watering task and further reduce the nursery growing period without adding excessively to cost.

Planting

Holing is less important on friable soils when the polythene bag technique is used, thus economising in planting time and accelerating the planting programme. Despite this simplification, the planting operation is of critical importance to successful establishment of young palms. While it is desirable that settlers should become intimately associated as soon as possible with the crop they are to look after, it is not in general recommended that they should undertake planting. Both the settlers and possibly also subordinate field staff will initially lack experience of this important operation.

Investigations into plant density per acre are continuing in West Malaysia. Until information to the contrary emerges, a density of 60 palms per acre (29 x 29 triangular) which is now commonly employed, should be used.

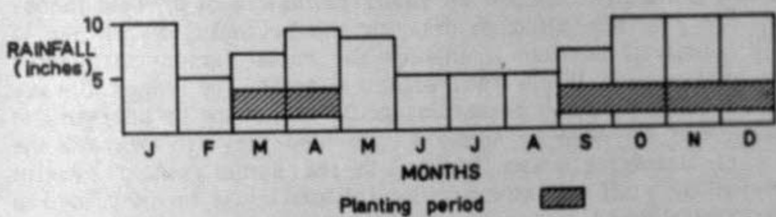
Transplanted oil palms ideally should be in the ground just before rainy weather is expected, and planting should be completed before drier weather conditions occur. The rainfall distribution in Jengka indicates that planting should commence in September and be completed in December. A subsidiary programme of planting (or replanting) could be undertaken in March and April (Figure 11-3). The estimated costs of lining, holing and planting are M$120 per acre.

The characteristics of the Jengka terrain and soils necessitate the use of cover crops to protect the soil from erosion, and their early establishment is essential. Provided that this is successful, a natural cover of Nephrolepis fern and mixed grasses can gradually take over without danger of serious invasion by lalang. As soon as this natural cover has established itself, the settler's weeding task should be limited to ring weeding and supressing of climbing weeds, jungle tree seedlings and lalang.

Fertilising

Fertiliser investigations for oil palms on inland soils have not yet reached such an advanced stage that definitive recommendations can be made. A programme of soil and foliar analyses will be advisable to determine the levels of fertilisers to be used initially on the Jengka soils. More information will become progressively available from existing sources for later plantings.

Figure 11 - 3
Oil Palm Planting Periods



Although still a matter of conjecture it is suggested that the following fertiliser applications should be made to young palms:

Year after Planting	Sulphate of Ammonia	Muriate of Potash
1	0.5 lb (1.3 oz. N)	0.5 lb (5 oz. K O)
2	1 lb (3 oz. N)	1 lb (10 oz. K_2O)
3	2 lb (6 oz. N)	2 lb (20 oz. K_2O)

The specific fertilisers given here are those mainly used in West Malaysia today. Alternatives are possible and for this reason amounts of the nutrient element are shown in parentheses.

There is no evidence that improved growth results from the common practice of applying rock phosphate in the planting hole. However, on soils derived from sedimentary rocks it may be wise to add phosphate to the mixture in the same proportion as other fertilisers.

Palms in production on soils derived from sedimentary rock have a primary phosphorus requirement and a secondary requirement of nitrogen. No experiments have been carried out on Segamat soil which is derived from Andesite, but it is likely that there is a primary potash need. A tentative annual schedule for general application would be 4 lbs. per palm of Sulphate of Ammonia, 4 lbs. per palm of rock phosphate, 6 lbs. per palm of Muriate of Potash and 4 lbs. per palm of Kieserite. It is, however, by no means certain at present that annual applications are necessary: less frequent applications at a higher rate may prove to be more effective and cheaper.

540 240. 80. 360. 270. 180.

Pests and Diseases

The financial losses which can result from pest and disease attack are considerable. Their prevention or early identification and control is essential. Timely control measures applied by the settlers will be necessary and will require that both they and the supervising staff are instructed in the recognition and control of the common pests and diseases especially rats and rhinoceros beetles.

Castration

Evidence on the profitability of castration (removal of inflorescenoes and immature bunches on young palms) is at present inconclusive. The practice, although delaying the beginning of harvest, is probably beneficial because it enables the initial factory throughput to start at economic levels and reduces attack by the fungus disease Marasmius and by rats. Castration should therefore be adopted and the task could be done by settlers, provided they are aware of the dangers of damaging young fronds. In the same context, careful supervision by staff and attention by settlers must be exercised in pruning. Yields could seriously be reduced by premature, careless and excessive pruning of fronds.

Pollination

As the palms develop, a shortage of male flowers may occur and the production of fruit may be reduced. If this occurs it will be necessary to employ assisted pollination for a few years to ensure economic levels of production. Although this operation can be undertaken by individual settlers after instruction, it would be more cheaply and effectively carried out by small trained teams, preferably drawn from the settler community.

Yields

The yields per acre of fresh fruit bunches (FFB) to be expected in Jengka will depend upon many factors, including the planting material used, the soil series, fertiliser programmes and other aspects of management, and climatic variation. The critical factors in yields from the smallholder viewpoint are the rate at which maximum yield can be reached and the period over which this yield can be sustained.

Because the expansion of oil palm growing in West Malaysia and the introduction of DxP planting material have been recent, levels of yield throughout a productive cycle have not yet been established. Evidence from estates shows that, in the best of circumstances, yields from mature palms have reached as high as 14 tons of FFB per acre (2 tons of oil per acre). However, in the Triangle very large scale oil palm growing will be in the hands of thousands of relatively inexperienced settlers. In these circumstances it is considered realistic to project a maximum yield of 9 tons per acre FFB from DxP material planted a density of 60 palms per acre (Table 11-5). It is assumed that this yield will be achieved in the 10th year after planting and will be sustained throughout the projected cycle of 22 years.

Harvesting

The harvesting operation is of critical importance to the settlers' income and will have an important bearing on the success of the Jengka scheme as a whole. It is in this task that effective supervision will help the settlers to develop regularity, discipline and skill in the selection of bunches ready for harvesting and in avoiding the excessive removal of fronds.

Table 11 - 5
Estimated Oil Palm Yield [1]

Palm Year (in Field)	FFB/Ac.	Oil to FFB	Oil/Ac. (Tons)	Kernel To FFB	Kernel/Ac (Tons)
3rd (2.5 - 3) Year	0.5	11	0.055	4.5	0.025
4th (3 - 4) "	3.6	13	0.468	4.5	0.162
5th (4 - 5) "	6.3	15	0.945	4.5	0.2855
6th (5 - 6) "	7.6	17	1.492	4.5	0.342
7th (6 - 7) "	8.0	20	1.60	4.5	0.36
8th (7 - 8) "	8.5	20	1.70	4.5	0.3725
9th (8 - 9) "	8.8	20	1.76	4.5	0.376
10th (9 - 10) "	9.0	20	1.8	4.5	0.405
11th (10 - 11) "	9.0	20	1.8	4.5	0.405
12th (11 - 12) "	9.0	20	1.8	4.5	0.405
13th (12 - 13) "	9.0	20	1.8	4.5	0.405
14th (13 - 14) "	9.0	20	1.8	4.5	0.405
15th (14 - 15) "	9.0	20	1.8	4.5	0.405
16th (15 - 16) "	9.0	20	1.8	4.5	0.405
17th (16 - 17) "	9.0	20	1.8	4.5	0.405
18th (17 - 18) "	9.0	20	1.8	4 5	0.405
19th (18 - 19) "	9.0	20	1.8	4.5	0.405
20th (19 - 20) "	9.0	20	1.8	4.5	0.405
21st (20 - 21) "	9.0	20	1.8	4.5	0.405
22nd (21 - 22) "	9.0	20	1.8	4.5	0.405
Average Yields	8.0	18.8	1.57	4.5	0.364

1) DXP palms, planted 60/acre, inland soils

Experience of oil palm harvesting by smallholders is so far lacking in West Malaysia. It has however been successfully achieved elsewhere and a recommended harvesting system for smallholders is described in Chapter 12.

The importance of efficient harvesting is expressed in terms of volume and quantity of oil obtained. As the fruit ripens, the quantity of oil per fruit rises until the period of peak ripeness is reached. Dry weight increases rapidly during the last week and the ratio of oil to mesocarp may increase three-fold in the last week. After maturity the fruit becomes overripe and any bruising of the fruit as it is harvested or transported causes an immediate rise in the free fatty acid (FFA) content of the oil. At present FFA contents in excess of five per cent incur a small price penalty. However, as competition with other oils becomes more intense this factor may become more important than at present.

Frequent harvesting by skilled harvesters improves the proportion of bunches which are at the right stage of ripeness. This tendency may be expected initially as the attraction of an enhanced income becomes evident to settlers.

To achieve optimal levels of ripeness, daily harvesting should in theory be practised. However, this increases the cost of fruit transport as well as harvesting, and is considered to be impracticable. Because labour and transport efficiency are regarded as more important as a cost than any benefit that can be obtained by greater degrees of ripeness, many estates as a compromise practice 7-10 day rounds of harvesting. As yet there is no experimental evidence to support this practice.

Within a smallholder system of farming however, more frequent harvesting rounds become more attractive. For increased efficiency of supervision and labour, harvesting at intervals of between 4 to 10 days is favoured, although the precise length of the interval depends upon environmental factors and may vary from month to month and from area to area. Social factors and the need to provide daily work also favour more frequent systems of harvesting in a community of smallholders with few additional outlets for their employment.

In order to establish a balance between the competing factors of frequent work opportunity, maximum oil content, low free fatty acid content and transport costs, a 4-day harvesting interval has been assumed for the evaluation of the smallholding in Chapter 13. It is assumed that the settler would harvest half of his plot alternately on every fourth day and that management staff would supervise half the settlers in their charge daily. It will rapidly be possible for them to identify those smallholders who require greatest attention and those who will become independent of frequent supervision.

Processing

Large central palm oil mills undoubtedly achieve considerably higher levels of oil extraction than the hand operated smallholder presses and also obtain lower FFA content. Low moisture and low FFA contents in processing are essential in oil for international use. A differential of only five per cent in efficiency in favour of the mill more than justifies its larger capital costs; it is likely that the efficiencies of modern mills would be considerably greater than this, as compared to smallholder presses.

In addition, with a system of large central mills management can be concentrated and used much more efficiently while a much higher quality product is produced. With increased competition from other oils likely in the future, the quality of palm oil should become a significant factor in international trade. For these reasons, large central palm mills are recommended for use in the Triangle. The optimum sizes of these mills and their location and phasing are discussed in Chapter 15.

RUBBER – MARKET PROSPECTS

In assessing the level and future trend in the prices of natural rubber, demand and supply of both natural and synthetic rubber must be considered. The future price of rubber will be determined as much by the competition between these two types of rubber as by the overall demand and supply situation for rubber in general. The contribution of the Jengka Triangle's production to the world rubber supply must be assessed to establish whether production levels in Jengka could affect expected prices.

Demand

Over the last 20 years, consumption of rubber of all types rose by 5-7.5 per cent annually to reach a level of nearly five million tons by 1964 (Table 11-6). Most of this increase was in consumption of synthetic rubber which rose nearly twice as fast as that of natural rubber.

This trend in overall consumption of rubber can be expected to continue. However, the relative shares of natural and synthetic in this continued rise in demand is likely to depend on technological research and on the capacity of both industries to increase production and to withstand price competition from each other.

Table 11-6
World Consumption of Natural and Synthetic Rubber

	1946-50 (average)	1956-60 (average)	1960	1961	1962	1963	1964
Natural	1250	1992	2065	2138	2193	2230	2220
Synthetic	610	1406	1798	1920	2170	2353	2720
	1860	3398	3863	4058	4363	4583	4940
Annual Increase (%)							
Total	6.0	6.0	5.0	7.5	5.0	7.8	
Natural	4.8	1.0	3.5	2.5	1.7	-	
Synthetic	8.5	12.0	6.8	13.0	8.4	15.5	

Source: Rubber Statistics Handbook, Department of Statistics, Malaysia

Supply

Generally the trends in the supply of rubber of all types follow closely the pattern of consumption. However, with rising stock levels of synthetic rubber over the years, production of synthetic has risen slightly faster than consumption.

Natural Rubber - World production of natural rubber has risen slowly in the last 5-7 years (Table 11-7). Malaysia is the world's largest producer and provides 35-40 per cent of world natural rubber supplies. Between 1960 and 1964, Malaysia's production increased by 16.6 per cent. Based on current replanting programmes, Malaysian output should rise by 5-7 per cent annually over the next 7-8 years.

Indonesia, the second largest producer has experienced a slight decline in output over the last 8-10 years. The prospects of expansion of rubber production in Indonesia are at present uncertain.

The overall prospects in world natural rubber supply make long term increases in supply of over five per cent per annum unlikely.

Synthetic Rubber - Supply and production capacity of synthetic rubber have been expanding very rapidly in recent years as evidenced by the increases in world consumption (Table 11-6). It is likely that this trend will continue in Europe and Japan as well as in the United States. In recent years, despite the rapid increases in demand, spare capacity has been a characteristic of the industry. Since the potential economies of large plants are attractive, there will be a trend towards the installation of even larger production units than in the past. Therefore it is likely that capacity will be available to enable recent upward trends in production to continue.

Table 11-7
Natural Rubber Production 1946-64
(000 tons)

	1946-50 (average)	1956-60 (average)	1960	1961	1962	1963	1964
Malaysia	623	672	708	737	752	789	825
Indonesia	403	672	610	671	671	573	639
Others	368	612	672	687	707	705	776
World Total	1394	1956	1990	2095	2130	2067	2240
Annual Increase (%)							
World Total	3.5	1.0	5.3	1.7	3.0	8.4	
Malaysia	0.8	2.3	4.0	2.0	4.9	4.6	

Source: Rubber Statictics Handbook, Department of Statistics, Malaysia

Based on future increases in world demand for rubber of all types of 5-7 per cent annually 1), it is estimated that natural rubber production will increase at a slower rate, and that continued increases in production of synthetic rubber will be possible without creating a surplus. The area in which natural and synthetic rubber can compete is likely to increase with improvements in the technology of synthetic production.

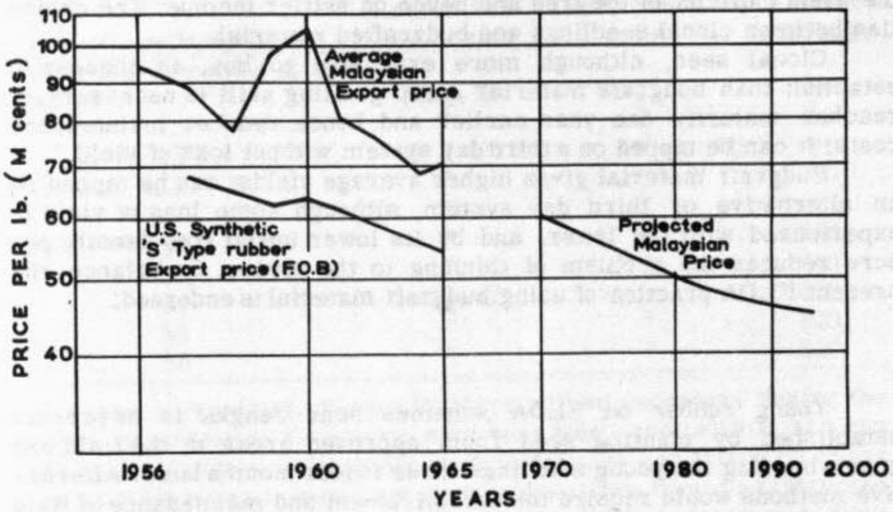
Effect of Jengka Production on Supply of Natural Rubber

Rapid increases in Malaysian output of natural rubber are expected from current replanting programmes, but it is expected that these increases will become less significant after 1972-1973. In the period 1968-1972 Malaysian production is expected to increase by about 75,000 tons annually, after 1972 by about 50,000 tons annually. Consequently, any output from Jengka will help to maintain the trend in production, but it would require much larger annual plantings in Jengka than are planned for this to be significant. For example, an annual planting programme in Jengka of 10,000 acres starting in 1967 would lead to an increase of only 7,500 tons annually from 1973/4 onwards. On these bases, Jengka output can be of no real significance to the future trend of world rubber prices.

Present and Future Prices

Recent trends in the average export price of Malaysian rubber and in the average export price of 'S' type synthetic rubber from the United States are shown in Figure 11-4. Ignoring the short term fluctuations in the price of natural rubber in 1958-1961, both natural and synthetic prices show a similar downward trend and a narrowing in the differential between the two types of rubber.

Figure 11 - 4
Rubber Prices



Natural and synthetic rubber are already competitive. Evidence for this is in the fall in the price premium of natural rubber over its synthetic substitutes. Therefore future trends in prices are likely to be determined largely by the prices of synthetic rubber. Not only is synthetic rubber expected to obtain the larger share of the market, but it will also be more competitive in the short run both in price and in satisfying demand. In the long run, however, synthetic rubber prices must be high enough to cover the high capital costs of production and earn a competitive return. The outlook, therefore, appears to be one in which the synthetic rubber industry supplies the increasing gap between the demand for all rubber and the supply of natural rubber, at a production cost which is likely to continue to fall over the foreseeable future, taking with it the price of natural rubber.

Trends in synthetic rubber prices suggest a 1970 price of United States 'S' type synthetic of US 15.5 to 16 cents per lb. (M45 to 48 cents per lb.). Applying a similar, but steeper fall in the price of natural rubber to reflect increased competition between the two types suggests prices of natural rubber in 1970 of around M cents 60 per lb. Continuation of these trends, which assume further economies of scale in synthetic rubber production, indicates an expected natural rubber price of M 50 cents per lb. for 1980 falling to M 45 cents per lb. in 1995.

RUBBER – CULTIVATION

The cultivation of rubber has certain features which are especially significant in its use as a smallholder crop. Considerable practical information has been developed from local research which is important to the efficient production of rubber by smallholders.

Planting Material

The selection of planting material has an important bearing on the yield capacity of the tree and hence on settler income. The choice lies between clonal seedlings and budgrafted material.

Clonal seed, although more expensive to buy, is cheaper to establish than budgraft material as no grafting skill is necessary. It reaches maturity one year earlier and hence reduces maintenance costs; it can be tapped on a third day system without loss of yield.

Budgraft material gives higher average yields; can be tapped on an alternative or third day system, although some loss of yield is experienced with the latter; and by its lower initial tree density per acre reduces the problem of thinning to the settler. On balance, the present FLDA practice of using budgraft material is endorsed.

Nurseries

Young rubber on FLDA schemes near Jengka is at present established by planting seed from approved areas in the field and green-budding the young seedlings three to four months later. Alternative methods would require the establishment and maintenance of field nurseries in which young seedlings are budded before planting out. The present system used is recommended initially for Jengka because large quantities of budwood are already produced in nurseries at Kampong Awah. By arrangement this material could be used for planting the large acreages of rubber planned for the Jengka Triangle.

There may be advantages in the future from the use of polythene bag techniques for rubber nurseries. Experience so far suggests that trees can thereby be brought into production sooner. If current yield recordings show that this practice increases yield by bringing the tree into bearing earlier the technique should be considered for Jengka.

A spacing of 30 feet between rows and 9 feet between trees, giving a population of 160 trees per acre, is commonly used and is suitable for Jengka although some variation of this spacing will be necessary on steeper land where terraces will be required.

The estimated cost of lining, holing and planting, including the cost of budding is M$36 per acre.

Maintenance

Good maintenance during the immature period increases the speed at which the trees can be bought into bearing. The objective should be to commence tapping when the trees have a girth of 20 inches at a height of 40 inches above the bud unions. This should be possible within 5 to 6 years from planting.

Care of the trees during the immature period should aim at establishing a robust tree for tapping. Adequate fertilisers is essential and smallholders should be trained to carry out the correct fertiliser programme and system of placement.

The fertiliser requirements for several of the oil series in Jengka have already been worked out and published by the Rubber Research Institute of Malaya. A fertiliser programme for the remaining series will have to be prepared based upon soil and foliar analysis. As a general recommendation the schedules shown in Table 11-8 using compound fertilisers is suitable.

Table 11 - 8
Fertiliser Applications to Immature Rubber

Time of Application	Soil Type: Loams and Clay Loams	Soil Type: Very Sandy soils	Amount in lb/acre
During First 8 months after planting	Mag. M	Mag. X	180
12	"	"	80
15	"	"	80
18	"	"	80
24	"	"	120
30	"	"	120
36	"	"	240
42	Mag. C2	Mag. Y	320
54	"	"	320
66	"	"	320

Close supervision of smallholders will be necessary during the weeding programme to ensure minimum weed competition and the eradication of undesirable plants such as Mikania and lalang from the cover crop. Pruning is also important and settlers must be instructed in techniques leading to development of well shaped trees, without laterals to about eight feet.

Neccessary thinning, primarily of unthrifty young trees, may meet with resistance from smallholders. Settlers must be made aware of the potential yield losses resulting from failure to thin to an ultimate population of 120 trees per acre. Current research into tree population densities should be kept under review so that any benefits which may arise from fresh information can be incorporated in later stages of the development programme.

At maturity the maintenance work will be limited to disease control and fertiliser application. Recommendations for the latter in Jengka have yet to be confirmed, but the schedule shown in Table 11-9 can be recommended as a guide.

Table 11 - 9
Fertiliser Applications to Mature Rubber

Time of Application	Soil Type: Loams and Clay Loams	Soil Type: Very Sandy soils	Amount in lb/acre
Annually for first 15 years of tapping	Mag. C2 or MMI	Mag. Y	250 / 320
Annually for each additional 5 years of tapping	MMI		320

Tapping

Frequently, the greatest difficulties for supervisory staff and settlers lie in the tapping programme. The attractions of the cash income when tapping starts encourages a very high tapping intensity. While this may be acceptable at the end of the productive period of the tree, efforts must be made by instruction and supervision to prevent smallholders from varying the system adopted, whether alternate day (at present recommended for FLDA Schemes) or third day systems, because excessive daily tapping reduces overall yields.

Care must be taken to develop and maintain a high technical standard of tapping. Damage by cutting too deep, or by consuming bark in excess of nine inches per year will cause damage to trees and reduce yields; both circumstances will adversely affect settler incomes. In view of the competition to which natural rubber is subjected by synthetic rubber, the need for high quality dirt-free latex is essential.

Field Transport

The field transport system for latex should maximize the opportunities to use settler labour; settler transport on bicycles to collecting station is recommended (Chapter 17).

Yields

Since many Jengka settlers will be comparatively inexperienced in rubber cultivation, modest levels of yield have been assumed for Jengka. These reach a maximum of 1,400 lbs of latex (dry rubber content) per acre per year and 245 lbs of scrap (Table 11 - 10) in the eighth year of tapping and fall off as the age of the tree increases.

Processing

For smallholder settlement, two processing systems are possible and require consideration. They are:-

i) Small Scale processing in communal centres
ii) Large Scale processing in central factories

Experience in Malaysia in group processing for smallholders suggests that there is little to choose between the operating costs of small and large scale sheet rubber processing units provided the latter are well managed and run to near capacity. Benefits from large factories arise mainly from improvements in grades, although some marginal reductions in costs can be achieved. Since many settlers may have little or no experience of rubber processing, large inputs of management would be required to operate small processing centres at village level. Furthermore, such a system, however well supervised, is likely to result in the production of lower grade rubber.

Grade will become more significant as competition with synthetic rubber increases; large factories would utilise the management required more efficiently and should result in higher grades being achieved. Therefore large scale processing in central factories is recommended for the Triangle.

Two types of factory process are possible. There is the conventional method of sheet production and a new process producing what is known as solid or 'crumb' rubber. The conventional method produces coagulated latex in smoked sheet form, which commands a high price, and processed scrap which is sold as brown crepe at a price some 8 - 10 per cent lower than that of smoked sheet. The sheet pro-

Table 11 - 10
Estimated Rubber Yield

Year of Tapping*	(Budgrafted Planting Material) Latex D.R.C. in lbs.	Scrap (lbs) 17.65% of latex D.R.C.	Total lbs.	(Clonal Seedling Planting Material) Latex D.R.C. in lbs.	Scrap (lbs) 17.65% of latex D.R.C.	Total lbs.
1	275	50	325	225	45	270
2	675	120	795	605	105	710
3	900	160	1060	815	150	965
4	1100	195	1295	1060	190	1250
5	1250	220	1470	1205	225	1430
6	1325	230	1555	1270	230	1500
7	1375	240	1625	1110	230	1500
8	1400	245	1645	1110	230	1500
9	1400	245	1645	1110	230	1500
10	1400	245	1645	1110	230	1500
11	1400	245	1645	1110	230	1500
12	1400	245	1645	1110	230	1500
13	1400	245	1645	1110	230	1500
14	1400	245	1645	1110	230	1500
15	1390	243	1633	1110	230	1500
16	1365	240	1605	1110	230	1500
17	1340	236	1576	1260	227	1487
18	1315	231	1546	1240	225	1465
19	1290	227	1517	1215	220	1435
20	1265	222	1487	1190	215	1405
21	1225	215	1440	1170	210	1380
22	1175	201	1376	1145	207	1352
23	1125	198	1323	1110	200	1310
24	1075	190	1265	1065	193	1258
25	1025	180	1205	1020	185	1205
26	-	-	-	975	175	1100

* The 1st year of tapping has been taken as being the second half of the 6th year after field planting for budgrafted material and the second half of the 5th year after field planting for clonal material.

cess is amenable to almost any scale of production although economies in the use of labour and supervisory staff occur as production rises. Data for crumb rubber production are at present limited, but since a number of estates are changing over to this process, indications are that it is more profitable to operate.

In the crumb process both latex and scrap are broken down into small granules before drying and packing. From coagulated latex this process produces a rubber of high and even grade. The cost of its production is expected to be similar or 10 - 15 per cent higher than sheet production. However, it is expected that crumb rubber from latex will be able to command a slightly higher price by achieving a higher grade. This will more than offset the higher processing cost (Table 11 - 11).

Considerable economies should be achieved in processing the scrap as well. A higher price is obtained because the scrap is more effectively washed and can therefore be classified in grades similar to the processed latex.

Table 11 - 11
Comparative Processing Costs and Sales Premiums

	Processing Costs [1] (M cents/lb)			Price Premiums [2] For Crumb (M cents/lb)
	Sheet (RSS-1)	Brown Crepe	Crumb	
Latex	2.0	-	2.3	5.0
Scrap	-	3.4	3.3	3.0-4.0

1) Excludes factory maintenance and capital cost
2) Compared with RSS - 1 at M cents 50 per lb.

The crumb rubber process is also more adaptable to the production of new types of rubber with improved properties. This is important to assist natural rubber in competing with synthetic. During the 5-6 years before rubber from Jengka comes into tapping the crumb process should become established and plant and equipment readily available. For these reasons, it appears realistic to plan Jengka rubber processing on the new method. Capital costs for factories are expected to favour the crumb process, although definitive construction cost estimates are not yet available. The sizes, location, and phasing of rubber factories recommended in the Triangle are given in Chapter 15.

PROFITABILITY OF PRIMARY CROPS

Profitability of crops has been compared using the concept of gross margin. Gross margins using social prices 1) have been discounted to the date of planting at 5, 10 and 15 per cent to reflect a possible range of interest rates that would be applicable. These are shown in Table 11 - 12 for oil palm and two types of rubber. Details of cost and revenue data on which Table 11 - 12 is based are given in Appendix 11 - 2. It is evident that oil palm can generate substantially higher returns than can rubber. Only after a 20 per cent fall in yield would oil palm and rubber have equal profitability.

Budgrafted rubber is expected to yield higher than clonal seedling rubber by about 10 per cent, but would come into tapping a year later. At high rates of interest clonal seedling rubber is marginally preferable to budgrafted rubber; both are equal at about 7 per cent interest.

The effect of small changes in price of oil palm and rubber was examined but made no appreciable difference in these results. Very large changes in price would be required to make oil palm less profitable than rubber at expected levels of yield.

Rubber has a higher daily labour requirement than oil palm. Assuming that alternate day tapping is required on budgrafted rubber, rubber requires an input of 51 man-days per acre at maturity, compared with an input of 25 man days per acre for oil palms (Appendix 11 - 2). Therefore under any system employing hired or smallholder labour, oil palm will be much more attractive to the farmer than rubber.

Table 11 - 12
Profitability of Primary Crops

Estimated Yields at Maturity (per acre per year)	Price during [1] first year of production	Present worth of annual Gross Margin for years 0 - 25 discounted to the date of planting — Rates of Interest used in discounting (M$ per acre)		
		50%	10%	15%
Oil Palm 9 tons FFB	M$500/ton oil) M$325/ton kernels)	5942	3095	1658
Rubber Budgrafted 2) 1,400 lbs. Latex (d.r.c.)	M cents 53 per lb.	4830	2415	1259
Rubber Clonal Seedling [2] 1,270 lbs. Latex (d.r.c.)	M cents 53 per lb.	4822	2496	1355

1) f.o.b. Jengka factories; palm oil and kernels; rubber 1977
2) 10% of value of processed latex added for scrap

In conclusion, whatever system of farming is implemented oil palm should be grown on all land that will give yields greater than 80 per cent of average projected yields.

LAND PREPARATION

Land clearance and soil conservation are major elements of land preparation necessary in Jengka for planting of crops. Other operations, while no less important are part of the normal cultural practices necessary for crop establishment in any area. The complete sequence of operations comprises underbrushing and felling; burning, pruning, stacking and reburning; road construction and conservation; and lining, holing and cover crop establishment.

Forest Clearance

Log extraction from Jengka must be completed in advance of the clearance of residual jungle if annual crop planting targets are to be achieved.

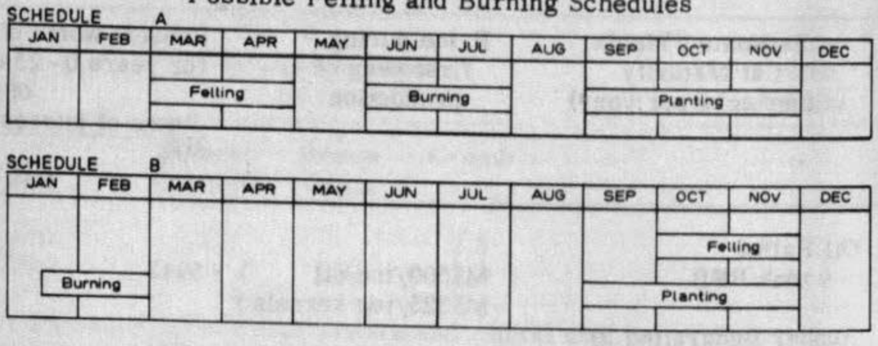
The two preliminary operations of underbrushing and felling must be completed before dry weather periods occur so that vegetation can dry out and maximum destruction of it by fire can be obtained.

As soon as burning is finished, pruning of unburnt growth, stacking of it and reburning should be carried out. During these operations the remaining tasks may be started so that all are completed by the time planting should commence.

In Jengka the sequence is governed by two dry periods occurring in January - February and June - July, and the long rainy season starting in September.

Two felling and burning schedules are possible in these circumstances (Figure 11 - 5).

Figure 11 - 5
Possible Felling and Burning Schedules

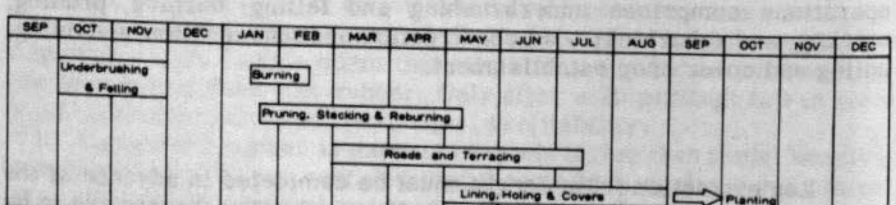


The first provides for felling in March - April, burning in June - July and planting in September. To fulfil this programme all other operations must be completed within about two to three months; large labour forces would be required during this short period.

The second schedule provides for underbrushing and felling at the end of one year, and burning in the following January - February. Thus three to five months are available for completion of all other tasks, and they may be more evenly distributed throughout the period. This schedule is therefore preferable.

The precise timing of each operation will be governed by the weather. Figure 11 - 6 gives a typical schedule in detail based upon FLDA contract timetables.

Figure 11 - 6
Typical Schedule for Land Preparation



Manual clearing - Hand labour has been extensively employed throughout West Malaysia and contractors are experienced in the organisation and management of gangs using chain saws for felling large acreages. Felling is regarded as skilled work and is normally done by contractors' gangs. However, a skilled logging force will be continuously on site during the years of jungle clearance, of whom about

10 per cent (110 men) are likely to be available for other work in October and November of each year. This force might be redeployed to assist in jungle felling. Other tasks in the overall process of land preparation require lesser degrees of skill and could provide some additional employment for nearby settlers during the early years of development of their own holdings.

During the past seven years contract rates per acre for clearing work on settlement schemes adjacent to the Jengka Triangle have risen from about M$140 to M$150. Local shortages of skilled labour may cause these costs to rise in the future, and a figure of M$167 per acre has been assumed for planning purposes.

Mechanical Clearing - Land clearance by mechanised means has not been undertaken on any scale in West Malaysia to date, except for some clearance of old rubber and coconut trees - a situation hardly comparable to that of removing even logged-over high forest. Very little data of cost are therefore available, nor data of suitable types of equipment and the direct effects of heavy tracked vehicles on the soil. Specific and large scale trials would be needed to determine suitable methods and costs directly, and such trials clearly could not be undertaken during the course of this study.

Discussions were held with manufacturers and suppliers of a range of possible types of clearing equipment and site visits to typical acreas in the Triangle to be cleared were arranged. The clearing techniques investigated included:

1. Conventional crawler tractor operations with angle blades
2. Conventional crawler tractor operations using an angle blade with cutting edge and tree splitting protruding point
3. Use of highly specialized power units with roller knife blades for tree pushing and crushing.

Conditions in which this equipment had operated were generally easier than those found in Jengka. Terrain was flatter, tree sizes smaller and densities lower. However, based on experience obtained in several areas of the United States, South America and in West Africa, manufacturers' agents expressed confidence that equipment now available could operate successfully and competitively with hand labour in Jengka. Some costs estimates were obtained (though not for strictly comparable conditions) in an attempt to assess the feasibility of mechanical clearance methods and to make cost comparisons with hand clearance. Figures provided showed costs of felling ranging from M$27 to M$41 per acre, and M$17 to M$28 for windrowing. These figures are likely to be on the low side for clearance of the kind of forest occurring in Jengka.

To these figures must be added the cost of burning in the windrow; estimated at between M$40 and M$100 per acre. Total clearance costs as estimated range therefore from as low as M$80 up to M$169 per acre. Even allowing for underestimating, it would appear that machine clearance costs are competitive.

Estimates of rate of clearance varied between 10 and 40 acres per day per machine. In all, the evidence obtained on both cost and speed of land clearance by machine makes it clear that FLDA should pursue these matters, perhaps not least in order to hold down present contractors' prices by being able to offer competitive alternatives.

Concern about the compacting effect of heavy tracked equipment on Jengka soils remains, however. Many of these soils have a high clay content and puddling of them in their usually wet state could lead to conditions adverse to plant establishment and also to a greater risk of erosion. This is a serious concern which can only be removed or confirmed by field trials.

At this stage therefore, definite opinions or recommendations on clearance by machine cannot be advanced. More information than could be obtained during this study is needed and direct trials should preferably be initiated by FLDA itself. There may well be opportunities for mechanical clearance if large areas can be let at once, and partial mechanisation, such as the use of machines for windrowing in combination with clearance by hand should be considered. Windrowing would be important in achieving a more efficient burn, a matter of particular importance in oil palm areas where large unburnt logs would create serious obstacles to harvesting heavy fruits.

Soil Conservation

Legislation has been passed to control land use on slopes and to counteract the serious effects of erosion in destroying national fertility. Slopes steeper than 18.5 degrees are not to be cleared but left under permanent forest.

The hazard of erosion and the need for conservation are directly related to the degree of slope. The land form units mapped on Jengka have been classified in terms of their predominant slopes, from 0-12 degrees rather than from 6-12 degrees, and include some gently sloping land on crests between valleys. The method of conservation cannot easily be varied within small areas of complex slopes and the proportions of land requiring different types of conservation have been estimated on Jengka from the classification of land forms.

The need for conservation is modified by the characteristics of the soil series. Soils having good physical properties, for example, Segamat and Munchong, and light-textured soils with free subsoil drainage such as Serdang are less likely to be eroded than others.

The type of conservation employed varies with the crop. Four main conservation techniques are relevant to Jengka. They are cover cropping, contour planting, contour terracing and platforms.

Mixed cover crops of three or four leguminous species are normally planted at a combined seed rate of about six pounds per acre, and are recommended for all areas irrespective of slope. By themselves covers are sufficient to prevent erosion on slopes of up to six degrees (Class C 2). The cost of establishment is estimated to be M$40.00 per acre.

Planting along the contour involves no significant extra cost compared with planting in straight lines. It reduces erosion hazards and is sufficient when cover crops are used, to prevent erosion on slopes up to 12 degrees (Class C3) for rubber, because the complete foliage cover protects the ground from an early stage in crop life. Contouring does not complicate latex collection since the amount of latex carried along each contour row will not be great, and carry distance can be controlled.

On the steep land of up to 18.5 degrees (Class C4) contour terraces between five and eight feet wide are recommended. The distance between rows will vary with the slope but a mean distance of 30 feet is recommended between rows. Estimated cost of construction is M$110 per acre for rubber on Class C 4 land, which comprises approximately two-thirds of the rubber area recommended for the Triangle.

The conservation techniques recommended for rubber on slopes above 6 degrees are not suitable for oil palms. On Class C3 land contour planting of oil palms is not considered adequate for three reasons; first the direct protection offered by the foliage is less than with rubber, second the rooting habit of oil palms is shallow and palms require level land for stability. Third, contouring increases the distance along rows that harvesters will have to carry heavy loads of bunches. Platforms of six feet by eight feet will be required to give sufficient protection against erosion of oil palm of up to 12 degrees in slope.

They have the advantage that a regular layout of rows will be possible over all oil palm land (Classes C 2 and C 3). Platforms need only be built for individual palms standing on slopes of between 6 degrees and 12 degrees. It has been estimated that approximately two-thirds of the oil palm area in the Triangle will require platforms, the construction of which has been estimated to be M$60 per acre. This is much cheaper than the alternative of providing contour terraces of six feet in width.

Planting of oil palms has not been recommended on Class C 4 land. Platforms would not be sufficient to prevent erosion and contour terraces of up to 15 feet in width would be required due to the steeper slopes. Most of the Class C 4 land comprises shallow soils whose suitability for oil palm is not confirmed.

Conservation within houselots will have to be given some emphasis. The use of tracked machinery for destumping the village areas tends to change the physical properties of the soil and makes it more susceptible to erosion. Settler guidance will be required to prevent erosion on houselots.

COSTS OF AGRICULTURAL OPERATIONS

There is given in Table 11 - 13, a summary of the costs of the main agricultural operations, discussed in preceding sections. These include the basic initial land preparation costs of clearing, drainage, platforming and terracing, and establishment of cover crops. They do not include other aspects of land preparation which are covered elsewhere in the report such as the construction of tertiary roads, and the development of villages.

Estimated costs of crop establishment, which include lining, holing and planting are also shown. Costs for land preparation and crop establishment are estimated costs for contractor operations, based on current FLDA costs.

The costs for crop maintenance are shown for the immature period and include only the estimated costs of materials and tools, using commercial prices. Labour costs for maintenance are not shown since these operations are assumed to be undertaken by settlers.

Table 11 - 13
Estimated Costs of Agricultural Operations
(M$ per acre)

	Year 0	1	2	3	4	5	6
Oil Palm							
1. Land Preparation							
Forest Clearance	167	-	-	-	-	-	-
Drainage 1)	40	-	-	-	-	-	-
Platforming 2)	60	-	-	-	-	-	-
Cover Crops	-	40	-	-	-	-	-
2. Crop Establishment							
Lining, Holing, planting	-	120	-	-	-	-	-
3. Crop Maintenance 3)							
Fertilisers and Sprays	-	15	20	40	79	-	-
Tools	-	6	3	3	3	-	-
Rubber							
1. Land Preparation							
Forest Clearance	167	-	-	-	-	-	-
Terracing 4)	110	-	-	-	-	-	-
Cover Crops	40	-	-	-	-	-	-
2. Crop Establishment							
Lining, holing, planting	-	36	-	-	-	-	-
3. Crop Maintenance 3)							
Fertilisers and Sprays	-	32	45	45	45	45	40
Tools	-	6	3	3	3	3	3

1) 15% of total acreage
2) 67% of total acreage
3) Labour excluded
4) 67% of total acreage

RECOMMENDED AGRICULTURAL LAND USE

Oil Palms and Rubber

Rubber and oil palms afford a sound basis for planning agricultural development and the economy of Jengka will depend upon them for some time to come. Moreover, it is clear that on the grounds of profitability, oil palms should be grown wherever they can be safely recommended and that where there are areas of low lying land they should be drained for oil palms and not cultivated to rice.

From the consideration fo the secondary crops in Appendix 11 - 1 it is evident that there are agronomic or economic reasons which preclude them from immediate selection for extensive development. Tapioca, rice and fruit trees can all be regarded as suitable enterprises on houselot areas or on areas which would be otherwise unused. Several other crops, such as groundnuts and soya beans will no doubt be grown on a vegetable garden scale although unsuited to planting extensively for reasons stated.

Freshwater fishponds should be constructed, wherever possible and especially in the areas recommended for rubber because their labour demand is not great. The sale of fresh fish can provide a valuable source of additional income to the rubber grower. Fishponds should be developed to the point of satisfying the increasing internal demand for fish within the Triangle. Thereafter it should be ascertained whether markets elsewhere could sustain further expansion of production.

Bananas should be regarded as a houselot activity for the time being. If performance of the varieties acceptable to the overseas market (particularly that of Japan) can be proven, and the necessary organisation and facilities created to handle large and regular shipments from West Malaysia, bananas could be included as a primary crop enterprise.

The development of a large manila hemp acreage in Jengka is dependent upon the assurance of a firm market. If this can be established, manila hemp might prove a valuable additional activity to the rubber grower as an intercrop in the 3 - 4 years following planting. Alternatively it could assume the proportions of a separate main crop.

As more agronomic and economic evidence becomes available for alternative crops the pattern proposed for Jengka may well change. The opportunities for such change should be regularly reviewed, especially in the context of the lands of lower capability.

The recommended agricultural land use map (Figure 11-7) is derived by assigning the crops selected on agronomic and economic grounds to their appropriate classes of land capability. It shows the location of areas to be planted to oil palms and rubber after reservation of certain categories of land for forest.

The forest lands occur in three main belts of steep terrain virtually dividing the Triangle from north to south and further subsidiary area reserved for forest on the southeast edge of the area. The forest lands form natural boundaries which will have to be taken into account for further planning purposes.

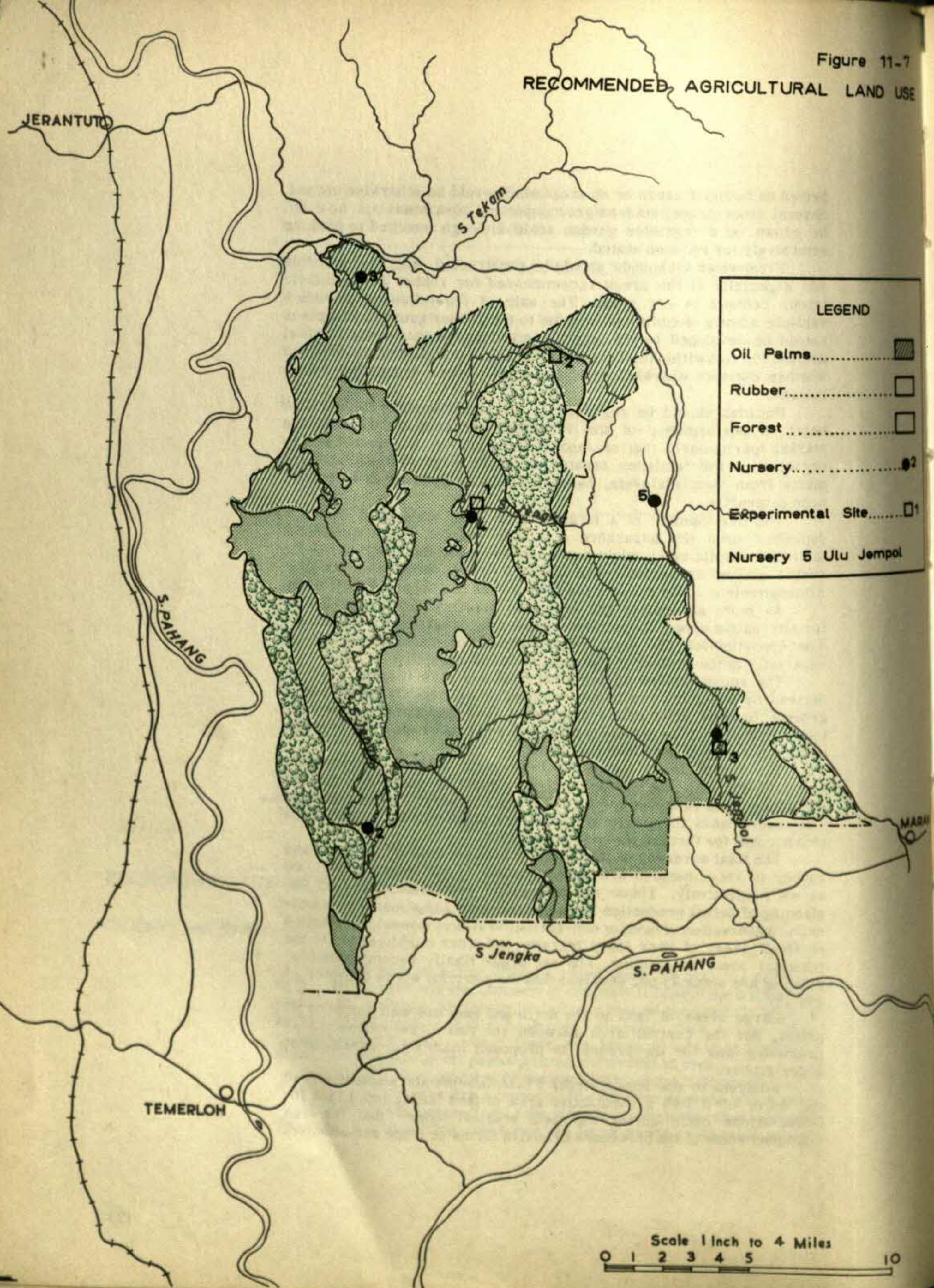
The total acreages of land for which the growing of oil palms and rubber is recommended are approximately 83,000 acres and 41,000 acres respectively. These are the gross potential acreages. The planning of actual production units necessitates adjustments to boundaries, reservation of land for non-agricultural uses (towns), elimination of small areas of very steep terrain, and other modifications to the potential area for planting. The net areas finally recommended for planting are about 25 per cent less than the potential areas (Chapter 14 and 15).

Large areas of land in the north and east are well suited to oil palms, but the central area between the two forest ridges is less promising and for the present is proposed mainly for development under rubber.

Adjacent to the Sungai Nerek FLDA Scheme and immediately to the north of it lies a substantial area of land falling into Class III. Observations made during the field studies showed that the area contained some of the best Class III land in terms of slope and effective

Figure 11-7

RECOMMENDED AGRICULTURAL LAND USE



soil depth. It is therefore recommended for planting to oil palms with the reservation that above average standards of management may be necessary.

Nurseries

A further and specialised land use is that of oil palm nurseries. Provisional sites have been selected (Figure 11-7), but their precise location must be confirmed when the jungle is cleared. Their use will be limited to two or three years only for the production and supply of oil palm seedlings to neighbouring planting areas. However, small areas of these nurseries might be retained for further use in supplying young fruit trees and other planting material to settlers, including oil palm replacements.

The amount of land allocated to nurseries totals 517 acres. Table 11-14 gives the acreages required at each site and the years during which oil palm seedlings will be supplied.

Table 11 - 14
Proposed Oil Palm Nurseries

Site	Maximum Size requirement in acres	Years of operation
Ulu Jempol (existing)	54	1967 - 8
No. 1	119	1968 - 9
No. 2	120	1970 - 2
No. 3	131	1972 - 3
No. 4	93	1973 - 4
	517	

At Ulu Jempol the present nursery site should continue to operate until 1968 and a further 20 acres should be developed without delay in the "dusun" area of the scheme.

AGRONOMIC INVESTIGATION IN JENGKA

The information derived from basic and applied research work already carried out in West Malaysia has been used extensively in the planning of Jengka. The organisations responsible for this information have continuing programmes and therefore in reviewing the need for investigational work in Jengka the possibility of duplication of effort must be avoided. It is not contemplated that either basic research work or advanced applied research should be carried out in Jengka; well staffed and well equipped research teams already exist elsewhere for this purpose. There is, however, a need for a small investigational team to be stationed in the Triangle, concerning itself primarily with problems which are either specific to Jengka or to the FLDA type of smallholder farming.

Soil/Crop Relationship

There is need for further data to be collected on the soil/crop relationship for several of the Jengka soil series. At present certain of these series are considered to have limitations precluding the planting of oil palm. For this reason conclusions on the suitability of some land in Jengka for planting oil palms is tentative and recommendations have been conservative. Possible soil moisture deficits have been referred to in connexion with certain soil series. The importance of laterite layers which may inhibit root development has also been discussed.

A series of studies should be designed and carried out in Jengka by properly qualified research personnel. They should include water-balance investigations, observations on rooting depth, and crop performance studies (especially on oil palms) on the soil series whose suitability is now in doubt. Trials to establish crop response to fertilisers are necessary for oil palms, but for rubber on those soils not at present covered by Rubber Research Institute recommendations. Fertiliser studies should be linked to soil and foliar analysis, and should be based on detailed soil surveys at representative sites selected after clearence of the forest.

Land Clearance

A study of land clearance alternatives is also important. In view of FLDA's large potential commitment for jungle clearance it would be of benefit to the Authority to undertake a formal field trial of land clearance methods. From such a study it should be possible to determine the most suitable system for clearing land on Jengka type terrain and to establish the order of savings in time and money which might result.

Oil Palms

In addition to the soils investigation with respect to oil palm discussed previously, there are several other factors affecting oil palm production to which FLDA, as a large scale producer in the future, should give attention. First, there is evidence to show that the damage to oil palms by porcupines may be considerable, especially in new areas still surrounded by forest. The potential loss is substantial. An ecological study of the porcupine should be made in order to establish at what point it could be best be controlled or eliminated.

It has been observed that, although the practice of castration of young oil palms is frequently employed (and is recommended in this report) its benefits have not yet been fully demonstrated. This operation is significant to the phasing of palm oil mills. If more precise evidence of its timing and value can be obtained, large sums of money may be saved by regulation of fruit production and adjustments to the early phasing of mills scheduled for construction in the later stages of development.

It is assumed that during the development programme oil palm seedlings for Jengka will be made available from existing sources which can provide planting material of proven quality. Looking to the future, however, it should be possible for FLDA to make large financial savings by providing their own pregerminated seedlings for the replanting cycle in the Triangle and elsewhere. To achieve this a programme of progeny testing would have to be drawn up and put into operation. While Jengka could provide a site for this work, assistance should be sought from the Department of Agriculture who maintain a staff of plant breeding personnel.

Three systems of recording fresh fruit bunches at harvest are discussed in Chapter 12. Their application in the field should be examined as part of the investigational programme in cooperation with the Ulu Jempol scheme management.

Rubber

In view of the comprehensive research coverage maintained by the Rubber Research Institute of Malaysia (RRIM), it is not anticipated that FLDA would initiate experimental work on the management of this crop. Doubtless, by arrangement, facilities could be provided to RRIM in Jengka if found to be necessary.

Crop Diversification

In one sense it has been possible to introduce diversification in Jengka, by introduction of oil palms as opposed to rubber. Nevertheless the pattern is basically one of only two crops. While this contributes to the National objective of encouraging alternative crops to rubber, it does not meet the need for increasing the range of potential primary crops for the Jengka smallholder. A wide range of possibilities was examined, but further diversification of the cropping pattern cannot be recommended as yet with certainty. It is prudent to recognise the instabilities inherent in farming due to climate, pest attack and economic influences and thus to study other crops which might be planted on a large scale in Jengka either in the latter phases of development or during the replanting cycle. Reference has already been made to the need for more precise agronomic data and for economic information on bananas and manila hemp. The studies should include consideration of suitable varieties, fertiliser requirements and pest and disease control.

Intercropping

The smallholder rubber grower is at a disadvantage with respect to his oil palm counterpart in that he faces a longer period before his crop begins to generate income and his total income potential is lower. This disadvantage is reflected in the size of the loan which he has to repay. Inorder to rectify this situation it would be to his benefit and that of FLDA if at least during some part of the establishment and maintenance period of his rubber, the land could support a second and short term crop. This practice is already employed by some smallholders, although the intercropped acreage recorded by RRIM is small relative to the total area growing rubber.

It has not been considered justifiable to recommend intercropping as general practice at present, nor to propose specific crops - though manila hemp and bananas would appear to be the most suitable. If the suitability of cocoa to the Jengka environment can be established, this crop also may merit consideration as an intercrop. On level land, intercropping raises few problems except possibly crop competition: a factor that can be corrected in the main by use of fertilisers. The successful development of intercropping on steeper land - involving reduction in the important cover crops and possible greater emphasis on terracing, and the overall financial benefits of intercropping - all need further critical examination and trial. It is felt that Jengka, where controlled conditions would apply, presents an opportunity for joint study between FLDA and RRIM.

The possibilities for intercropping with oil palms are less significant as the period to bearing is shorter and the adverse competitive effects of the intercrop on the palm crop itself are likely to be important.

Livestock

The indications are that the environment of Jengka is suitable to livestock production. Evidence of the performance of poultry is available and it is to be expected that, to meet the settler's requirements and the internal demands of the increasing Triangle population, poultry production based upon improved stock and management will be introduced. Similarly, goats may be introduced if improved animals and standards of management are used.

The future for cattle in the Triangle is less well known and there is a need for investigation into suitable breeds, rearing, feeding and housing.

While it is not envisaged that there will be any call for freshwater fisheries research work to be carried out by experimental staff in Jengka, practical aspects of pond construction and management should be demonstrated at experimental centres.

Farming Systems

As the potential for a wider range of crops and livestock is proven the need arises to determine the extent to which they can be integrated into a farming system and the relative roles which each enterprise can play. In this comparatively unexplored field FLDA has an important role the importance of which could extend well beyond Jengka. It will be expedient to study the extent to which crops and livestock are compatible and marketable, their demands upon land, labour and capital, the levels of management required and the degree of acceptibility to the smallholder of any potential system. The adaptability of systems to the differing terrain conditions of Jengka will also be important.

Specifically, there would seem to be a good case for examining the integration of cattle grazing with oil palm when the latter are sufficiently well grown. Under smallholder conditions tethering would probably be necessary: alternatively forage could be cut and the cattle stall-fed. A parallel investigation into suitable grass and/or legume mixtures for seeding under oil palm could be undertaken.

Experimental Sites

Experimental results will be required for the different soil series and slope conditions of the Triangle; to obtain such a coverage more than one site will be required. In selecting sites the accessibility and proximity of water should be considered. Possible sites are indicated on Figure 11-7 and would include the following series:

Site 1 (Main Site) Malacca, Durian and Segamat series

Site 2 Serdang, Batu Anam, Kedah and Durian series

Site 3 Segamat, Munchong, Telemong, River Alluvium and Akob series.

Final location would be made when clearing is complete and the precise nature of the work programme determined. The main site (Site 1) is easily accessible to all Jengka and should provide a focus for demonstrating experimental results to staff and to settlers as they are achieved.

Initially, the acreage of land required will be quite small. The central site, which will house staff and equipment should be 300 to 400 acres. As the programme develops and such activities as progeny testing are introduced the total acreage of all sites will increase until up to 1,000 acres may be involved.

Staffing of Investigational Unit

The investigational unit, essentially an FLDA team, should work in close cooperation with the Department of Agriculture, the Rubber Research Institute of Malaysia and other research bodies; its staffing requirements are provisionally assessed at one Agronomist in charge supported by an Agricultural Economist and an Animal Husbandry Experimentalist. Further additions may be required later. Finance for this unit will be required and provision has been made for evaluation purposes.

The estimated capital costs of this unit are M$172,000. The operating costs are estimated to be M$118,000 per annum. However, these costs need not necessarily be met permanently from the funds of FLDA. As the main crops come into bearing a small levy per unit of production from the Jengka settler and perhaps from settlers on other schemes would recoup the outlay. By 1985 a levy of M$2 per ton each of palm oil and of rubber would provide nearly M$320,000 from the Jengka settlers alone for financing experimentation.

CHAPTER 12
LAND DEVELOPMENT AND SYSTEMS OF FARMING

In the preceding chapter it was concluded that Jengka development must be based on two primary crops, oil palm and rubber.

Land resources are by their nature fixed, but the other main inputs are variable. Labour is plentiful; capital and management resources are limited. This is the situation today, and it seems likely to obtain for some time to come. Capital is scarce mainly due to the number of competing alternative uses; the scarcity of management is in some respects absolute. Management from outside sources can be hired just as foreign capital may be borrowed; although such assistance can and should contribute effectively to management in the short-term, it cannot be more than a partial and temporary substitute for properly qualified and trained local personnel. Moreover, its comparatively greater cost limits its application to a few senior positions. The level of inputs selected should make the most efficient use of these two scarce resources, capital and mangement.

TYPE OF LAND DEVELOPMENT

In West Malaysia, over two million acres of independent rubber smallholdings have already been developed with unskilled and semi-skilled labour and with very limited supplies of capital and managerial skill. For Jengka, however, a system of land development which would be considerably more intensive in its use of capital and management will be necessary. This is because of the relatively greater need for capital expenditure for roads, villages and other supporting infrastructure in the almost wholly undeveloped Triangle, for subsistence and housing for settlers' and for contract services. Jengka, unlike independent smallholder areas will also require overall supervision from the outset, for control and co-ordination of development; similarly agricultural management is needed at relatively high levels due to the predominance of oil palms in Jengka. A discussion of these factors, and of their influence on the type of land development necessary for Jengka follows:

Need for Capital Expenditure

Roads and Services - Generally in West Malaysia, independent smallholdings only develop where roads, villages, services and other related elements of infrastructure are already present; in the past rivers afforded the necessary transportation base for development of rural smallholdings. Land development on the scale of Jengka, however, is virtually bound to take place in areas where there is at present little or no infrastructure. Primary and secondary roads will have to be built before development can start; existing schools and other services will be too far distant or without adequate capacity. The direct return to capital from investment in such new infrastructure is generally very low but in the present context the benefits from it accrue almost entirely within the Triangle. This means that a higher return on the investment must be obtained than would be necessary on smaller projects where infrastructure costs could be shared between several classes of user outside the project proper.

Subsistence and Settler Housing - Substantial capital expenditure arises from the need to provide for subsistence of settlers in Jengka in the early years before production begins. On independent smallholdings which develop near existing settlements, settlers can commute daily to their new holdings during the non-yielding period without having to leave their existing employment, family or food supply. By contrast, the distance of Jengka from the present homes of potential settlers means that food and housing will have to be provided for settlers in the period before the start of production. For economic viability the system of development must be profitable enough to enable these additional costs to be repaid.

Contract Services - The plentiful supply of unskilled labour in West Malaysia, and the need to find maximum numbers of employment opportunities indicate that settlers' labour should be used in land development whenever possible. In the development of an undertaking of as large as Jengka, however, there are fewer opportunities to utilise low-cost settler labour than exist in development of independent smallholdings where settlers can proceed with clearing and planting at their own pace. This is because in Jengka, rapid development of the land must take place to minimise the period between jungle clearing and the start of repayment; interest accumulating on the initial expenditure must be prevented from becoming unduly large. It is necessary, therefore, for even such preliminary stages, as clearing and planting, to organise development on an efficient contract basis. While settler labour would be cheaper than contract labour, the cost in time lost by training settlers to undertake relatively skilled work outweighs any purely short-term financial advantage.

Once the crop is planted, contract labour should not be needed, since settlers can be trained to maintain their crops in the considerable time available before the start of harvesting.

Management

The development of the Jengka Triangle necessitates the co-ordination of a wide range of successive and interdependent operations. In this respect, the Triangle development differs significantly from the development of independent smallholdings. It will involve the carefully timed logging of a rich forest, land clearing, planting (in some years nearly 700,000 oil palms) and the construction of the entire required infrastructure of villages, roads, schools and other services and facilities. To succeed in this large effort, effective overall supervision is needed and a comprehensive management structure for the Triangle as a whole will be required from the start; management staff for individual projects will have to be added as they are developed.

Two thirds of the total crop area in the Triangle is suitable for oil palms. Generally, they will require a higher standard and intensity of management for establishment, and for harvesting, collection and transport of fresh fruit bunches to mills than is needed for rubber, particularly on a smallholder basis. There is very little smallholding experience with this crop in West Malaysia and management will therefore have to be provided by FLDA, especially in the early years of projects. Greatly increased profitability can be obtained from close supervision and highly skilled management, involving high densities of staffing. This will be effective both in crop establishment as well as through the years of harvesting until settlers are trained sufficiently for management to be reduced.

For rubber there is already a large amount of independent smallholder knowledge of the crop. If, however, Jengka's intake of settlers comprises mainly those with little or no experience with rubber, a management density similar to that of oil palm will be required, since modern bud-grafted clones are far less tolerant to poor maintenance than the unselected seedlings usually planted on independent smallholdings in the past.

Settlers with some experience with rubber could be settled with the minimum of supervision. It is hoped, but not assumed in costing management for this report, that by the time later phases of Jengka develop a proportion of the settlers will be of this type and can be settled in the rubber areas at relatively low management costs.

It is for these reasons, involving an intense use of both capital and management, that Jengka's system of land development must be capable of generating a high return, and of achieving this as soon as possible. An indication of the feasibility of a high return will substantially improve the prospects of attracting the necessary capital.

SYSTEMS OF FARMING

The high inputs of capital and management postulated for Jengka could be applied to a number of farming systems. This section of the report considers various alternatives and combinations and concludes by recommending a supervised smallholding system for both oil palms and rubber. The systems to be examined include commercial type estates, owned and managed either by private enterprise or by the FLDA communal or co-operative settlements and individual smallholdings. All these are considered in terms of potential gross production and the use of capital, management and labour resources. They are also examined in relation to social policy.

The Estate System

The characteristics of the estate system are high inputs of management and capital, efficient use of labour, and a high return to capital. Each worker is fully occupied, is paid a fixed or piece-rate wage and is provided with housing, but does not normally take any share in the profits. Labour overheads are minimised by employing more than one worker per household.

Private Enterprise Estates - Where capital and skilled management are important and scarce there are clear advantages in encouraging private enterprise. The part that private enterprise can play in rapid and efficient land development under rubber and oil palms has been amply demonstrated in West Malaysia and the extension of this type of development into Jengka has therefore been carefully considered.

Contribution by private enterprise could conceivably take two forms; either as large self-contained estates or smaller nucleus estates integrated with surrounding independent smallholdings. Both forms would necessitate the grant of extensive areas of land; the first to provide an economic entity and the second to ensure the minimum economic throughput of produce for the factory.

There can be little doubt that under the estate system rapid land development would be possible, capital and management resources would be used efficiently, and labour would be employed under good conditions. But the allocation of large areas of land for private enterprise development is inconsistent with one of the primary planning requirements of Jengka - that of land settlement involving the granting of land rights to individual settlers. This is an important feature of Government policy. It would be difficult to justify the heavy public investment necessary for infrastructure on Jengka if it did not at the same time promote rural social policy to the fullest possible extent.

The profitability of commercial estates is dependent on full utilisation of labour, resulting in a smaller number of employment opportunities than on other systems and conflicting with the national objective of providing a large number of employment opportunities.

For these reasons and despite undoubted economic advantages, the allocation of land for large scale private enterprise plantations is not recommended for Jengka. This does not mean, however, that private enterprise estate development should not be encouraged elsewhere in West Malaysia. Other ways in which private enterprise can assist development of Jengka are discussed elsewhere in this report.

FLDA Estates - FLDA has recently proposed that on its oil palm schemes, some land should be retained by the Authority and operated on an estate basis so that the profits could meet the costs of management. The proposal has not specifically been made for Jengka but its suitability has been examined in this context.

As the scale of land development increases, subsidised settlement clearly cannot be afforded. Management costs must therefore be covered, as well as other costs. There is, however, as alternative to FLDA's proposal which is considered preferable. The smallholding itself can provide the necessary source of revenue; it is desirable that the smallholder should pay for this service rather than that it should be a subsidy to him. It is proposed that management costs can and should be recovered direct from the settler. The way in which this can be done is discussed in Chapter 13.

The development of estates by FLDA to recoup management costs in Jengka would require reservation of nearly one quarter of the oil palm land. A large reduction would have to be accepted in the area available for settlers. This is at variance with social policy on land settlement.

The running of the whole Triangle by FLDA on an estate basis encounters essentially the same objections - though there would be similar economic advantages - as those listed in connection with private enterprise estates. This approach is, again, not recommended.

Individual Holdings and Communual Settlements

The estate system described provided a highly efficient form of land development but it fails to provide land settlement in that the working force do not participate in the management, rights in and profits from land.

It is a corollary of the need to obtain a high return from a high cost enterprise that whatever system is adopted it must be effectively organised and supervised by FLDA until settlers are experienced enough to manage the land with little outside assistance. However, the requirements of land settlement also mean that FLDA will have to settle more families and accept a lower return to capital than would be the case with the full labour utilisation on an estate.

Land settlement implies occupation of land and a share in the profits from the enterprise but not necessarily freehold ownership. Basically there are two alternatives. The first is a system in which individual settlers have a recognised responsibility and a right to the income from a particular plot of land. In the second there is no individual occupation of land; settlers are participants in a communal enterprise whose profits they share.

Only a small proportion of existing FLDA schemes have come into bearing. A definite policy decision therefore as to the most appropriate system for settlers as a whole is still under consideration. There is in principle, an inclination to allocate plots to individual settlers and this is the current practice on rubber schemes. But hitherto a communal system has been adopted for the two oil palm schemes that are in bearing. The differential treatment is due to the greater complexity of oil palm production, particularly harvesting and the comparative lack of experience with oil palms as a smallholder crop in West Malaysia. It has been found, however, that individual smallholders are capable of displaying initiative, judgement and diligence in the growing of a high priced cash crop. Perhaps the closest analogy is that of Kenya where the efficient collection of young green tea and its transport to the tea factory is very critical but where operation by smallholders has been very successful.

The planning of the Jengka Triangle for development of about 83,000 acres (gross) of oil palm land provided a suitable opportunity for a critical comparison of the advantages and disadvantages of the two basic systems. Individual and communal holdings systems are compared here on the bases of the relative ease of organisation and supervision and harvesting. The incentives to the settlers with respect to those aspects of the two systems are particularly important factors in this comparison.

Organisation and Supervision - The main arguments against the adoption of the individual smallholder system turn on the practicability of organising individual production, harvesting, and payment. Supervision or financial incentive either together or separately are essential prerequisites for high value production. The degree of supervision possible for a given level of staffing is somewhat greater in the communal system than in the individual one, so there must be a real incentive for the settler to practise good crop husbandry if the individual system is to produce the same quantity and quality of output.

The agronomic disadvantages of the two systems are compared for the main operations for rubber and oil palms in Table 12-1 which shows that there are no agronomic reasons to prefer either system provided there is adequate supervision or incentive.

During the period before the main crop comes into bearing, the communal system is to be preferred whichever alternative is adopted later; it provides for the necessary close and direct supervision during this critical period. Most settlers are likely to be inexperienced, especially in the cultivation of oil palms, and therefore will lack technical knowledge of the benefits of careful maintenance. Individual settler incentive is unlikely to be an effective replacement for supervision by project management staff at this stage.

Table 12 - 1
Comparison of Farming Systems

Operation	Communal System	Individual Smallholding
Maintenance (oil palms or rubber)	No difficulty	No real difficulty but possibility of neglect with consequent spread of lalang.
Pruning (Oil palms)	No difficulty though gang methods are often too severe	Possibility of neglect, but underpruning is preferable to overpruning.
Fertiliser application (oil palms or rubber)	No difficulty	No difficulty
Tapping (rubber)	No difficulty	No difficulty.
Harvesting (oil palms)	No individual care of palms. Excessive cutting of green leaves possible	Possibility of irregular harvesting or harvesting of under-ripe bunches unless incentive only to cut ripe bunches.
Collecting (Rubber)	No difficulty	No difficulty.
(Oil palms)	No difficulty	The settler must keep to a set harvesting schedule.
Processing (Rubber and oil palms)	No difficulty	Level throughput at factory depends on settlers' cooperation.

Harvesting - With experience and instruction settlers will appreciate the extra benefits resulting from good crop husbandry. Such an appreciation will only provide settlers with effective incentives, however, if they can relate their earnings to the quantity and quality of their own production. The communal system obscures this relationship, but a system of individual holdings strengthens it and thereby enhances settler incentives. It is the system of harvesting, and the payment for the harvest, that can provide the opportunities for settlers to recognise the real value and productivity of their work.

For rubber, settlers can be trained in correct tapping procedures before the start of production. Under a system of individual holdings payments for harvest can be directly related to production at little extra cost by weighing each settler's latex and measuring its specific gravity. An incentive for settlers to increase yields by regular maintenance and fertiliser applications and to lengthen the productive life of their trees by careful tapping is therefore easily provided.

For oil palms, there are several practical difficulties involved in harvesting efficiently on a system of individual holdings, caused by the bulkiness of fresh fruit bunches and the importance of harvesting ripe bunches whose value depends as much on quality as on quantity. These problems must be solved if settlers are to be allowed to operate as smallholders with individual holdings, as seems socially desirable. Through training and supervision in the first few months of harvesting the settler can be taught to recognise ripe bunches. There is ample evidence at the FLDA Kulai oil palm scheme of the efficiency with which this has already been achieved by FLDA. In fact, there is a distinct possibility that selected settlers can with diligence gain very considerable skill in harvesting, but under the communal system as it is now, being operated, they cannot earn a proportionate return for their superior effort. More important, the settler must also be enabled to identify what he harvests (or the price paid for it) with his holding; he will have no incentive to become a more efficient farmer if he cannot enjoy the benefits of that efficiency.

Collection of fruit bunches from individual holdings is a difficulty much easier to resolve than is the recording of quality and quantity for each settler. Fruit bunches are heavy and cannot in any case be transported by hand very far. Careful layout of holdings in relation to the harvest road system will do much to reduce additional journeys by collecting trucks and it is not considered that transport costs need increase significantly because of additional mileage travelled.

More checking and supervision will be needed if collection is on individual holding basis but with time this should also be reduced provided settlers have an incentive to produce good quality ripe bunches. To provide such an incentive fully it will be necessary to develop a method of recording at collection points which effectively provides a premium on quality. This is usually done on estates by assessing the proportion of loose fruits and indication of the ripeness (and therefore quality).

Three methods of recording harvested fruit from individual holdings are suggested. These are arranged here in order of complexity - and hence time and cost in practical operation.

1. Recording of individual settlers' harvest can be made on a basis of bunch count. This procedure is simple and quick and is already carried out by FLDA when group harvesting is employed. Bunch counts by themselves do not, of course, allow either weight of fruit or degree of maturity to be related to individual holdings. This system, therefore, though

easy to operate provides the minimal level of incentive to the settler.

2 Recording can be made on the basis of total weight of bunches (loose fruits included). This would still constitute a fairly rapid operation and recording would not be difficult. It would provide an additional level of incentive to the settler.

3. Bunch and loose fruit weights could be recorded separately at each holding and a price differential awarded on the basis of the ratio of loose fruits to bunches. The operation would involve considerable extra time and recording and price assessment would be rather complex. It would however provide the highest level of incentive to the individual settler since he would be enabled to relate both quantity and quality of his product to his own holding. Such an incentive would not be effective within a communal system.

A satisfactory system could be worked out in stages beginning on a basis of simple bunch counts. For both bunch counting and bunch weighing systems it should be possible to develop bunch count - weight - degree of maturity relationships for areas within settlements or projects by means of statistically controlled sampling at chosen intervals of time. In this way an additional element of incentive could be provided on a limited area/group basis.

Finally, at more widely spaced intervals individual holding checks on bunch weight and loose fruit weights individually could be set up in order to relate quantity and quality more closely to individual settlers' output and hence approach the highest degree of incentive.

In the long term, provision of proper incentives and the resulting greater independence of settlers on individual holdings will make possible larger reductions in FLDA management than is possible on the communal system. Trials of the alternative systems of harvest recording suggested and possibly additional variations of them should be instituted by FLDA at field scale with a view to developing a method which will become increasingly responsive to the need to stimulate settler incentives. Trials should be planned as soon as possible, based on tests which could be undertaken at existing FLDA oil palm schemes, and should be commenced at full scale in the Triangle as the oil palms of the first project come into bearing.

Recommended Farming System

It is concluded from this review of the basic systems of settlement that it is not necessary to differentiate between rubber and oil palm growers and that the individual smallholder system is preferable. In a large composite scheme such as Jengka where both crops will be grown (though not on the same settlement unit) radical differentiation in the treatment of the settlers would be invidious and liable to cause discontent and trouble. A system of individually operated holdings conforms with traditional rural organisation in West Malaysia. Provided such a system is workable for oil palm and rubber cultivation - and it has been concluded that it is - there are clear sociological advantages in continuing it. In addition, there is a rural tradition of co-operation between members of a community for certain crop activities, most notably in rice cultivation where certain activities are undertaken co-operatively. Such a tradition could usefully be exploited for the quite different crops to be grown in Jengka.

From evidence obtained during the study from settlers, potential settlers, and management staff on schemes, it was clear that the prospect of eventual title to a specific holding makes FLDA schemes particularly attractive to settlers. Individual occupation of land undoubtedly has a great significance to them as evidence of achievement, providing a sense of security and constituting an identifiable asset which may be handed on to the next generation. FLDA rubber schemes already operate on an individual holding basis; the social aspect provides a further reason for extending the system to oil palm schemes and therefore in the present context to Jengka as a whole.

Allocation of Holdings

The arguments in favour of the individual holding system are considered conclusive but for a variety of practical reasons the identification of a settler with his plot should not take place too early. While confirming in the long-term that the smallholder system should be adopted it is recommended that a communal system should be operated in the first few years after planting. There are a number of reasons for advocating this. In the first place the great majority of settlers are not expected to be experienced in the cultivation of either oil palm or rubber. A period of communal activity can therefore serve also as a training period - and training can be more readily carried out by treating settlers on a group basis than individually.

Secondly a number of maintenance operations, such as weeding, are more easily carried out and properly supervised on a communal basis. It is important that these operations are properly carried out throughout each settlement unit to ensure successful establishment of the main crop.

There are, however, important differences between oil palm and rubber. Rubber comes into bearing after six years, and there is plenty of time to train settlers in tapping procedures before production begins. It would therefore be reasonable to allocate holdings some years in advance of the actual start of tapping.

With oil palm, however, harvesting begins only three to four years after planting but important elements of settler training (recognition of ripeness in the fruit bunches, etc.) can only take place as harvesting proceeds. The extension of the communal system into the early years of harvesting therefore has certain merits.

On balance, considering also the social importance of land tenure, it would seem wise to allocate holdings on both oil palm and rubber settlements at about the same time after planting. If this was done after five years, the rubber settler would be allocated his plot within about a year of first tapping and the oil palm settler about 18 months after beginning harvest. By that time both types of settler should be properly trained in handling their crops.

One final qualification should perhaps be made. Five years after planting the rubber settler will still be on a low income awaiting his first crop. The oil palm settler will have begun to increase his income substantially. It has been observed that the early allocation of holdings in the case of rubber has resulted in greatly increased standards of maintenance - the settler feeling he is then looking after his own crop. If this observation can be confirmed by more extensive evidence there would be a strong case for allocating holdings sooner after planting, perhaps after two years in the case of rubber.

COMPOSITION OF THE SMALLHOLDING

Holdings in the early FLDA schemes were divided into three parts; the main crop area, the dusun (orchard) area, and the houselot area.

Individual dusun lots, generally of two acres, were allocated to settlers to encourage diversification and to stimulate incentive. These dusun lots have not proved effective, possibly in the main because the dusun areas tend to be some distance from the settlers' houses and the types of activity likely to be carried out on these additional lots tend to need particularly close supervision or watching. Fruit or livestock production are cases in point. Furthermore, separate dusun areas involve a third place of work (in addition to main crop area and houselot) and thereby complicate FLDA management.

It is recommended that provision for the kind of activities envisaged in the dusun areas be made by allocating larger individual houselots to settlers. Present houselots are one-quarter acre in area and provide only enough room for a settler's house and sufficient vegetables and some fruit for home consumption.

Provision of additional land for diversification into secondary crops for sale will not be as profitable (per acre) to the settler as his main crop until marketing channels are developed. However, there are long term social and economic reasons for incorporating the characteristics of the dusun into the houselot and making it larger. It is recommended that a three quarter acre houselot be provided, with the following advantages:

1) It provides an area for diversification and incentive.
2) It gives settlers a chance to build up production and marketing systems on a small scale that could be expanded rapidly to suit changes in the relative prices of agricultural commodities.
3) It provides an area for animal husbandry activity, e.g. paddock grazing of cattle or intensive poultry production.
4) It provides a larger area for food crops for settlers with large families.
5) It allows a variable input of labour depending on the enterprises chosen. By selecting labour intensive enterprises like poultry or vegetable production, the employment on oil palm holdings and on holdings supporting large families with plenty of labour available will be increased.
6) It provides an additional income. The cash income from sales from labour extensive crops is likely to be over M$200 per year after some years and the value of home consumed produce over M$100. Income from labour intensive enterprises may well be greater.

Additional advantages of the large houselot are discussed in Chapter 14.

Rights in Land

The Land (Group Settlement Area) Act 1960 provides for control of settlement scheme land to be vested in FLDA until FLDA's investment is repaid. After this, these powers revert to the State Government concerned. Ownership of the land remains with the State throughout. The Act further entitles FLDA to recoup its own investment, including capital expenditure, costs of services (supervision and administration) and interest, as well as premiums and rents due to the State - the whole as a consolidated annual charge.

The settler is entitled to occupy land 'in expectation of title' and his security of occupation is guaranteed by the issue of a certificate (Form "A"). The land however remains in the ownership of the State until the settler's repayments to FLDA are completed. At the same time the settler is required to maintain his land according to rules of good husbandry. His rights can be cancelled by FLDA if he is in default or breach of his obligations.

Since the repayment of the annual charge may take as long as 22 years, presentation to the settler of a copy of Form "A" when land is allocated would provide tangible evidence of the State's ultimate intentions to alienate the land.

SETTLER SELECTION

The system of selection of settlers now in use by FLDA is based on a preliminary application followed by an interview in which points are awarded for various factors. One third of the points are allocated in respect to age and physical fitness. Another third relate to agricultural background, with emphasis on previous experience of rubber and oil palm. The remaining points are awarded on the basis of family size and land ownership, emphasis here being placed on need (lack of land and/or large families). The system of selection is considered sound and the relative weighting of points gives consideration to qualification and need in a proper proportion.

It is clearly important that selection of settlers on this basis is in practice as effective as possible, in view of the very large amounts of public expenditure in settlement which are involved. Proper selection would be further safeguarded if FLDA was given the prime or ultimate responsibility.

Two matters which follow after selection of the settlers should be mentioned here. These are proper briefing of the settler, on selection or on arrival in his village, and training the settler in the establishment, maintenance and harvesting of his crop. Both functions are currently carried out by FLDA; their introduction here is made in order to emphasise their importance. Thorough briefing of the settler on both his rights and obligations can avoid misunderstandings and possible future friction or unrest as well as assisting in developing individual training. The importance of thorough training, including demonatration and active participation by the settler, has been referred to in other parts of this report.

RESERVED AREAS

Although an individual smallholder system has been recommended for the main crop area it remains to be considered whether some of the land should be reserved for a period and not distributed to settlers. This section of the report discusses reasons for withholding land and makes recommendations on their practicability.

Reservation of uncultivated land

Reservation of land for later distribution would make it possible to increase the size of holding if it was considered advisable to increase incomes and employment for settlers at a later date. It would also allow for extra land to be distributed to the especially enterprising settlers, to settlers with larger families, or to the children of settlers as they reach an age to undertake farming on their own. Settlement of a somewhat reduced area of land would not reduce infrastructure or management costs unless such reserved land was kept in one block within the Triangle as a whole. To fulfill the purposes indicated above, land would have to be reserved within each settlement unit and in this case the net effect would be a considerable loss in revenue. Reservation of uncultivated land is not therefore recommended.

Reservation of cultivated land

The only practicable method of reservation of cultivated land would be to keep in production under FLDA control, central areas of land for later distribution, at the same time guaranteeing throughput for the factory. This would involve a permanent labour force and an estate system of operation. This has already been discussed and is not recommended for Jengka.

CHAPTER 13

SMALLHOLDINGS

The purpose of this chapter is to arrive at a recommendation for a smallholding size that will give a settler a satisfactory income in return for a reasonable input of work, at the same time enabling him to repay the costs incurred on his behalf and giving FLDA a proper return on their capital.

Size of holding depends on the relative emphasis placed on such factors as employment opportunities, labour input requirements, farm income, loan repayment and settler's cash income over the entire length of the evaluation period, and the desirability of uniformity in land ownership (Appendix 13-1). Determination of holding size is complicated by the fact that once established it is not susceptible to adjustment; whereas acceptable levels of income and employment as well as prices, which largely determine the farm income, are all likely to change.

In the short term the interests of FLDA in settler's income, of national planners in providing employment, and of the lending agency in repayment may appear to conflict, although their long term interests in the development of West Malaysia are all the same.

The factors affecting the size of smallholding are discussed separately in the following sections, then drawn together at the end of the chapter when recommending the most suitable size for each main crop.

FIXED OR VARIABLE HOLDING SIZES

If size of holding could be varied, it would be possible to use this instrument as a means for adjusting employment and income levels to comply with need and opportunity. It is not practicable to attempt to allocate different sized holdings at the outset according to the capacity of individual settlers and it was concluded in Chapter 12 that provision of additional land for increased income or as an incentive to enterprise, by reserving areas in the Triangle for later distribution, was not to be recommended. Provision of such additional land by transferring, at a later stage in development, a proportion of families to another scheme is also not considered practicable. A constant size of holding seems therefore to be the desired solution.

Since land ownership is an element of considerable importance to individual settlers and different-sized holdings would lead to friction or discontent, the holdings should be of equal size irrespective of the crops to be grown.

They would also facilitate substitution between crops, when replanting is due, should relative profitability change greatly. Equal-sized holdings are for these reasons to be preferred.

EMPLOYMENT

Employment Opportunities

There is at present in West Malaysia a rapidly increasing rural population, much of which is under-employed. A National objective of the First Malaysia Plan is to provide the maximum number of employment opportunities.

In the short term, fulfilment of this objective requires the settlement of the maximum number of families on new land, and therefore small holdings. In the longer term, larger holdings can generate increased government savings which can be reinvested to provide further opportunities.

From the point of view of employment opportunities, it is possible to indicate a range of levels extending from the minimum effort needed to yield a subsistence income up to full labour input by a settler family in the later life of a perennial crop.

In this report a 'reasonable' level of employment, between these two extremes, has been adopted as desirable. This is most easily defined as full labour input by the settler, as opposed to full labour input by the settler plus his family. This level of labour input is further defined as providing eight hours work per day for 300 days per year: a level which is certainly higher than the average level of labour input in rural occupations in West Malaysia to-day.

The extent to which additional assistance from within the family can or should be expected is discussed later in this Chapter. It should however be pointed out here that the enterprising settler can find additional opportunities for productive employment on his houselot or in fish farming.

Labour Requirements

The labour requirements of both main crops are high initially, then decline until the start of tapping or harvesting; thereafter they increase rapidly with rubber, more slowly with oil palms, to a maximum level which remains unchanged for the rest of the crop's life.

The labour requirements for up to ten acres of either crop through the immature period are not limiting to a settler except possibly on ten acres of rubber when some help for weeding from his wife in the second year after planting may be needed. It is the requirements of the fully mature crop that are limiting and are summarised in Tables 13-1 and 13-2. (The requirements for each year of crop life are tabulated in Appendix 11-2).

For rubber the normal tapping task on an alternate daily system is four acres per day, since tapping must be limited to the early morning to obtain maximum yields. Five acres of tapping per day, 300 days per year, require a daily input of five hours excluding collection. This can be accomplished by the settler if he starts tapping before dawn with a head-lamp, as is often the practice. Alternatively, he may receive some assistance from his wife, though with experience this need should decrease from two hours per day to one.

If an individual settler and his family could not consistently manage a five-acre daily task, it can be reduced to three acres by changing to tapping every third day. With currently recommended bud-grafted clones the resulting reduction in yield (after allowance has been made for smaller losses from brown-best and premature death from other causes) is less than ten per cent over the tapping life of the tree. Alternatively he could reasonably expect some casual assistance from relatives and others - as is now the case when the need exceeds the immediate family capacity.

Table 13 - 1
Labour Requirements for Rubber in Alternate Day Tapping
(No seasonal peak - 25 days tapping per month)

Size of holding in acres (120 trees per acre)	6	8	10	12 [1]
	Hours	per	day	
Daily tapping requirement before 10.30 hours				
Inexperienced (1st two years tapping)	3.6	4.8	6.0	4.8
Experienced	3.0	4.0	5.0	4.0
All other work	1.4	1.8	2.1	1.8
Total hours per day				
Inexperienced (1st two years)	5.0	6.6	8.1	6.6
Experienced	4.4	5.8	7.1	5.8

Source: Records of the Rubber Research Institute and Discussion in July 1966.

1) This holding would require more work than could be done by a settler alone with alternate day tapping, or would involve lower yields under a three day tapping system. (Yield drop of 7.5 per cent assumed.)

Table 13 - 2
Labour Requirements for Oil Palms

Size of holding in Acres		6	8	10	12
Days per month					
Harvesting		12	12	12	12
Other work		5	6	8	10
		17	18	20	22
Hours work per harvesting day [1]					
Peak month	harvesting	2.6	3.4	4.2	5.1
	collecting	2.6	3.4	4.2 [2]	5.1 [2]
Average month	harvesting	1.7	2.3	2.8	3.4
	collecting	1.7	2.3	2.8	3.4

(1) Sabah Planters Association Oil Palm Seminar "Fruit Evacution and Collection", N. S. Sanker.
(2) Settler will require assistance from wife or children in collecting loose fruits for several months per year.

With alternate day tapping, 10 acres can be maintained with 300 days of seven hours work. With three-day tapping 12 acres is reasonable but some assistance would be required for weeding in the initial years. With any of these acreages there would be sufficient time during the afternoon to maintain a three-quarter acre houselot.

The labour requirements for yielding oil palms increase to a maximum level of 25 man days per acre per year from the tenth crop year onwards. At least 12 acres of oil palms are required to give the settler the same level of employment, including harvesting and weeding, as is found on an oil palm estate. Twelve acres of oil palms could be managed in 300 days and the houselot maintained in the afternoons by a settler without assistance.

It should not, however, be assumed that a smallholding of 10 acres requiring only 250 days work per year would be wasteful of potential labour since in the spare time thus available the settler could make more use of his houselot. He might also engage in rice cultivation and fish farming and these activities could occupy him for at least 50 man days per year.

It is concluded that on the basis of 'reasonable' employment the labour requirements of the main crops suggest holdings with eight or ten acres of rubber and ten or twelve acres of oil palms.

INCOME

The sections that follow deal with the farm income (farm gross margin) generated by different sizes of holding and the distribution of that income between FLDA (loan repayment) and settlers (settler's cash income).

The distribution of a limited farm gross margin between the conflicting demands of loan repayment and settler's cash income should remain a matter for continual review but the size of the farm gross margin, from which the distribution has to be made, is governed by the holding size and must be decided at the outset. For these reasons farm gross margin and its components, loan repayment and settler's cash income, must all be considered before holding size can be determined.

FARM GROSS MARGIN

The requirements for farm gross margin are that it must be large enough to rule out any possibility of repayment failure, and that it should be large enough to provide an adequate long term cash income for the settler and his family.

The farm gross margin (equivalent to FLDA's "net farm income before deduction of repayment") is directly proportional to the acreage of main crop. The settler's cash income is that part of the farm gross margin that remains after each annual instalment of loan repayment has been made.

The farm gross margins from rubber and oil palms on different sizes of holding are shown in Figure 13-1 and 13-2 over the 26-year evaluation period from the beginning of forest clearing. The negative values in the first few years illustrate the costs of establishing and maintaining the crop before there is any revenue from tapping or harvesting. The declining of the gross margins in later years is due to the projected falling prices for both crops and also to a fall in the yield of rubber from the twentieth year after planting onwards.

The gross margins shown are those calculated for a crop planted in 1972 and include the value of houselot produce sold and consumed. They assume all processing will be at cost.

Two requirements for farm gross margin estimates must be considered: first, the uncertainty of medium and long term price projections and the attendant risk of repayment failure, and second the long term estimates of potential farm gross margin.

Uncertainty and Risk of Repayment Failure

The size of the farm gross margin is a major consideration since it affects the risk of repayment failure.

Although price falls are projected, there remains a high degree of uncertainty as to rate and amount of fall due to the impossibility of estimating the rate of technological advance in synthetic substitutes or alternative crops yielding competitive products. Long term price projections can be no more than general indicators; even a variation of M$0.05 per pound in the f.o.b. price of rubber makes a difference of M$75 per acre in the annual farm gross margin.

The cost involved in Jengka is large enough for the finances of the public sector of the economy to be materially affected if FLDA is unable to meet its repayment commitments during a period of seriously adverse prices. With so great a degree of uncertainty it is desirable to safeguard against the risk of repayment failure by selecting a larger holding and projected farm gross margin than is otherwise absolutely necessary, so that a deduction can be made to a reserve fund. Provision of such a reserve is considered in the next section as part of loan repayment.

Long Term Farm Gross Margin

Settlers can receive the whole of the farm gross margin after the last repayments minus any deduction for harvesting and transport organisation and any deduction due to the State for rent or premium. Thus the farm gross margins projected for the end of the repayment period give an upper limit to the levels of settler's cash incomes in the long term.

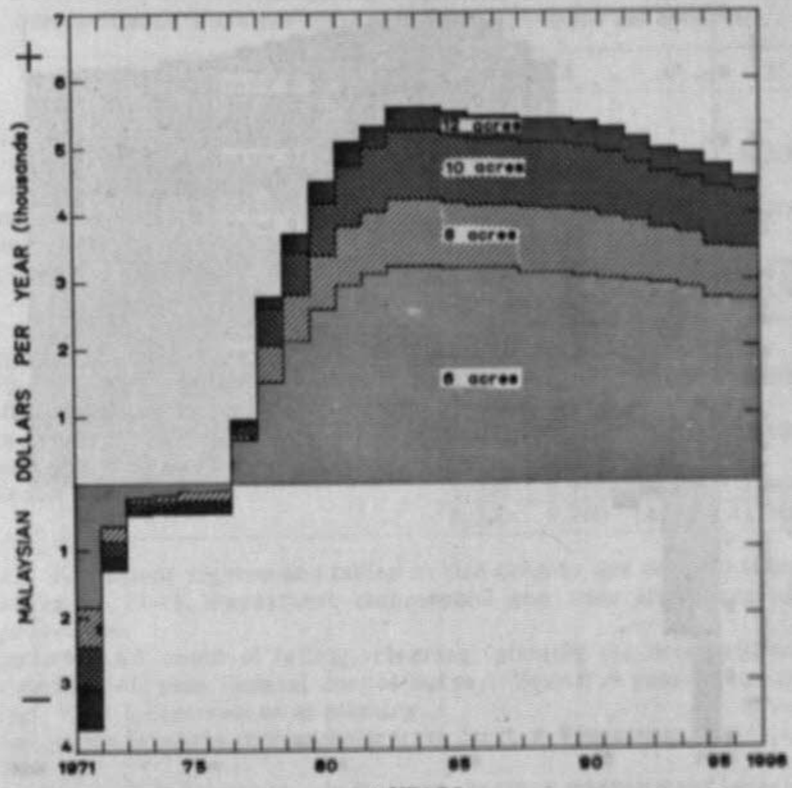
The farm gross margins illustrated in Figures 13-1 and 13-2 are lower in the later years and it is important that the size of the holding selected is not influenced by comparatively high and probably temporary levels of farm gross margin in the early years of repayment. It is not until the years after repayment has been completed that farm gross margins are closely related to settlers' cash incomes and can be compared with the stated FLDA target of M$4,200 from the main crop (plus the value of the dusun and house lot, say M$350; a total of M$4,550).

Figures 13-1 and 13-2 indicate that ten acres of rubber and nine acres of oil palms will meet the targets.

It is concluded that 10 acres of rubber and 9 acres of oil palms will provide a farm gross margin from which a satisfactory settler's cash income may be provided for the foreseeable future but it is not suggested that the whole of this farm gross margin should necessarily become available to the settler at the end of the repayment period. That is a matter which can be regulated at that time by the amount of rent levied by the State or Federal Authorities.

At this time the settler will have to arrange for financing the replanting of his main crop and will be faced not only with this cost but a period of lower returns until his new crop progressively takes

Figure 13-1
Rubber - Farm Gross Margin



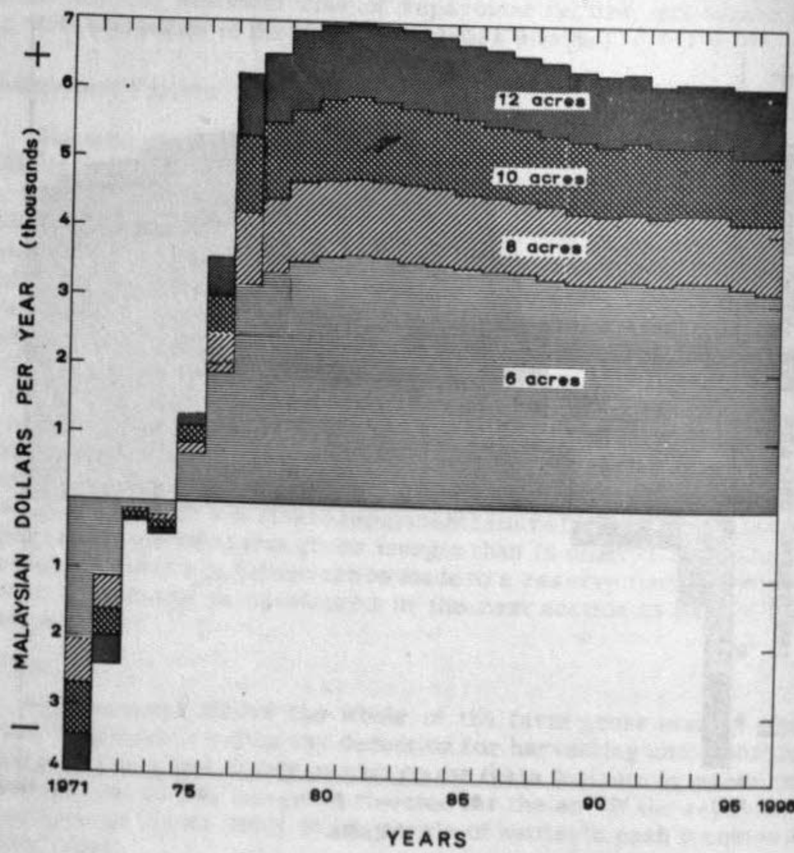
over from the old. There will also remain a small and progressively reducing charge to cover continuing management costs. In practice therefore, the settler will not be able to reach a cash income closely related to farm gross margin until the second-cycle main crop is in full production, perhaps ten years after the close of the repayment period. It is to be expected that he will have developed additional sources of income from intensive use of his houselot and from external activities such as fish farming, which may be important factors contributing to a reasonable income during the replanting years.

LOAN REPAYMENT

Provision is made in the Land (Group Settlement Areas) Act 1960 for settlers to repay to FLDA all the costs of development, including supervision and administration, interest and other charges in a "consolidated annual charge"

Oil palm harvesting and rubber tapping commence in the fourth and sixth years respectively after planting. As soon as there is revenue from the crop the settler starts to pay the consolidated charge to FLDA but in the first few months this revenue will be insufficient to meet the cost of supervision or administration. Therefore new investment by

Figure 13-2
Oil Palms - Farm Gross Margin



FLDA must continue until the fifth and seventh years after planting, or until the consolidated annual charge exceeds FLDA's costs.

The total amount outstanding at the end of this period (termed the investment period) is the investment made by FLDA in each smallholding. The period thereafter until the end of repayment is termed "the repayment period".

The Investment Period

Costs of Development excluding Management - On existing FLDA schemes the costs debited to the settler's account are the initial capital costs of development, including the cost of clearing and planting the holding, house lot, village area and agricultural (tertiary) roads, but not the costs of infrastructure (primary and secondary roads and social services). The settlers selected are assumed to have insufficient resources to pay for the construction of their houses or to keep themselves and families through the immature period of the crop. The income loaned through this period and the cost of the house are added to the loan on the settler's account.

These costs, called "settler's loan" by FLDA, are shown in Table 13-3.

Table 13-3
Costs of Development (Excluding Management)
to the Start of Repayment [1]
(Actual costs in M$ per holding with no provision for interest)

Size of holding in acres	6	8	10	12
RUBBER				
Main crop costs (Years 0 - 6) [2]	3,200	4,200	5,300	6,300
Maintenance income and subsistence loan (Years 1 - 6) [3]	4,900	4,900	4,900	4,900
House, clearing and destumping houselot and village	1,900	1,900	1,900	1,900
	10,000	11,000	12,100	13,100
OIL PALMS				
Main crop costs (Years 0 - 4) [2]	3,200	4,200	5,300	6,300
Maintenance income and subsistence loan (Years 1 - 4) [3]	3,100	3,100	3,100	3,100
House, clearing and destumping houselot and village	1,900	1,900	1,900	1,900
	8,200	9,200	10,300	11,300

1) All subsequent figures and tables in this chapter are derived from Appendix 13-1. Repayment commences one year after start of production.
2) Includes all costs of felling, clearing, planting the holding(from Figure 13-1) plus Federal cost of survey. Year 0 is year of clearing. Year 1 commences at planting.
3) See under Settler's income before the Start of Repayment.

Costs of Management - In the past, costs of management (supervision and administration) of schemes have been considered as overheads and have been met by direct Treasury grant to FLDA. Recently it has been proposed that part of the oil palm land might be retained in hand by FLDA to contribute towards these costs. The proposal has been given thorough consideration but is not recommended for Jengka (Chapter 12).

The recommendation made here is that management costs should be recovered as part of the consolidated annual charge to the settler. The justification for so large an additional levy on Jengka settlers lies partly in the size of the scheme but also in the changing role of FLDA which is fast becoming the most substantial single manager of land in Malaysia. The costs of supervising and administering Jengka are as large as the other costs of development and must be recovered if the project is not to be an encumbrance on the rest of the economy.

FLDA pays for individual training for the settler and supervision of the scheme until eventually settlers are able to manage their own holdings with the minimum of outside assistance. All the costs of training and supervision should be recovered from settlers if settlers are not to be subsidised, though some allowance may be made for the initial lack of experience of managerial staff. In this report the operating and capital costs of field supervision, project headquarters and Triangle headquarters, but not those of Kuala Lumpur headquarters, have all been charged against Jengka settlers throughout the investment and repayment periods. Staffing densities have been calculated on the basis of ten-acre holdings, but in practise it is not considered that there will be significant differences in cost throughout the range of holding size considered (6 to 12 acres) or between the oil palm and rubber crops. The cost of management depends partly upon the size of the project and is shown in Table 13-4.

Table 13 - 4
Cost of Management [1]
(Crops planted in Project IV. M$ per holding)

Size of holding in acres	6	8	10	12
RUBBER				
Capital and total operating cost to start of repayment. Years 0 - 6 (Investment period.)	5,300	7,100	8,900	10,700
Total operating cost through production. Years 7 - 25 (Repayment period.)	7,800	10,400	12,900	15,500
	13,100	17,500	21,800	26,200
OIL PALM				
Capital and total operating cost to start of repayment. Years 0 - 4 (Investment period.)	4,400	5,800	7,300	8,800
Total operating cost through production. Years 5 - 25 (Repayment period.)	8,700	11,600	14,500	17,400
	13,100	17,400	21,800	26,200

Note :
1) It is assumed here that management is not reduced between years 10 - 25. In practice it is probable that the annual cost will be reduced in later years as settlers obtain greater managerial independence.

Interest Charges in Investment Period - The Land (Group Settlement Areas) Act 1960 and Amendment 1965 makes provision for "such charges in respect of interest as may be approved by the Minister" to be included in the consolidated annual charge.

There are two aspects of interest rates that have to be considered. One is the rate at which the settler must pay if he is not to be subsidised; the other is the rate at which he should pay to provide FLDA with a proper return on its capital.

The present rate of interest on international loans to Malaysia is six per cent. The rate of interest used in this evaluation has been taken as seven per cent, after provision for a service charge, and in view of the rising cost of international funding.

Adoption of an interest rate of seven per cent in this report is considered reasonable in connexion with both aspects mentioned above, although it is clear that the local opportunity cost of capital is at present substantially higher. Capital currently invested in rubber yields around 12 per cent and in oil palms rather more, around 15 per cent.

Returns of these levels are in general achieved by commercial estate development. It has been argued in Chapter 12 that as estate type of development should not be adopted for Jengka, and that a lower labour utilisation and a relatively higher return to labour should be accepted. From this it follows that a lower return to capital than that obtainable by commercial estates must also be accepted.

The need to develop land and with it the demand for capital can, however, hardly fail to increase at least in the forseeable future. High interest rates are therefore both desirable and justifiable. At a relatively low rate of interest (compared to local opportunity cost of capital), the FLDA settler gains a significant advantage; and, in addition, obtains both short-term credit (for purchase of fertilisers etc.) and long-term credit at the same rate. The generation of surpluses for further investment in land development is so important that interest charges made to settlers should be frequently reviewed.

For the rubber holding, where size is limited to 10 acres by labour capacity, provision of the settler with the minimum cash income considered acceptable does not appear feasible if interest rates higher than seven per cent are charged. For oil palm settlers, higher rates could be charged even on 10 acre holdings. Differential interest rates are not, however, advocated for generation of a surplus to FLDA can better be achieved through rent differentials.

Table 13-5
Summary of Investment by FLDA
(M$ per holding)

Size of holding in acres	6	8	10	12
RUBBER (Years 0 - 6)				
Costs of Development excluding management	10,000	11,000	12,100	13,100
Management	5,300	7,100	8,900	10,700
Accumulated Interest @ 7 per cent to start of repayment	5,700	6,900	8,000	9,200
	21,000	25,000	29,000	33,000
OIL PALMS (Years 0 - 4)				
Costs of Development excluding management	8,200	9,200	10,300	11,300
Management	4,400	5,800	7,300	8,800
Accumulated Interest @ 7 per cent to start of repayment	3,300	4,000	4,700	5,500
	15,900	19,000	22,300	25,600

Summary of Investment by FLDA - The total investment by FLDA will be influenced by the actual length of the period of investment because interest accumulates rapidly as the investment period lengthens. This is particularly significant with rubber where the investment period is seven years before repayment commences. This is shown in Table 13-5 which summarises the total investment up to the start of repayment on different sizes of holdings.

The Repayment Period

The major influence affecting repayment is settler's cash income which is discussed in later sections. The other aspects of repayment are considered here.

Length of Repayment Period - The length of the repayment period has been assumed to be 25 years from planting (26 years from the initial jungle clearance). This is within the normal high yielding period of either main crop, and allows for 19 years of repayment for rubber and 21 years for oil palms. A shorter period of repayment, say 15 years, would severely limit the settler's cash income during that time. On the other hand, the interest due on the outstanding balance becomes so large over a long repayment period that lengthening it does little to improve the level of settler's cash income.

It is assumed that all settlers continue to repay for the full repayment period. All rates of interest, sums repaid, and any surpluses accumulated have been calculated on this assumption.

Interest through the Repayment Period - The importance of interest rates has been discussed under the Investment Period, in the preceding section of this Chapter. The effects of changes in the interest rate on settler's cash income, and the relationships between interest rates, income levels and sizes of holding for both rubber and oil palm, are shown graphically in Figure 13 - 5.

Rent on Land - The State of Pahang may charge a premium and an annual rent on all Jengka land occupied in expectation of title. This would probably be collected through the FLDA as part of the consolidated annual charge but has yet to be negotiated. Charges of M$60 per acre premium and M$6 per acre per year rent both due from the start of production have been assumed.

Differential Charges - It is not anticipated that the State would differentiate initially between the rental rates for oil palm and rubber lands. However, oil palms are only recommended at present to be grown on the better quality land, and are generally more profitable as a crop than rubber. In principal a differential rent could be charged based on these factors. It is recommended that such a charge should be made by FLDA; it is possible that the State would wish to continue this annual charge after the end of the repayment period.

One of the implications of the price projections is that there is a similar inequality in profitability between holdings on early and late projects as between holdings with oil palms and those with rubber. Holdings on late projects must be large enough to enable settlers to repay their loans. This implies either a) that holdings on early projects will have to be smaller than on late projects or b) that settler's incomes on early projects will be larger, or c) that settlers on early projects must repay a larger sum. A similar differential charge could be levied on early projects, justified by their greater profitability.

The present policy of FLDA is for all settlers to have the same amount to repay (it comprises the amount on the settler's loan account and the interest on it at a given rate). This implies that smaller holdings would have to be recommended for oil palms and for early projects to prevent the incomes of these settlers, over the 26 years evaluation period, becoming undersirably large, thus leading to a wasteful distribution of income and possibly to the creation of a rural elite on FLDA schemes.

Such variation in holding size is not recommended. Instead, it is proposed that holding size should remain constant but provision be made for different repayments.

Reserve Fund - The Lands (Group Settlement Areas) Act 1960 makes provision for the costs of any service provided by the FLDA to be included in the consolidated annual charge. The greater capacity of settlers on early projects to repay their loans can be absorbed by an extra item included in the consolidated annual charge to build up a reserve fund and reduce the risk of repayment failure. If the reserve is not needed to make up dificiencies in repayments, it can be used to contribute towards the cost of replanting.

Replanting - At present a cess on assessment is payable by all rubber growers at the rate of M cents 4.5 per lb. of rubber produced. This cess is funded to provide a fixed amount per acre payable to growers at replanting. It is possible to withdraw from this payment if the grower concerned owns more than 100 acres of high yielding rubber trees. Unlike private estates, FLDA has not yet taken this course. As the amount of cess is proportional to yield and yields projected for Jengka are considerably higher than those for smallholders, FLDA rubber smallholders will contribute far more than they will receive in 25 years time. Furthermore, replanting programmes on large acreages can be organised more efficiently by combining the financial provision for replanting with a set replanting cycle.

It is therefore recommended that FLDA should negotiate to withdraw from the replanting cess.

On the assumption that a further loan will be available for replanting and that FLDA discontinues paying the cess, the value of the cess has been included in the sum available for repayment.

SETTLERS INCOME

The objective is to provide a settler with a reasonable return for his work, an income for his family which compares favourably with incomes obtained from alternative employment in the rural sector, and the opportunity for an income that increases as his loan is repaid and his managerial skills increase.

Components of Settlers Income

Settler's income is made up of three components, cash income from sales of the main crop, income from sales of houselot produce and the value of produce consumed by the family. The produce of the houselot is assumed to be constant irrespective of the size of income from the main crop. The houselot provides an additional source of income to the settler but since it is quite independent of FLDA it is the cash income from the main crop that has a direct bearing on the annual repayment, and it is this "settler's cash income" which is here examined.

Settlers Cash Income before the Start of Repayment

The loan income that the settler receives in the years before production has to be repaid with interest. In consequence, over this initial period the minimum cash income compatible with the needs of the settler and his family must be considered.

Present FLDA settlers are at paid M$2.90 for each day worked on the main crop and a subsistence allowance granted when work is short and casual work on phases of the schemes under development, or on other schemes, is not available to make the total up to M$70 per month. Some FLDA field staff have stated that M$70 per month is too low a level of income for large families, and cases of indebtedness to local shopkeepers have been reported as well as lethargy from malnutrition.

The daily rate assumed for Jengka is M$3.00 per day for 25 days per month, but it is a fair assumption that when the labour requirement over the month is low, casual work will be made available in the Triangle on nearby development areas to bring the family's earning above the level of M$90 per month.

The first year after planting is the basic training period for the settler and a critical time for the crop. Here managers find that they need maximum control and cannot risk neglect of holdings by allowing settlers to work outside the scheme, so a direct subsidy is assumed to make the income up to M$90 per month. No targets have been specified by FLDA but the assumptions made here are believed to agree with FLDA policy. The total loan income up to the time that the settlers start to repay their loans has been included in Table 13-3

Possible Settlers Cash Income

The size of the cash income received by the settler from the main crop determines the repayment potential of any particular size of holding, (i.e. an eight-acre holding may generate a large enough farm gross margin for repayment with one level of cash income but not with a lower one). A number of cash incomes must therefore be considered to establish which levels permit repayment within the repayment period.

A small income and large repayments in the early years of repayment reduce the total amount that will have to be repaid by reducing the outstanding balance and the interest on it. On the other hand after several years of waiting for the start of production on a very low cash income the settler will naturally desire a higher standard of living once harvesting commences.

FLDA have suggested that the settler's cash income should increase over the repayment period to take into account the increasing independence and skills of the settler. In addition FLDA has requested that the feasibility of a cash income of M$2,400 per year in the fifth year after planting for oil palm holdings and the seventh year for rubber should be assessed.

Figure 13-3
Rubber - Possible Settler Income

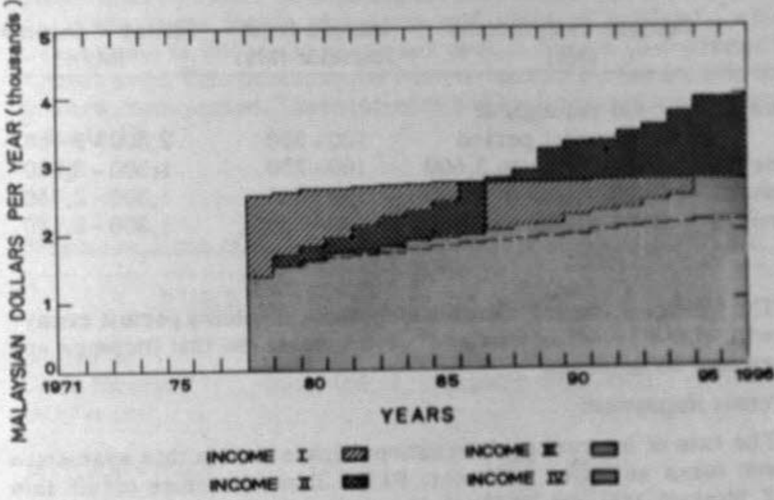
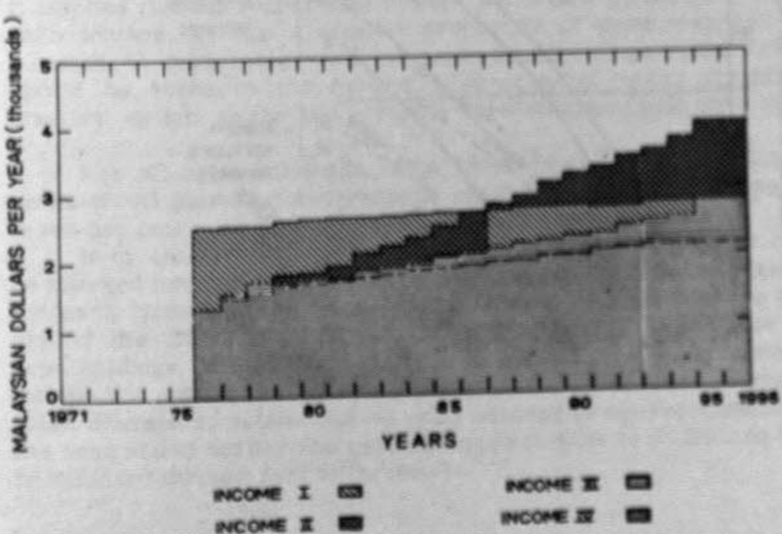


Figure 13-4
Oil Palms - Possible Settler Income
(Main crop and houselot)



Figures 13-3 and 13-4 show settlers' income - including both settlers' cash income and income from the houselot - for four levels of income. The four income levels postulated for assessment during the repayment period are as follows:-

	Settlers cash income (M$)	Income from houselot (M$)	Settler's income (M$)
Income I	2,400 throughout repayment period	100 - 350	2,500 - 2,750
Income II	1,200 rising to 3,600	100 - 350	1,300 - 3,950
Income III	1,200 rising to 2,400	100 - 350	1,300 - 2,750
Income IV	1,200 rising to 1,800	100 - 350	1,300 - 2,150

The following section shows which sizes of holding permit repayment with these levels of settlers' cash income, so that incomes and holdings may be selected.

Incomes and Holdings that Permit Repayment

The rate of interest on international loans used in this evaluation has been taken as seven per cent. FLDA must therefore obtain this rate of interest (return) on their investment in Jengka if they are to break even.

Figure 13 - 5
Loan Interest Rates for Varying Cash Incomes and Holding Sizes

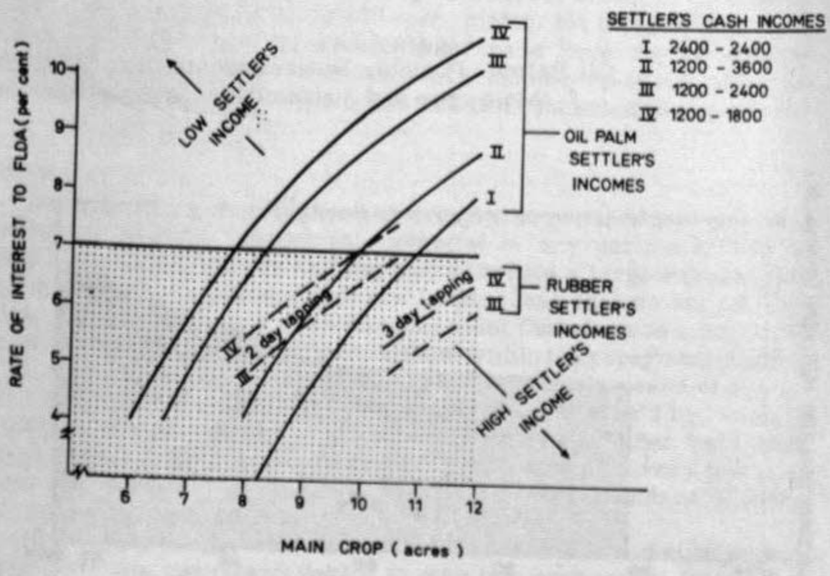


Figure 13-5 shows the interest rates which when used throughout with differerent sizes of holding and different levels of income would generate sufficient funds for FLDA to repay the funds it borrows at the rate of interest, after recovering its costs of administration.

Only those levels of income and sizes of holding on which the interest rate is above the seven per cent in Figure 13-5 permit FLDA to break even. This puts an upper limit on settler's cash income through the repayment period. These incomes and holding sizes are summarised in Table 13-6.

Table 13 - 6
Minimum Sizes of Holding Permitting Repayment at seven per cent

RUBBER		OIL PALMS	
Settler's Cash Income (M$/year)	Acreage	Settler's Cash Income (M$/year)	Acreage
IV (1200 - 1800)	10	I (2400 - 2400)	11
		II (1200 - 3600)	10
		III (1200 - 2400)	8.5
		IV (1200 - 1800)	8

The only rubber holdings that can repay its loan on the basis of Table 13-6 is 10 acres with income IV (M$1,200 per year rising to M$1,800). This is a mean value for all rubber holdings. Holdings on earlier projects would be able to repay at higher rates of interest; so also would holdings on better quality land.

Conversely holdings in the last projects and on poor quality land will not be able to repay with seven per cent interest. This does not mean that it is not worthwhile for FLDA to develop rubber land. Rather it implies that the rubber smallholder would have to accept a smaller cash income, or that a smaller proportion of those overhead costs common to both rubber and oil palm smallholdings in the Triangle should be borne by the former. Ten acres of rubber provides the smallest deficit on the last projects when combined with cash income IV.

For oil palm holdings, Table 13-6 shows that 8, 8.5 10 and 11 acres of oil palms provide enough surplus to give FLDA a return of seven per cent with incomes IV, III, II and I respectively.

It is apparent from Figure 13-5 that the rubber settler cannot be charged interest at more than seven per cent without either reducing his cash income below income IV or increasing his holding to a size beyond his labour capacity (more than 10 acres). In the case of oil palm holdings, a higher rate of interest is feasible (with the same cash income and size of holding as for rubber) but a differential between the rates charged to rubber and oil palm settlers is not recommended. It has been stated earlier that generation of a surplus to FLDA can better be achieved through rent differentials.

Cash Incomes Recommended

The limited opportunity for members of settler's families to find employment in the Triangle has been recognised by making income recommendations for the family rather than for the settler although the level of employment has been projected earlier for the settler alone. In this way a deliberate but socially desirable measure of subsidy has been incorporated into the income recommendations.

The cash income on a rubber holding that can be operated by a single settler family is limited to one that rises from M$1,200 to no more than M$1,800 per year in the repayment period unless repayment is to be subsidised, whereas for oil palms there is a higher range, depending on the size of holding or the amount of rent charged.

Two levels of cash income at the start of the repayment period have been tested, M$2,400 per year and M$1,200. Settlers are still relatively unskilled and inexperienced at this stage. A number of surveys of rural family incomes have been made in the past few years. From these it is estimated that nearly half the rural families have incomes less than M$1,200 per year. A cash income of M$1,200 (excluding M$100 value of produce from the houselot) thus compares favourably with a typical present day income for unskilled rural families. The largest starting income possible on a rubber holding is M$1,200 but comparability of incomes between settlers on rubber and oil palm holdings is also desirable since the allocation of their holdings is arbitrary. A cash income of M$1,200 at the start of repayment therefore seems reasonable and is adopted in this report for both oil palm and rubber.

By the end of the repayment period the settler will be a highly trained and virtually independent smallholder whose income should be at least equivalent to that of the more skilled rural families outside FLDA schemes. Table 13-6 shows cash incomes to the settler consistent with giving a return to FLDA of seven per cent on investment. The lowest shown rises to M$1,800 (for the 10 acre rubber holding and the 8 acre oil palm holding).

Although a cash income of M$1,200 has been adopted as reasonable starting figure for FLDA settlers at the start of repayment, the most highly skilled rural families today - on some estates and on some smallholdings - are estimated to have attained cash incomes around M$1,800. This can be equated with future settler incomes, and a cash income of M$1,800 would therefore appear reasonable. M$1,800 from the primary crops is probably near the minimum acceptable figure. In addition, however, it is anticipated that the settler may be able to earn a further M$350 through sale or consumption of produce from his houselot.

As already indicated, M$1,800 can just be obtained from either eight acres of oil palm or ten acres of rubber. Should general rural incomes in West Malaysia rise more rapidly than now seems likely, or increased settler cash incomes be desirable for other reasons (such as increased costs) ,neither of these holdings would be able to repay and maintain such higher levels of income. It is in this context that an important degree of flexibility can be imparted by allocating ten-acre holdings for both rubber and oil palm. As shown in Table 13-6, the ten-acre oil palm holding permits a cash income (assuming no different rents) of M$3,600 to be attained, after the loan is repaid. If it became desirable, during the loan repayment period for the average cash income of all settlers in Jengka to rise to, say, M$2,400, the ten-acre holding would provide adequate repayment as well as a surplus for the rubber holding, permitting all the Jengka settlers' incomes to rise to this level.

It is proposed that holdings of both oil palms and rubber should be of ten acres to satisfy the requirements for settler's cash income. Ten acres of rubber is recommended as being the minimum size of holding which permits repayment while still leaving the settler with a cash income of M$1,800. The ten-acre oil palm holding is also preferred because it provides greater flexibility in respect of future incomes and safeguards repayment, in addition to reasons previously advanced in this chapter which reinforce the desirability of equal-sized holdings for both main crops.

Annual Review of Settlers Cash Incomes

The settler's cash income recommended and used in the financial analysis is based on present day figures. Long term projections as to the level of rural incomes in general are subject to so many uncertainties that reliance on them for assessing the adequacy of M$1,800 as a future income is not justifiable. The rate at which rural incomes in general change will depend on such factors as the rate of increase in the rural working force, the pace of land development, opportunities for employment outside the rural sector, and the availability of investment capital.

It is recommended that the levels of cash income of Jengka settlers be reviewed frequently in the light of then prevailing economic conditions. The large financial stake of the Nation in the capital and running costs of Jengka justify the recommendation that this review should be made between the FLDA on the one hand and representatives of the National Development Planning Committee on the other an arrangement analogous to the annual price review of some countries where the State has a direct financial interest in agricultural and rural incomes.

Such reviews will also permit comparisons to be made between the levels of cash income of Jengka settlers (or FLDA settlers in general) and those for alternative employment in the rural sector. There are obvious social and economic implications if too great a disparity develops, either up or down, between FLDA settler incomes and those attainable by other rural families.

Surpluses

Adjustment of the level of settler's cash income means that a surplus to the minimum repayment requirements may become available. Two surpluses have already been mentioned and included as part of the consolidated annual charge, first the larger gross farm margins on early projects, nominally charged as a reserve; secondly the differential charge on oil palm land, a premium for better quality land.

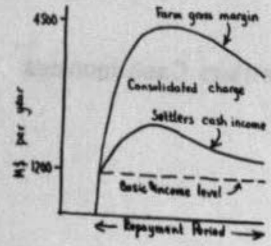
However, if prices do not fall as much as projected then there will be an overall surplus on all projects which can either be distributed as cash to settlers or reinvested by FLDA.

The Land (Group Settlement Areas) Act 1960 makes no specific provision for any surplus to be made for the express purpose of reinvesting in further land development. If there was such provision, it would be possible to plan for full utilisation and a large government surplus, which could become one of the most successful forms of capital accumulation available for national development.

Method and Rate of Repayment

The existing system of repayment is for FLDA to retain two-thirds of any income in excess of a basic guaranteed cash income (M$100 per month), the annual repayment being deducted from debt on the settler's loan account. This is shown on Figure 13-6 and gives the settler an incentive to repay his loan as quickly as possible.

Figure 13 - 6

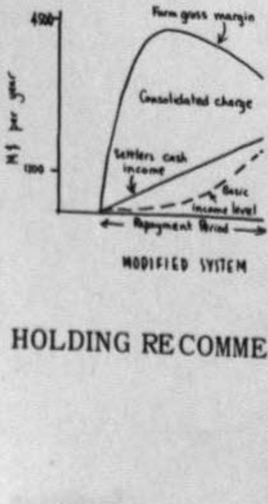


PRESENT SYSTEM

The recommended system of repayment is to divide the annual consolidated charge for which provision is already made in the Land Act, into two parts.

a) A fixed annual repayment with interest on the original capital cost and all costs up to the start of repayment including project and Triangle headquarters and the estimated average cost of management through the repayment period.
b) A variable amount to adjust the level of settler's income which would include the sum retained for the reserve fund, the differential rent on the oil palm land, and any other charges which may be established for this purpose.

Figure 13 - 7



MODIFIED SYSTEM

There are many possible variations in the actual mechanism of repayment. Shown in Figure 13-7 is a typical system. This provides a rising settler income in the face of a declining farm gross margin, by means of the adjustable component of the consolidated charge, and by introduction of a variable "basic income level"

The rate of repayment, that is the length of the repayment period can be adjusted. It has been assumed here and in the financial analysis that repayment is made to continue until the end of the twenty-fifth year after planting in all cases. The size of any surplus depends on this assumption.

HOLDING RECOMMENDED

The size of holding has to be selected as a compromise between the short and long term objectives and constraints of employment, income and repayment. In this selection sizes of rubber and oil palm holdings are first considered separately and then in combination together.

Rubber

The essential features of different sizes of holding with rubber as the main crop are shown in Table 13-7 which indicates employment, capability for repayment expressed in terms of interest rate payable, and maximum long term settler's cash income after completion of loan repayment. This income is the farm gross margin; it would in practice be reduced by certain overheads such as State rent, provision for replanting, and any remaining management charges.

Six acres of rubber only provides part time employment for a settler, and is in repayment deficit at all the levels of settler's cash income.

Eight acres provides a good level of employment for one tapper but does not permit a settler to repay his loan, at seven per cent interest, with any of the levels of cash income considered. Also it limits the long term cash income of the family to a maximum of M$3,200 per year before deducting overheads.

Table 13-7

Employment, Income and Repayment from Rubber Holdings including Houselot

Size of Holding in Acres	6	8	10	12 [1]	Houselot
Employment Days per year (average)	300	300	300	300	150
Hours per day (average)	4.5	6	7	6	1
Repayment to FLDA. Rate of interest (in per cent) 2) payable by settler while maintaining settler's cash incomes through the repayment period at:-					
Income I - 2400 per year remaining constant	-	-	-	-	
Income II - 1200 rising to 3600 per year	-	-	5	< 5	
Income III - 1200 rising to 2400 per year	< 5	5	6.5	6	
Income IV - 1200 rising to 1800 per year (excluding income from Houselot 100 rising to 350 per year, all income in M$)	< 5	5.5	7	6.5	
Maximum long term settler's cash income, after completion of loan repayment. (M$) i.e. long term farm gross margin excluding income from Houselot.	2400	3200	3900	4200	350

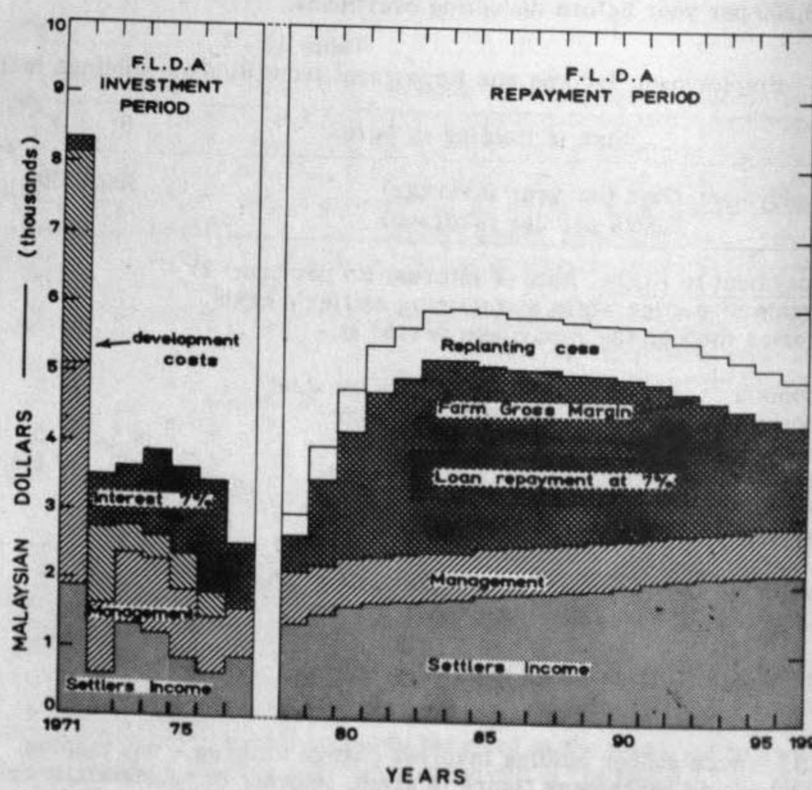
1) 12 - acre rubber holding involves change to three - day tapping.
2) Where no percentage figure is given, interest is substantially below 5 per cent.

Ten acres gives very full employment for a settler unless some help from his wife or other members of his family is available. However, since there will be few other employment opportunities in the Triangle in the early years it is not unreasonable to expect the settler's wife to assist in tapping or collecting. With a cash income that rises from M$1,200 to M$1,800 through the repayment period the settler can just repay his loan at seven per cent interest. The potential long term settler's cash income from ten acres is M$3,900 per year before deducting overheads. This level is considered satisfactory.

Twelve acres of rubber give no financial advantage over ten acres, due to three-day tapping, unless hired labour is employed and alternate day tapping practised.

Ten-acre holdings are therefore recommended for rubber in all circumstances unless it becomes deliberate policy to subsidise the repayments from settlers. Income and expenditure through the investment and repayment periods on a ten acre rubber holding are shown in Figure 13-8.

Figure 13-8
Investment and Repayment - Rubber
(10 acre holding)



Oil Palms

The main characteristics of oil palm holdings are given in Table 13-8.

Six acres of oil palms do not allow repayment at any level of settlers income and only gives part time employment.

Eight acres of oil palms provide a less than satisfactory level of employment for settlers in view of the limited opportunity for other employment in the Triangle. Settlers can repay their loans at the lowest level of income but not at higher ones. Eight acres provides a satisfactory long term level of cash income but precludes the opportunity for a differential rent based on the better quality of oil palm land.

Ten acres gives a fair level of employment on the main crop and allows the settler time to make full use of his house-lot.

If loan repayment comprises the costs of development, management and interest at only seven per cent, the settlers cash income can rise from M$1,200 to M$3,600 per year through the repayment period. Alternatively if the settler's cash income is reduced by a differential charge towards the level of that of a settler on a rubber holding so that it rises only to M$1,800, then FLDA will receive an effective rate of interest on the capital they borrow of 9.5 per cent, a surplus of M$790 per holding per year through the repayment period.

Table 13 - 8

Employment, Income and Repayment from Oil Palm Holdings including Houselot

Size of Holding in Acres	6	8	10	12	Houselot
Employment Days per year (average)	200	220	240	240	150
Hours per day (average)	3.5	4.5	5.5	7	2
Repayment to FLDA. Rate of Interest (in per cent) payable by settler while maintaining settler's cash income through the repayment period at :-					
Income I - 2400 per year remaining constant	-	<5	6	8	
Income II - 1200 rising to 3600 per year	-	<5	7	9	
Income III - 1200 rising to 2400 per year	-5	6.5	9	10	
Income IV - 1200 rising to 1800 per year	<5	7	9.5	11	
(excluding income from houselot rising to 350 per year, all incomes in M$)					
Maximum long term settler's cash income, after completion of loan repayment. (M$) i.e. long term farm gross margin excluding income from houselot.	2800	3800	4800	5700	350

Note :- where no percentage figure is given, interest rate is substantially below 5 per cent.

The long term potential cash income from ten acres of oil palms is M$4,800, the same as the long term National target.

Twelve acres of oil palms provides full employment, high levels of cash income or a large surplus to FLDA, but results in a very low settlement density. In practice it might be difficult to impose a rent that absorbed so large a proportion of the farm gross margin.

Ten acres of oil palms is therefore recommended. Figure 13-9 shows the investment and repayments from such a holding.

Conclusions

The considerations presented in this chapter lead to the firm recommendation that holdings for both rubber and oil palms should be equal in size and that the size should be ten acres. This recommendation is based on certain assumptions and is supported by some further recommemdations.

i) FLDA should recover all its costs - the costs of development and the capital and operating costs of management - together with interest at at least the same rate as that at which FLDA has had to borrow. The borrowing rate is assumed to be seven per cent.

ii) FLDA should make additional charges, which include a differential rent on the better quality oil palm land and an extra charge on settlers on early projects, and these charges should be included in the consolidated annual charge so that the settlers' cash income can be adjusted throughout the repayment period.

iii) Settlers' cash income and the consolidated charge should be reviewed annually.

The stress laid on the need for FLDA to recover all its costs derives to a considerable extent from the scale of Jengka itself, and the rapidly increasing scale of FLDA's operations in general. In addition to recovering its costs, generation of a surplus is considered very important.

The ten acre oil palm holding - rather than the eight acre holding which can just repay at seven per cent interest - contributes in some measure to the generation of such a surplus. This chapter has advanced a number of other reasons however, all strengthening the recommendation for ten acres rather than eight for oil palms: reasons which include equity of land holding as such, a reasonable level of employment, and an important degree of flexibility which allows for an increase in settlers' cash income over what has been projected as adequate.

As now planned, 65,500 acres of oil palm would be developed in the Triangle, involving 6,550 settlers on ten-acre oil palm holdings. Reduction of oil palm holdings to eight acres would mean an increase in the number of settlers on oil palm holdings to 8,190. Management costs would not increase significantly but the increased proportion of the revenue needed to provide this extra number of settlers with a cash income would absorb the potential surplus previously available to FLDA as a differential charge. Flexibility, as well as this surplus, would be lost. Such losses are considered to outweigh the gain.

THE SMALLHOLDING AND THE GOVERNMENT

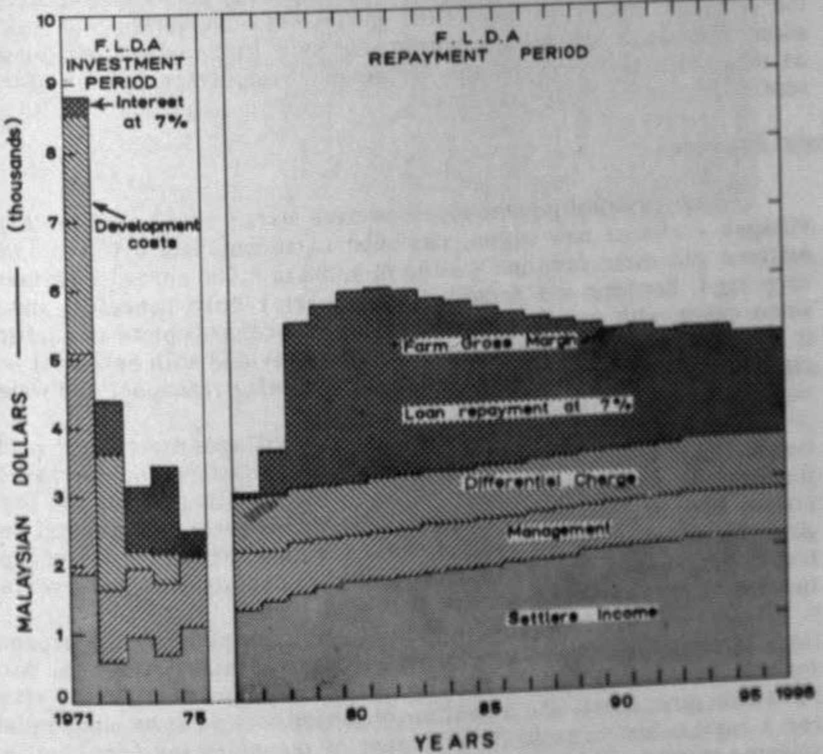
The size of smallholding selected has as much effect on the rate of return on capital obtained by Government (all Federal Government departments including FLDA) as on the rate obtained by FLDA alone. For in addition to the costs and returns of FLDA, other government departments receive export duties and research cesses from the settler and are responsible for primary and secondary roads, water supplies and other services in the Triangle. Thus the return to Government capital must also be considered in selecting smallholding size and settler's cash income.

In this chapter those aspects of investment and repayment considered in determining holding size have been limited to calculating the return on capital that FLDA could expect from holdings with different acreages of oil palms and rubber planted in 1972 (mid way through the planting programme).

It is not possible to allocate infrastructure costs precisely to a single crop or smallholding but it is possible to assess the effect of holding size on the return to Government as a whole. If the return calculated for government was unsatisfactory then it would be necessary either to reduce the settler's cash income or increase the size of oil palm holdings.

The rate of return calculated for FLDA alone is nine per cent and the combined return to Government is about eight per cent (excluding revenue from the timber industry and the operating costs of education). The implication of these rates is that the sizes of small-holding and cash incomes recommended are satisfactory to Government as a whole in that, without the timber industry, the surplus of FLDA is sufficient to cover the relatively unprofitable expenditure by other government departments.

Figure 13 - 9
Investment and Repayment - Oil Palms
(10 acre holding)



CHAPTER 14
SETTLEMENT UNITS

The development of the Jengka Triangle involves the rural settlement of about 85,000 people; a number approximately one fifth of the present estimated population of Pahang and larger than the estimated population of any District in the State. The sound planning and successful implementation of Jengka rests squarely on the suitability of the smallest unit in the plan - the settlement - and on the successful establishment of the settler within that unit. Planning for settlement on this scale is therefore one of the most important aspects of this study.

Present FLDA Settlement Practices

FLDA land settlement schemes have so far been based on large villages - almost new towns, designed to accomodate 2,400 to 3,000 settlers and their families - sited in 4,000 to 5,000 acres of primary crop land. Settlers are provided with quarter-acre houselots and in some cases with separate two-acre dusun (orchard) plots in addition to their primary cropland. They are also provided with essential social services and with the basic infra-structure for transport and water supply.

In the existing schemes distances from villages to settlers' holdings are long and in some cases involve as much as three hours travelling each day to and from crop lands. The present villages lack the population base for secondary schools and higher level commercial and government services; they tend to have lost the characteristics of typical rural villages, but are not large enough to develop the characteristics and more complete services of towns.

In practice FLDA have had little choice in planning the present form of settlement due to the isolated location of many schemes. With Jengka, however, it has been made possible to examine further the size, infrastructure, costs, and amenities of settler communities, and to plan for a logical and organic development of communuties from settler villages to relatively large towns. A new proposal for settlement units, which are the basic components of the Jengka plan, is described in this chapter.

THE SETTLEMENT UNIT

It is proposed that settlement unit prototypes for the Jengka Triangle be based broadly on the rural settlements found throughout West Malaysia. These consist of agricultural lands, villages having enough families to develop cohesive social structures, usually a few shops, and such additional public services and facilities as can be supported by the population. The existing rural settlements have charm and vitality, and are social units that are understood by all (Figure 14-1). It is from the

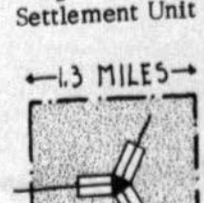
Figure 14 - 1
A Small Rice Farming Settlement in Malacca

villages throughout West Malaysia that the future settlers for Jengka will come.

The selected size and scope of the settlement unit proposed for Jengka, with its village, closely associated agricultural lands, and larger house lots, would constitute a natural extension and continuation of a known settlement pattern.

Size

Figure 14 - 2
Settlement Unit

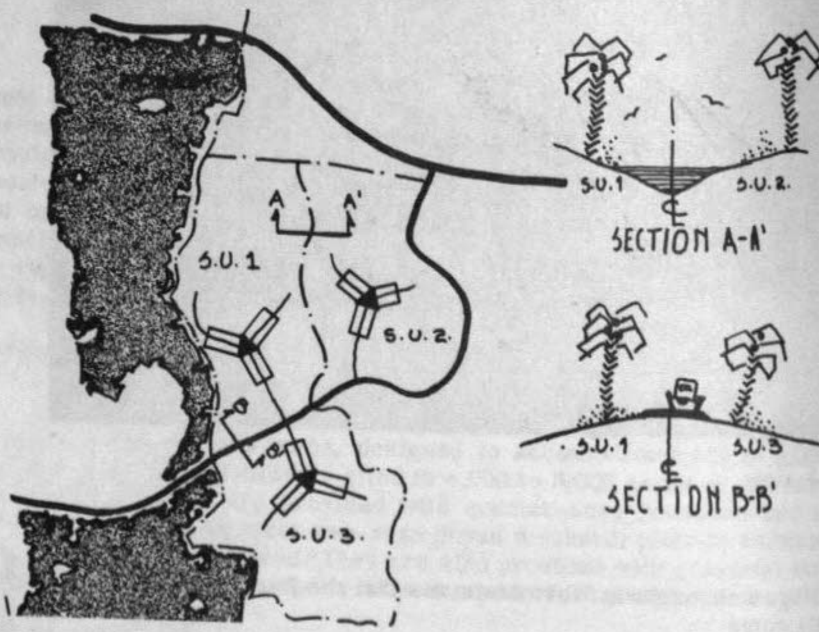


The settlement unit planned for the Jengka Triangle would consist of about 100 settler families on approximately 1,200 acres of land. Such a settlement unit if geometrically confined, would be just over one and a quarter miles square requiring about 20-25 minutes walking from one side to the other; thus any part of the settlement unit would be within easy walking distance of the village. An area of this size is clearly within the experience of all new settlers. (Figure 14-2). Ten acres of primary crop land and a three-quarter acre house lot in the village would be allocated to each settler (Chapter 13). Settlement unit villages would also include a rural support population of teachers, police, midwives, FLDA staff and others. The total population of the design village is assumed to be about 700-800 people, or about one quarter to one third the size of the present FLDA settlements.

Boundaries

Where possible, settlement units should be bounded by roads, streams, ridge lines or other clearly defined natural boundaries, easily identified in the field and easily recognised by all villagers (Figure 14 - 3).

Figure 14 - 3
Settlement Unit Boundaries



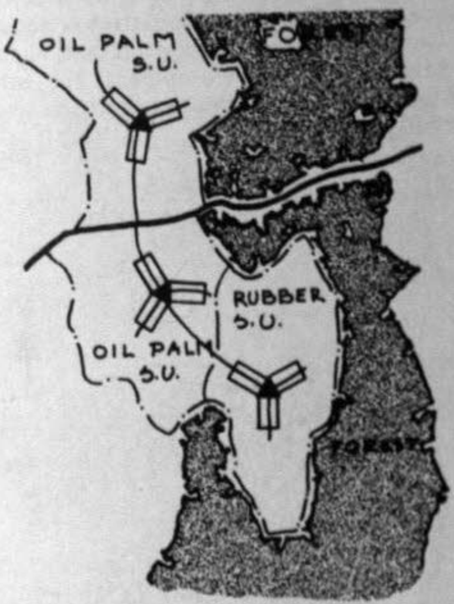
Adaptability to Land Use

The pattern of soils and landforms occurring within the Jengka Triangle is complex, and sudden changes occur from one soil type to another. The relatively small settlement unit is therefore adaptable to changes in soils, topography or other physical conditions and isolated areas of land suitable for rubber, although surrounded by oil palms and forest can be economically brought into production (Figure 14 - 4). This in turn reduces the likelihood of large areas of crops being planted on lands which are marginally suitable.

Adaptability to Management

The small settlement unit affords new means for effective assignment of management staff; individually, the settlement units are small enough for control by relatively inexperienced supervisory personnel. As experience and confidence among staff and smallholders grows, settlement units can be aggregated in groups, possible including as many as six settlement units for experienced managers. An important element of flexibility in management is thus introduced, providing opportunities for increased authority and responsibility to the more capable staff.

Figure 14 - 4
The Settlement Unit Used to Vary Land Use



Adaptability to Infrastructure

The settlement unit, either separately or in combination with other settlement units, would provide all the basic public services and facilities required by settlers. Many rural communities in West Malaysia have developed as riverine societies and as such the pattern of services is attenuated with many services and facilities shared by adjacent communities. In the same way, it would be unnecessary to provide completely independent systems of services in Jengka's settlement units; the small villages close to each other can share and support jointly many elements. Examples include:

Schools - A combination of settlement units either in twos or threes would provide enough primary school age children to require a primary school; six or seven settlement units would support a secondary school (Chapter 21).

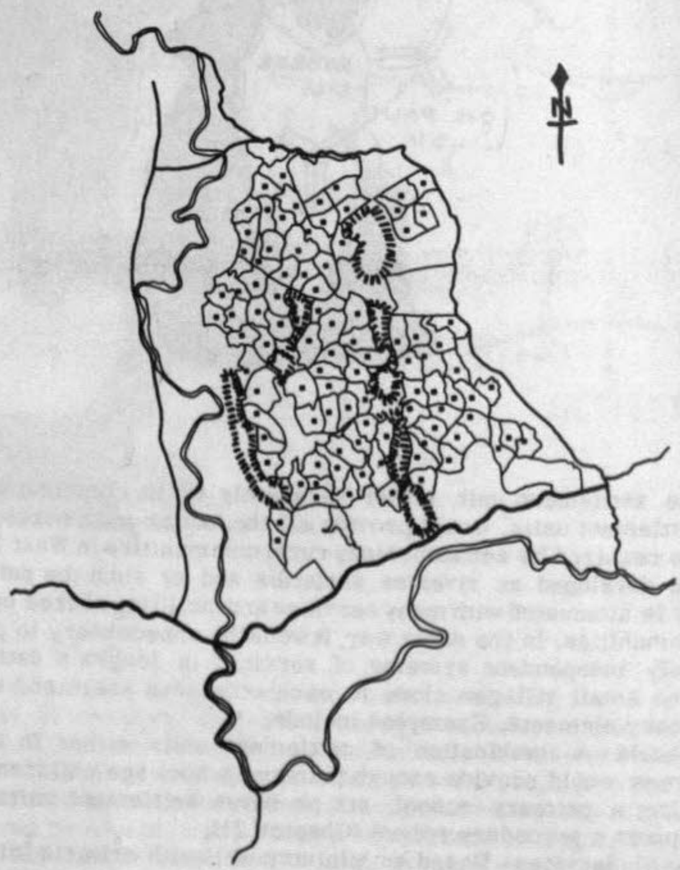
Health Services - Based on Ministry of Health criteria for health services as applied to the settlement pattern, two or three settlement units would require a midwife clinic; every 10 settlement units would require a health centre (Chapter 20).

This flexibility in the use of essential facilities would also apply to water supplies, telecommunications, police, postal services, religious facilities and all the other services required by viable communities.

Regional Settlement Plan

Based on the foregoing planning and design recommendations, 97 settlement units are proposed (Figure 14 - 5). There would be 68 oil palm settlement units (78,900 gross acres planting area) and 29 rubber settlement units (35,200 gross acres planting area). The overall population of the proposed settlement units is estimated to be about 69,000 people; this includes a rural support population of about 10,000 residing in the villages. Considering also the settler and support population of existing FLDA schemes under development, the total planned rural population of the Jengka Triangle is estimated to be about 84,500 people when the area is fully developed.

Figure 14 - 5
Regional Settlement Plan



The areas and populations of average oil palm and rubber settlement units are given in Tables 14-1 and 14-2. Areas would range in size from 772 to 1,957 gross acres for oil palm settlement units, and from 785 to 2,077 gross acres for rubber settlement units.

In the design of the settlement unit plan, 540 acres of land were added to the Ulu Jempol FLDA Scheme, and 304 acres to the Bukit Tajau Scheme. These constituted small areas of good agricultural land which should be used, but which because of their locations, could not conveniently be incorporated into new settlement units.

A list of settlement units with acreages and estimated populations of each is given in Appendix 14-1. For population estimates, a family size of 6.35 persons was used, based on a review of family size characteristics in existing FLDA schemes (Appendix 14-2).

Table 14 - 1
Average Characteristics - Oil Palm Settlement Unit

Land Use		Acres	Per Cent
Crop Land		960	83
Roads and Land unsuitable for development		114	10
Village			
Settler Lots (96 families x .75)	72.0		
Other Lots	5.0		
Commercial and Parking	0.7		
Co-operative Shop	0.3		
FLDA Office	0.5		
MARA Bus Station	1.0		
Community Hall	0.5		
Religious Building	0.5		
Football Field (Padang)	2.0		
Reserve 1)	4.5	87	7
Total (Gross Area)		1,161	100

Population			Persons	Per Cent
Settlers (96 families x 6.35)			609	83
Support				
FLDA Staff	(5 families x 5)	25		
Teachers	(6 families x 5)	30		
Commercial	(5 families x 10)	50		
Reserve 1)	(4 families x 5)	20	125	17
Total			734	100

1) The reserve is to accommodate the immediate and possible future requirements for additional service areas and related population within villages.

THE SETTLEMENT UNIT VILLAGE

The proposed settlement unit village can reflect the typical rural village of West Malaysia in size, shape, and character. Two prototype village designs have been prepared (Figure 14-6 and 14-7), using the actual topographic conditions of the Ulu Jempol FLDA scheme for layout purposes. This topography was selected as being representative of the type of landforms that will be found within the Jengka Triangle.

Village Location

Villages should be centred in the settlement units, in order to equalise the distance, as much as possible, from houses to the crop lands, to make the feeling and pleasures of land ownership apparent, and to relate the settlers directly to the land.

Main Village Components

The main components of settlement unit villages are the houselots which would occupy nearly 90 per cent of the village areas, and the vill-

Table 14 - 2
Average Characteristics - Rubber Settlement Unit

Land Use		Area (Acres)	Per Cent
Crop Land		950	78
Roads and Land Unsuitable for Development		176	15
Village			
Settler Lots (95)	71.2		
Other Lots	5.0		
Commercial and Parking	0.7		
Co-operative Shop	0.3		
FLDA Office	0.5		
MARA Bus Station	1.0		
Community Hall	0.5		
Religious Building	0.5		
Football Field (Padang)	2.0		
Reserve 1)	4.3	86	7
Total (Gross Area)		1,212	100

Population			Persons	Per Cent
Settlers (95 families x 6.35)			603	63
Support				
FLDA Staff	(5 families x 5)	25		
Teachers	(6 families x 5)	30		
Commercial	(5 families x 10)	50		
Others	(4 families x 5)	20	125	17
Total			728	100

1) For immediate and future requirements for additional service areas (and related population) within villages.

age centres. The separate elements of village land use are discussed below; acreages shown are average values for each village.

Houselots (77 acres) - Settler houselots would be three quarters of an acre in area (Chapter 13). So that villagers other than settlers could raise fruits and vegetables, houselots for the rural support population in the villages should be between one quarter and a half acre in area.

Village Centres (10 acres) - There would be many variations in the final design of the village centres. Some villages would have midwife clinics; others post offices or mosques; and some would have none of these facilities. A typical village centre is shown in Figure 14-8. Figures 14-6 and 14-7 discussed previously show two other types of village centres, based on assumed variations in the services and facilities of the villages. In common for all village centres should be the following standards:

1) Recreational Land (2 acres) - A sports field (padang) should be placed in the centre of each settlement village. The padang would be the heart of the village centre. The field should be well maintained; a formal perimeter planting strip would

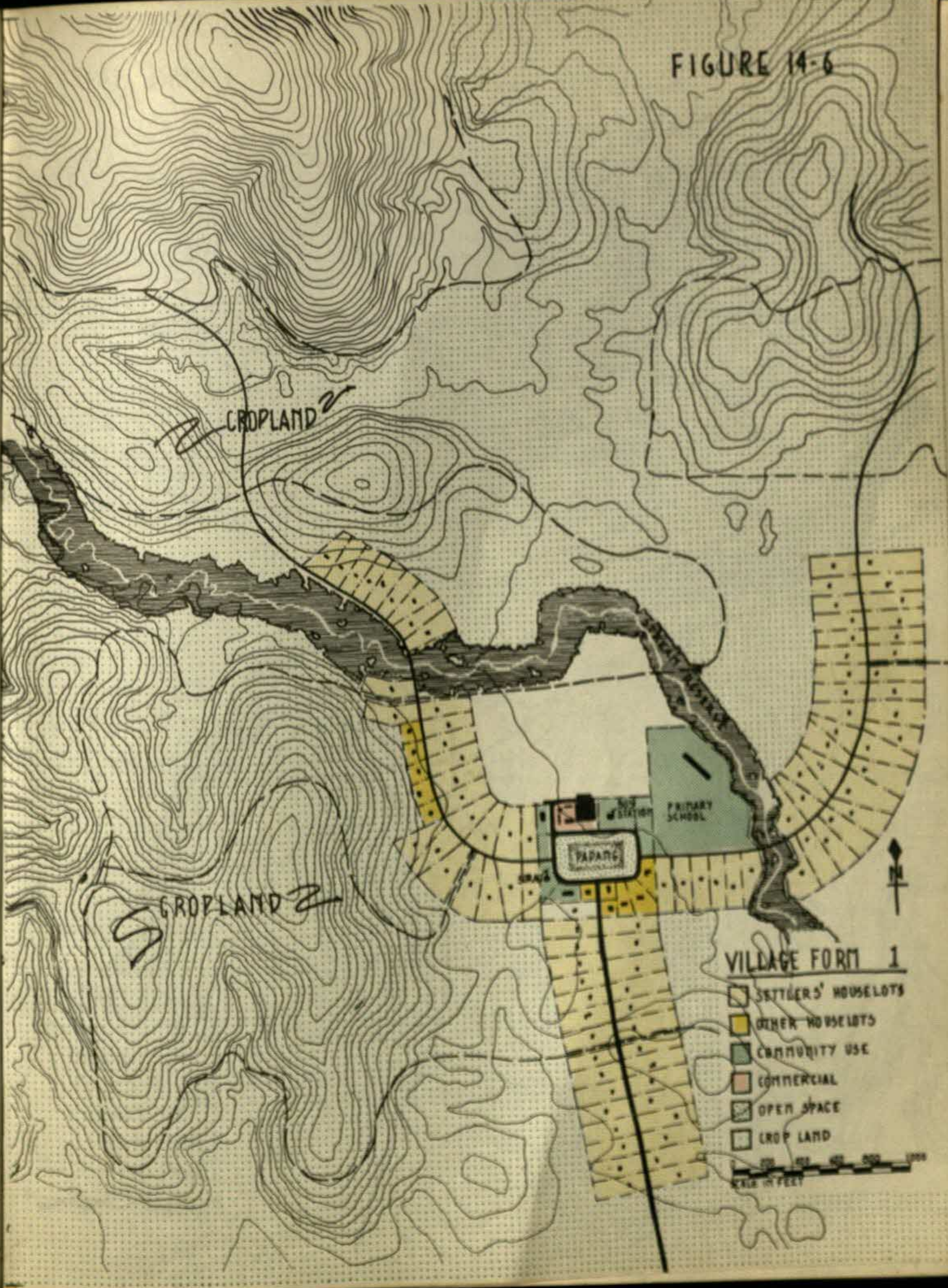


FIGURE 14-6
CROPLAND
CROPLAND
BUS STATION
PRIMARY SCHOOL
PADANG
VILLAGE FORM 1
SETTLERS' HOUSELOTS
OTHER HOUSELOTS
COMMUNITY USE
COMMERCIAL
OPEN SPACE
CROP LAND

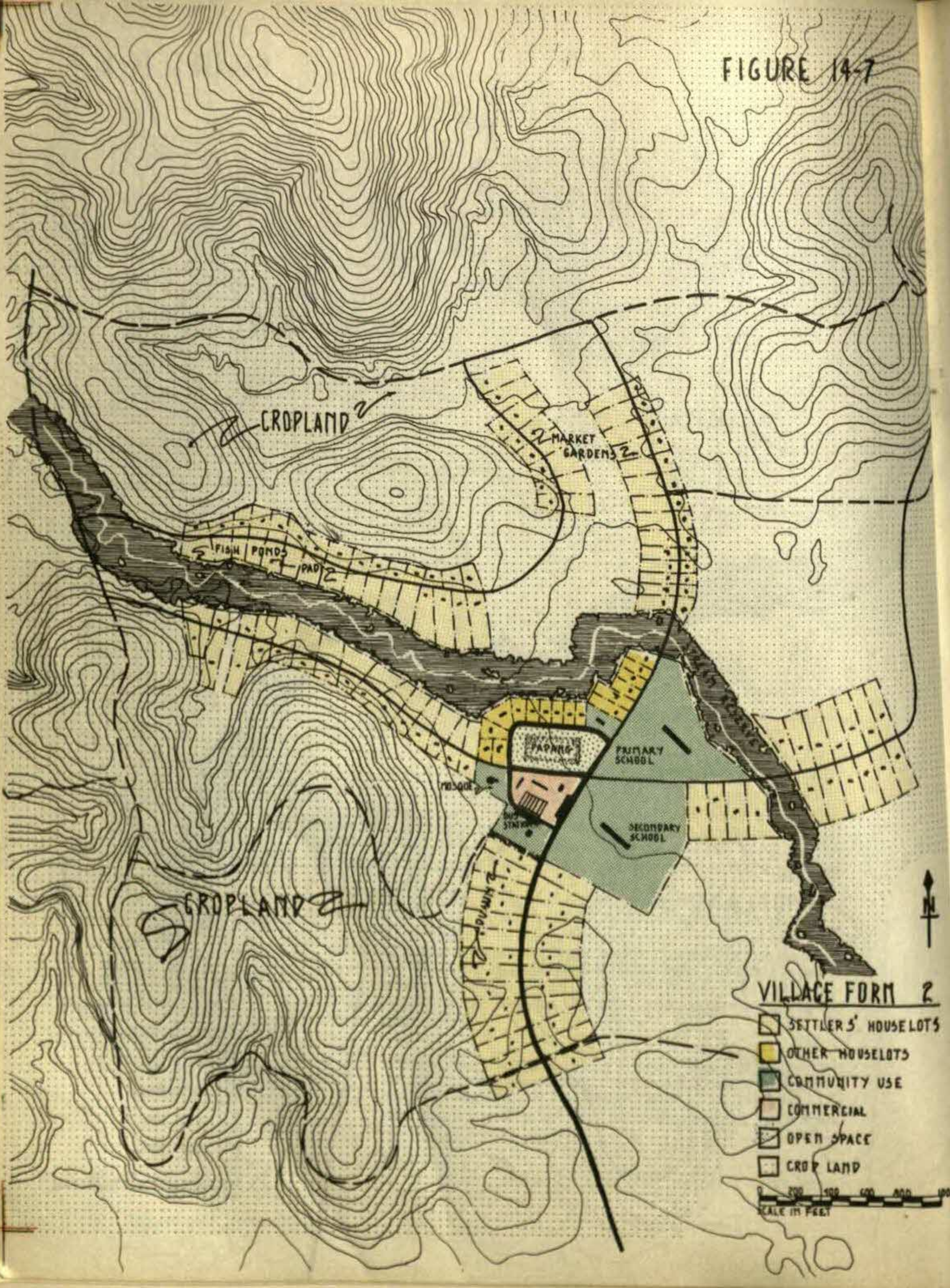

CROPLAND
MARKET GARDENS
FISH PONDS
PADI
PADANG
PRIMARY SCHOOL
SECONDARY SCHOOL
MOSQUE
CROPLAND
VILLAGE FORM 2
SETTLERS' HOUSELOTS
OTHER HOUSELOTS
COMMUNITY USE
COMMERCIAL
OPEN SPACE
CROP LAND
0 200 400 600 800 1000
SCALE IN FEET

FIGURE 14-7

contrast with the surrounding house lots and crop lands. In the rural environment in which the villages are placed there would be no need for parks or other types of recreational areas.

2) Commercial (1 acre) - Provision of space is recommended for shop buildings or stalls where small businesses such as coffee, provision, bicycle repair and other miscellaneous shops could develop as needs arise. The shops should be placed next to the padang. Space adjacent to them, equal in size, should be reserved for parking and small open air market sheds. Space should also be allocated for one FLDA-type co-operative shop.
3) Public Use (2.5 acres) - Public buildings in all villages would include FLDA office, bus station, small community hall, and a religious building (Surau). Land requirements for schools range up to 10 acres per school but is probable that few if any schools would be located in village centres (Chapter 21). Similarly, burial grounds would be located peripherally, and are not included in estimated village space, although allowance is made for them in the settlement unit as a whole.
4) Reserves (4.5 acres) - A reserve of between three and seven acres, depending on settlement size, should be provided in each village for possible future expansion of public services.

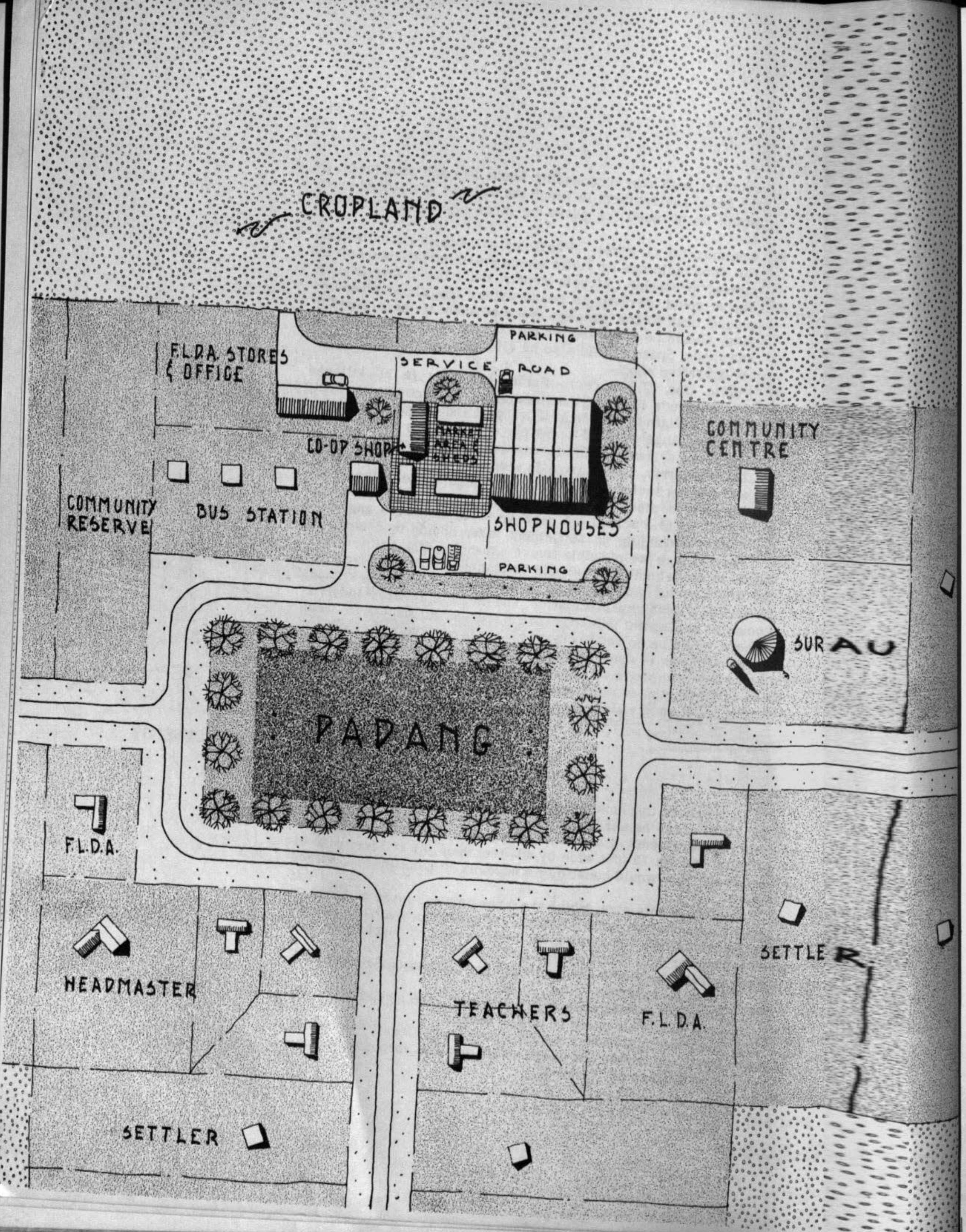
Roads in settlement units should be planned for agricultural service, but would perform a dual function by providing service to villages for both access and internal circulation. The layout, standards and estimated costs of settlement unit roads are discussed in Chapter 18. Generally, there would be no requirement for roads constructed solely for village use, although in some designs, short additional lengths of road might be added to improve access to sections of the villages. The need for these extra lengths of road would be determined by actual topographic conditions at each village site.

THE SETTLER'S HOUSELOT

It is proposed that houselot areas similar in size to those found in existing rural areas be used within the settlement villages (Figure 14 - 9). Field measurements of a number of typical rural houselots suggest the adoption of a lot 75 feet wide by 400 feet deep, or 100 feet wide by 300 feet deep. This would constitute a houselot of about three quarters of an acre.

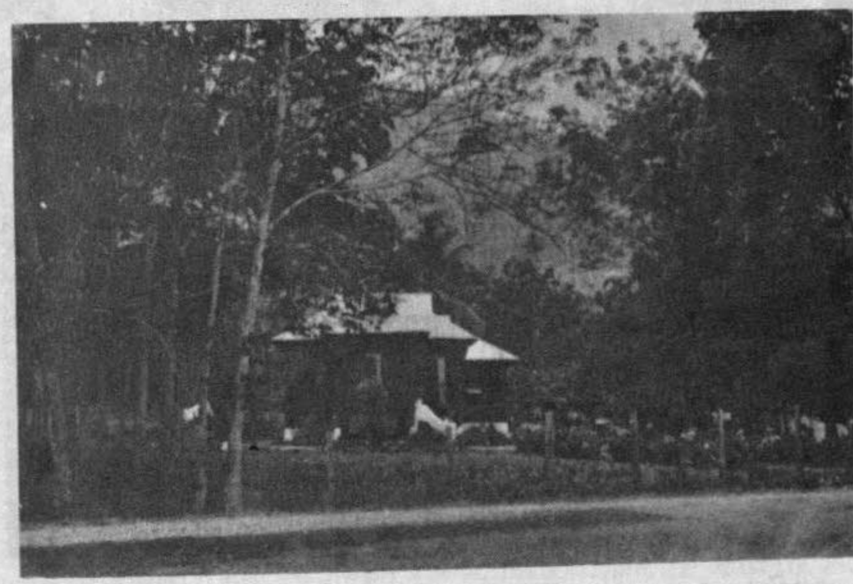
Houselots of this size, which are three times as large as those on present FLDA schemes, afford a number of agricultural advantages including opportunities for raising secondary crops to supplement cash incomes (Chapter 13). Other advantages include:

1) Rural type home environments and population densities in a rural landscape.
2) Room for family growth by additions to the settlers' houses, or later construction of larger houses.
3) Possible nutritional benefits from additional food crops.
4) Improved human and waste water disposal through additional land surface per family.


CROPLAND
F.L.D.A. STORES & OFFICE
SERVICE ROAD
PARKING
MARKET AREA & SHEDS
CO-OP SHOP
COMMUNITY CENTRE
COMMUNITY RESERVE
BUS STATION
SHOPHOUSES
PARKING
SURAU
PADANG
F.L.D.A.
HEADMASTER
TEACHERS
F.L.D.A.
SETTLER
SETTLER

For privacy, individuality, and avoidance of an institutional appearance, houses should be randomly sited on the lots

Figure 14-9
Rural House and Lot - Malacca



Fine integration of house and environment. The house is not placed squarely on its lot.

THE SETTLER'S HOUSE

The present FLDA policy of mass produced housing is affirmed for speed and simplicity of development. There would be approximately 9,300 settler's houses of the present quality and character, estimated to cost about M$13,300,000. These houses could be obtained from the prefabrication plant recommended for construction as part of the forest industry complex (Chapter 10).

It would be appropriate in spirit and scale to the FLDA programme, however, to experiment at later stages of Jengka's development with self-help housing. Under capable direction, and provided the full cooperation of interested settlers was obtained, construction of houses by settlers could reduce initial capital outlay by as much as M$1,000 per house, reduce settlers loans, and afford other less tangible advantages in terms of development of community spirit and in providing for the settler the type of house he wants (Figure 14-10). Self-help housing could range from completely individual construction by settlers to utilization of prefabricated modular panels obtained from the local plant.

Figure 14 - 10
Self Help Housing

Attap houses among tree stumps on recently cleared land

Access road to FLDA Schemes, Lasah, Perak. As the land is developed so is the house. The original house is at right.

The estimated initial capital cost for the average oil palm settlement unit is about M$935,000 and for the average rubber settlement unit about M$814,000 (Appendix 14 - 3). These estimates are given to express the range of initial capital cost at this level of development. They include costs of site preparation, planting, internal roads, water supplies, housing (settlers and support population), offices, co-operative shops, public buildings, markets, and amenities (padang). They do not include costs for commercial buildings, or for any of the public service facilities shared by settlement units such as police facilities, health services, schools and main roads outside the individual settlement units.

Comparisons of these costs with those for schemes of the types currently undertaken by FLDA cannot be made definitively. This is largely because of the essentially differing elements of design in each. The recommended settlement units are without dusun or reserve areas and also vary significantly in their village plan. While schemes of the FLDA type and the proposed Jengka settlement units would both utilize six to eight per cent of the gross area for villages, within the proposed settlement unit villages, only about 10 per cent of the village area would be allocated to uses other than houselots, compared with about 60 per cent in present schemes (Appendix 14 - 4).

Cost comparisons are also misleading because the very large scale of the Triangle's plan gives rise to many costs of a regional nature; primary and secondary roads, for example, lie entirely outside settlement units and their cost cannot be allocated to units individually. This is not the case with FLDA schemes which, because of their relative isolation in many areas, must bear individually disproportionate costs for access roads.

For those elements of development, however, which can reasonably be allocated to settlement units, examination of the requirements and costs reveals that the dispersion of rural population in small units has no significant effect on infrastructure and its costs as compared to the larger units presently used by FLDA.

Site preparation, including clearing, drainage and platforming (or terracing), planting, agricultural roads and housing make up over 80 per cent of all allocable settlement unit costs and all of these items are directly related to the acreage of the settlement and the numbers of settlers, not to the size of individual units. For roads within villages, the smaller settlement unit indicates economies because the need to build roads solely for village service is obviated; considerable savings can be achieved thereby. The largest element of infrastructure which would tend to rise with smaller settlement units is water supply (15 per cent of the total) but suggested economies in the design of individual water supply systems, and the grouping of small settlement units to use central sources of water, tend to offset this (Chapter 19).

A number of lesser items would also tend to increase in cost, including FLDA offices, cooperative shops, telecommunication facilities, and community halls. Offsetting factors, however, would be the somewhat smaller sizes of each needed in the smaller villages.

CHAPTER 15
PROJECTS

The project is a number of settlement units grouped in a composite geographical block for management purposes and to a lesser extent for processing of palm oil and latex. One of the basic planning requirements of the Master Plan is that projects should be capable of independent implementation and be economically viable units. Consequently projects are also subject to individual financial and economic analysis.

This chapter determines project size, location and phasing. The sizes, locations, and phasing of palm oil mills and rubber factories which are important components of projects, are also considered.

PROJECT SIZE

The sizes of individual projects are determined by management, geographical boundaries and processing requirements.

The project would need a relatively independent management structure which would be responsible for such activities as fresh fruit bunch and latex transport and processing, and supervision of settlement unit operations. Based on a review of the management structure at comparable levels on estates in West Malaysia, and considering the broad range of responsibilities which must be assumed at project level, it is reasonable to expect that an experienced project management staff could effectively control a maximum of about 25,000 acres of planted crops. Less experienced staff should probably not be allotted more than 20,000 acres and possibly less.

To ensure effective control it is also important that projects should where possible be composite blocks of land with no large topographical barriers dividing the area. Projects growing both oil palm, and rubber are not expected to incur additional management problems.

Efficient processing for both oil palms and rubber is achieved by employment of relatively large units. In Jengka large palm oil mills provide the optimum size where the haulage distances from settlement units to mills are at most 10 miles on surfaced roads. With rubber the economies of large plants appear to outweigh small increments in additional transport costs incurred by longer hauls of liquid latex from more distant settlement units to the factories. Taking costs of plant, management and transport into account, processing units can be constructed to accomodate a range of areas, but with a maximum of 19,000 acres of oil palms and 15,000 acres of rubber. If processing units are built to serve areas under 50 per cent of these maximum acreages, they are likely to be significantly less economic.

The costs of many elements of infrastructure such as main roads, towns, and supporting public services, and the costs of central management for the Triangle as a whole, cannot precisely be attributed to individual projects. The economies of different plans of infrastructure, services and central management can only be considered on a Triangle basis and do not therefore affect project size.

Most of the fringe areas of Jengka include existing FLDA schemes which can obtain considerable benefit from being incorporated into the management structure of Jengka. Since these schemes will already be planted or in production before the neighbouring areas of Jengka, the management demand from them will be somewhat less. Therefore larger projects can be considered when a substantial part of their acreage includes existing FLDA schemes.

Projects have been selected to provide composite geographical blocks of a maximum of 25,000 planted acres including FLDA Schemes (20,000 excluding FLDA Schemes) and a minimum of 15,000 planted acres. Differences in size are desirable and would enable optimum use to be made of the varying calibre of managers.

The total net planted acreage of the Triangle can be about 93,000 acres of new land; of this 65,500 acres are suitable for oil palms (Chapter 9). In addition, 17,900 acres on five existing FLDA schemes, including 5,200 acres of oil palms, may be included in the planned projects. The total area of 110,900 net acres can be divided into five or six projects, as determined by topography.

PROJECT LOCATION

The Jengka ridge separates the Triangle into a clearly defined east side and west side.

The east side of the Triangle which includes the Ulu Jempol and Bukit Tajau FLDA Schemes has a potential planted acreage of about 37,000 acres. This naturally divides itself into two projects (Figure 15-1).

Project I - A 17,300-acre unit in the north with 11,500 acres of new oil palms, 5,200 acres of existing oil palms on the Ulu Jempol Scheme, and 600 acres of new rubber.

Project II - A 19,400-acre unit in the south with 10,800 acres of new oil palm, 4,800 acres of new rubber and 3,800 acres of existing rubber on the Bukit Tajau FLDA Scheme.

The west side of the Triangle which includes the Kampong Awah, Sungai Nerek, and Sungai Tekam FLDA Schemes, has a potential planted acreage of about 74,000 acres. It can be divided into four composite projects, with the exception of a narrow 7,000-acre strip of oil palm land lying between two smaller ridges on the western edge of the Triangle. This strip can be considered either as a separate unit, which would be too small for efficient management, or as a part of the southern block. The four projects on the west side are as follows:

Project III - A 24,400-acre unit on the south which would include 16,400 acres of new oil palms, 2,400 acres of new rubber, and 5,600 acres of existing rubber on the Kampong Awah and Sungai Nerek Schemes. This project approaches the maximum desirable size.

Project IV - A 16,800-acre unit in the northwest which would include 13,500 acres of new oil palms, and 3,300 acres of existing

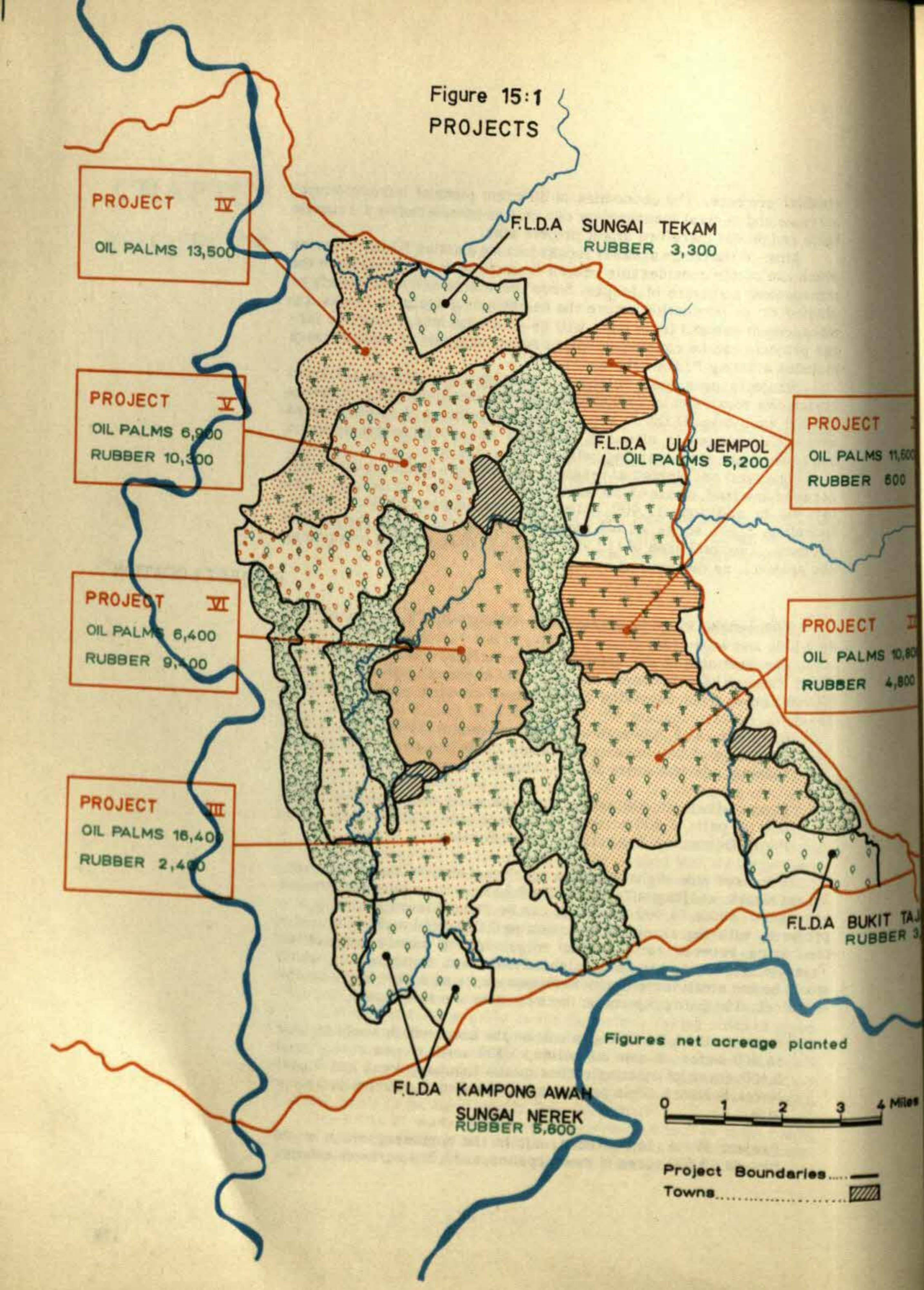


Figure 15:1
PROJECTS

rubber in the Sungai Tekam Scheme.

Project V – A 17,200-acre unit in the north centre with 6,900 acres of new oil palms and 10,300 acres of new rubber. It would lie between a low ridge on the west, and the forest area on the east. All the new rubber land in the northern portion of the Triangle would be grouped in this project for economy in processing. Project V would contain 40 per cent of the new rubber to be planted in the Triangle.

Project VI – A 15,800-acre unit in the centre with 6,400 acres of new oil palm and 9,400 acres of new rubber. It would be the second largest rubber project and would contain 30 per cent of the new rubber to be planted in the Triangle.

For efficient operation and control of project activities, project management staff should be located with offices in or near the individual projects. Economic groupings of management facilities can best be achieved by siting the various project headquarters in the towns proposed for development as part of the Triangle plan (Chapter 16). Management operations would thus have the advantages of modern communications, roads and utilities without the need for building (and duplicating) those facilities on an individual project basis. Project management staff could also reside in the towns and thus have access to amenities not otherwise available in agricultural areas; this may be important in attracting qualified personnel to Jengka.

A summary of projects, planting areas, and locations of project headquarters is given in Table 15-1.

Table 15-1
Project Size
(planted acres)

	New Land			FLDA Schemes				
	Oil Palm	Rubber	Total		Oil Palm	Rubber	Total Planted Acreage	Site of Project Headquarters
East Side								
Project I	11,500	600	12,100	Ulu Jempol	5,200	-	17,300	Regional Centre
Project II	10,800	4,800	15,600	Bukit Tajau		3,800	19,400	Southeast Town
West Side								
South								
Project III	16,400	2,400	18,800	Kampong Awah	-	5,600	24,400	Southwest Town
North								
Project IV	13,500	-	13,500	Sungai Tekam	-	3,300	16,800	Regional Centre
Project V	6,900	10,300	17,200		-	-	17,200	Regional Centre
Centre								
Project VI	6,400	9,400	15,800		-	-	15,800	Regional Centre
Total	65,500	27,500	93,000		5,200	12,700	110,900	

PROJECT PHASING

Individual projects should be developed as rapidly as possible to ensure the most rapid recovery of capital investment and management expenditure from agricultural production. The rate of project development, however, is determined by factors which affect the pace of overall development in Jengka.

Agricultural development - In oil palm areas the importance of management in achieving expected yields implies that the speed of development of oil palms will be determined as much by the supply of trained management personnel as by other factors such as the availability of planting material and contractors to establish the crop. These factors will be most important in the immediate future, prior to the establishment of nurseries and management training schemes.

Rubber being a crop in which FLDA and contractors have greater experience should cause fewer difficulties, although the supply of trained management will be critical if large acreages are planted in the immediate future.

Forest Exploitation and Clearance - The present lack of organizations in West Malaysia with the capacity or techniques to exploit the forest to its optimum and the necessity in consequence to establish an entirely new form of forest industry complex in Jengka (Chapter 10), suggests that better exploitation will be achieved if working of disturbed forest areas precedes that of the richer undisturbed areas. On this basis, forest exploitation, and subsequent land development, should be directed first to the large logged over areas in the southeast, south and northwest, prior to entering the Jengka Forest Reserve areas. It is also estimated that economies in timber processing plant can be achieved if the most productive areas of forest are left untouched until late in the programme. This would allow the timber industry to absorb the output of the forest at a more uniform rate with lower capacity.

The capacity of the contractors to clear the land prior to planting is also critical to the pace of development. Pahang is a relatively unpopulated area and the Jengka Triangle is remote from present centres of supply of contract labour. It is estimated that contractor capacity could reach a maximum of about 15,000 acres annually by 1970, but before this time smaller clearing acreages should be planned.

Aspects of agricultural development, forestry and land clearance indicate that rates of land development in the immediate future must be small if expected yields are to be achieved. As the capacities of management and contractors increase, annual acreages cleared and planted can rise to a maximum in the 4th and 5th years of development (around 1970). A schedule of maximum feasible rates of annual clearing and of oil palm planting is shown in Table 15-2.

In practice "annual" clearing operations in any given area are in general more related to the 12-month period, 1 July - 30 June, than to a calendar year. This is also true of planting. For these reasons, analyses of expenditure and return in this report are based on fiscal years covering the last six months of one year and the first six months of the next. Table 15-2, and ensuing tables which relate to aspects of project phasing are presented on this basis.

The maxima set out in Table 15-2 for agricultural development do not present excessive demands on the supply of infrastructure, particularly since usable access roads will generally be available as a result of logging. The rates of development are within those assumed when assessing the market prospects in the main commodities. The resultant targets for construction of agricultural processing plants are within the country's capacity. It is assumed that capital can be supplied to meet this rate of development.

Table 15-2
Recommended Maximum Land Clearance and Planting
(acres)

	1966/7 1	1967/8	1968/9	1969/70	1970/1	1971/2	1972/3
Forest Clearance (gross acreage)	5,000	9,000	12,000	14,000	15,000	15,000	15,000
Planting Oil Palms (net acreage)	-	4,500	7,500	9,500	10,500	11,000	11,000

1) Fiscal years (1st July - 30th June)

Location of Initial Phase

The most economic form of agricultural development demands that oil palm land which produces a higher and more immediate income than rubber should where possible be developed first. This land is mainly found on the east side (Projects I and II) the south (Project III) and the northwest (Project IV). Efficient forest exploitation requires that the most productive areas of timber which occur in areas recommended as suitable for rubber lying in Projects V and VI should be left until the later years of development of Jengka.

The concept of concentrating first on oil palm land might conceivably lead to the inclusion of the Tekam area before Projects V and VI since Tekam is mainly oil palm land. This would necessitate some project re-phasing but its inclusion would almost certainly improve the viability of the scheme as a whole.

The fact that FLDA has already planted oil palms on the Ulu Jempol Scheme, and has began construction of a palm oil mill nearby, requires that development of new land in Jengka should start in the vicinity of Ulu Jempol and on the east side. This general area contains a predominance of oil palm land, and has already been logged in varying degrees. It can be developed without construction of long access roads through undeveloped land.

Recommended Project Phasing

Project phasing has been planned to achieve the most economic development of the Triangle subject to certain limitations. When started, projects should be phased over two or three years of continuous development. Similarly settlement units must be developed within a single year to enable all settlers in any village to be brought in at the same time. This also ensures that land clearance and planting is done in units of not less than 1,000 acres which are believed to be the minimum economic sizes for land clearing and agricultural development.

The recommended phasing programme is shown in Figure 15 - 2 and summarized in Table 15 - 3. Wherever possible oil palm land would be developed prior to rubber, while adhering to the maximum annual acreages for development established. Development of most of the east side of the Triangle would be completed in three years (Projects I and II). By mid-1971 most of the oil palm land in the southwestern part of the Triangle (Project III) would be cleared, as well as the rubber land in the southeast. Little benefit could be achieved by delaying the rubber in the southeast (4,800 acres in Project II) as the annual acreage planted to oil palm would be near its maximum in 1969/70.

Table 15 - 3
Project Phasing

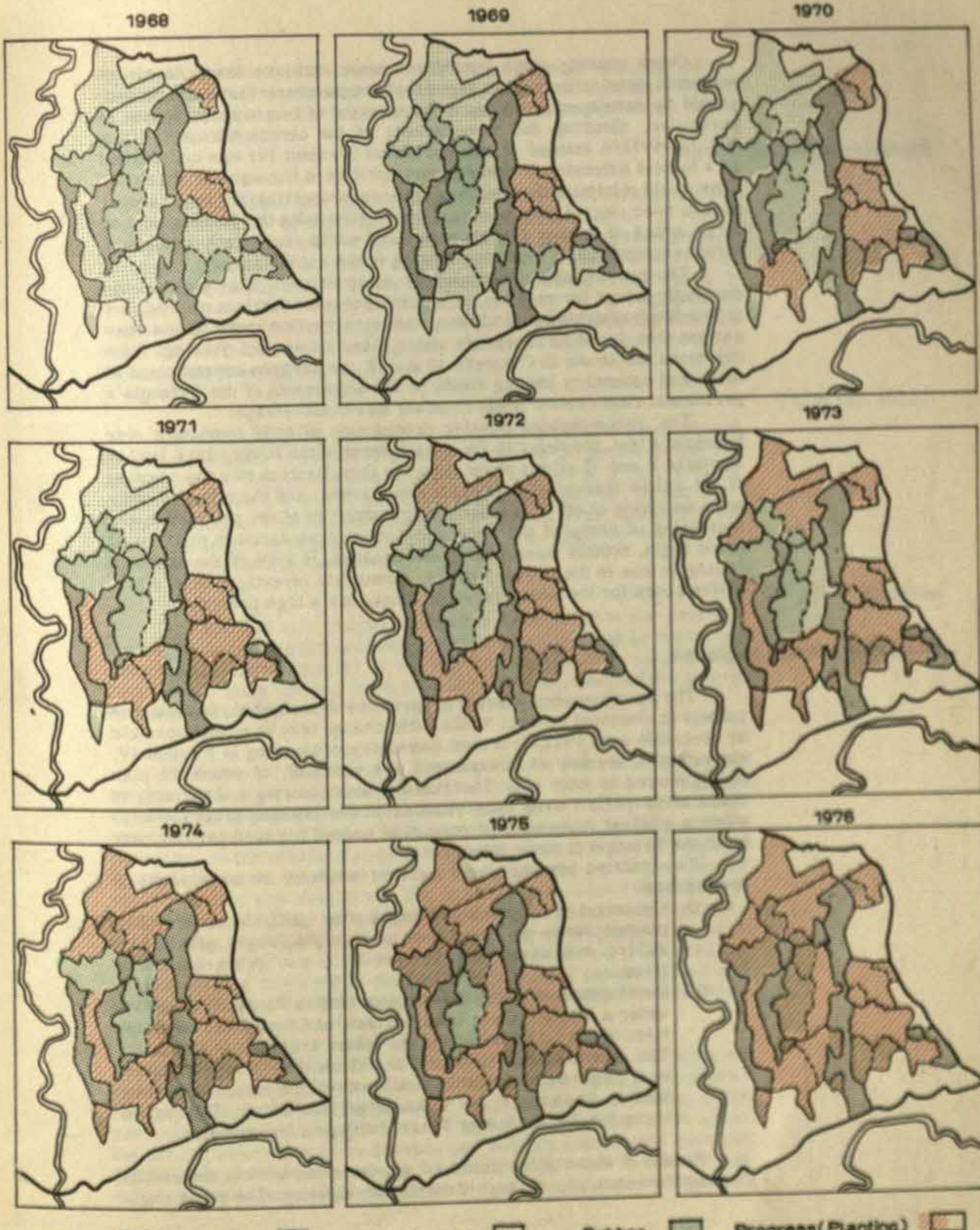
	1966/7 [1]	1967/8	1968/9	1969/70	1970/1	1971/2	1972/3	1973/4	1975/5	1975/6	1976/7	Total [2] New Land	Total FLDA	Total Project
Clearing (gross acres)														
Project I	4,800	8,600	1,300									14,700		14,700
Project II			9,600	6,100	3,600							19,300		19,300
Project III				7,700	11,500	3,000						22,200		22,200
Project IV						11,800	4,600					16,400		16,400
Project V							8,400	4,600	8,600			21,600		21,600
Project VI								7,800	2,400	9,700		19,900		19,900
Total cleared	4,800	8,600	10,900	13,800	15,100	14,800	13,000	12,400	11,000	9,700		114,100		114,100
Planting (net acres)														
Project I													5,200	17,300
Oil Palm		4,000	6,400	1,100								11,500		
Rubber			600									600		
Project II													3,800	19,400
Oil Palm				7,900	2,900							10,800		
Rubber					2,000	2,800						4,800		
Project III													5,600	24,400
Oil Palm					6,300	9,400	700					16,400		
Rubber							2,400					2,400		
Project IV													3,300	16,800
Oil Palm							9,700	3,800				13,500		
Rubber												-		
Project V														17,200
Oil Palm								6,900				6,900		
Rubber									3,600	6,700		10,300		
Project VI														15,800
Oil Palm									6,400			6,400		
Rubber										1,900	7,500	9,400		
Total Oil Palm		4,000	6,400	9,000	9,200	9,400	10,400	10,700	6,400			65,500		
Total Rubber		-	600	-	2,000	2,800	2,400	-	3,600	8,600	7,500	27,500		
Total Planted		4,000	7,000	9,000	11,200	12,200	12,800	10,700	10,000	8,600	7,500	93,000	17,900	110,900

1) Fiscal years (1st July - 30th June)
2) Does not include land added to existing FLDA Scheme (800 acres)

After Project III, development would move to the oil palm land in the northwest (Project IV) followed by the remaining oil palm land in the north and centre of the Triangle (Projects V and VI). By mid-1975 all oil palm land should be developed.

The main block of steeper land in the centre, which under present technology is classified as only suitable for rubber, would be cleared in the last two and a half years of development. This final area includes some of the richest forest in the Triangle and the deferment of its development consequently allows the maximum time for forest exploitation.

Figure 15-2
PHASING OF DEVELOPMENT



Other phasing plans considered would achieve lower levels of economic development. This is due to the requirement that each project should be developed in one continuous period of two to three years. In particular, clearing and development of the centre (Project VI) in 1971/2 - 1972/3 instead of the northwest (Project IV) was considered as a logical extension of development northward through the Triangle. This would minimise the need for advance construction of a long central access road. Such a plan however, would substitute the development of large areas of rubber for oil palms and would accelerate the rate of forest exploitation by directing logging to the richer areas.

The development of Project IV after Project III as planned undoubtedly brings forward the construction of some sections of road, but it is unlikely that this would advance road construction more than a year earlier than would be necessary under other systems of phasing. Furthermore, as shown in Chapters 10 and 18, the advance construction of main and secondary logging roads on the alignments of the Triangle's permanent road system tends to offset this disadvantage.

The recommended phasing programme affords important side benefits. First, the delay in the development of the lower class land of Projects V and VI allows more time for investigation into the growing of oil palms instead of rubber in these areas, and the effect of their soils on yields of oil palms. Second, investigation of the production and marketing of some of the secondary crops considered in this report could begin, notably manila hemp and bananas. In view of the expected falling prices in the primary crops, immediate investigation of alternative crops for the later stages of Jengka has a high priority.

Alternative phasing programme

The recommended phasing programme described above should be subject to continual review. While little change may be either possible or desirable until 1972/3, or until completion of clearing in Project IV, thereafter a number of alternatives are possible, of which the plan recommended is only one. The rates of both clearing and planting in years after 1972/3 have been reduced in the phasing programme to allow a gradual movement of resources needed for land development from the Triangle to some other area.

Two related phasing plans warrant attention in later years of development:

i) Continued development of Jengka after 1972/3 at about 13,000 planted acres per year thus completing Jengka planting by 1975/6 and developing Project VI in two years instead of three.

ii) Development of only the oil palm land in Projects V and VI, under a single project headquarters, and thereafter development of the oil palm land in the Tekam area if it is available. The rubber land in Projects V and VI could be developed later, or it might be practicable to allow development of the rubber land in Projects V and VI by the private sector. This would leave Jengka, excluding Tekam, with only five projects.

Either of these plans could be implemented without materially altering the annual input of logs to the timber industry. The plans might appear attractive to FLDA in that they either avoid or delay direct investment by FLDA in less profitable land. Even if it is found possible to grow oil palms on this land, the alternatives would still merit serious consideration.

Project Industrial Development

As an integral part of the recommended project plan, including project phasing, a coordinated plan for forest operations and forest products processing, and for palm oil and latex processing facilities, is required. The entire structure and timing of the project plan rests on the implementation of the forestry plan (Chapter 10); its importance to the success of the Triangle development must be re-emphasized. Recommendations for palm oil and latex processing facilities which in their sizes, location and timing are closely related to project size, location and phasing, follow.

PALM OIL MILLS

The recommended planting of oil palms on 65,500 acres of new land in the Jengka Triangle, plus the production of oil palms on the Ulu Jempol FLDA Scheme necessitate the installation of a total milling capacity of about 170 to 180 tons of fresh fruit bunches (FFB) per hour in the Triangle. This capacity constitutes a very large new industrial requirement in West Malaysia, and one which must be met in as yet an almost wholly undeveloped area.

Mill Size

The optimum size of a palm oil mill is determined by the possible economies in the use of management, labour and plant, and by transport costs which are a function of hauling distance of FFB. As stated in Chapter 11, large central palm oil mills are recommended for use in the Jengka Triangle.

Management and labour - The experience and skill required to operate and maintain palm oil mills of from 15 to 45 tons capacity (FFB) per hour is considerable. Personnel qualified in palm oil mill operation are scarce and it will take considerable time to train new personnel to the standard required. Available experienced and skilled supervisory staff therefore can best be employed in large mills, of 40 - 45 ton per hour capacities. The potential losses due to breakdown, unrectified reductions in extraction efficiency, or rises in free fatty acid content of the palm oil are so great in terms of income lost as to make it essential that the best management obtainable is secured for Jengka. Larger mills would also make better use of factory labour and be more efficient in their use of skilled mechanics and maintenance workers than smaller mills.

Economies in Plant Size - Considerable economies are achieved by building mills of at least 20 tons per hour capacity, capable of processing FFB from 7 - 8,000 acres of oil palm. Above this size, mills are built in multiple units of 15 or 20 tons per hour capacity, in which the 20-ton line tends to be cheaper per unit of capacity than does the 15-ton line. A somewhat reduced flexibility of operation in a 2 x 20-ton mill, as compared to a 3 x 15 ton mill, can be overcome by incorporating selected standby units. Based on comparisons of the capital costs for processing machinery and ancillary equipment for mills ranging from 15-45 tons per hour capacity, it appears that the optimum capacity in terms of plant cost occurs at 40 tons per hour (Table 15-4).

Table 15-4
Palm Oil Mill Capital Cost and Capacity

Capacity (tons FFB per hour)	15	20	30	40	45
Number of lines	1	1	2	2	3
Size of line (tons per hour)	15	20	15	20	15
Capital Cost (M$000) 1)					
Machinery	1,920	2,352	3,697	4,206	5,473
Ancillary Equipment	868	951	1,436	1,772	1,753
Total	2,788	3,303	5,133	5,978	7,226
Capital Cost per ton per hour capacity (M$000)	180	165	168	150	160

1) Based on manufacturers' quotations.

Economies of transport - Transport distances generally are important in assessing mill size. In Jengka, however, the distances are so small that large increases in capacity result in only small marginal increases in transport cost. In the Triangle, for example, a complex of twelve 15-ton mills instead of five 30 or 40-ton mills would reduce the average haul by only 1.2 miles. Annual savings in transport of M$133,000 (at marginal transport cost of M cent 20 per ton mile) would be small compared with the increased capital cost of the numerous smaller mills, equivalent at seven per cent to M$300,000 per year.

On the foregoing bases, the installation of large mills, preferably of 40 tons capacity, is recommended for Jengka provided good management can be obtained.

Mill Efficiency

The critical factor in planning mill capacity for any given acreage is the level of intensity at which the mill can be worked during the peak month when 12.5 per cent of the total annual crop must be processed. This volume is 50 per cent greater than the average monthly crop. In West Malaysia, 400 hours per month (two 8-hour shifts, 25 days per month) is usually considered to be a reasonable working level. There are significant variations in the operating practices of existing mills; some work only one shift (200 hours per month), others work far in excess of these levels, up to 550-600 hours per month. In selecting the level of intensity for Jengka, numbers of shifts worked and the additional cost of labour must be considered. With the relatively high levels of cost of mills shown in Table 15-4, the cost of additional labour in using the mills more intensively appears justified. Were mills to be available at lower prices, more mills running at lower levels of intensity might seem preferable, because the higher mill cost would be offset by the lower cost of labour and housing.

The cost of the mills used for the purposes of this report would not justify single as opposed to double shift working. Therefore mill capacities have been calculated assuming that mills in the initial phases should generally be operated at around 400 hours during the peak month, but that later mills should be operated at up to 500 hours per month.

Recommended Mill Plan

Palm oil mills should be sited near the centres of the areas they serve, close to adequate supplies of water, and adjacent to suitable roads. Three alternative plans were considered for Jengka, based on a total required capacity for the Triangle as a whole of 170 tons FFB per hour (Table 15 - 5). This capacity reflects a relatively high efficiency, averaging for all mills 468 running hours per month. The plans were as follows:

Plan 1 - Independent processing of FFB by each project. This plan neccessitates two small (15-ton) mills in Projects V and VI; it requires the greatest capital investment without achieving any significant transport economies.

Plan 2 - Independent project processing, except for Projects V and VI which would share one 30-ton mill. An estimated saving of M$0.5 million compared to Plan 1 is possible.

Plan 3 - Construction of only four mills with movement of FFB to nearest mill, regardless of project boundaries. A further estimated capital cost saving of M$1.1 as compared to Plan 2 is possible.

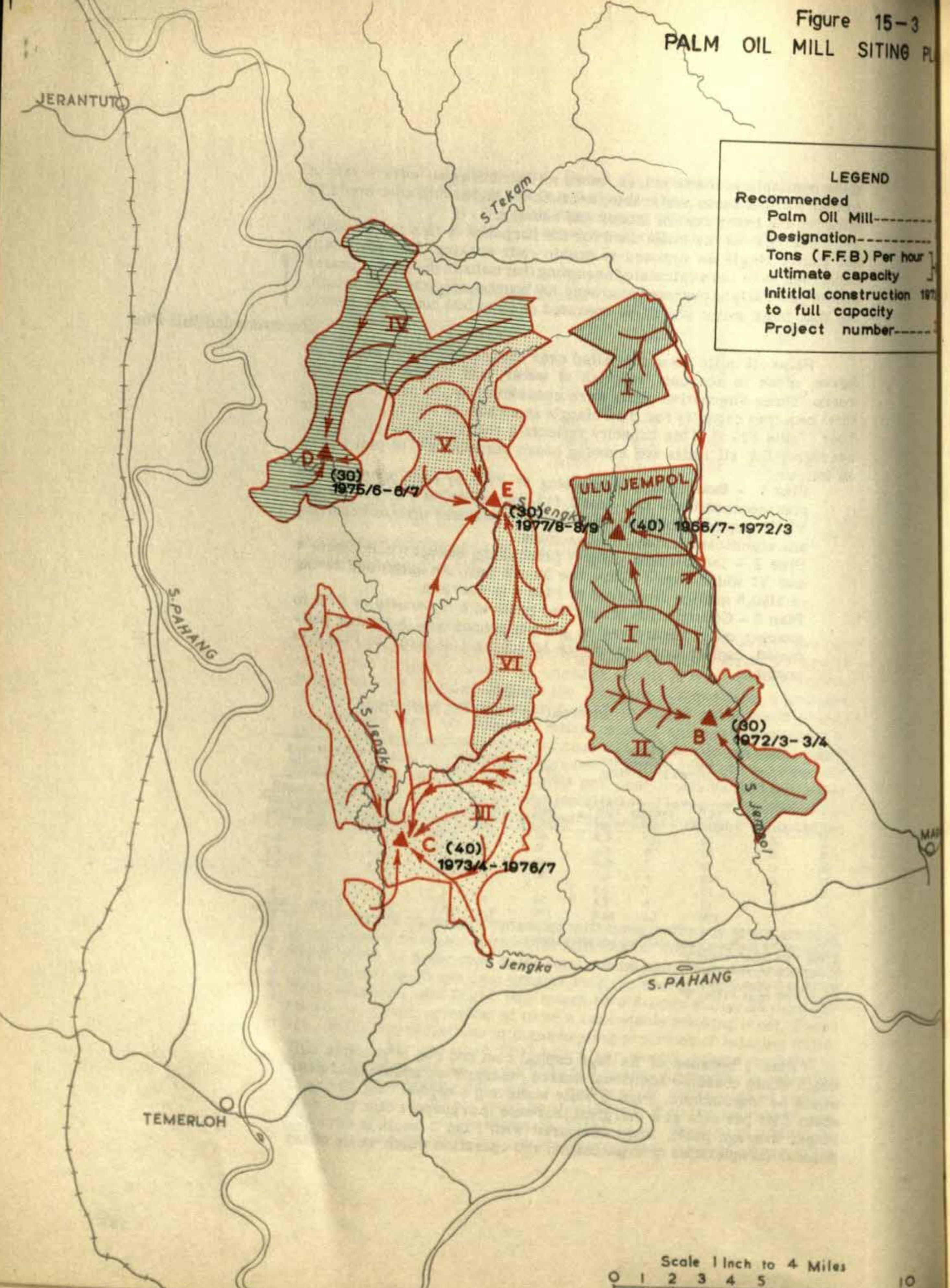
Table 15 - 5
Alternative Palm Oil Mill Plans

		Plan 1 (independent project processing)			Plan 2 (combined processing in Project V and VI)			Plan 3 (minimum number of mills; FFB to nearest mill, regardless of project)		
Project	Mill	Mill Capacity	Average Haul	Mill [1] Cost	Mill Capacity	Average Haul	Mill [1] Cost	Mill Capacity	Average Haul	Mill [1] Cost
I	A	40	10	6.2	40	10	6.2	45 [2]	10	7.2
II	B	30	6	5.1	30	6	5.1	40 [3]	7	6.0
III	C	40	7	6.0	40	7	6.0	40 [4]	8	6.0
IV	D	30	6	5.1	30	6	5.1	45 [5]	7	7.2
V	E	15	7	2.8)				-	-	-
VI	F	15	6	2.8)	30	8	5.1	-	-	-
		170	7.3	28.0	170	7.5	27.5	170	8.0	26.4

1) Processing machinery and ancillary equipment only
2) 10% FFB from Project V
3) 13% FFB from Project VI; from III
4) 25% FFB from Project VI
5) 27% FFB from Project V

Plan 1 because of its high capital cost and use of an extra mill which would consume additional scarce management and skilled labour would be uneconomic. Plan 3 while achieving a capital cost saving of about four per cent at a marginal increase in transport cost (0.3 mile longer average haul), when compared with Plan 2 would involve additional complexities of organization and operation which would offset

Figure 15-3
PALM OIL MILL SITING PL



capital cost saving and would reduce opportunities for independent project implementation. Due to the relatively short distances in the Triangle, the average FFB haul distances do not vary significantly in any plan tested (maximum range under 10 per cent).

For these reasons, Plan 2 is recommended and has been used for the planning and economic analyses of this report. The siting of the recommended mills, their sizes, and years of construction, are shown on Figure 15 - 3.

As part of these analyses, the financial and operational implications of two other plans (Plans 4 and 5) which would involve variations in mill size and inter-project processing were also tested; the implications of all plans on the basis of larger overall capacity (180 tons FFB per hour) which would permit slightly lower working rates (average 442 hours per month) were also examined. These analyses indicated that somewhat greater economies would be possible through higher utilization of mills than through construction of larger mills. Under Plan 3, for example, a saving of M$2.4 million is estimated with high utilization as compared with low utilization (170 tons vs 180 tons overall capacity), while the saving through use of larger mills (Plan 1 vs Plan 3) is about M$1.6 million. Comparative costs, acreages served, haul distances and mill capacities for all plans tested are given in Appendix 15 - 1.

The estimated cost of the five mills recommended under Plan 2 is M$37,357,000 (Table 15 - 6), including processing machinery and ancillary equipment, as well as site preparation, water supplies, workshops, and staff housing. Costs were increased by 15 per cent for contingencies, but no allowances for engineering or supervision of construction were made since these services are often part of contract costs for mill construction, equipment and installation.

Table 15 - 6
Estimated Construction Costs of Palm Oil Mills
(M$ thousands)

Mill	A	B	D	E	C	All Mills
Project	I [1]	II	IV	V - VI	III	
Capacity (tons FFB/hour)	40	30	30	30	40	170
Mill Costs						
Machinery	4,427 [2]	3,697	3,697	3,697	4,206	19,724
Ancillary Equipment	1,772	1,436	1,436	1,436	1,772	7,852
	6,199	5,133	5,133	5,133	5,978	27,576
Other Costs						
Site preparation and water supply	80	80	80	80	80	400
Workshop	100	70	70	70	100	410
Staff housing	878	791	791	791	878	4,129
	7,257	6,074	6,074	6,074	7,036	32,515
Contingencies (15%)	1,089	899	899	899	1,056	4,842
Total Estimated Costs	8,346	6,973	6,973	6,973	8,092	37,357

1) Mill at Ulu Jempol FLDA Scheme, under construction 1966
2) This mill estimated to cost M$221,000 more than 40 - ton mill in Project III due to installation of 3 - ton press in initial phase.

There are factors which could require changes in the mill plan given here and at this stage it would be unwise for FLDA to commit themselves rigidly to one plan. Additional capacity may be required if yields exceed those expected and if it is decided to process fresh fruit bunches from smallholdings on the edge of the Triangle. The planned capacities of the later mills should be constantly reappraised in the light of experience in the early stages of Jengka.

Mill Phasing

The proposed phasing of the five recommended palm oil mills is given in Table 15 - 7 and is illustrated in Figure 15 - 4. The most immediate aspect of mill phasing will be the phasing of Mill A (Project I); this is already under construction by FLDA on the Ulu Jempol FLDA Scheme, and an initial three-ton press is being installed. Additional capacity will be needed in 1968/9. The distribution of FFB input to this mill from the Ulu Jempol FLDA Scheme and Project I and an alternative phasing for a 45-ton mill are given in Appendix 15 - 2.

The proximity of this mill to the proposed Project II mill (nine miles, Figure 15 - 2) would make it possible to use spare capacity in emergencies from Project II when that mill is built (1972/73). For this reason, a 40-ton mill in Project I, ultimately running at 470 hours per month maximum, is preferable to a larger mill running at a lower utilisation, as long as its phasing-in provides for an excess of capacity up to 1972/3.

The phasing of mills in Projects II, III, IV and V - VI, was based on the project phasing and planting programme shown in Table 15 - 3. Phasing for each mill was planned to allow low levels of utilisation in the first year, building up to the final level after 7 - 8 years (Table 15 - 7). The final level of utilisation would rise with the installation of successive mills; thus the last mills to be built, those in Projects IV and V - VI, would operate at higher levels of intensity in all years than would mills in Projects II and III. A standard phasing programme has been assumed for the three 30-ton mills of Projects II, IV and V - VI. During the initial period of each mill, use should be made of spare capacity in neighbouring mills. For this purpose, Projects I and II can be treated as one unit, Projects III, IV, V and VI as another and, if necessary, Projects II and III as a third.

Organisation and Construction

Until very recently West Malaysia's palm oil producers relied solely on imports of oil palm milling equipment and the palm oil mill costs used for estimating purposes in this report are based on quotations for imported equipment. Recently, however, a few mills have been installed in West Malaysia which are predominantly locally manufactured. With the exception of certain key items such as presses, digesters, boilers, and sludge centrifuges, local industry is capable of manufacturing most items in the mills at costs substantially lower than for imported equipment. At a recently installed 20-ton mill which is designed to be extended to 40 tons, for example, the complete 40-ton plant is estimated to cost 30 per cent less than an equivalent imported version. This saving when applied over an investment programme of M$28 - 30 million in Jengka would amount to M$8 - 9 million; savings in

Figure 15 - 4
Palm Oil Mill Phasing

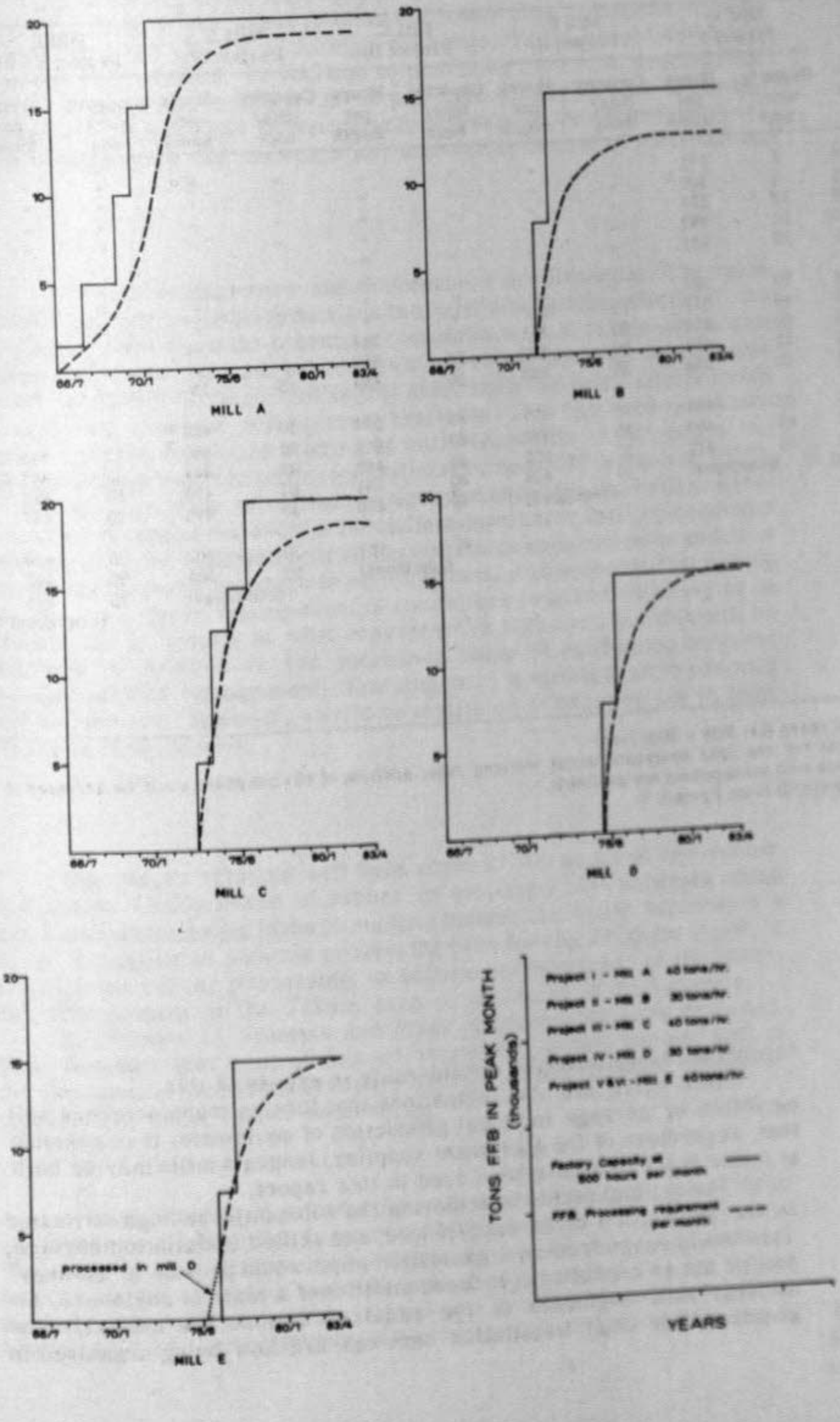


Table 15 - 7
Palm Oil Mill Phasing

Year [1]	Mill A Project I		Mill B Project II		Mill C Project III		Mill D Project IV		Mill E Project V - VI	
	Capacity tons/hour	Hours per month	Capacity tons/hour	Hours per month	Capacity tons/hour	Hours per month	Capacity tons/hour	Hours per month	Capacity tons/hour	Hours per month
1966/7	3	142								
7/8	3	500 [2]	-	-	-	-	-	-	-	-
8/9	10	253	-	-	-	-	-	-	-	-
9/70	10	392	-	-	-	-	-	-	-	-
70/1	20	331	-	-	-	-	-	-	-	-
71/2	30	384	-	-	-	-	-	-	-	-
72/3	40	371	15	237	-	-	-	-	-	-
73/4	40	416	30	251	10	284	-	-	-	-
74/5	40	438	30	329	25	367	-	-	-	-
75/6	40	454	30	355	30	456	15	15	-	-
76/7	40	464	30	376	40	394	30	415 [3]	-	-
77/8	40	469	30	392	40	419	30	460 [3]	15	448
78/9	40	470	30	402	40	440	30	444	30	383
79/80	(continues)		30	405	40	454	30	470	30	432
80/1			(continucs)		40	460	30	490	30	457
81/2					40	461	30	502	30	479
82/3					(continues)		30	506	30	493
83/4							(continues)		30	498
84/5									(continues)	
85/6										
86/7										
87/8										
88/9										

1) Fiscal years (1st July - 30th June)
2) Exceeds for one year desirable initial working rate; addition of 10 - ton phase could be advanced if adequate mill management not available.
3) Includes FFB from Project V

foreign exchange would be considerably in excess of this.

Since there are also indications that foreign manufacturers will establish or arrange for local production of equipment, it is possible that, regardless of the equipment supplier, Jengka's mills may be built at lower costs than have been used in this report.

The critical factor in achieving the substantial savings estimated is the acquisition of an experienced and skilled installation service. This would range from an organisation which would provide a "turnkey" job, or act as consultants, to the acquisition of a team of engineers. Individual mill engineers of the required calibre are unlikely to be acquired, but local installation services are now being organised in

West Malaysia, and it is likely that foreign suppliers of equipment will provide locally-based services to maintain their competitive position.

The benefits from high quality local manufacture and qualified local installation are great in terms of lower cost, provision of local employment and saving of foreign exchange. FLDA should seriously consider this method. In addition to providing the mills, practical as well as theoretical training can be provided locally as part of the installation service. This is particularly essential as the economies from good management far outweigh any economies in cost of installation.

Mill Operation

Efficient management and maintenance are essential. The value of palm oil lost by small reductions in a mill's operating efficiency can be greater than the total operating cost of the mill. A fall in extraction efficiency of two per cent would result in a 10 per cent fall in the value of oil produced. So important is this that there can be no compromise in obtaining the best management available. This has been taken into account in the suggested staffing of mills (Appendix 15 - 3), and in the relatively high cost of factory operation assumed (M$7 per ton of FFB).

The acquisition of skilled management and other staff will present a number of problems and the immediate demand for mill management is unlikely to be satisfied by training since it is experience as much as theoretical knowledge which is so important. It is probable that during the next 5 - 7 years management of the calibre required will have to be brought in to Jengka at what may seem a high cost, but this will be minimal in relation to the increased value of production achieved through skilled management. Training with a strong bias to practice and experience, however, should be instituted at once for use in later stages of development.

RUBBER FACTORIES

The Jengka triangle will have about 27,500 acres of new rubber and nearly 13,000 acres of rubber on existing FLDA schemes which will come into tapping in the immediate future. The FLDA schemes are to be incorporated into the processing plan for the Triangle itself. In planning for rubber processing, no account has been taken of the possible development in the Tekam area to the north of the Triangle.

In Chapter 11 systems and types of processing were reviewed. This revealed that central factory processing should be used and, of the two types of processes available 'crumb', or solid rubber, should be preferred to sheet rubber processing.

Factory Size

The production of crumb rubber is a new development and there are not yet sufficient data to estimate definitively the economies possible with large factories as compared to small ones. Approximate factory construction cost estimates are given in Table 15 - 8 for factories varying in capacity from 12 to 48 tons per day of latex dry rubber content (d.r.c.). The estimates were compiled from individual items of known plant equipment and are believed to be valid for comparative purposes; they include a contingency allowance of 30 per cent, or twice that used elsewhere in this report, because of the relatively incomplete cost data presently available for these types of factories.

Table 15 - 8
Rubber Processing Factories (Crumb Rubber) Cost and Capacity

Capacity (lbs/day)	tons/day	Acres Processed	Cost in M$ (thousands) Factory	Staff Housing	Total +30%	$ per acre
27,000	12	3,800	436	131	737	194
54,000	24	7,500	725	175	1,170	156
67,000	30	9,400	866	188	1,370	145
81,000	36	11,300	1,000	200	1,560	138
108,000	48	15,100	1,300	225	1,980	131

Factory capacities were determined using an expected level of annual yield of mature rubber of 1,400 lbs of latex (d.r.c.) and 245 lbs of scrap per acre. A daily peak of 30 per cent in excess of the average over a 300-day tapping year was assumed. The total peak daily processing requirement is about 285,000 lbs of latex (d.r.c.) per day, or about 127 tons of latex (d.r.c.) per day.

The most critical factor in factory sizing is likely to be the standard of management. In view of the shortage of skilled and experienced management, a 48-ton per day factory is probably the largest that should be installed.

The economies of large factories appear to be significant. The saving in capital cost between one 48-ton factory and two 24-ton factories is M$25 per acre. With the cost of capital at seven per cent and a marginal cost of transport of M cents 15 per ton-mile of latex, it would be preferable to install the larger factory so long as the average haul is not increased by more than 7 - 8 miles. Of equal importance are the economies of increasing capacity in the large factories in Jengka to take account of adjacent FLDA schemes. Processing 3,800 acres of adjacent FLDA rubber by increasing what would have been a 24-ton per day factory to 36 tons per day reduces the capital cost of processing for the adjacent scheme by M$100 per acre. Given the transport costs above it would be preferable to carry an adjacent scheme's latex up to 30 miles to the larger factory. Because no two FLDA rubber schemes in Jengka are more than 28 miles apart by road, large central factories processing latex from a group of schemes or projects are preferred.

Recommended Factory Plan

The areas in Jengka which will produce latex for processing were divided into separate geographical and phasing groups: small areas for which separate factories would not be practicable; medium-sized areas which could share a common factory; and areas for which separate factories would be needed (Table 15 - 9). The locations of these areas and the factories required to serve them are shown in Figure 15 - 5. Four factories are recommended, as follows:

Factory G - A 30-ton per day factory located adjacent to the Bukit Tajau FLDA Scheme on one of the Triangle's new primary roads (Chapter 18) and serving primarily Bukit Tajau and Project II. Transport distances favour the small volume of Project I rubber being processed at this factory also.

Factory H - A 36-ton per day factory located in the Sungai Nerek FLDA Scheme and serving primarily that Scheme, the Kampong Awah Scheme, and Project III. Sungai Tekam FLDA Scheme's latex was also assumed for the purposes of this report to be processed in Factory H; the implications of possible variations in the handling of Sungai Tekam's latex are discussed in the following section (Factory Phasing).

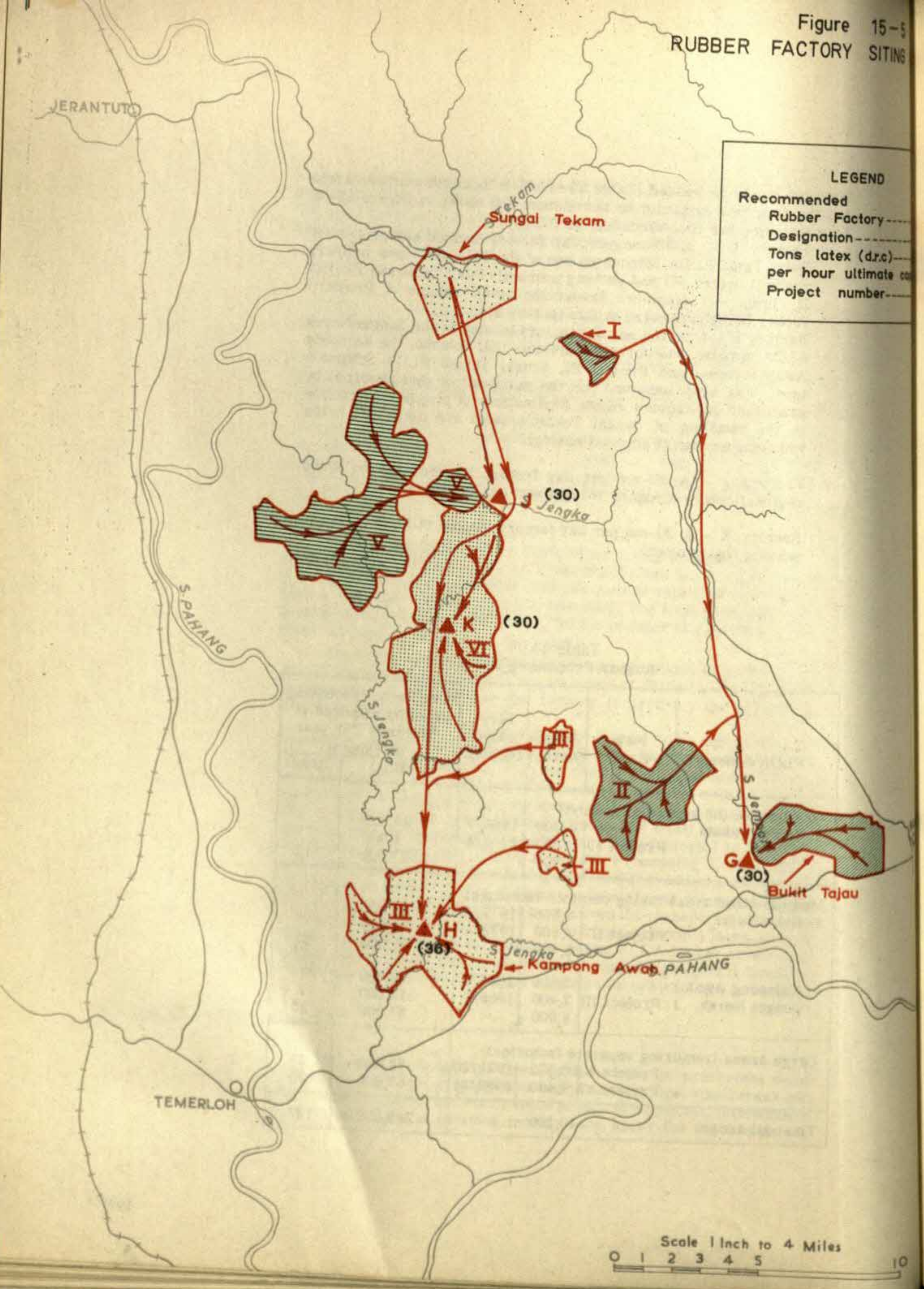
Factory J - A 30-ton per day factory located adjacent to the regional centre (Chapter 16) and serving Project V.

Factory K - A 30-ton per day factory located in Project VI and serving that project.

Table 15 - 9
Rubber Processing Areas

FLDA Scheme	New Land	Areas (Acres)	First Year of Tapping	Peak Daily Processing Capacity required at Maturity (7th year of Tapping) (lbs)	(tons)
Small areas (no separate factory)					
Sungei Tekam	-	3,300	1968/9	23,000	
-	Project I	600	1973/4	4,000	
		3,900		27,000	12
Medium sized areas (using common factories)					
a) Bukit Tajau	-	3,800	1971/2	27,000	
-	Project II	4,800	1975/6	34,000	
		8,600		61,000	27
b) Kampong Awah)		5,600	1967/8	40,000	
Sungei Nerek)	Project III	2,400	1966/7	17,000	
		8,000		57,000	25
Large areas (requiring separate factories)					
-	Project V	10,300	1979/80	73,000	33
-	Project VI	9,400	1980/81	67,000	30
Total all areas		40,200		285,000	127

Figure 15-5
RUBBER FACTORY SITING



As an alternative to the siting plan described, a single large (54 to 66-ton) factory was considered to replace factories G and H for the two main areas of rubber in the southeast and southwest. This would be only workable so long as it was run by a very experienced manager. With the distance between the two areas being in the order of 18 miles, however, a central factory would involve an average haul nine miles further than hauls to two separate factories. At this distance, overall economies would no longer exist and separate factories have therefore been recommended.

The estimated cost of the four factories shown in Figure 15 - 5 is M$5,670,000 (Table 15 - 10).

Table 15 - 10
Estimated Construction Cost of Rubber Factories

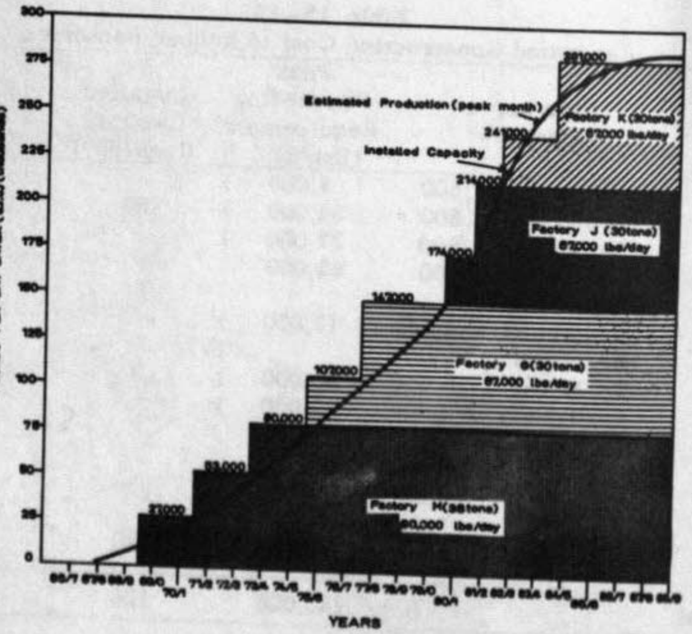
Site	Area served (acres)		Peak Processing Requirement (lbs/day)	Installed Capacity (tons/day)	Estimated Cost (M$)
G	Project I	600	4,000	30	1,370,000
	Project II	4,800	34,000		
	Bukit Tajau	3,800	27,000		
		9,200	65,000		
H	Project III	2,400	17,000	36	1,560,000
	Kg. Awah) Sg. Nerek)	5,600	40,000		
	Sg. Tekam	3,300	23,000		
		11,300	80,000		
J	Project V	10,300	73,000	30	1,370,000
K	Project VI	9,400	67,000	30	1,370,000
Total		40,200	285,000	126	5,670,000

Factory Phasing

With the exception of Sungai Tekam FLDA Scheme, the phasing programme for the four factories proposed is relatively simple (Figure 15 - 6). A table of processing requirements and capacity provided appears in Appendix 15 - 4. Some inter-project processing would be necessary in the initial years if full utilisation of factory capacities is to be achieved. This would mainly consist of Bukit Tajau latex being processed at Factory H in the years before Factory G is in operation. The short distances between factories would allow use to be made of spare capacity in neighbouring factories with little or no increase in cost.

The alternative for providing capacity for Sungai Tekam latex is to increase the capacity of Factory J to 42 tons per day and process the Sungai Tekam latex there instead of in Factory H. This would afford the most economical transport distance (7 miles). Full capacity for Sungai Tekam latex, however, would not be required until the 1975 - 1979 period, which is the five years that would immediately precede the installation of Factory J (Project V). To use Factory J to process Sungai Tekam rubber, therefore, it would be necessary to bring forward the first phase of that factory by five years and to make minor adjustments in the phasing of other factories. This is undesirable for investment reasons. However, since Factory J could be sited near the Project V - VI palm oil mill, early installation of this phase, even in 1974/5, would not result in bringing forward any of the required infrastructure expenditure, chiefly roads.

Figure 15 - 6
Rubber Factory Phasing



The principal reason for not including Sungai Tekam latex in Factory J for planning purposes was to take account of the requirement that projects should be subject where possible to separate analyses of profitability. In addition, however, the possibility of an alternative project phasing plan which has been referred to previously, was recognised. This, assuming the Tekam area was available, would provide for development of only the oil palm land in Projects V and VI, followed by development of Tekam oil palm land, and the development of the rubber land in Projects V and VI by the private sector.

As with the palm oil mills, the siting, capacities and phasing of the rubber processing complex should be considered as open to alteration in the light of experience in the early stages of Jengka and the nearby FLDA schemes.

Organisation and Construction

Rubber factories have been constructed in West Malaysia for many years. Organisations are available and fully capable of manufacturing the relatively simple machinery required, as well as providing staff to install it. The foreign exchange cost of these factories is fairly low. Four factories to be built over a period of 15 years present only a small demand on the resources available to construct and install them.

Factory Operation

Efficient production of a high quality crumb rubber requires technical and management staff with experience and skill. The staff requirements for crumb rubber factories over the next 10 years are shown in Appendix 15 - 5 Although skilled staff for the first factory at Kampong Awah would have to be obtained from outside sources, there would be sufficient time to train additional staff for subsequent factories. To achieve the standards required, training of skilled staff should begin as soon as possible.

In the economic analyses of this report, the costs of processing have been assessed at M cents 2.3 per lb. of latex (d.r.c.) and M cents 3.3 per lb. of scrap.

CHAPTER 16

TOWNS

With the concept of the small settlement units recommended for the Jengka Triangle, urban services would cease to be functions of the villages or responsibilities of FLDA. Instead, towns are proposed which would embrace all normal urban activities. They should be capable of free growth and development, within which Federal, State and local Government services would be provided.

The Need for Urban Services within the Jengka Triangle

The Jengka Triangle will develop as an integrated group of 97 villages with an estimated total rural population of 84,500 persons (Chapter 14). A rural population of this size will generate needs for specialized and central administrative, medical, educational, commercial and industrial services. These services are partially interdependent and operate more efficiently and effectively if placed together in conveniently located towns.

There are also social and recreational requirements that only can be met by towns.

> "The accelerated development of the small towns is important. It extends the distribution of urban places throughout the entire country and therefore increases the opportunities of contact between the rural population and the modern civilization that penetrates into Malaya by way of the towns (Hamzah Sendut 1965).

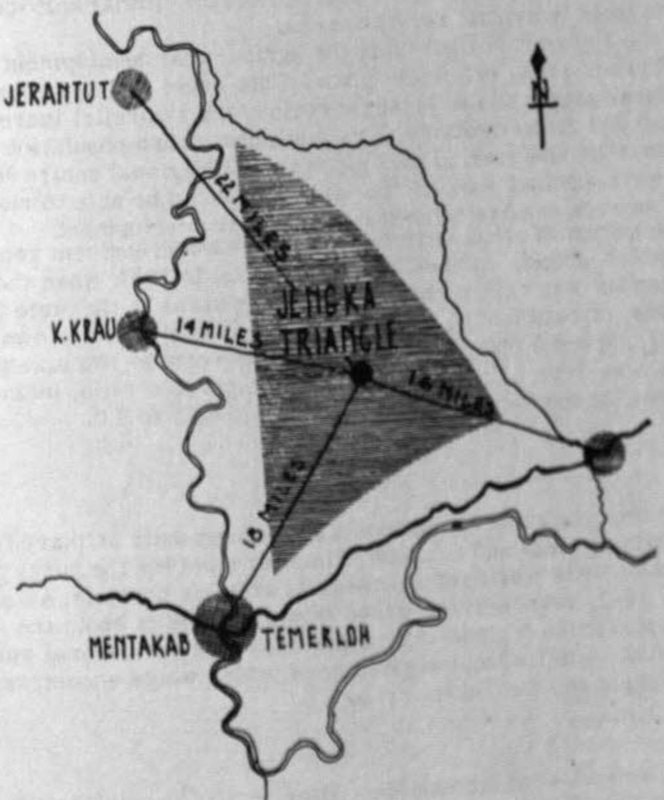
Existing Towns

At present, areas adjacent to the Triangle are served by the towns of Jerantut (4,300 persons) Kuala Krau (1,740 persons) and Temerloh-Mentekab (16,500 persons) on the west side of the Sungai Pahang, and by Maran (780 persons) at the extreme southeast cornerof the Triangle. 1) These urban centres can assist greatly in the development of the Triangle, especially in the early phases, but they cannot take the place of new urban centres located within the development area. They are too far away from the main body of the anticipated rural population of the Triangle to serve that population conveniently (Figure 16 - 1). In addition, the Sungai Pahang is an effective barrier to the utilization of Jerantut, Kuala Krau and Mentekab-Temerloh by the rural population of Jengka. It is evident that new urban centres must be developed.

Future Urban Population in the Jengka Triangle

The future urban population within the Jengka Triangle cannot be projected as reliably as the rural populations of the settlement units, where factors which determine population can be estimated closely (numbers of agricultural holdings, average settler family size, and area available in each settlement unit). An investigation was made therefore of five long established towns in West Malaysia with reasonably identifiable surrounding agricultural service areas. Urban populations were found to range from 19 to 29 per cent of the surrounding rural populations in the towns studied (Appendix 16 - 1). The National urban to rural ratio is higher than this but includes major urban centres which have grown at high rates in recent years.

Figure 16 - 1
The Existing Urban Centres



At a relatively conservative urban to rural population factor of 20 per cent, the urban population required for Jengka's rural population of about 85,000 would be in the order of 17,000 people. There would be added to this an additional 3,000 persons connected with the forest industry. This would bring the total urban population to 20,000 persons and the total rural and urban population of the Jengka Triangle as a whole to about 105,000 persons.

PROPOSED TOWNS

For the urban population within the Triangle, three towns are proposed: two in the southeast and southwest of the Triangle respectively, with a population of 4,000 persons each, and a regional centre in the north central area with a population of 12,000 persons.

The regional centre would provide space for special services covering the needs of the Triangle as a whole, as well as those related to the centre's more local service area. Thus it would include FLDA Triangle headquarters as well as headquarters of nearby FLDA projects, the hospital, teachers' training school, central police station, and State and Federal offices. The forest industrial complex would also be located there.

The two subsidiary towns would provide for similar services, but related to their individual service areas.

In the future it is likely that the agricultural development of the Sungai Tekam area will take place. This could add approximately 25,000 rural people to the Triangle region, and a parallel increase of 4,000 to 5,000 urban dwellers. This additional urban population would require another new town in the Tekam area. A regional centre located in the north central part of the Triangle would be able to meet the regional service requirements for this further development.

The pattern of urban settlement in Jengka would conform generally to that which obtains in the State of Pahang. In 1957, when the most recent census was taken, there were three towns in the State having populations of between 10,000 and 20,000 people, and 11 towns with between 2,000 and 5,000 people. The ratio between the two size groups of towns was 1 to 3.7; for Jengka the comparable ratio, including a future town for the Sungai Tekam area, would be 1 to 3.0.

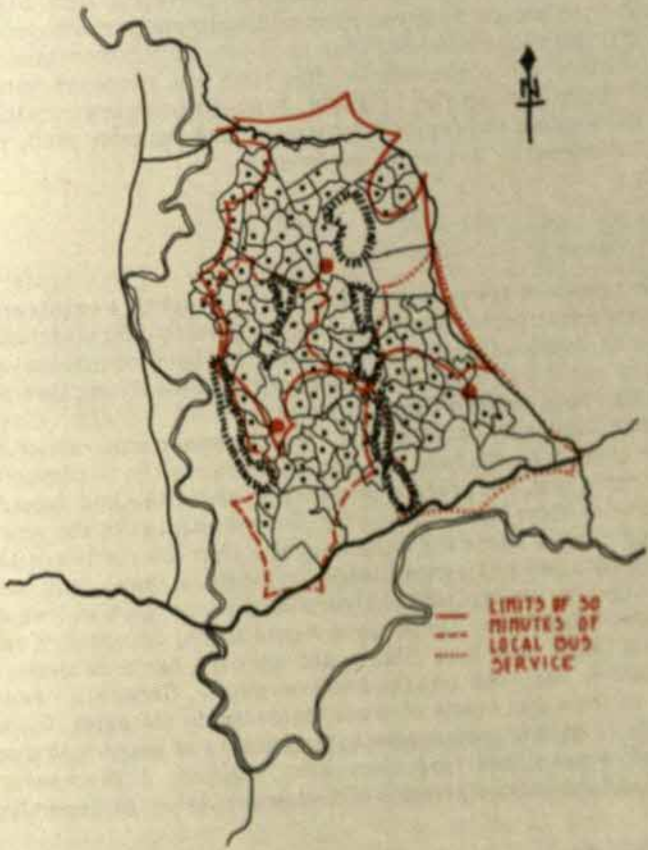
Town Service Areas

It is important that the proposed towns meet their primary function of providing local and regional urban services for the rural population, with as little overlap of their service areas as possible. As shown in Figure 16-2, town service areas would each be of about the same size, except that the regional centre would have a more general service area, in addition to its local service area, which would encompass the entire Triangle and the Tekam area.

Town Sites

The selection of actual town sites in the Triangle, within the general framework of population distribution and town service areas, is principally a function of topographic, soil and drainage conditions. These factors have a significant impact on the economics of urban development; unfavourable conditions can add very greatly to the cost of construction and maintenance. Land with slopes exceeding 10 per cent, for example, may necessitate unduly large expenditures for foundation excavations, and grading of building sites and road alignments, as well as high costs for more complex water supply, drainage and sewage systems. For these reasons sites for urban development have a high priority in the assignment of land in the Triangle and their selection should be coordinated closely with the assignment of land to the other principal land uses - the planting of oil palms and rubber.

Figure 16-2
Town Service Areas



Sites for each of the three towns were selected from existing 1:25,000 scale maps (50-foot contour intervals). Reconnaissance field inspections of each site were made; all are under heavy forest cover, but based on the limited data available, all appear to be suitable for urban development.

The site for the regional centre is at the confluence of the Sungai Jengka and Sungai Chenerai, about three miles west of the Ulu Jempol FLDA scheme, in a relatively level area rising to a steep ridge on the east (Figure 16-2). There appears to be a possible site for a small airfield nearby, but the technical feasibility of airfield construction in this area will necessitate thorough study when land surveys are made.

The site for the southeastern town lies on gradually undulating, well-drained land, adjacent to the Sungai Jempol and about four miles north of the existing Temerloh-Maran road.

The site for the southwest town is on somewhat steeper land, and is located on the Sungai Jengka approximately five miles north of the Sungai Nerek FLDA scheme.

Potential supplies of water to meet the domestic and industrial water requirements of the towns are considered to be adequate at all of the sites, either from surface or groundwater (Chapter 19).

When land surveys and detailed town site investigations are undertaken, attention should be given to possible alternative sites which may better fulfil the requirements. This is of particular importance for the regional centre since the site of this town would occupy some of the better oil palm land in the Triangle. It would be economically advantageous to relocate the regional centre to less valuable land, provided an acceptable nearby site could be found.

LAND USE AND SIZE

The proposed towns must meet the urban service requirements of a large new rural population. They should develop character and vitality, blend harmoniously into the landscape, and become integral parts of the Jengka rural and urban environment. Judiciously applied ratios of land use can help achieve these objectives.

Urban land use requirements for the new towns cannot be estimated as closely as the land use requirements of the settlement units. It is desirable that the present patterns of activities and uses found in rural towns of West Malaysia be extended and adapted to the new towns. Accordingly, as a basis for assessing the characteristics of the main classes of land use to be established in Jengka's towns, and the ratios of each class to be applied, analyses of the land uses in five existing towns were undertaken. These were Kuala Lipis, Jerantut, Kuala Klawang, Batu Gajah, and Kota Bharu, and were the same as those used in the population analyses referred to previously. Generally, records of land use in the rural towns of West Malaysia do not exist. Inspections were made of each of the five towns, inventories of main land uses prepared and generalized land uses were mapped. A discussion of the existing land use characteristics of the towns is given in Appendix 16 - 2.

Summary of Proposed Urban Land Use

Seven categories of land use were defined for application in the proposed new towns of the Triangle (Table 16-1). The regional centre would require approximately 1,700 acres of land and the two smaller towns 500 acres each.

The anticipated land uses and town sizes should be considered as a guide for reserving appropriate areas of land for the towns and for their general layout and design. The amount of land allocated to various uses may have to be modified as town designs develop.

A discussion of proposed land uses for each category follows:

1. Commercial - Commercial includes retail and wholesale uses, markets, filling stations and other commercial activities. It also included the combined residential and commercial uses of shophouses. These buildings, consisting of a ground floor shop with one or more residential floors above, are the typical commercial area structures. There is little reason to expect that the present commercial patterns found in existing rural towns should change. They should, however, be

controlled and directed in the new towns. Shophouses, which would be the dominant form of commercial buildings of the town centres, can be built easily and economically, thereby aiding in rapid town development. Because of their versatility they can serve a number of interim uses until the population and services in the new towns settle down and reach a balance. All the towns will also require markets, hotels, rest houses, filling stations and cinemas. The integration of most of these facilities, as well as Government offices, in a multi-use town centre is desirable.

Table 16-1
Summary of Proposed Urban Land Uses

Use Classification	Regional Centre acres	Regional Centre per cent	Southwest Town acres	Southwest Town per cent	Southeast Town acres	Southeast Town per cent
1. Commercial	43	2.6	12	2.4	12	2.4
2. Residential	330	19.4	100	20.0	100	20.0
3. Institutional	334	19.7	150	30.0	150	30.0
4. Public Utilities and Transportation	585	34.2	119	23.8	119	23.8
5. Industrial	160	9.5	30	6.0	30	6.0
6. Recreational	70	4.1	11	2.2	11	2.2
7. Open Space and Residual	178	10.5	78	15.6	78	15.6
TOTAL	1,700	100.0	500	100.0	500	100.0

Sufficient land should also be reserved in the town centres for more sophisticated commercial uses such as bowling alleys and small department stores, developments which are unlikely in the early years.

Based on ratios of 0.30 acres of commercial land use per 100 persons in the regional centre and 0.25 acres per 100 persons in each of the towns, plus an allowance of 20 per cent for reserve, the commercial land use requirements would be as follows:

	Regional Centre	Smaller towns (each)
Commercial	36	10
Reserve	7	2
	43 acres	12 acres

2. Residential - Space for housing of several types should be provided for each of the three towns. Estate-type housing (terrace houses, attached blocks) which can be built and financed by private investors may be an important housing type in the new towns. A large number of single family houses on one quarter to three quarter acre lots, housing Government, FLDA and commercial officials and staff will be needed. A smaller number of spacious houses on large lots (up to two acres) will be required for senior officials and managers in all the new towns.

A limited number of flats, labour lines, and other high density housing types will also occur.

For all types of housing, an allowance of 2.75 acres per 100 persons was used in the regional centre, and 2.5 per 100 persons in the towns. This results in an allowance for residential land use of 330 acres in the regional centre and 100 acres in each of the smaller towns.

3. Institutional - Based on conditions elsewhere in West Malaysia, it is likely that as many as 20 Federal and State Government departments and agencies may require space in the Triangle's towns. Many of these activities, such as the administrative services, police headquarters and post offices should be located centrally, and could be used to form civic centres in the towns. Others such as schools, the hospital, and health centres, would be more suitably placed at convenient locations throughout the new towns. Religious buildings should be as centrally located as possible, however, so as to create an interplay of different activities. They have design interest and can be used to accent the architecture of the town centres.

Land requirements for institutional uses were based on the anticipated urban population, and where possible on acreages recommended by the various public agencies involved (Table 16 - 2).

Table 16 - 2
Proposed Institutional Land Use

	Regional Centre Acres	Smaller Towns (each) Acres
Schools		
Primary	90	25
Secondary	30	25
Upper Secondary	45	45
Teacher Training	30	-
Sub-Total	195	95
Health		
Hospital	20	-
Health Centre	-	5
Sub-Total	20	5
Religious		
Buildings	12	4
Burial Grounds	12	4
Sub-Total	24	8
Other		
Post Office	1	1
Government Offices	15	5
Police	15	5
Miscellaneous	64	31
Sub-Total	95	42
Total	334	150

4. Transportation and Utilities - For transportation and public utilities efforts should be made to vary current practices found in rural towns and to establish use requirements based on modern standards.

With rising standards of living, which result in more motor cars, buses and lorries, particular attention will have to be paid to the adequacy of roads, bus terminals, taxi stands, car parks and other transport facilities. Approximately 300 acres would be allocated to urban transportation facilities in the regional centre, and 100 acres in each of the smaller towns, based on a ratio of 2.5 acres of roads per 100 persons, and including small allowances for bus stations and taxi stands (Table 16 - 3). Similarly, there will be rising demands for adequate water, sewage and electrical services. In the regional centre, 26 acres should be allocated for these services, and 13 acres in each of the smaller towns.

The Triangle has no air service, although an existing short landing strip at Temerloh can be used by light aircraft. It is envisaged that a small airfield would be needed in the Triangle and that ultimately this facility could serve as the centre for all commercial air service in the region. It should be located adjacent to the regional centre and should be designed with a runway capable of extension to 4,500 feet, although at first a smaller facility would serve. An area of 250 acres has been allocated to the airfield; this is more land than needed initially, and the excess area could be used for market gardening or other types of agriculture in the early years,

Table 16 - 3
Proposed Transportation and Utilities Land Use

	Regional Centre Acres	Smaller Towns (each) Acres
Power Station	2	1
Water Supply	12	4
Sewage Treatment	12	8
Roads Parking	300	100
Bus Station	2	2
Outstation Taxi Stand	2	2
Telecoms	1	1
Television and Radio Station	4	1
Airfield	250	-
TOTAL	585	119

5. Industrial - The wide range of small industries usually found in the commercial areas of most existing rural towns should be permitted, within the bounds of nuisance limitations. This type of industrial use has been allowed for in the proposed commercial land use class.

At the regional centre an industrial area of 100 acres should be reserved for the recommended forest industry (Chapter 10). Other industries, related to the forest industry and to the principal agricultural production of the triangle, may also locate in the proposed towns eventually.

For planning industrial area requirements, it was assumed that approximately 20 per cent of the urban population might ultimately be engaged in industry and that the labour force density might be about 30 persons per industrial acre. On these bases, a reserve for industry of 80 acres in the regional centre and 30 acres in each of the two smaller towns is recommended.

6. Recreational - The new towns would be surrounded by large areas of open space (agricultural land). The towns would also include ample school reserves, and they would be sited adjacent to forest lands. It should not therefore be necessary to set aside large areas for recreational purposes. On the contrary, the towns should have a compact urban look for contrast with the rural environment; this is important, for the rural villagers will use their town visits not only to obtain town services, but also for change and recreation.

The placing of recreational areas should be arranged to complement other civic and commercial uses. One of the most prominent features of all rural towns, and the traditional public recreational area, is the town 'padang'. This is essentially a multi-purpose sports field, which is also used for a variety of other public gatherings and events. The town padangs, if not too large, could be used as focal points of the town centres. They could be sited next to markets, for example, and adjacent to the town civic centres. It is important to integrate these uses and utilize them as tools for building community centres.

For the padangs of the smaller towns, an area sufficient for a football field, with an ample perimeter planting strip, was allocated; in each an area twice as large was allocated in the regional centre (Table 16 - 4). Additional allowances were made for small parks, badminton and tennis courts, and clubs. A 40 acre reserve was allocated for a golf course in the regional centre.

Table 16 - 4
Proposed Recreational Land Use

	Regional Centre Acres	Smaller Towns (each) Acres
Sports Field (Padang)	6	3
Parks	12	4
Badminton Courts Swimming Pools Tennis Courts etc.	6	2
Clubs	6	2
Golf Course	40	-
TOTAL	70	11

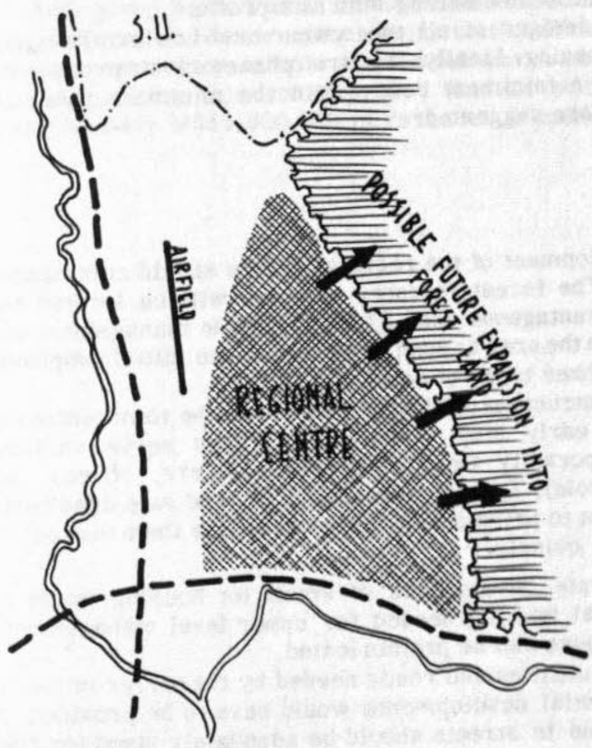
7. Open Space and Residual - Not all land within town areas may be usable due to steep topography; other areas may have to remain vacant for stream bank protection. Based on limited field data, it is estimated that approximately 10 per cent of the land in the regional centre, and 15 per cent in each of the smaller towns should be classified as open space and residual.

Future Expansion

Estimates of urban land use requirements and future town sizes are necessarily general and there may be considerable variation in the actual sizes of the towns and in their rates of growth as they develop.

For future expansion, beyond the sizes now envisaged, forest land adjacent to each proposed town could be developed, thus avoiding disruption of established agricultural settlements (Figure 16-3).

Figure 16 - 3
Future Urban Expansion



This would involve using steeper land than is normally desirable for urban development, but by allocating less intensive land uses to these areas, such as residential development on large (1 to 2 acre) lots, such land could be used effectively. The final town road and land use patterns should be designed to accommodate possible town expansion in this manner.

IMPLEMENTATION, PHASING AND COSTS

The towns should be planned and suitable land uses established through approved planning instruments. They would receive strong Government input by such means as National and State Government department offices, health centres, schools, and other services. The main input, however, would come from the private sector of the economy. To provide a proper environment for private investment it will be necessary to provide utilities and roads progressively as the towns grow.

A considerable part of the initial capital required to develop the towns could be recovered from the sale of improved residential, commercial and industrial lots to the public. Such sales of improved land have proved successful in the new town of Petaling Jaya, where the Government is now selling land at a profit.

The designs of all the towns must be flexible enough to permit suitable phasing. Ideally, the first phases should produce the maximum result for a minimum cost within the minimum time. The following priorities are suggested:

Regional Centre

Development of the regional centre should commence as early as possible. The forest industry complex will be located here and it is clearly advantageous that FLDA Triangle management should be established in the area as soon as possible. The initial emphasis should be placed on three types of development.

1. Construction of shophouses within the town centre is an important early step. They can perhaps serve various purposes temporarily (for labourers' quarters, offices, and possibly schools). Special allowances or land sale conditions should be given to private developers to enable them to erect these buildings quickly.
2. Private development of small lot housing would provide the initial housing needed for upper level management. This type of house can be prefabricated.
3. The utilities and roads needed by the early commercial and residential developments would have to be provided. All utilities placed in streets should be adequately sized for final development.

Southeast and Southwest Towns

The second urban priority would be the smaller towns. A strong demand would build up early for the southeast town, owing to the development of the first agricultural projects on the east side of the Triangle. An order of priorities similar to that of the regional centre should be followed.

For all towns, it is assumed that urban development would continue at a rate commensurate with the settlement of the agricultural areas and that all towns would be fully developed by about 1979. Development of the regional centre should begin in 1968/9, the southeast town in 1968/9, and the southwest town in 1970/71.

The basic town development costs incurred by the public sector include site preparation, roads, utilities, airfield, as well as primary and secondary schools to serve the town populations (Appendix 16 - 3). They are summarised as follows:

Regional Centre	M$ 17,700,000
Southeast Town	5,200,000
Southwest Town	5,200,000
	M$ 28,100,000

There are many other public facilities and services which would in fact be located in the towns. Since these would serve mainly the Triangle as a whole, their costs are not included in the basic town development costs given here. These services include police, telecommunications, posts, health, Government administration offices and staff housing, and upper secondary schools and the teacher training school.

It is estimated that sales of improved land in the towns could generate approximately M$15,600,000 in revenues (Appendix 16-4).

CHAPTER 17

TRANSPORTATION

The purpose of the transportation plan is to provide the Jengka Triangle with an internal and external transport system that will facilitate its development. As such the recommended transport system must be economically sound and adequate for the Triangle's needs both in the initial growth period and in subsequent years of mature output levels.

For analyses of alternative systems of transport, criteria have been established to assure that the transportation plan achieves its object in conformity with the overall aims for development of Jengka. They include:

1. Limitation of FLDA's involvement in transport to the minimum required for the efficient organization of Jengka.
2. Encouragement of private enterprise in transport to provide private capital and experienced management.
3. The planning of individual transport activities in relation to other transport demand and to opportunities for outside utilization of equipment in off peak seasons.
4. To assess the efficiency of Jengka's transportation system in cost terms to the economy as a whole, as well as to FLDA. To this end, the costs of all alternative transportation systems have been shown at cost to FLDA (market prices) and at cost to the economy (social prices). For FLDA cost, an interest rate of seven per cent was used; costs to the economy include an interest rate of 12 per cent, and exclude road taxes.
5. The maximum use of the existing transport work net so as to minimize the need for additional investment in infrastructure.

In addition to these criteria two important asumptions have been made:

1. It is recognized there will be variations between individual projects in the types and amounts of commodities to be transported, but it has been assumed that these will not result in any significant differential in transport cost between projects.
2. While intermodal analysis has been related generally to project-sized outputs, account has been taken in some cases of economies possible through consideration of total Triangle outputs. These include economies from lower rates on full train loads.

Recommendations have been made without the benefit of a long-term programme for the development and coordination of transport in Malaysia. The preparation of such a programme has been authorized and will be completed within the current five-year plan period. Future National transport policies based on that programme may require review of some aspects of Jengka's transportation plan.

The recommendations are primarily concerned with a transport system to deal with output at maturity levels. In the first few years of development very small output levels may have some affect on the relative costs of different systems. In view of the short period and the small quantities involved, this aspect has been excluded from the analyses.

Procedures in developing transport recommendations for Jengka were to identify and forecast transportation requirements. Based on these forecasts, intermodal transport analyses were made for internal and external movements to arrive at recommended types of transport for various commodities. Finally, estimates of traffic were made as a basis for establishing standards for the facilities required.

TRANSPORTATION REQUIREMENTS

Jengka's aggregate transportation requirements will reflect the nature and volume of activities planned for the Triangle. Consequently, it is assumed that all plan recommendations will in fact be carried out as planned. In assessing transportation requirements, outputs of existing FLDA schemes have been included. Where accurate volume estimates of individual traffic flows could not be prepared, assumptions were made based on existing studies and similar situations observed elsewhere.

Primary Goods Movement

The Triangle's primary goods movements comprise the intra-triangle flow of primary commodities - oil palm (FFB), rubber and timber - from field to processing plant and external flows of the processed commodities from processing plant to market or port of shipment (Table 17-1).

Table 17 - 1
Primary Goods Movements
(tons per year)

Internal - Triangle	1970	1975	1980	1985
Oil Palm (FFB)	55,300	375,000	625,000	640,000
Rubber (Latex)	5,600	23,000	46,000	80,000
Logs [1]	255,000	255,000	255,000 [2]	200,000 [3]
External				
Palm Oil (in bulk)	9,000	69,000	125,000	128,000
Palm Kernels (in sacks)	2,400	17,000	28,000	29,000
Rubber (crates)	2,000	8,000	16,000	28,000
Logs [1]	50,000	50,000	50,000	50,000
Processed Timber	100,000	100,000	100,000	100,000

1) Log tons of 50 cubic feet (Forest Department Measure)
2) Annual volume assumed from Sungai Tekam area 1979-1981 moving to Triangle's Forest Industry
3) Possible annual volume from forest areas outside Triangle and Sungai Tekam, moving to Triangle's forest industry.

Oil palm cultivation would be extensive. The crop would be processed in five mills producing palm oil and kernels, predominantly for export. When full production is expected the annual volume of fresh fruit bunches to be hauled from field to the proposed mills would reach almost 640,000 tons; annual volumes of palm oil and kernels to be moved outside the Triangle to port of shipment would be about 130,000 tons and 30,000 tons respectively.

Rubber cultivation would be less extensive and more localized than that of oil palms. When full production is reached the annual volume of latex and scrap to be transported from collecting stations within individual settlement units to the rubber factories is estimated to amount to 80,000 tons. The volume of processed rubber to be moved from the Triangle to the port of shipment would be about 28,000 tons.

The forest industry would rely on Jengka's timber resources until 1978. Thereafter is is assumed that logging would take place in the Tekam area and elsewhere, which would result in both logs and processed timber products requiring transport through the Triangle to other parts, of West Malaysia. Movement of logs direct from the forest would total 255,000 tons per year. These would require transport to destinations outside the Triangle, or to the processing factory. It is expected that 50,000 tons of logs and 100,000 tons of processed timber would require transport away from the Triangle from 1970 onwards.

Ancillary Goods and Passenger Movements

A substantial volume of goods to meet the needs of agriculture and the area's population would be required on an increasing scale as development takes place (Table 17-2).

Table 17 - 2
Secondary Goods Movements [1]

	1970	1975	1980	1985
		(tons per year)		
Food	9,000	24,000	30,000	30,000
Consumer Goods	9,000	24,000	30,000	50,000
Miscellaneous Goods	6,000	9,000	12,000	15,000
Fuel	6,000	16,000	20,000	20,000
Fertilizer	12,000	31,000	32,000	32,000

1) External only, additional internal movement would be required for local distribution.

About 30,000 tons of food and about 50,000 tons of consumer goods would be required from sources outside the Triangle mainly from Kuala Lumpur and the West Coast. Another 10 - 15,000 tons of miscellaneous goods produced by Jengka's minor industries may leave the Triangle annually. Fuel and fertilizer to the Triangle might total 50,000 tons per year.

Jengka's settlers and their families would generate the bulk of passenger travel in the project area. Most of the settlers' trips would be to work and market on foot or bicycle, and would be short in duration and distance.

The propensity for travel would be considerably higher for Jengka's numerically smaller urban population. Most of this travel would be inter-urban within the Triangle, or would end or originate outside the Triangle. It would consist primarily of business and government travel and would depend for the most part on Jengka's principal communication roads and on existing transportation facilities outside the Triangle. The selection and supply of transport facilities required to accommodate these movements should be left to the transport industry, which is well established elsewhere in West Malaysia and operating in a vigorous competitive environment. The function of the FLDA should be limited to the following: (1) provision of an adequate transportation infrastructure to attract and facilitate the operation of the transport industry; (2) regulation, in cooperation with the Road Transport Department, of the transport industry serving Jengka to assure adequate, effective and competitive transportation services; and (3) provision of transportation services only in cases where the transport industry is unable or unwilling to assume this responsibility.

INTERNAL TRANSPORT COST ANALYSIS

Comparisons of the estimated cost of alternative transportation systems within the Jengka Triangle for oil palm fresh fruit bunches and latex are developed below. The transportation of logs from forest working areas to the timber mills would involve specialized 200,000-pound gross weight vehicles, and a logging road system designed for this service. The organisation of this aspect of the internal transportation system, and its cost, is discussed in Chapter 10.

Alternative transport systems for oil palm fresh fruit bunches (FFB) and latex were compared under varying degrees of utilization.

Transport of Oil Palm Fresh Fruit Bunches (FFB) from Field to Mill

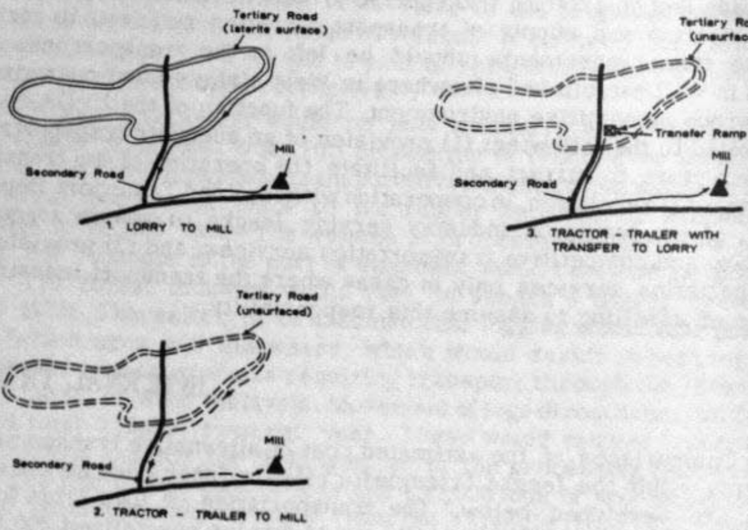
On existing oil palm plantations FFB are transported from field to mill by rail, lorry, tractor trailer, or combinations of these methods. The design of FFB transport systems, and the choice of method, depend very largely on terrain, on the distribution of the crop (length of haul to mill), and on annual volumes to be moved.

The quantity of FFB requiring transport varies substantially throughout the year. In peak month, 12.5 per cent of the annual crop is harvested, while in months of low yield, only six per cent. Under these conditions, transport capacity sufficient for peak harvesting is partially idle during the remainder of the year, unless outside utilization is achieved. Three systems were analysed (Figure 17-1):

1. Lorry
2. Tractor trailer
3. Tractor trailer with transfer to lorry

All systems included a simple tertiary (harvest) road system in the plantation areas, laterited, or unsurfaced, depending on the types of vehicles, with roads spaced at approximately 12 chains. The cost of these roads was included in all comparisons since the types of road and their cost vary depending on the type of vehicles used. The tertiary roads in turn would be connected to secondary roads of higher standard leading to the oil palm mills. An average haul distance of seven and a half miles was used in all estimates.

Figure 17 - 1
Internal Transport Systems



Within oil palm planting areas rail transport was not considered. On most of the oil palm land of the Triangle, rail spurs into the planted areas would have to be up to three times as long as roads, to achieve acceptable locomotive gradients. Since even a simple harvest-type rail system would cost seven times as much per mile as the cheapest tertiary roads, the costs of rail lines might be in the order of 21 times as great as those of roads.

The use of a rail system in substitution for the secondary roads is also clearly not economic. This is because secondary roads are required under any system of transport and a railway would duplicate facilities. The overall cost of rail transport (both capital and operating cost) is always equal to, or greater than the overall cost of the road vehicle alone. This is true whatever level of interest is used to assess the cost of capital.

Comparative costs for the alternative systems are given in Table 17 - 3; details of the estimates appear in Appendix 17 - 1. Since the three systems considered all require the same type of secondary road, the costs of these types of roads were excluded from the analysis. Characteristics of the systems considered are as follows:

1. Lorry - A system of diesel-powered 5-ton payload tipping lorries was tested, operating direct from field to mill. For the conditions assumed, a round trip time of two hours or four round trips per day, would be possible. Lorries of this size would require laterite harvest roads (M$7,650 per mile) in the planted areas, with grades not exceeding ten per cent.

With no outside utilization available and with a lorry fleet large enough to meet peak month transportation requirements, estimated costs are M$6.2 per ton to FLDA: this includes estimated vehicle costs of M$4.2 per ton (Table 17-3).

Table 17-3
Oil Palm FFB Transport Cost - Field to Mill

	M$ per ton - to FLDA			M$ per ton - to Economy		
	Vehicle	Tertiary Roads	Total	Vehicle	Tertiary Roads	Total
Lorry						
No outside utilization	4.2	2.0	6.2	3.3	2.4	5.7
Low outside utilization	3.3	2.0	5.3	2.6	2.4	5.0
High outside utilization	1.9	2.0	3.9	1.5	2.4	3.9
Tractor Trailer						
No outside utilization	3.4	0.8	4.2	3.5	0.9	4.4
Tractor Trailer with Transfer to Lorry						
No outside utilization	5.4	0.8	6.2	4.9	0.9	5.8
High outside utilization (lorry only)	4.7	0.8	5.5	4.5	0.9	5.4

The availability of alternative loads which can be carried in oil palm lorries during "off peak" periods would result in reduced costs. This is indicated by the low rates offered by transport contractors in areas where other utilization is possible. In the Klang - Kuala Lumpur area, for example, FFB transport is available at about M cents 20-25 per ten-mile. At Kulai FLDA oil palm scheme in Johore, also a populated area with opportunities for outside utilization, rates of M cents 37-45 per ton-mile are offered.

To demonstrate the effect of a low outside utilization, costs based on average month transportation requirements were used. For this condition estimated total costs to FLDA are M$5.3 per ton, nearly 15 per cent less than for the case of no outside utilization. This is a conservative estimate, but since the availability of alternative loads for contractors is expected to be restricted, at least in the early stages of development of Jengka, it is believed to be a reasonable approximation of the cost of contract lorry operations in the Triangle in initial years.

To represent high outside utilization, a rate of M cents 25 per ton mile was used, resulting in an estimated total lorry transport cost of M$3.9 per ton to FLDA. For operations of the large scale of Jengka it is probable that ultimately the cost of contract lorries would be reduced to this level.

2. Tractor-Trailer - A system of diesel-powered 56-58 HP tractors hauling 6-ton payload tipping trailers was tested for direct field-to-mill haul. Due to the slower travel speeds of this equipment only three round trips per day were assumed for average conditions of the Triangle. An advantage of the tractor-trailer system is the ability to negotiate steeper grades and to use minimum cost, unsurfaced, tertiary roads (M$3,400 per mile).

Opportunities for outside utilization of tractors and trailers would be very limited and none have been assumed possible in this analysis.

For this reason, the system would probably have to be owned and operated by FLDA.

The total cost of a tractor trailer system, with no outside utilization, is estimated to be M$4.4 per ton to FLDA; vehicle cost alone is estimated at M$3.4 per ton to FLDA. The total costs would be about 30 per cent less than the costs of either lorries or tractor trailer with transfer to lorry, when compared on the same utilization basis.

3. Tractor-Trailer with Transfer to Lorry - To assess the advantages of low cost roads which are possible with tractors and trailers in harvest areas and the higher operating speeds of lorries on the secondary road system to mills, a system of tractor trailers with transfer to lorries was tested.

Two conditions of outside utilization were assumed, a high level for lorries but none for the tractor trailers, and none at all for either vehicle. FFB would be loaded onto lorries at transfer ramps provided at one per 1,000 acres of oil palm land. This transfer would inevitably result in additional bruising and lead to higher free fatty acid (FFA) content. In this analysis, a rise of one per cent has been assumed, equivalent to a loss in revenue of M$1 per ton of FFB. The cost of this system to FLDA, assuming no outside utilization, is estimated to be the same as that of a lorry system (M$6 - 2 per ton) for comparable utilization. Otherwise, it would be more expensive than any other system under comparable levels of outside utilization.

Recommended System for Oil Palm Bunch Transport

For a condition of no outside utilization, a tractor trailer system would be the cheapest method of transport, both to FLDA (M$4.4 per ton) and to the economy (M$4.6 per ton).

With low outside utilization of lorries, a tractor and trailer system with no outside utilization would be slightly less costly than contract lorries - by only M$0.9 per ton to FLDA and M$0.4 to the economy.

With high outside utilization, lorries would be cheapest to FLDA (M$3.9 per ton) and to the economy (M$3.9 per ton).

The Triangle itself could provide substantial outside utilization which with the exception of logs, and palm oil and latex which require tankers, would amount to about 300,000 tons per annum. In these circumstances a lorry system may be assumed to have a reasonably high level of outside utilization so that it would be the least costly internal transport method.

A system of lorries has other advantages; first it enables bunch transport to be put in the hands of private contractors, who not only would provide expert and experienced management, but would be able to maximize opportunities for outside utilization. Second, it enables the private sector to invest capital in a public project, thus saving public investment for use elsewhere. A lorry system operated by contractors would thereby result in the most efficient use of capital resources to the economy as well as to FLDA while in addition, releasing FLDA from the responsibility of managing the transport fleet and financing the cost of vehicles.

For these reasons, a contractor lorry system is recommended. The average transport cost to FLDA is assumed to be cents 50 per ton mile for the purposes of this report. This is considerably above the actual rate which FLDA maybe expected to pay when maturity output levels are reached, and as opportunities for outside utilization in the area expand. It may be lower, however, than rates in the development years when the crop is small and opportunities for outside utilization are not great.

Latex Transportation from Field to Factory

Analyses have been made to identify and recommend the most economical, efficient and reliable method of transporting latex and scrap from small holdings to rubber factories.

In general it is clearly preferable where possible to use low cost settler labour and bicycles to carry latex and scrap from field to collecting stations. This is in accord with existing practice throughout West Malaysia and is recommended for the Jengka Triangle.

It is recognised that the newer high-yielding materials to be planted in Jengka would give rise to daily latex transport requirements in excess of the capacity of a bicycle, and that for some months and in some areas, two bicycle trips per day would be necessary for individual settlers. The alternative is some form of "assisted collection" involving mechanized transport direct to the factories in small containers (churns) on trailers or lorries, which would obviate the need for intermediate collection stations. A system of this type is clearly less preferable. This is because the resulting congestion at the factory, the difficulty of accounting, testing and paying for settler production and the increased cost of transport make the system more costly both to FLDA and the settler, and even more so to the economy.

Small intermediate collection stations, serving 1,000 to 1,200 acres of planted rubber, are therefore recommended. they would serve as the transfer points between settler transport and forms of motor vehicle road transport; they would also be the specific points at which settlers would hand over their latex and obtain cash, or credit for the rubber content produced. The most suitable place for this, given the small distances involved (up to 1.25 miles), is the village.

Thus one collection station should be set up for every 1,000 - 1,200 acres costing M$4 - 5,000 and consisting of bulking tanks, scrap storage, bucket washing facilities and latex testing equipment. This should be run by one man responsible for bulking and recording of settlers' production.

Between collecting stations and factories and for an average haul of four miles (as in main rubber areas of Projects V and VI), two systems of bulk latex transport were considered, based on current practice in West Malaysia. (Appendix 17 - 1).

1. Tractor with tank trailer
2. Lorry with fixed, or removable tank

Latex transport to the factories takes place for only four hours per day. In addition the peak daily output of latex is about 30 per cent higher than the average daily output. This occurs from November to February each year. During the remainder of the time, transport vehicles are available for other uses within projects, or for use outside the Triangle. In this respect, lorries are much more suited to outside utilization than are tractors, particularly if the tanks are not fixed to the lorries.

Under a system which allows for no outside utilization, tractor and trailer is less costly to FLDA than a system of five-ton lorries (Table 17-4). To the economy, however, the reverse is the case.

Table 17-4
Latex Transport Cost - Collection Station to Factory [1]

	M$ per ton to FLDA	M$ per ton to Economy
Lorry		
No outside utilization	4.0	3.0
Low outside utilization [2]	2.0	1.5
Tractor and Tank Trailer		
No outside utilization	3.6	3.6

1) Includes scrap
2) Contractor rate of 50 cents per ton mile used to represent low outside utilization

For a system which allows for even a low outside utilization, lorries are clearly preferable to a tractor and trailer system. This is the case both to FLDA and to the economy. The opportunities for vehicle utilization apart from latex transport are considerable and are the same as those available to FFB lorries. In addition, opportunities of FFB transport by latex lorries also exist, especially in months of low latex production (March to October).

The advantages demonstrated in favour of contractor-operated transport for FFB are equally applicable to latex. The opportunity for high vehicle utilization and private sector involvement in finance and management make a system of lorries under contract hire the most advantageous use of resources both to FLDA and the economy. This system is recommended for all areas to be planted to rubber in the Triangle. The average transport cost to FLDA is assumed to be M cents 50 per ton mile.

Internal Transport Organization

It is important to relate the requirements of the internal transport system to the present resources of the transport industry. At full production during the peak months, nearly 200 five-ton lorries would be needed for FFB transport and about 26 for latex transport, for the Triangle as a whole. The demand would build up slowly; by 1970, 13 lorries would be employed during the average month. Within the next five years the average number would rise to over 80 lorries employed on FFB and latex transport. At full production the investment in lorries for latex and bunch carrying in average months would exceed M$1.9 million and for peak month capacity, would exceed M$2.8 million. It is unlikely that this fleet could be provided by a single contractor and in fact it would be undesirable to allow one contractor a monopoly position.

Because a large investment in lorries would be involved in new areas of operation, contractor participation should be actively encouraged by assuring contractors large volumes of transport over reasonable periods. As Jengka develops in the early years there would be sufficient opportunities to modify the operation of the contractor system, and to engage additional contractors should they offer more favourable rates.

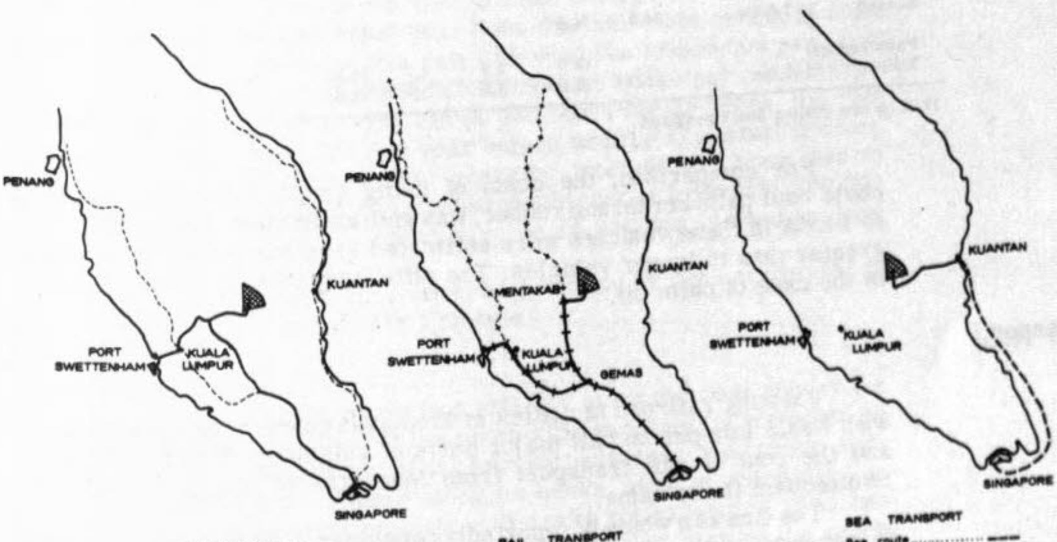
The recommended use of road transport for internal movement in Jengka makes an efficient internal road network essential to Jengka's development.

EXTERNAL TRANSPORT COST ANALYSIS

Transport cost comparisons have been made for movement of the Triangle's primary goods by means of road, rail, sea, and combination of these modes, using the existing external transportation network (Figure 17-2). Consideration has also been given to river and pipeline transport.

The external transport of logs and forest products from the recommended forest industry has been treated as an integral part of that industry's operations (Chapter 10). The analyses of log and forest product transport costs were coordinated, however, with the analyses described here for palm oil, palm kernel and rubber. Comparative cost estimates are summarised in Table 17-5; details of these estimates appear in Appendix 17-2.

Figure 17-2
External Transport Systems



Road Transport

Roads between the Triangle and existing ports generally provide facilities well in excess of present needs.

For this analysis, operating costs were developed separately for 12.5 ton payload tankers for palm oil and 7.5 ton payload lorries for palm kernel and rubber. Costs were based on a 145-mile haul from Jengka to Port Swettenham and a 260-mile haul to Singapore, and allowed for average levels of vehicle utilization.

For movement of palm oil, palm kernel and rubber to Port Swettenham the cost to FLDA was estimated to range from M$15.5 to 20.3 per ton (Table 17 - 5). Singapore is 115 miles further from Jengka than Port Swettenham; transport costs would be about 75 per cent higher for Singapore.

Table 17 - 5
Comparative External Transport Costs
(M$ per ton)

Commodity (lorry capacity)			Road - Rail				Road - Sea			
To FLDA (market prices)		Road	Road	Transfer	Rail	Total	Road	Transfer	Sea	Total
Palm oil	12.5 tons	15.5	4.9	2.5	15.0	22.4	9.3	5.0	17.0	31.3
Palm kernel) Rubber)	7.5 tons	17.6	5.8	2.5	16.0	24.3	10.7	5.0	17.5	33.2
Palm kernel) Rubber)	5 tons	20.3	6.7	2.5	16.0	25.2	-	-	-	-
To Economy (Social prices)										
Palm oil	12.5 ton	13.9	4.2	2.5	8.3	15.0	8.3	N/A	N/A	N/A
Palm kernel) Rubber)	7.5 ton	14.5	(4.6	2.5	8.7 [1]	15.8	8.8	N/A	N/A	N/A
Palm kernel) Rubber)	5 ton	16.0	(5.6 (5.6	2.5 2.5	8.7 3.9 [1]	16.8) 12.0)	-	-	-	-

1) If no new rolling stock required.

For comparison, the costs of using small, 5-ton lorries which could haul palm kernel and rubber, was also estimated. Transport costs to FLDA in these vehicles were estimated to be more than 40 per cent greater than in larger vehicles. The differences would be even greater in the case of palm oil.

Rail Transport

Existing railroad facilities at Mentakab connect the Triangle area with Kuala Lumpur and all major ports of shipment. Both the distance and the cost of rail transport from Mentakab to Singapore and Port Swettenham is the same.

The line as a whole is reportedly capable of a 50 per cent increase in capacity with only minor improvements, although for some commodities additional rolling stock and motive power would probably be required to achieve this.

The Malayan Railway Administration has quoted approximate rates which take into account the large volumes to be shipped from Jengka, and include rates on a full train load basis for palm oil. The actual discounts from published tariffs, however, would have to be negotiated at the appropriate time.

For rail shipments from Mentakab, all commodities would have to be moved initially by lorry, the average road distance being about 35 miles. Table 17 - 5 shows combined road-rail costs, including road transport over 35 miles and transfer cost at Mentakab. The cost to FLDA was estimated to range from M$22.4 to M$24.3 per ton, based on the special rates that have been offered and on use of the larger lorries for movement to railhead.

The estimated costs to the economy of a road and rail system are substantially lower than the costs to FLDA. They are based on the railway's marginal costs, estimated at M$8.3 to M$8.7 per ton, assuming that additional rolling stock and motive power would be needed. If additional equipment were not needed, railway marginal costs would be considerably lower. This might be the case for palm kernels and rubber, especially in the initial years, and on this basis, total road-rail costs to the economy for these commodities might be as low as M$11 per ton.

Railway Link to Triangle - The costs of rail transport were based on use of the existing rail network. The extension of the rail network into the Triangle was considered to assess its effect on the level of cost involving rail transport.

Preliminary investigations show that the construction of a railway link between Kuala Krau and the Jengka Triangle across the Pahang is technically feasible. Rough estimates prepared by Malayan Railways, without field information, indicate total construction costs might be in the order of M$9 to M$10 million.

The construction of a railway spur would not elimate the need for and cost of constructing a network of primary roads for internal transport of all commodities. Consequently, with the possible exception of the timber industry sited at the railhead the only advantage of this rail link would be a somewhat shorter road distance to the railway depot. This might reduce road hauls to railhead from 34 miles to about 7, but is unlikely to reduce the cost of road haulage by more than half or between M$2.5 to M$3.0 per ton. Thus the maximum saving in road haulage cost attributable to this rail link would be M$855,000 per year being the total external volume of 285,000 tons at M$3.0 per ton. Charging interest on capital at only seven per cent over 25 years, the rail link would cost M$830,000 per year before additional operating costs were included. To the economy, charging interest at 12 per cent to reflect its opportunity cost, the rail link would cost at least M$1,200,000 annually compared with a reduced value of savings in road haulage when valued at social prices.

It is recommended, therefore, that nothing be done at present to extend the railway line into the Triangle.

River Transport

The Sungei Pahang extending entirely along the west side of the Triangle, and passing close to the south side at points, is travelled by a variety of small river craft which provide passenger and freight service to the numerous villages along its banks, most of which have no road access. The river is shallow with drafts not exceeding 18 inches in low water months (June to July) over the crossing bars on the reach between Temerloh and Jerantut. Somewhat deeper water obtains further downstream and soundings taken on a 10-mile reach from Lubok Paku to Tasek Chini indicate a probable depth of three feet in the channel at times of low water.

Due to the shallow depths, and evidence of a shifting narrow channel, the river would be wholly unsuitable for any form of water transport serving the Jengka commodities.

Sea Transport

The usefulness of sea transport as an alternative means of transporting Jengka's output is limited to coastal shipping which, in turn, is affected by limitations of the port of Kuantan and by the fact that this mode of transport is applicable to Singapore-bound shipments only. Improvements to cosatal shipping facilities at Kuantan would increase the port's cargo handling capacity, without any perceptible effects on transport costs.

All coastal shipments from Kuantan would have to be first transported by road from Jengka (80 miles). Including road transport and transfer costs, the aggregate cost to FLDA of coastal transport to Singapore would be M$31.2 to M$33.1 per ton. (Table 17 - 5).

Pipeline

As a possible link in the external transport system for Jengka palm oil, preliminary analysis was also made of the cost of constructing a pipeline connecting the five proposed palm oil mills and extending to a common point of transfer to either road or rail transport. The pipeline would be of little benefit to a system based solely on lorries and the comparison must be based on transfer to a rail system. To justify a rail-pipeline system, overall pipeline costs would have to be less than M$4.9 per ton which is the lowest FLDA cost of road transport from mill to railhead (Table 17 - 5). With an estimated capital cost of M$10 million, interest and capital cost alone would be M$6.1 per ton. The technical difficulties and operating cost of a pipeline system make it clearly inferior to road transport.

Recommended System

On the bases of estimated costs to FLDA and to the economy, road transport using 7.5 - 12.5 ton payload lorries is recommended for the commodities analysed here, and this mode of transportation has been assumed in the planning for Jengka.

In the evaluation of projects, smallholdings and individual crops a transport cost of M$15 per ton has been used for all commodities. This allows for some return hauls in the 7.5 ton lorries used for kernels and rubber.

Road transport is also recommended for logs and timber products, based on similar analyses undertaken as part of the planning for the forest industry (Chapter 10). The wide use of road transport will require that parts of the internal road system of the Triangle, and links to the existing road network, be built to standards adequate for the large vehicles anticipated.

Transport Organisation

The operation of lorries by contractor for all external transport activities is recommended throughout Jengka. The number of 12.5 ton palm oil tankers is expected to rise to 47 when full production is reached; this would require an investment in tankers of M$2.3 million. Similarly, 35 lorries for latex and palm kernels would ultimately be needed, at an estimated total first cost of M$619,000. These are large sums in view of the present size of most transport contracting firms. If contractors with sufficient financial resources cannot be found, either individually or in a group, some public sector organisation other than FLDA should, if possible, provide the management and finance. To attract private contractors into a new venture of this nature contracts may have to be given for large tonnages to be guaranteed over a number of years.

Opportunity for Use of Rail

A substantial difference between the railways' quoted rates and estimated marginal operating costs exists, and suggests that for some types of freight traffic it may be possible to negotiate rates below Jengka's lowest available road transport costs. For palm kernels and rubber the marginal rail costs may vary from a high of M$8.7 per ton if additional rolling stock and motive power are required, to a low of M$3.9 per ton if no additional equipment is needed (Table 17 - 5). Provided the railway has sufficient equipment, rail would be preferable at social cost for these commodities. This condition is probable in the early years of Jengka and therefore the railway should be in a position to offer competitive rates for palm kernel and rubber transport in that period. For these reasons, it is recommended that the possibility of rail rates negotiated on this basis be explored by FLDA for palm kernel and rubber.

For palm oil transport, which would definitely require additional rolling stock, the marginal cost of rail transport would be fractionally lower than the cost of road transport to FLDA. To the economy, road transport would always be preferable for palm oil. Even in the early years when palm oil shipments are very limited (providing full employment in 1970 for only three road tankers) it is likely that road transport would be preferable.

TRAFFIC FORECASTS

External traffic was estimated by converting annual tonnage of commodities transported to and from Jengka to commercial motor vehicle trips, and thus deriving aggregate estimates for Jengka-generated commercial transport. These estimates assumed capacity loads and empty returns and were based on vehicle characteristics recommended in the report, or on the trends observed in West Malaysia's commercial transport industry.

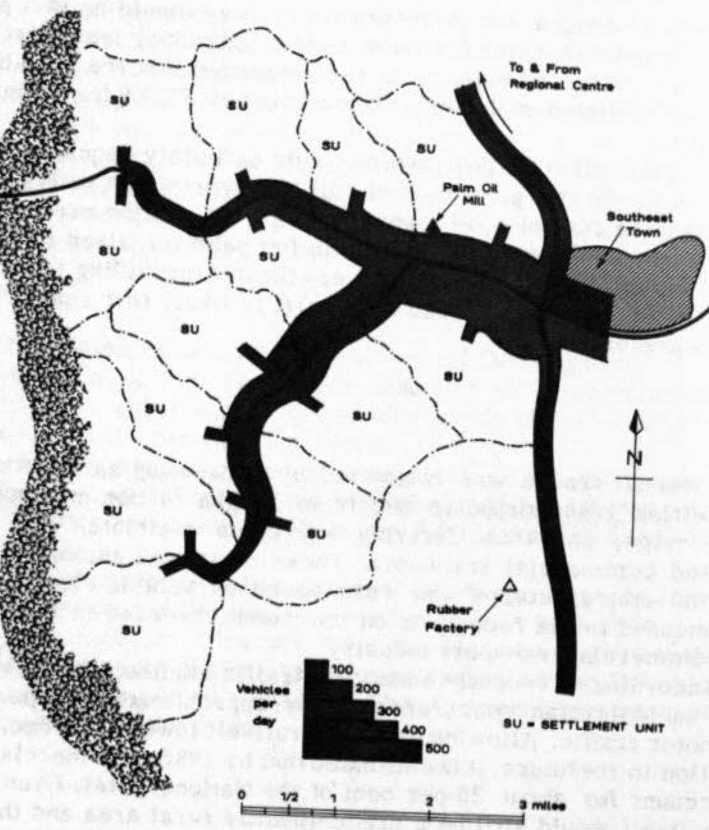
According to recently conducted traffic studies, commercial vehicles on Malaysian roads account for approximately 30 per cent of total motor traffic. Allowing for comparatively lower passenger vehicle utilization in the future, it is estimated that by 1985, commercial traffic will account for about 25 per cent of the National total. Even by 1985 Jengka itself would still be a predominantly rural area and these National coefficients may represent the maximum traffic potential.

In 1985, when maturity output levels for the Jengka Triangle would be reached, average daily traffic between Jengka and external points should be about 1,800 vehicles per day (Table 17-6). National Route II, over which most of this traffic would move has an average daily traffic volume at Temerloh of about 1,400 vehicles at present.

Table 17-6
Estimated External Motor Vehicle Traffic

Year	Tons	Commercial and Passenger Vehicles per day
1970	205,000	1000
1975	348,000	1400
1980	443,000	1800
1985	432,000	1850

Figure 17-3
Average Daily Traffic



These traffic estimates result in an external traffic volume which would be attained only if: (a) all Jengka-generated external traffic exclusively used road transport and: (b) if it relied on only one principal external link.

It is improbable that all Jengka-generated external traffic would rely on only one principal external link. The proposed primary road network for the Triangle provides three links with the existing road network outside the Triangle. It is estimated that about 90 per cent of commercial traffic and 75 per cent of passenger traffic would be between the Triangle and points west, while the rest would be distributed, principally to the east and south.

The average daily traffic entirely within the Triangle cannot be estimated precisely, but it would be dominated, in terms of tonnage transported, by the movement of fresh fruit bunches, liquid latex and where logging was still active, by logs. Under favourable economic circumstances, and rising settler income, the demand for goods, service and recreation in the rural areas could give rise to substantially higher travel ratios than now exist in similar areas elsewhere. Within individual projects, the transport demand from typical groups of settlement units probably would not exceed 250 vehicles per day, except at such main points of concentration as the oil palm mills, or the approaches to towns (Figure 17 - 3). Within individual settlement units, however, traffic would be far below the volume needed for rational design of roads, and roads in these areas must be planned to serve the characteristics of the vehicles which would use them.

CHAPTER 18

ROADS AND PORTS

Based on the findings of the transportation cost analyses (Chapter 17), the primary emphasis in the transport sector should be on the development of adequate road communications within the Triangle and on providing effective links with existing roads outside the Triangle. The recommended plan of an internal road network, and its standards and estimated cost, as well as an assessment of the capabilities of existing external transport facilities, are given in this Chapter.

INTERNAL ROADS

Existing Facilities

The Jengka Triangle is linked to other points in West Malaysia by an adequate system of National highways. Within the Triangle, however, there are few roads capable of providing effective service to Triangle operations, although some may be of value in early development stages. These include:

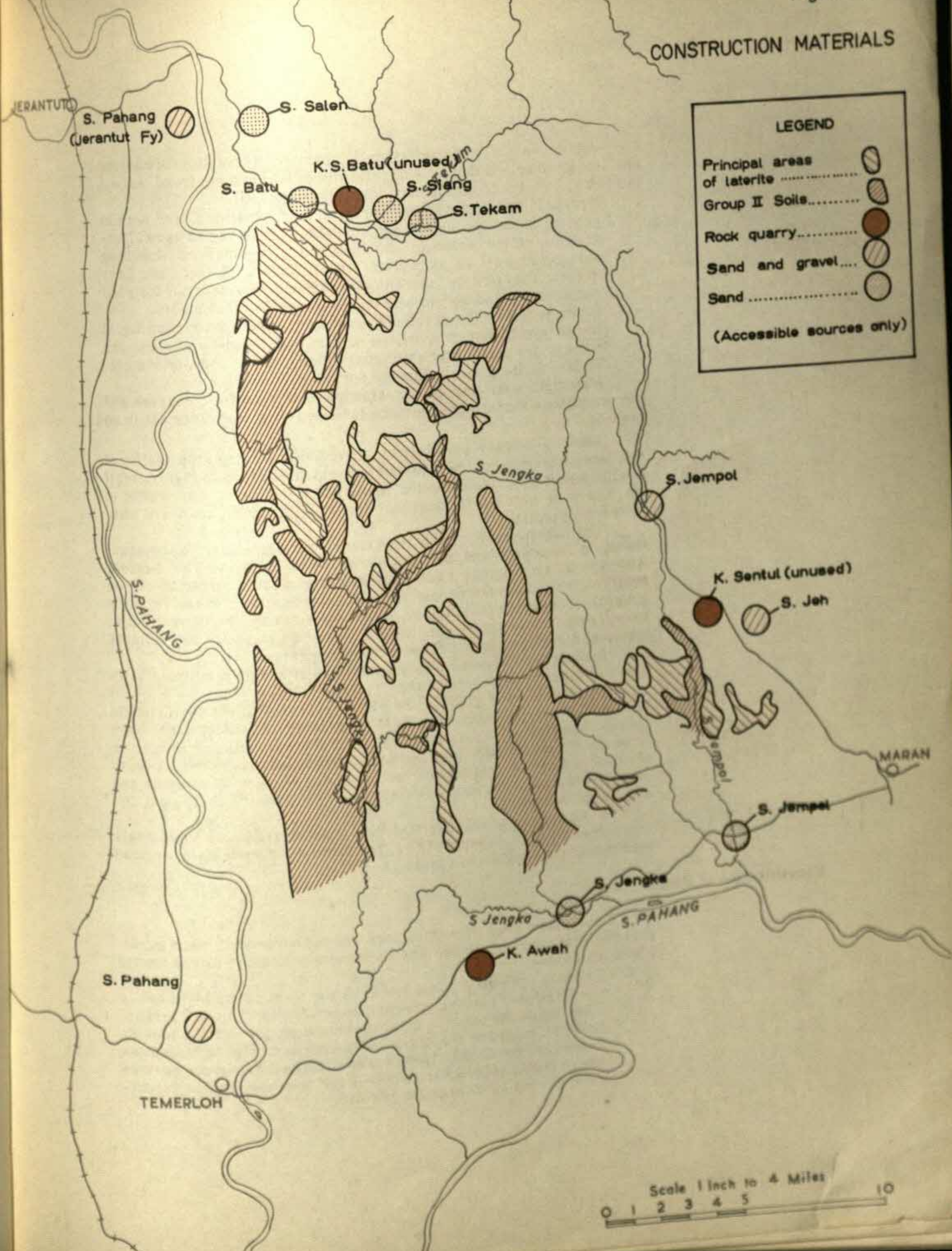
1. The Maran-Jerantut road (50 miles) along the east and north sides of the Triangle. It will be the only means of access to the first development areas of the Triangle, but its narrow carriageway (10 - 14 ft), tortuous alignment, widespread foundation failure, and location on the eastern edge of the Triangle, restrict its value for future transportation service.
2. FLDA access roads at Kampong Awah - Sungai Nerek schemes (5 miles) and Sungai Tekam (1 mile). Those will be useful for access initially.
3. A new rural road which has been built south along the Sungai Pahang as far as Kampong Kelola (7 miles). It is to be extended in the future, and should ultimately be connected to the Triangle's road system.
4. Active and abandoned logging tracks which enter the Triangle from the north, east and south. They are not built to any particular alignment, being directed often to selected trees. They are worthless in foundation value, for vehicles travel over the natural soil until it becomes impassable. They have some value as access tracks for survey and land clearing crews.

Construction Materials

A preliminary assessment of the engineering characteristics of the Triangle's soils was made. Grain size distribution, moisture contents, and liquid and plastic limits were determined for the main agricultural soil series to assess their relative suitability as sub-base material in road construction.

Figure 18-1

CONSTRUCTION MATERIALS



All of the soils of the Triangle, apart from lateritic formations are fine grained and deposits of sand and gravel are not found, except in rivers. Two broad soil groups were distinguished:

Group I Soils - These are soils of high plasticity, and have in general more than 50 per cent clay; they are the better agricultural soils of the Triangle and include the Segamat and Munchong series, as well as Akob, Batu Anam, Durian, Malacca and Tavy series. They are the least suitable as foundation material for road construction and should be avoided where a choice exists.

Group II Soils - These soils have generally lower plastic and liquid limits, and higher proportions of sand than Group I soils, and are to be preferred for highway construction. They include the Bungor, Kedah, Serdang and Telemong series.

Materials available in the Triangle for road base courses and non bituminous surface courses are laterite, rock, and river sands and gravels.

Laterite is only satisfactory for roads carrying slow traffic of low density because of the loose surface which develops in high rainfall conditions. It is undesirable for roads which will carry fast traffic in the future or high traffic densities for which bituminisation will ultimately be required.

The laterite resources of the Triangle are not believed to belarge; the main sources would be the soils of the Malacca and Tavy series. Although a satisfactory base course and surfacing material can be obtained from selected deposits, the nodular laterites of the Triangle generally contain unsatisfactory parent material which will wash out in heavy rain; it would be difficult to obtain a consistent and reliable material for a large-scale construction programme.

Rock occurs in satisfactory exposures affording conditions suitable for quarry in and around the Triangle.

River sands and gravels are extensively available in the Triangle area and would probably constitute a primary source of cheap base course material. Good frictional sand and some gravels are obtainable from the Sungai Pahang, (borings at Temerloh indicate a 50-foot depth of these deposits); finer sands occur in the beds of all streams and extensive deposits of boulders have been observed in the Sungai Jeh and Sungai Jempol.

A discussion of engineering soils characteristics and materials sources is given in Appendix 18 - 1. The locations of materials for road construction are shown in Figure 18 - 1.

Classification of Roads

Four basic road classifications are recommended, each incorporating standards of design and construction suited to future traffic needs, as follows:

1. Primary - primary roads would be the main public highways of the Triangle, serving internal, external, and through traffic. They would be capable of accommodating fast traffic (design speed 60 mph) and the heaviest vehicles permitted on Malaysian roads (24 - ton GVW). These roads would be designed for service where traffic volumes at the time of full development are expected to exceed 1,000 vehicles per day.

2. Secondary - The functions of secondary roads would be to connect the settlement units and processing centres to the primary roads; at the same time they would provide access to settlement unit villages and serve as well as frontage roads for some of the village houselots. With careful planning, the secondary road system can combine a basic agricultural collection function with village service, and a road system built solely for village access and internal circulation can largely be avoided.

   Secondary roads would carry repetitive loads arising from agricultural production as well as a range of other types of traffic and would be designed for service to future traffic volumes in the order of 100 - 400 vehicles per day.

3. Improved Tertiary - improved tertiary roads would be extensions of secondary roads into harvest areas of individual oil palm settlement units. They would also serve as frontage roads for those village houselots not located on the secondary roads and like the secondary road system, would also provide a combined agricultural and village service. Traffic volumes on these roads would be unlikely to exceed 15 to 20 vehicles per day.

4. Tertiary (Harvesting) - tertiary, or harvesting roads would extend entirely within the actual maincrop areas of settlement units and would be built to the minimum standard necessitated by vehicles used in harvest service. No more than one vehicle a day would be expected on many of these roads.

Primary Roads

About 64 miles of primary road are recommended, consisting of a north-south artery through the centre of the Triangle with a link west across the Pahang (44 miles), an eastern segment (13 miles), and a connection between the two (7 miles), as shown in Figure 18 - 2.

The basic structure of the primary road system is to use two existing natural alignments, the north-south valleys of the Sungai Jengka and Sungai Jempol, and to connect them through the Jengka Ridge near Ulu Jempol where there are indications of favourable topography for road construction. The valley alignments may also afford opportunities to use the Telemong alluvial soils (Group II) which appear to be relatively favourable for road construction.

The central segment of the primary road system would follow the valley of the Sungai Jengka north from a junction with the Maran-Temerloh road at Kampong Awah, past the proposed southwest town, to the regional centre. It would continue northward in the valley of the Sungai Chenerai to the Sungai Tekam FLDA scheme, then turn west across the Pahang on a new bridge to connect with the Jerantut-Temerloh road about five miles south of Jerantut. This segment would provide the principal transportation connection for the entire part of the Triangle lying west of the Jengka ridge and would provide through service between points in northwest Pahang and the East Coast as well.

The proposed connection across the Sungai Pahang on the north would not be required until late in the Triangle's development period (after 1975). It would provide a highway of benefit not only to the Triangle but also to the Jerantut District, and would be a main access route for the Tekam area when that land is developed.

On the south, the central route would connect directly with the Temerloh-Maran road.

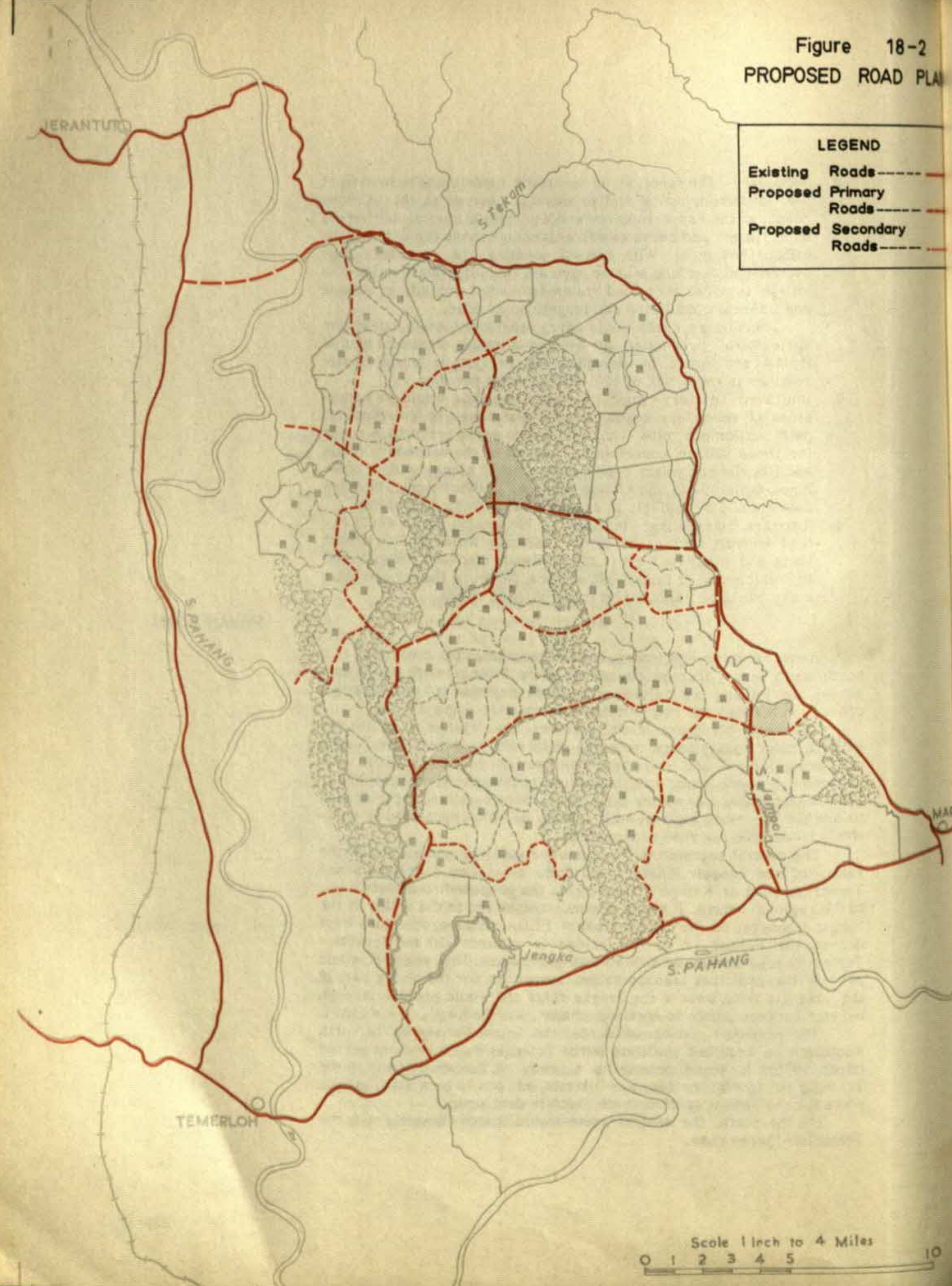


Figure 18-2
PROPOSED ROAD PLA

The eastern segment of the primary road system, following the valley of the Sungai Jempol, and the connection through the Jengka ridge, would link all agricultural areas east of the Jengka ridge and the southeast town, to the regional centre and to points outside the Triangle.

The primary roads should be built to Federal trunk road standards (Figure 18-3).

With care, a level alignment with a design speed of 60 mph can be selected for these roads in almost all sections of the Triangle. Where Group II soils are traversed or used as sub-base, they would require a foundation thickness of 8 to 12 inches for 9000-pound wheel loads. where Group II soils are not on the line of the road, they may still be considered for fill or sub-base in view of their relatively favourable engineering qualities. On Group I soils, a 15-inch foundation would be required. It is important that an extensive and carefully planned highway route soil survey be carried out for all proposed primary road alignments. This survey would also provide essential information on materials, bridge foundation conditions, soil properties, and the possibility of rock in excavation areas.

Traffic will grow gradually, in order to conserve capital these roads should be constructed in stages. The geometry of the final section cannot be reduced initially, but the foundation thickness can be progressively increased. The carriageway should originally be constructed of either river material or crushed rock, blinded on the surface with river sand, and sealed with bitumen. It should be used in this stage as long as possible and in any case for a year in order to allow settling to occur.

When observations show the traffic density to warrant it, bituminous double surface dressing (3/4 and 3/8 inch stone) should be applied. Tests should be carried out to see whether river gravel is suitable for this purpose, mainly for bitumen adhesion, skidding resistance and soundness.

A final stage if found necessary would be the application of a final bitumen surface course of a thickness and design appropriate to the roads and traffic volumes encountered.

The primary roads are estimated to cost about M$177,000 per mile for the first stage, plus about M$21,000 per mile for the bituminous surface. The construction of a final stage has not been assumed in these estimates.

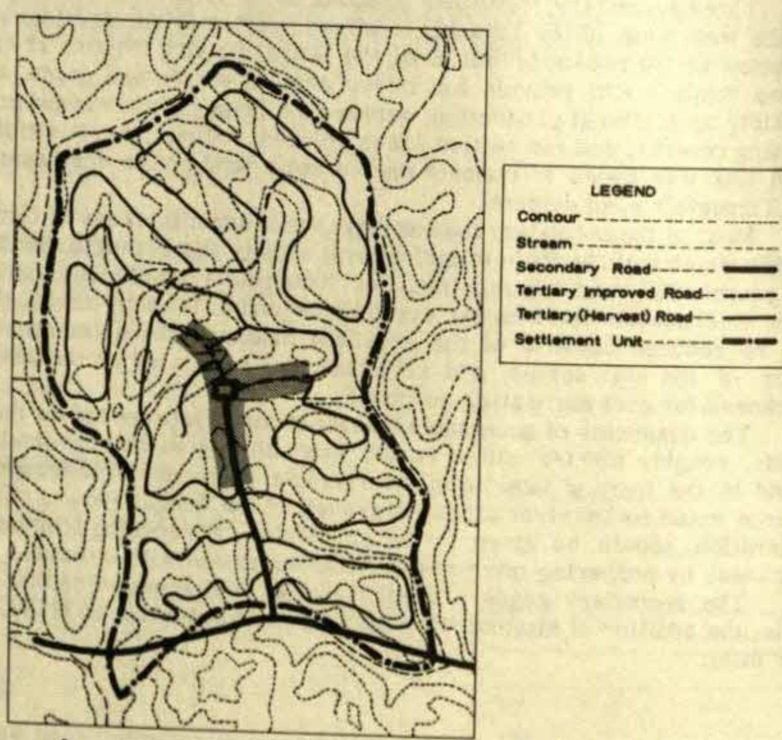
Secondary Roads

About 202 miles of secondary roads are recommended; approximately 81 miles linking the settlement units with the primary roads and about 121 miles within the settlement units (Figure 18-2).

The estimated secondary road mileage within settlement units was considered to be the length of road needed to construct secondary roads as far as the centres of all villages. An additional allowance of 25 chains per village was made to provide for construction of a road of secondary standard on all sides of each village padang.

At points of traffic concentration which could occur in oil palm areas, secondary roads would be required to carry in peak periods up to 100 loaded fresh fruit bunch lorries per day. Total daily traffic at such points might thus be in the order of 300 commercial and passenger vehicles; for limited distances near mills and towns, traffic volumes would probably be higher.

Figure 18 - 6
Typical Settlement Unit Roads



For rubber areas, tertiary roads can be spaced further apart, and an estimate of 20 chains (0.25 miles) has been used as the theoretical desirable distance between them. Since latex would be transported on settlers' bicycles to village collecting stations, the vehicular traffic served by these roads would be very light and would include only occasional lorry or tractor and trailer movements of fertilizer and other materials, as well as FLDA supervisory staff traffic. Finally, rubber areas generally include the better road building soils of Group II and thus foundation construction procedures can be greatly simplified.

For the very light traffic to which tertiary roads would be subjected, normal design procedures which are empirical and relate to large numbers of vehicle passes, cannot be rationally applied. The recommended procedure is to minimize initial construction, where possible by building the earthworks only, and to adopt a system of gradual improvement by a well-organised system of maintenance. This would be possible on the sandy alluvial soils of Group II which will compact well and form a surface having good frictional properties. Where advisable, river sand, gravel, or laterite can be rolled into the surface of roads built in this way to improve their performance under traffic and to avoid slipping. Initially, however, these roads could be seeded to grass, since grass provides a certain tensile strength at the surface and is capable of reducing or preventing erosion when it is well established. Where grass will not maintain itself, or wears away, granular material would be added under the maintenance programme until gradually sufficient material was in place to satisfy the design condition existing there, and as this condition was approached, the frequency of application of material would decrease. Grasses for use on tertiary roads are listed in Appendix 18 - 2.

The approach described above, or "construction by maintenance", is recommended for tertiary roads in all rubber areas and the estimated costs of such roads were computed on this basis.

Untreated soil as a road surface would not be effective at all for the Group I soils, and where they occur, a more conventional road design based on application of a three inch laterite base course is recommended (Figure 18 - 7). This condition was assumed to obtain in all oil palm areas, and the costs of tertiary roads in those areas are based on this type of laterite foundation. Through systematic maintenance, the thin initial foundation layer of these roads would be strengthened where necessary in the ordinary repair of failures (potholes and ruts) as they occurred.

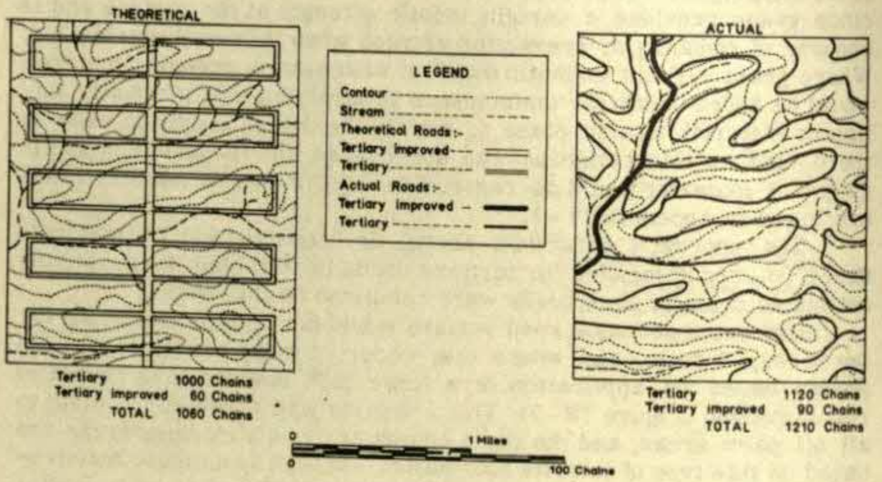
When tertiary roads are to be built in oil palm areas, at which time more detailed site information would be available, consideration should be given to dispensing with laterite initially where soil conditions are satisfactory. Substantial savings would accrue if this is possible, since tertiary roads built with laterite are estimated to cost about M$7,650 per mile, compared to an estimated cost of M$3,400 per mile for tertiary roads without laterite.

Tertiary Road Layout – Oil Palms

The great density of tertiary roads needed to support oil palm harvesting operations necessitates careful planning to ensure both minimum length of road and minimum numbers of passes by collecting vehicles. Minimum road length is achieved by arranging that the tertiary road serves the maximum carry distance (6 chains) on both sides. Minimum travel can be achieved by basing tertiary road layout on a grid system as much as possible, connecting parallel segments in loops. The length of individual loops should be closely related to the carrying capacity of a single transport vehicle (5-ton lorry) under peak harvest conditions. A layout on this basis would require only 100 chains of tertiary road per 120 acres, or 0.833 chains per acre (Figure 18-8). For such a system, the theoretical number of passes would never exceed one per day. If in practice more vehicles were to use these roads, they would tend to be carrying reduced loads and thus causing less road damage.

A detailed analysis of tertiary road layout on land similar to that of most of the oil palm areas of the Triangle, using an absolute maximum gradient of 1 in 10 (10%) and a desirable maximum of 1 in 20 (5%), indicated that the extra length due to physical relief alone would be 1.11 of the basic grid (Figure 18-8). This would result in an average requirement of about one chain per acre; the total system required is estimated to be about 815 miles.

Figure 18 - 8
Tertiary Road Layout



Tertiary Road Layout – Rubber

The average road spacing assumed for rubber areas is 20 chains; the virtual absence of highway-type transport vehicles on these roads greatly simplifies their layout. As for oil palms, the objective should be a grid network, with variations from it as dictated by topography and the need to maintain acceptable grades. Individual segments of tertiary roads should be interconnected to afford settlers the most direct route practicable between their smallholdings and the village latex collecting stations. Because of the extremely light traffic loads, improved tertiary roads would not be built in rubber areas.

For average conditions in the Triangle, tertiary roads in rubber areas would be required at a rate of about 0.6 chains per acre; the total system required is estimated to be about 211 miles.

Drainage and Bridges

The numbers of cross drainage structures were estimated from analyses of actual conditions on the Ulu Jempol FLDA scheme where suitable topographic mapping was available, assuming rainfall intensity of five inches per hour and runoff of about 25 per cent. Minimum pipe size was taken to be 15 inches. Allowances for cross drainage structures are given in Appendix 18 - 3.

Estimated bridge construction for primary roads was based on an assumed 16 bridge ranging in length from 30 to 180 feet, or about 18 feet of bridge construction per mile (Appendix 18 - 3), secondary road bridge construction was estimated to be about 11 feet per mile, or at approximately the same density as obtains on the existing Maran-

Jerantut road.

The Sungai Pahang bridge was assumed to have a crossing length of 400 feet at the site indicated on Figure 18 - 2.

Estimated Construction Costs

The total road construction programme is estimated to cost about M$37,496,000 (Table 18 - 1). This includes M$28,459,000 for primary and secondary roads which serve the Triangle as a whole and M$9,037,000 for tertiary-improved and tertiary roads which are allocated to individual projects.

Table 18 - 1
Estimated Road Construction Cost

Project	Primary		Secondary		Tertiary improved		Tertiary		Total	
	miles	cost (M$)	miles	cost (M$)	miles	cost (M$)	miles	cost (M$)	miles	cost (M$)
I	not distributed to individual projects		not distributed to individual projects		12	270,000	149	1,105,000	not distributed to individual projects	
II					16	357,000	171	1,159,000		
III					21	467,000	223	1,635,000		
IV					17	360,000	169	1,295,000		
V					14	311,000	164	924,000		
VI					14	300,000	150	854,000		
Total	64	14,207,000	202	14,252,000	94	2,065,000	1026	6,972,000	1386	37,496,000

Estimated construction costs are based on a number of approximate assumptions and simplifications. They have been developed from study of available 50-foot contour base maps at 1:25,000 scale and from air photograph interpretation. As such they indicate the magnitude of investment required in each of the proposed road classes. Accurate engineering cost estimates cannot be developed until adequate soils and materials investigations are carried out and centre-line surveys are made.

Unit costs used in the estimates were obtained from the Public Works Department (PWD), FLDA, and contractors and represent contractors' prices including an allowance of 20 per cent for contractors' overhead and profit. An allowance of 25 per cent for contract administration, engineering and supervision of construction, and contingencies has been added to all estimates.

No costs for land acquisition are anticipated, therefore no allowance has been made for them in the estimates.

Summaries of quantities and the main elements of cost for each road class are given in Appendix 18 - 4.

Maintenance

It was assumed that the PWD would be responsible for maintaining primary and secondary roads in accordance with present policy. The PWD, Pahang, estimate that the cost of maintenance of any type of road is M$4,500 per mile per year, because the larger amount of maintenance required for roads of lower standard with low-cost materials is offset by the less frequent maintenance of better roads using more expensive materials. This maintenance factor has been adopted for the purpose of this report.

For improved tertiary and tertiary roads maintenance could be provided by FLDA with its own forces, or preferably by contract. For laterite roads in oil palm areas, annual grading and replacement of five per cent of the laterite is assumed, at an annual cost per mile of M$ 1,000 for improved tertiary roads, and M$750 for tertiary roads.

Tertiary roads in rubber areas are assumed to be built initially with untreated soil, and systematic "construction by maintenance" is recommended. It was assumed that one half the cost of construction of a laterite road would be finally incurred over a period of ten years, and that the annual cost of maintenance would be M$400 per mile.

Coordination with Logging Roads

The proposed Jengka logging industry has been planned on the basis of modern log hauling and logging equipment which would require an extensive system of well built logging roads (Chapter 10). These would be built to a heavier foundation standard than needed for agricultural development and would include 18-inch crushed stone base courses to support the heavy log hauling vehicles (200,000 GVW) planned (Table 18 - 2). Logging roads would be built in three classes (main, secondary, and spur) corresponding approximately to the first three classes of permanent roads proposed for the Triangle. Their temporary nature would facilitate economies in design and construction. Construction of permanent cross drainage and bridges would largely be avoided and alignment, grade and width would be sacrificed in favour of simpler road building conditions.

Table 18 - 2
Logging Road Standards

	Main Logging	Secondary Logging	Spur Logging
Carriage Width (feet)	20	16	12
Shoulder Width (feet)	5	5	3
Base Course	18 inches crushed stone	18 inches crushed stone	18 inches crushed stone
Maximum grade (per cent)	4 (adverse) 6 (favourable)	6 (adverse) 10 (favourable)	6 (adverse) 10 (favourable)
Minimum Radius of horiz. curvature (feet)	500	250	100

Logging would precede agricultural development, and the logging roads could adequately serve the agricultural development operation, on completion of log hauling. Their layout has been coordinated therefore with that of the permanent road system of the Triangle to avoid construction of a duplicate system. Main, secondary and spur logging roads would be built initially on more than half of the Triangle's permanent primary and secondary road system (Table 18 - 3).

Table 18 - 3
Coordination of Logging Roads

Permanent Road Classification	Total Required	Built initially for logging: Main Logging Roads	Secondary Logging Roads	Spur Logging Roads
Primary	64	16	9	-
Secondary (outside settlement units)	81	10	25	-
Secondary (inside settlement units)	121	-	-	87
Tertiary - improved	94	-	-	19
Tertiary (oil palm)	815	-	-	-
Tertiary (rubber)	211	-	-	-

The advance construction of logging roads on alignments ultimately needed for the Triangle's permanent road system would afford an opportunity for substantial savings in the construction cost of that system. As logging operations are successively withdrawn from sections of the Triangle, the logging roads would be improved to desirable standards. The possible saving is estimated at approximately M$ 7,000,000.

A deduction has not been made in the estimates of this report for the possible savings indicated, since their realization would depend on the implementation of the logging programme in the manner and within the time schedule recommended. Were the savings deducted from the Triangle's budget funds and were the logging programme not implemented as recommended, then capital costs of the permanent road system would be understated.

The advance construction of logging roads, however, has been assumed for purposes of developing a construction schedule for roads, and for phasing of their required capital investment.

Road Construction Schedule

The proposed road construction schedule, based on the assumed advance construction of logging roads in many areas is illustrated in Figure 18 - 9 for primary roads and for the sections of secondary roads located outside individual settlement units and is summarized in Table 18 - 4. A complete construction schedule, indicating the anticipated responsibility for initial construction is given in Appendix 18 - 5. The phasing of capital investment in roads appears in Appendices 18 - 6 and 18 - 7.

Table 18 - 4
Road Construction Schedule

	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	Total
Primary	6	14	13	15	3	3	-	4	2	4	-	64
Secondary	8	26	20	24	28	20	33	15	11	11	6	202
Tertiary-improved	4	7	13	8	11	12	13	11	11	4	-	94
Tertiary	39	99	110	130	139	148	134	107	50	14	56	1026

EXTERNAL ROADS

The preceding analyses of external transport costs for Jengka's movements have shown that road transport, using large lorries (7.5 to 12.5 ton payload), would be the most economic form of transportation between the Triangle and ports. Transport cost estimates used in this report for all commodities have been based on this system. The conditions, capacities, and plans for improvement of the existing highways which could be used to move Jengka's primary and induced goods traffic are reviewed in this section.

National Route II

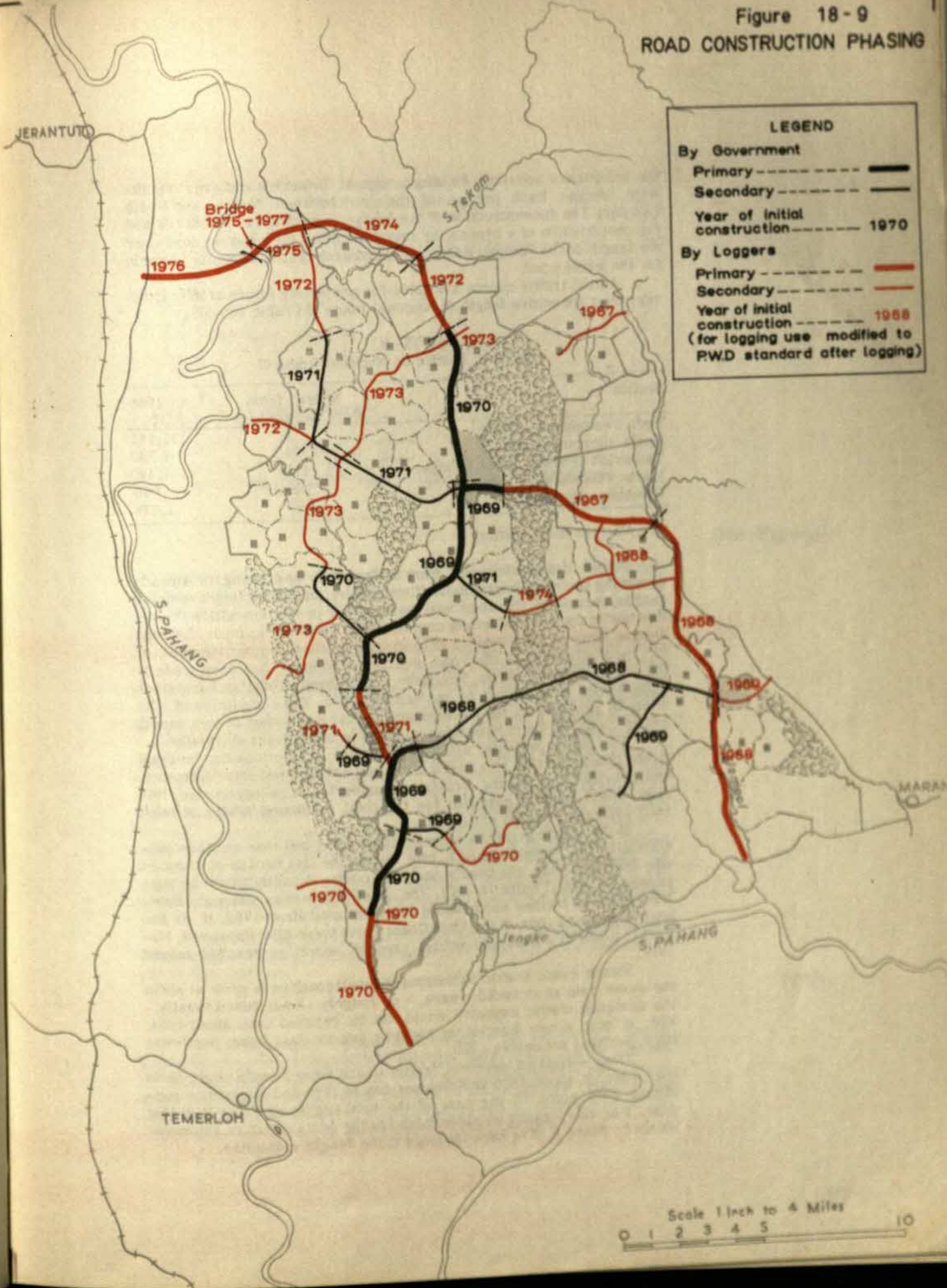
Jengka's most important external link would be the National Route II. It connects the Triangle with Port Swettenham, its principal port of shipment, with Kuala Lumpur and other major domestic markets, and with the port of Kuantan on the East Coast.

Conditions and standards of Route II vary over its route across the peninsula from Port Swettenham to Kuantan, a distance of 200 miles. Traffic is restricted by a temporary bridge at the Sungai Pahang to a single-lane. Elsewhere the road is at or near Public Works Department trunk road standards throughout its length. The most important exception is the section at the Sempah Pass (20 miles) between Bentong and Kuala Lumpur where more than 100 curves severely restrict speed, and in 10 places two vehicles cannot pass each other.

For the entire length of Route II, axle loads of 8 tons and gross vehicle weights of 36,000 pounds are permissible. These allowances would accomodate the types of lorries for which the economic evaluation of alternative transport systems were made. Special permits for movement of larger vehicles, to 48,000-pound gross vehicle weights, are obtainable through the Public Works Department. The use of such larger vehicles would make possible payloads in the order of 14 tons and would reinforce the desirability of road transport as compared to other modes.

National Route II has a designed traffic capacity of 1,200 vehicles per hour (both directions) or 12,000 vehicles daily, except for the Kuala Lumpur-Klang section which has a design capacity of 40,000 vehicles per day. This is based on an observed traffic mix of 70 per cent passenger vehicles and 30 per cent commercial vehicles. The actual traffic capacity, however, is restricted to 400 vehicles per hour at the site of

Figure 18 - 9
ROAD CONSTRUCTION PHASING



the temporary one-lane Pahang bridge at Temerloh and over the 20-mile Sempah Pass portion of the road between Bentong and Kuala Lumpur. The reconstruction of the bridge to its original standards and the construction of a bypass, or improvement of the existing road over the length of the Sempah Pass, would make the traffic capacity uniform for the whole road.

Actual traffic counts available for projecting future traffic flows vary over the entire length of National Route II (Table 18 - 5).

Table 18 - 5
Existing Traffic on National Route II

Section	Miles from Port Swettenham	1966 ADT [1]
Port Swettenham - Klang	5	11,145
Kuala Lumpur - Katari	71	1,730
Temerloh (Pahang River Bridge)	116	1,440
Maran - Gambang	180	936
Gambang - Kuantan	197	1,128

1) Average daily traffic.

Motor traffic between Port Swettenham and Klang is already exceeding the road's designed traffic capacity; additional improvements to this section of the road will be required in the immediate future. For use in transport of Jengka commodities, the Kuala Lumpur-Bentong section must be improved by 1975; provision for this improvement, or for reconstruction of the road on a new alignment, has been made in the First Malaysia Plan. Similarly, the Pahang bridge at Termerloh must either be repaired or replaced by 1975. The completion of both of these projects by the Government has been assumed in this report and no costs for them have been included in the Jengka estimates.

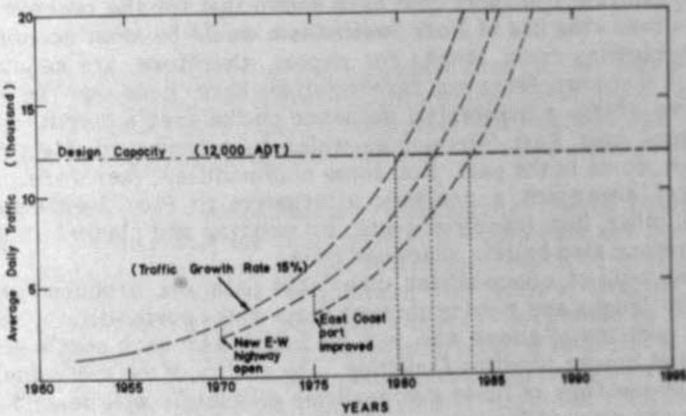
For future service, after 1975, traffic projections for National Route II indicate that as a result of current and planned improvements, and provided the Pahang Bridge at Termerloh is reconstructed, this road would remain adequate for the total estimated traffic at least until 1980 and possibly until 1990.

If the traffic grows at 15 per cent per year and thus exceeds substantially the national growth rate during the last decade of about 11 per cent per year, the road's designed traffic capacity would be surpassed by 1980 (Figure 18 - 10). The construction of an alternate East-West highway further north would delay this until about 1982. If, as has been suggested, one of the East Coast ports were also improved, National Route II's designed traffic capacity would be reached around 1984.

Should motor traffic on National Route II continue to grow at about the same rate as in recent years, - or roughly 12 per cent annually - the designed traffic capacity would not be reached until about 1984, and, if both a new East-West highway and an East Coast port were built, perhaps not before 1990.

Total estimated external traffic to and from Jengka might be in the order of about 1800 vehicles per day in 1985 and might thus constitute only about 10 per cent of the total traffic on Route II in that year. For this reason no allowances for the costs of future improvements to Route II have been included in the Jengka estimates.

Figure 18-10
Traffic Forecast - Route II



Other Highways

Relatively little use would be made of highways other than Route II for Jengka operations in the near future, except for local traffic in the immediate vicinity of Jengka. Existing facilities are described below.

From Karak, 33 miles west of the Triangle, an all-weather highway extends south to connect with National Route I at Gemas, and thus provides a direct link to Singapore. The route is not of PWD trunk road standard and provides only limited service to traffic between western Pahang and Singapore. No improvements to this route are planned.

North from Mentakab a new all-weather highway extends about 34 miles to Jerantut, and provides connections to Kuala Lipis and points in north-west Pahang. It is proposed in this report to connect this route with the northern end of the Triangle's primary highway system, via a new Pahang bridge near Jerantut. This connection would ultimately become an important access route to the Sungai Tekam area when it is developed and as such might generate appreciable increases in traffic volumes on the existing Mentakab-Jerantut road. For such service, the existing highway would have to be strengthened by replacement of the existing laterite base course and construction of a new surface course.

At the Jerantut Ferry, which is the only other vehicular crossing of the Sungai Pahang, loads are limited to 12 tons; the daily capacity is 200 to 300 vehicles.

PORTS

Port Swettenham, Penang and Singapore are the three principal ports handling West Malaysia's foreign trade. Each can be reached from the Triangle by road, rail, water or combinations of these three mode of transport. Sea freight charges to all but the few neighbouring countries are the same for all three ports and all compete on an approximately equal footing with respect to port charges.

The general area of the Jengka Triangle lies in Port Swettenham's hinterland, both on broad economic grounds and on specific land transport cost break-even point studies for individual commodities. Analyses of external transport cost have shown that for the recommended system - road - the use of Port Swettenham would be most economical. All commodities from Jengka for export, therefore, are assumed to move via that port. However, investigations have shown that the port of Singapore exerts a substantial influence on the area's output, and has advantages over Port Swettenham which have tended to offset higher transport costs in the past. For some commodities, therefore, Singapore may represent a realistic alternative to Port Swettenham on grounds other than transport costs; its existing and planned facilities are therefore also briefly examined here.

The bulk of commodities other than palm oil, produced or consumed by Jengka and moving through deep-water ports will not require special port installations and will be handled by each port's general export and import handling facilities. The ability of the individual port to handle the flow of these commodities efficiently will depend on its existing and planned facilities, and also on the total anticipated traffic growth. The major facilities available at Port Swettenham and Singapore are summarized in Table 18 - 6.

Table 18 - 6
Comparison of Facilities Available at Port Swettenham and Singapore

Port Facility	Port Swettenham [1]	Singapore
Ocean Shipping		
Wharves	2	5
Berths	7	25
Coastal Shipping		
Wharves	1	1
Berths	2	5
Warehouses and Transit Shed (Thousand Square Feet)	641	1,950
Open Storage Yards (Thousand Square Feet)	230	850
Equipment		
Tugs	7	11
Lighters	83	N.A.
Fork Lift Trucks	56	206

1) Including new facilities at North Klang Straits.

In each port, responsible authorities are planning for substantial capacity increases. At Singapore, the present expansion plan calls for the addition by 1968 of four new deep-water berths of 600 feet each, one finger pier for coastal vessels also 600 feet long, four blocks of warehouses with a total storage area of 600,000 sq, feet and one new port facility principally for bulk cargo in the Selat Damar Lant area northwest of Singapore. Port Swettenham authorities plan to reconstruct two berths in the old section of the port and to construct two additional berths, each with an annual cargo-handling capacity of 200,000 tons, before 1970.

Port Swettenham

Traffic forecast for Port Swettenham based on 1961 data and extended through 1975 were prepared recently by the University of Malaysia and it was recommended that two additional wharves would be needed and should be constructed before 1970 and two more wharves between 1970-75.

The effect of the proposed East-West highway linking the competing port of Penang with the large part of the northeast now served by Port Swettenham would tend to reduce the future share of foreign trade handled by Port Swettenham. In addition, the volume of diverted traffic would be even more substantial if improvements were made on the East Coast. Finally, newly established petroleum refining facilities at nearby Port Dickson may further reduce petroleum imports via Port Swettenham. On the other hand, the continuation of improved relations with Indonesia and of restrictions on trade with Singapore are likely to produce some additional business for Port Swettenham.

While it is impossible within the scope of this report to evaluate the overall effect of these trends on Port Swettenham's projected traffic volume, it is felt that existing and currently planned facilities should remain adequate during the next decade, especially if no efforts are made to suppress or eliminate existing lighterage operations now handling nearly one third of total cargo. In any case, Jengka's traffic, other than palm oil, is not likely to exceed at any time more than a fraction of the port's overall capacity and should not require special or separate installations. Overall facilities at Port Swettenham will probably have to be expanded before 1980; a better appreciation of the port's future should result from the proposed National transport study which is expected to be undertaken in 1967.

Palm Oil Bulking Facilities at Port Swettenham

Palm oil bulking facilities at Port Swettenham are currently provided by two major private palm oil exporters, with storage capacity of 7,500 tons and 9,000 tons respectively. Based on customary relationships, the aggregate annual capacity is about 130,000 tons. In 1963, 72,000 tons of bulk palm oil were exported through these facilities, indicating a capacity utilization ratio of 55 per cent.

Palm oil shipments other than those of FLDA through Port Swettenham are expected to double by 1975 and may be considerably higher if transhipment of palm oil exports from Indonesia is resumed. In anticipation of growing palm oil exports, plans are underway gradually to add another 18,000 tons of storage capacity capable of handling over 140,000 tons of palm oil annually.

FLDA's existing and planned oil palm schemes likely to use Port Swettenham will export about 214,000 tons of palm oil in 1975, of which about 74,000 tons would come from Jengka. By 1985, Jengka alone would export about 128,000 tons of palm oil and total FLDA palm oil exports through Port Swettenham might exceed 320,000 tons.

These figures indicate that while FLDA can initially depend on storage and loading facilities of existing palm oil shipping parties, it must plan at an early stage to erect its own facilities at Port Swettenham. It is understood that a site has been reserved for this purpose. The estimated cost of a palm oil bulking installation for FLDA is M$ 7,230,000 of which about M$1,770,000 should be charged to Jengka, based on the ultimate proportion of use by Jengka (Table 18 - 7). These estimates are given to provide a basis of investment required in Jengka; the annual operation costs of the palm oil bulking facility have been deducted directly from palm oil prices for the purposes of this report.

Table 18 - 7
Estimated Cost of Palm Oil Bulking Facility

	Total	Charge Jengka
Oil receiving facilities	120	50
Tank storage	2,990	1,260
Ship loading	100	40
Ancillary (cleaning, steam generation, offices, laboratory)	170	70
	3,380	1,420
Engineering, supervision and contingencies (25%)	850	350
Total	4,230	1,770

Port of Kuantan

The analysis of terminal facilities should also consider whether improvements at the Port of Kuantan would make it an effective alternative to Port Swettenham for ocean shipments of Jengka's output. Kuantan has almost no natural advantages as a deep-water port site. Its elevation to an ocean port would require substantial investments in port handling and storage facilities, dredging, breakwaters and navigational aids. The costs of these works have not been estimated; however, for a single-berth terminal, turning basin and channel, breakwater structure, and permanent dredge, the minimum cost might be in the order M$20,000,000, but in all probability considerably more. Total identifiable demand for port facilities generated by the Triangle are less than 300,000 tons annually. Even if all this traffic were handled at Kuantan, resulting land transport cost savings and possibly lower sea freight rates to neighbouring countries would never justify investments of this magnitude.

Although Jengka traffic alone would not justify the construction of a protected deep water port at Kuantan, there may be other considerations which necessitate evaluation of this proposal, either at Kuantan, or possibly at some other East Coast site. The traffic volume handled by Kuantan in 1965 exceeded 340,000 tons (of which 275,000 tons were iron ore shipments) and partial data for 1966 indicates futher growth. More important, it is widely believed that the establishment of such a port would stimulate the economic development of the East Coast. The construction of an East Coast port would also delay the need for additional improvements at Port Swettenham, and substantially reduce transport cost of the East Coast's large timber resources.

CHAPTER 19

WATER SUPPLY, DRAINAGE AND IRRIGATION

Recommendations for the establishment of rural, urban and industrial water supplies, and for catchment protection and river maintenance are made here. The technical feasibility of irrigation has also been considered.

Water Supply Requirements and Standards

The total water requirements of the Triangle's villages, towns and the industries is estimated to be about 10,000,000 gallons per day and to require a pumping capacity in the order of 35 to 40 cubic feet per second for 12 hours a day.

Estimate of domestic water requirements for the rural villages of the Jengka Triangle have been based on a supply of 60 gallons per day per capita. This is in accordance with existing practice for new rural water supply schemes in West Malaysia; it is a normal criterion but may over estimate requirements of the rural villages in the Triangle in early years. It assumes that all houses would have piped water connections and waterbourne sewage facilities. These services would not in fact be available in the initial years and the demand rate of 60 gallons per day per capita may not be attained, but such services are expected to be required with rising family income and education.

A supply of 75 gallons per capita per day for towns, as distinct from the villages, is recommended. This would be sufficient to meet both their domestic and industrial water requirements.

The recommendations of the World Health Organisation on standards for treatment of domestic water supplies have been followed in planning treatment facilities; these standards also conform closely with normal water supply practice in West Malaysia. A comparison of World Health Organisation standards with the analyses of water samples from Jengka Triangle streams is given in Appendix 19 - 1.

Industrial water supplies which may be separate from the village and town water supplies discussed above would be needed for the palm oil mills, rubber factories and timber processing industry of the Jengka Triangle. Estimated industrial water supply requirements for these industries based on the recommendations of the manufacturers of milling equipment, are relatively small (Table 19 - 1).

The design population in all cases has been determined by using an allowance for population growth 1) of 70 per cent in 25 years and is in accordance with Malaysian water supply service.

For palm oil processing the water must be clear, tasteless, colourless, soft and free from ferric salts, manganese, hydrogen disulphide and organic matter. For rubber processing it should meet normal domestic standards of physical and chemical purity. For steam raising purposes the boiler feed water should be soft, alkaline, and free

Table 19 - 1
Industrial Water Requirements (peak demand)

Mill	Per output of	Processing Water gallons per hour	Boiler water gallons/hour
Palm oil	10 tons of Fresh Fruit Bunches/hour	1000	1000 *
Rubber	1000 acres	600	-
Plywood	-	-	1000

* Make-up water to replace that used for processing

from suspended solids, dissolved oxygen and ferric salts (Appendix 19-2) The treatment required for industrial supplies would depend on the particular source of water developed and its use. The recommendations of equipment manufacturers should be followed for all industrial water supplies.

RURAL WATER SUPPLY DEVELOPMENT

Existing Rural Water Supplies

Where no piped water supply is available the existing rural communities on the fringe of the Triangle draw their water from shallow wells or from nearby streams. The water is untreated and only superficial attempts are made to protect the wells from pollution. Small pumped supplies are available in Kampong Datu and Kampong Sungai Jerik. Only the supply at Sungai Jerik is treated. None of these small systems has enough capacity in excess of existing requirements to meet the demands of any of the proposed villages.

Three FLDA schemes in the area are each provided with piped and treated water supplies (Table 19 - 2). These are designed with capacities sufficient to meet the demands of the population anticipated by the year 1990. In the early years of the Jengka development an excess capacity of about 70,000 gallons per day should be available from each scheme; this could meet temporarily the water supply requirements of one small additional village adjacent to each existing supply.

Table 19 - 2
Existing FLDA Water Supplies in Jengka Triangle

Scheme	Design Supply in gallons/day	Estimated Cost (M$)
Sungei Tekam	140,000	462,000
Kampong Awah	198,000 [1]	460,000
Ulu Jempol	140,000	500,000

1) based on 16.5 hours pumping

Existing Urban Water Supplies Adjacent to the Triangle

Water supply schemes are operated by the Public Works Department for the towns of Temerloh, Mentakab, Maran and Jerantut, and at Mentakab military camp (Table 19-3). None of these supplies has excess capacity and all are so remote from Triangle development areas that connections to them would be impracticable. A new water source and pipeline is currently under construction to serve the Temerloh-Mentakab area, but this also will be too far from Triangle centres of water demand to permit economical connection.

Table 19-3
Existing Urban Water Supplies Adjacent to Jengka Triangle

Scheme	Capacity in gallons per day (pumping 16 hours per day)	Probable excess capacity in gallons per day (Basis: 1962 consumption)
Jerantut	25,000	nil
Temerloh	170,000	nil
Mentakab	240,000	28,000
Mentakab Camp	220,000	26,000
Maran	23,000	14,000

Water Supply Sources

Three practicable sources of water for Triangle development have been considered: streams, small local catchments, and groundwater (bores or wells).

Water supplies based on streams would depend solely on the streams' natural flows; minimum stream discharges are the critical factors in evaluating the adequacy of these sources. The Triangle's streams are generally capable of supplying all foreseeable water requirements; any one of the three major streams alone would have an adequate minimum discharge to meet the requirements of the entire development area. The minimum discharges of small streams having catchments of five square miles or more would also provide reliable village supplies.

Water supplies based on local catchments may prove economic in some areas where the development of stream or groundwater sources appear unduly expensive. Small dams and reservoirs could be sited near most villages and factories throughout the Triangle. Water from reservoirs would probably require less treatment than that derived from streams and rivers. To ascertain the feasibility of developing local catchments, 13 small catchments were investigated using the conditions of the FLDA Ulu Jempol scheme for which adequate topographic detail is available. Nine of these proved feasible for the economic development of small reservoirs which would be suitable as supply sources for adjacent villages. Their useful capacities ranged from 12 to 50 million gallons.

The development of groundwater sources involves the drilling of wells at selected sites and the installation of pumps, pipelines and other works. The opportunities for successful groundwater development have been discussed previously (Chapter 7).

RURAL WATER SUPPLIES

Comparison of Alternative Types

Preliminary estimates of construction costs were prepared for each of three types of water supply schemes considered, to assess the relative advantages of each. The actual site conditions of the FLDA Ulu Jempol scheme were used in a comparison of preliminary scheme layouts (Figure 19 - 1). Each scheme was considered to supply a village of approximately 115 settler families with an initial population of about 700 inhabitants. The 25-year design population was taken as 1.200 inhabitants; requiring a water supply of 72,000 gallons per day (Table 19 - 4).

Table 19 - 4
Capital Costs of Alternative Schemes

Number of Villages	25-year Design Population	Source of supply	Estimated Capital Cost (M$)	Capital Cost per Capita (M$)
1	1,200	Stream	140,000	117
1	1,200	Local catchment	156,000	130
1	1,200	Groundwater	125,000	105

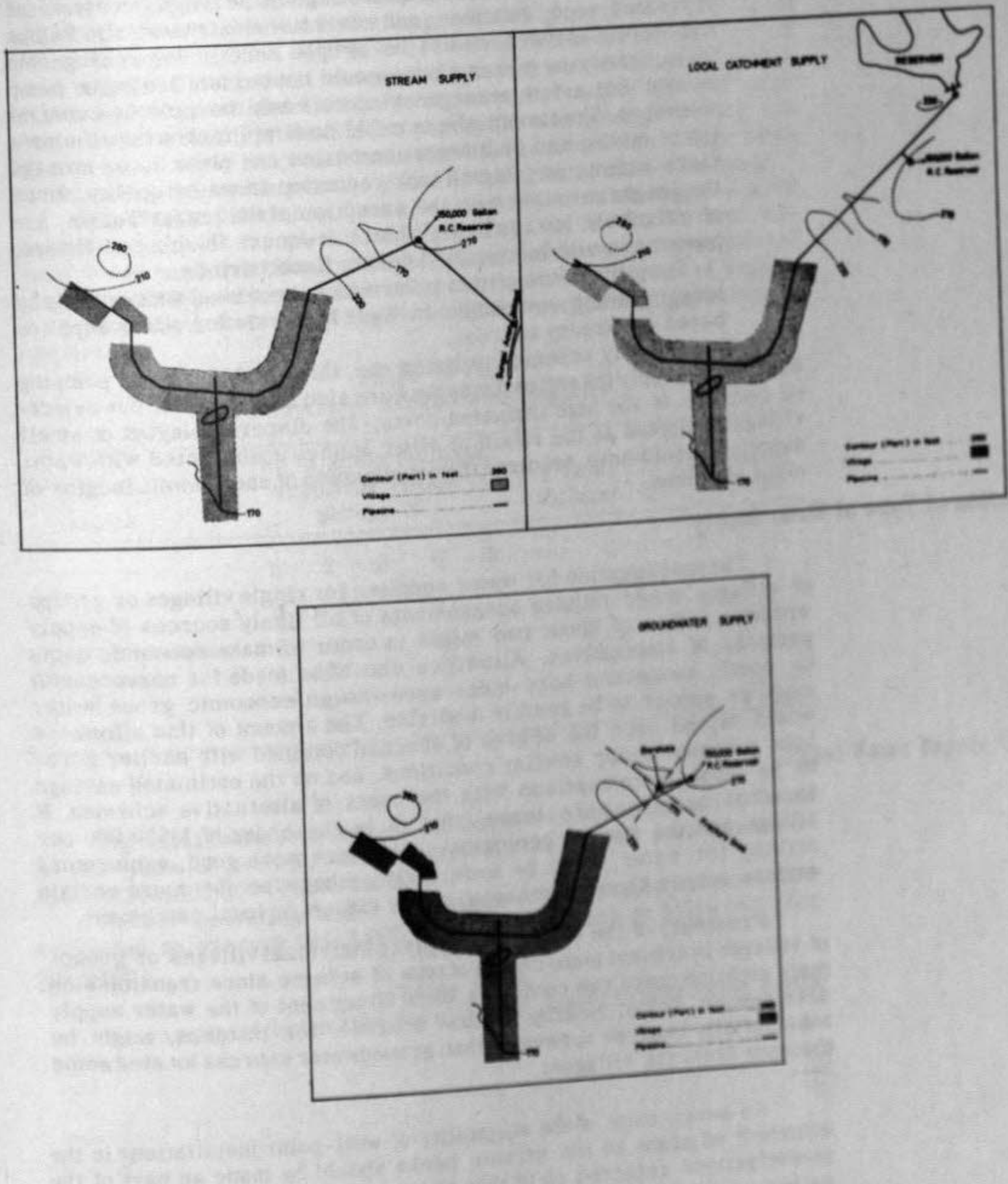
The general topography and other site conditions of Ulu Jempol are representative of site conditions throughout the Triangle and the costs developed for these conditions may be taken as workable average construction costs for estimating purposes on all settlement units planned for the Triangle. The estimated costs given in table 19 - 4 have been based on single village supplies except in the case of local catchment schemes, for which it was assumed that the reservoirs could each supply four villages. The cost of reservoir construction was proportioned accordingly. Details of the costs appear in Appendix 19 - 3.

The three types of water supplies compared in Table 19 - 4 are basically less elaborate than many of the schemes in present use on FLDA schemes and would therefore be less expensive to install. The design of these schemes should include the following features:

1) Standardization - Standardization in scheme design of structures and equipment is desirable because of the large area to be developed and the large number of individual water supplies required. Planning, design and construction work would be simplified and original designs, construction schedules and specifications would not be required for each scheme. In this way schemes could be installed quickly and with the minimum of excess capacity, thus freeing capital which would otherwise be idle. Stores and stand-by equipment would be reduced to a minimum and maintenance simplified.

Although savings can be made in equipment costs where groups of villages are supplied from a single source by installing larger capacity pumps and power plants in place of small multiple units, this practice is not recommended. There would be a

Figure 19 - 1
Alternative Village Water Supplies



loss of interchangeability and therefore more stand-by units would have to be carried. Design costs would also increase since the ancillary civil works would be different for each station.

2) Simplicity - Pump and filter houses should be simply constructed of treated wood, asbestos, and other low-cost materials. Pumps and prime-movers should be simple readily interchangeable units. Standy-by power plants would not be installed in the pump houses but a few emergency units could be held in a central workshop. Treatment plants could be simplified by the elimination of mixing and sedimentation basins and clear water storage tanks without any significant reduction in water quality, since the Jengka streams with the exception of the Sungai Tekam, are of relatively low turbidity. More frequent flushing of filters, however, would be required during flood periods.

Simplifications of this nature have been used successfully by larger mining companies in West Malaysia for water supplies based on stream sources.

Water supply schemes utilizing one, three and nine large pumping stations to supply the entire Triangle were also investigated, but rejected because of the high indicated costs. The dispersed layout of small villages, adopted as the result of other studies unconnected with water supplies, would have required the construction of uneconomic lengths of main pipelines.

Selection of Type of Water Supply

The investigation for water supplies for single villages or groups of villages would require assessments of all likely sources of supply within a radius of about two miles in order to make economic comparisons of alternatives. Allowance should be made for unsuccessful or partly successful bore-holes even though economic groundwater supplies appear to be readily available. The amount of this allowance would depend upon the degree of success obtained with earlier bore-hole schemes under similar conditions, and on the estimated savings to be made in comparison with the costs of alternative schemes. If expected savings were large, that is in the order of M$30,000 per village and the surface geological indications were good, exploratory drilling for water would be undertaken; otherwise the more certain surface source should be chosen, either stream or local catchment.

Proximity of the source of supply to individual villages or groups of villages is critical in the choice of type of scheme since transmission main pipeline costs can comprise about 30 per cent of the water supply development costs. Nearby stream sources, for instance, might be substantially cheaper to develop than groundwater sources located some distance from the villages.

An assessment of the suitability of well-point installations in the alluvium adjacent to the stream banks should be made as part of the investigations referred to in this section. Well-points and infiltration galleries are essentially shallow wells located in suitable sands, gravels or other porous deposits near the river banks. Their use can eliminate the costly filter equipment often needed for the treatment of water supplies derived from surface sources.

Village Water Supply Plan

An approximate layout of water supplies for settlement unit villages has been made, and the type of supplies at all sites estimated, based on existing topographic maps, aerial photographs, preliminary geological data, and limited site inspection (Figure 19 - 2). The layout cannot be considered a definitive recommendation for actual types of water supply development at specific sites. It was developed for cost estimating purposes and as a guide to possible feasible types of supplies. Until adequately detailed topographic and geological data are available and water sources, main pipeline locations and village sites can be inspected, more precies plans and estimates cannot be made.

On these preliminary bases, 47 individual water supplies were planned for the 97 recommended villages (Table 19 - 5). Thirteen villages would need individual schemes; the remainder could be connected in groups of two, three and four villages to common sources of supply. It is estimated that 40 villages could be served with groundwater supplies.

Table 19 - 5
Summary of Rural Water Supplies

Source	No. of pump stations supplying village groups of					Total Villages	Total pump stations
	1	2	3	4	5		
Streams	2	2	6	4	-	40	14
Local catchments	3	7	-	-	-	17	10
Groundwater	8	14	-	1	-	40	23
Total	13	23	6	5	-	97	47

Rural Water Supply Costs

The total estimated costs of village water supply systems, based on the types of systems and the typical plan of their arrangement is about M$13,300,000 (Table 19-6).

Annual operating costs for village water supply schemes are estimated to average M$12,000 per year for each or M$10 per year per capita.

Table 19 - 6
Summary of Estimated Rural Water Supply Construction Costs

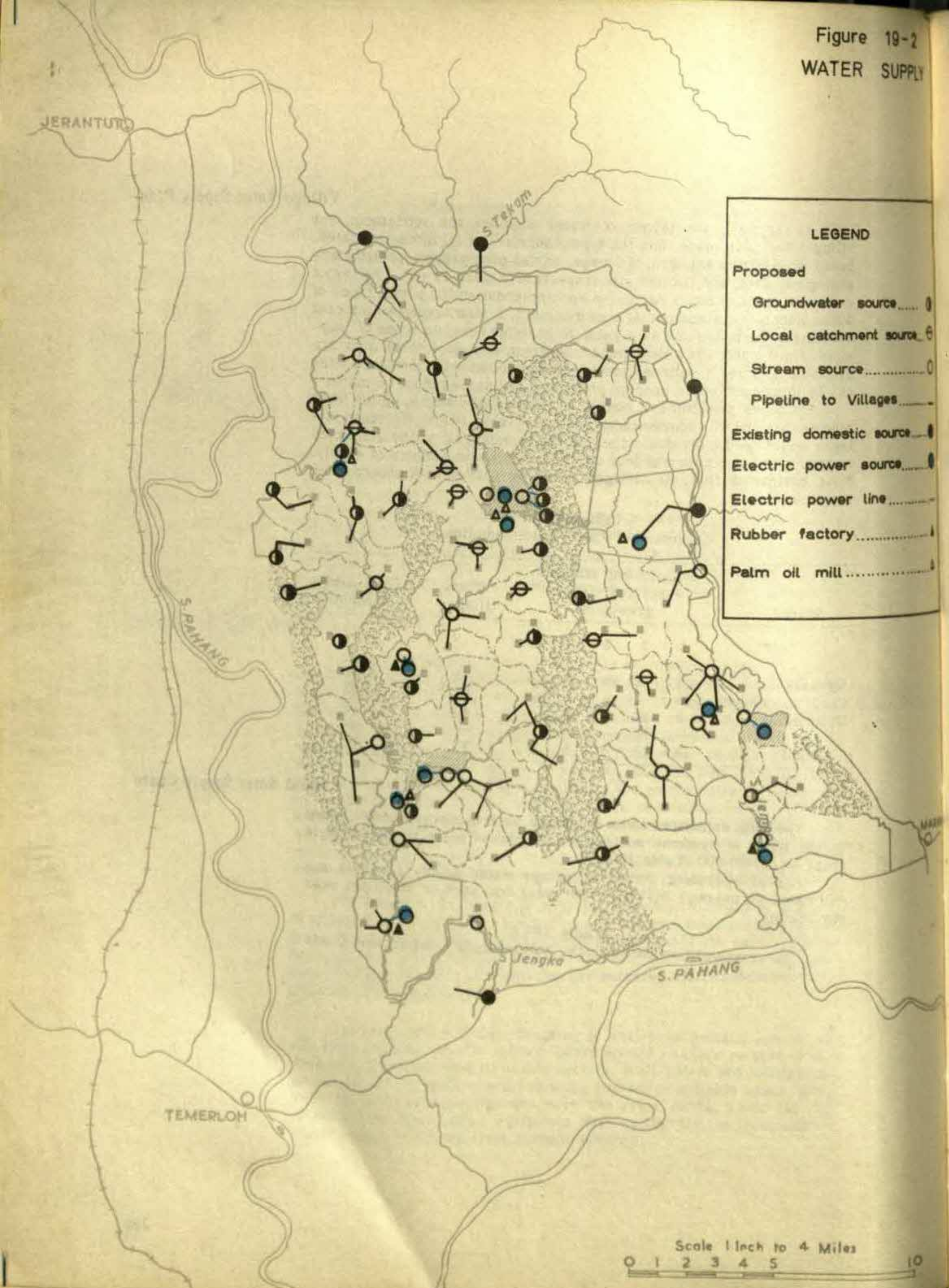


Figure 19-2
WATER SUPPLY
LEGEND
Proposed
Groundwater source
Local catchment source
Stream source
Pipeline to Villages
Existing domestic source
Electric power source
Electric power line
Rubber factory
Palm oil mill
JERANTUT
S. Tekam
S. PAHANG
S. Jengka
S. PAHANG
TEMERLOH
Scale 1 Inch to 4 Miles
0 1 2 3 4 5 10

Towns

The selection of the types of water supplies for the three proposed towns in the Jengka Triangle and their planning and design, should follow the procedures recommended for water supplies in the agricultural villages. The same three alternative sources of supply should be considered and the relative differences in cost between them determined. It is anticipated, based on studies of maps, aerial photographs and reconnaissance field inspections of each town site, that the regional centre can most economically be served by groundwater, and that the two smaller towns can best be served by stream or river supplies (Figure 19 - 2).

The regional centre is expected to have a 25 - year design population of 12,000 people and a consumption of 75 gallons per day per capita. The population would be large enough to justify the construction of a more expensive and sophisticated type of water supply scheme than is warranted for agricultural areas. It was not possible to make a close estimate of costs with the information currently available but it is expected that the final cost of the scheme would be about M$1,400,000 if groundwater supplies can be utilized (Table 19 - 7). Adequate stream supplies are unlikely to be available close to the town, although they would be available from the Sungai Tekam eight miles to the north. Main pipe lines to bring Sungai Tekam water to the regional centre would probably add M$400,000 to the estimated cost of the scheme. In addition, there would have to be added M$150,000 to cover the costs of prime-movers, more elaborate treatment plant, and additional civil works. For these reasons it is recommended that the investigation of groundwater supplies for the regional centre be accorded a high priority.

Table 19 - 7
Town Water Supplies

Town	Design Population	Assumed Source of Supply	Demand (gallons per day)	Estimated Construction Cost (M$)
Regional Centre	12,000	Groundwater	900,000	1,400,000
Southwest Town	4,000	Sg. Jengka	300,000	460,000
Southeast Town	4,000	Sg. Jempol	300,000	460,000

The two smaller towns are each expected to have a 25-year design population of 4,000 people and a consumption of 75 gallons per day per capita. This is equivalent to the combined demand of four villages. The same basic type of supply should be provided in these towns as in villages, but more elaborate treatment may be needed than would be given to an equivalent village population. The southeast town is expected to derive its water from the Sungai Jempol; the southwest town from the Sungai Jengka (Figure 19 - 2). The installation of pumps and treatment plants should be phased to suit the growth of the towns. Phasing may also be possible with the town distribution systems but the transmission mains and storage reservoirs should be built to meet the design demand. Costs are expected to be about M$460,000 for each town (Table

19 - 7). Cost back-up and summaries of the components of each supply are given in Appendix 19 - 4.

Annual operating costs are estimated to be about M$80,000 for the regional centre and about M$34,000 for each of the two smaller towns.

Palm Oil Mills

Five palm oil mills are planned within the Jengka Triangle (Figure 19 - 2). The estimated costs for providing each with a water supply ranges from M$76,000 to M$85,000 (Table 19 - 8).

Costs are based on a peak demand of 4,500 gallons per hour for each mill and depend upon the amount of treatment required and the distance of the mill from the source of water supply. Electric power is assumed to be available at the mills. The estimated costs are detailed in Appendix 19 - 5.

Table 19 - 8
Water Supplies for Palm Oil Mills

Mill [1] Site	Project	Mill Capacity in tons fresh fruit bunches per hour	Water requirements in gallons per hour peak demand	Probable source of supply	Estimated cost (M$
A	I	40	4,000	stream	85,000
B	II	30	3,000	stream	85,000
C	III	40	4,000	stream	85,000
D	IV	30	3,000	groundwater	96,000
E	V and VI	30	3,000	groundwater	96,000

1) See Figure 19 - 2 for mill location

Rubber Factories

The rubber producing areas of the Jengka Triangle would be served by four rubber factories (Figure 19 - 2). The estimated costs of providing each factory with a water supply ranges from M$62,000 to M$70,000 (Table 19 - 9).

Table 19 - 9
Water Supplies for Rubber Factories

Factory [1]	Project	Factory Peak capacity in tons dry rubber per day	Acreage served	Water requirements in gallons per hour peak demand	Source of supply	Capital Costs M$
G	I and II	30	9,200	5,500	stream	76,000
H	III	36	11,300	6,500	stream	76,000
J	IV and V	30	10,300	6,000	groundwater	62,000
K	VI	30	9,400	5,500	stream	76,000

1) See Figure 19 - 2 for factory location

The costs estimated are based on a peak demand of 6,500 gallons per hour for each factory and depend upon the amount of treatment required and the distance of the factory from the source of water supply. Electric power is assumed to be available at the factory. The estimated costs are detailed in Appendix 19 - 5.

Forest Industry

Only 10,000 gallons of water are required daily for steam raising purposes in the proposed forest industry. This small amount is best obtained from the nearest adjacent local water supply. The cost therefore would be that of a pipeline only and has been estimated at M$1,500.

LAND DRAINAGE

The Triangle as a whole is well drained; the drainage density exceeds 40,000 linear feet of drainage channel per 1,000 acres, the land is undulating, and the soils generally are highly permeable. Exceptions are likely to be the swamps and payas in the valley bottoms, many of which would drain naturally when the stream channels have been improved; artificial drainage could be required for the remainder.

The correct depth and the spacing of drains (ditches) is largely a matter of experience and experiment with the particular area, crop and soil. For the narrower payas in Jengka, single drains running down the valley centres and connecting to the nearest streams should provide satisfactory drainage. For payas greater than about 10 chains in width it may be necessary additionally to construct secondary drains following the fall of the land. Drainage costs for such simple schemes should be between M$30 and M$60 per acre.

Wide and extensive swamps would require more elaborate drainage involving systems of main drains, sub-drains and field drains. The capital costs for drainage works for these areas are estimated to range from M$80 to M$120 per acre depending on drain spacing and dimensions, and based on a contract price for earthworks of M cents 60 per cubic yard. Maintenance would consist of control of vegetation growing in the drains, repairs to banks and periodic desilting and should cost from M$6 to M$9 per acre per annum.

CATCHMENT AND STREAM PROTECTION

Catchment Reserves

About 41,000 acres of forested land, consisting of the upper catchments of the Sungai Jengka and Kundang and of their major tributaries are expected to remain under forest at the conclusion of the development programme. These areas should be gazetted Catchment Reserve so that legal control 1) can be exercised over logging and agricultural activities within the gazetted area (Figure 17 - 3); otherwise deterioration of the stream channels and increased flooding and water logging may occur in the valley bottoms and flatter land of the lower reaches of the streams.

The main catchments of the Sungai Jempol and Tekam should also be gazetted as Catchment Reserves. These lie outside the Jengka Triangle and consist of part of the Berkelah and Tekam Forest Reserves (Figure 19 - 3).

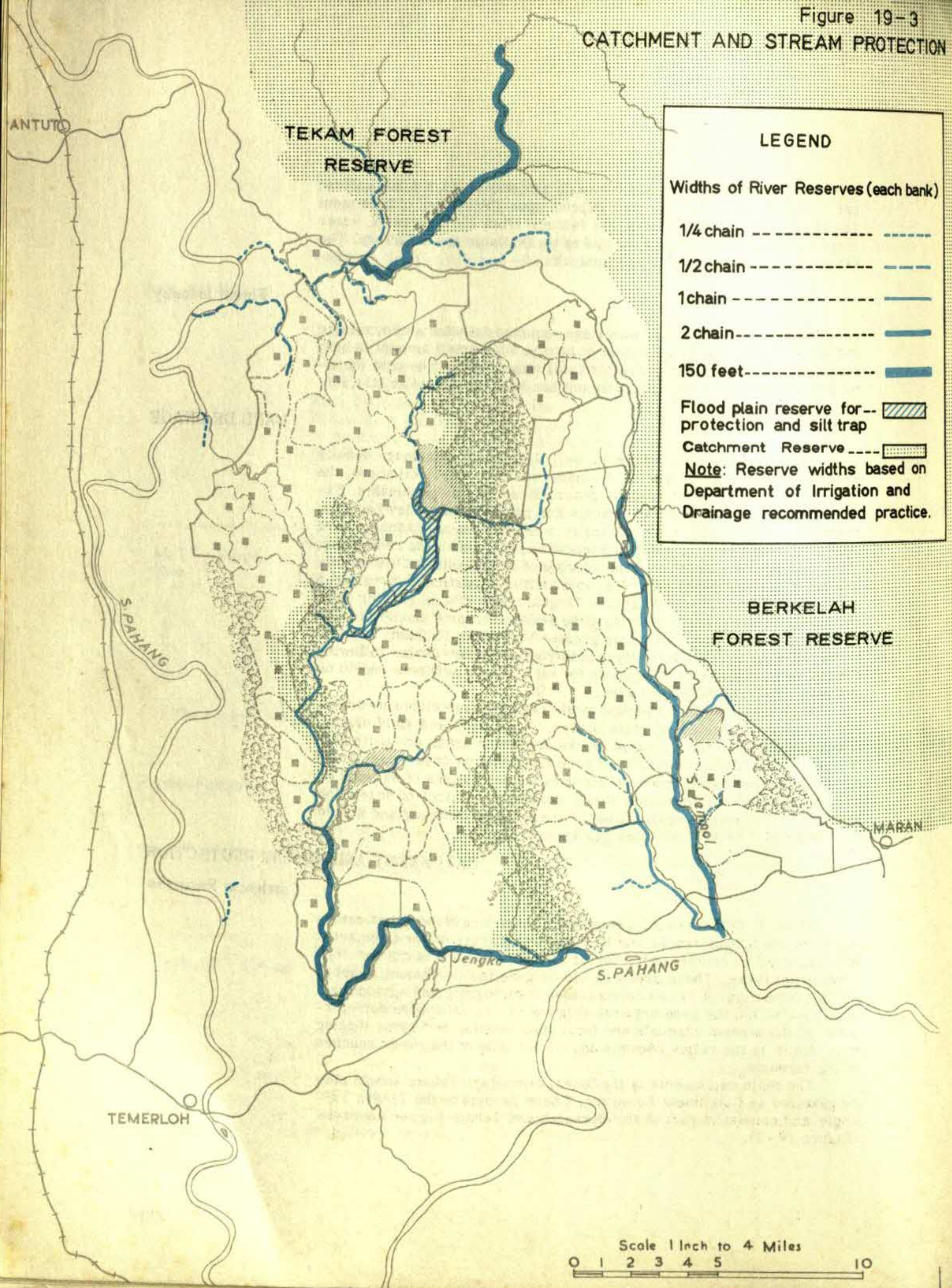


Figure 19-3
CATCHMENT AND STREAM PROTECTION

River Bank Reserves

Protection additional to that proposed should be given to the lower reaches of the major streams and tributaries within the Triangle (Figure 19 - 3) and in these cases, the normal Drainage and Irrigation Department practice of gazetting river bank reserves should be followed. The felling of timber and agricultural activities within the reserves and interference with stream banks and beds may then be controlled under the provisions of the National Land Code. About 4,000 acres of reserve have been excised from the agricultural lands for this purpose. It includes a flood plan of the Jengka river which performs a useful function as a silt trap during periods of high flood (Figure 19 - 3).

The settlement unit managers should be aware of the provisions of the various enactments so that they can exercise control over the catchment and river bank reserves within the Triangle. The assistance of the Forest Department should be obtained for the supervision of the remaining areas. This control is a necessary adjunct to the river channel improvement programme outlined in the following section.

River Channel Improvement

The channels of all the streams of the Jengka Triangle are littered with fallen timber which impedes the flow of water and sediment and renders them less effective as land drainage channels. It was estimated from a study of aerial photographs, from aerial inspection of main streams, and from selected field reconnaissance, that the larger river channels contain 200 - 300 tons of timber per mile of channel, with probably a similar tonnage buried beneath the silt forming the stream beds. A total of about 80 miles of the channels of the Sungai Jengka, Jempol and Tekam and about 70 miles of their tributaries would require cleaning. Three to four years of work would be needed for the removal of visible timber using four de-snagging crews; this should result in general lowering of the stream beds by about two feet. Thereafter the crews would be needed permanently for regular cleaning in order to maintain satisfactory flow conditions. The composition of the crews, their equipment and working techniques should follow normal Drainage and Irrigation Department practice and the assistance of the Department should be sought in the execution of the stream maintenance programme. The work would cost about M$6,000 per month including transport and overhead charges.

IRRIGATION

The technical feasibility of irrigated rice cultivation and the costs of spray irrigation of oil palm seedling nurseries have been considered.

Irrigation for Rice

Twenty one swamps and other low lying areas totalling 7,700 acres have been investigated, but of these only six areas totalling 2,000 acres proved to be capable of development into technically feasible irrigated rice schemes. These areas would be capable of providing the rice requirements of 4,000 families of the Jengka Triangle.

Economic investigations, however, indicate that oil palms and not rice should be cultivated if the best use is to be made of land, capital and labour (chapter 11). Accordingly it was concluded that the potentially irrigable rice areas would be drained and planted with oil palms.

Oil Palm Nursery Irrigation

Overhead sprays have been found to be the only practicable system of irrigation for nurseries of the types envisaged for the Jengka Triangle (large polythene bags). The estimated capital costs for a spray irrigation system for a 150-acre nursery are M$1,600 per acre, and the estimated annual operating costs are M$400 per acre (Appendix 19-6). These estimates are based on an application rate of 0.4 inches per day of twelve working hours. Nurseries should be located near reliable sources of water supply yielding not less than 0.04 cubic feet of water per second per irrigated acre.

CHAPTER 20
SANITATION AND HEALTH

Recommendations are made here for the provision of Health Services and the establishment of acceptable systems of sanitation in the Jengka Triangle.

HEALTH SERVICES

Existing Health Services

The population surrounding the Jengka Triangle is served by facilities which meet approximately the requirements of the Ministry of Health: they include a hospital at Mentakab, main health centres at Temerloh and Jerantut, five sub-centres on the periphery of the area, and nine midwife clinics, four of which are located within the Triangle on existing FLDA schemes (Figure 20-1).

Proposed Health Services

The anticipated population of the Jengka Triangle is expected to number about 105,000 people on completion of development. This includes an estimated rural population of 85,000 (Chapter 14) and an estimated urban population of 20,000 (Chapter 16).

Criteria used for planning health facilities in the Triangle were based on Ministry of Health practice 1). These provide for a Rural Health Unit for 50,000 people which includes a main health centre, four sub-centres and 20 midwife clinics.

To meet the population's health requirements, therefore, two Rural Health Units would be established in the Triangle; each covering the whole range of medical work, including midwifery and preventative and curative medicine. Each unit would ultimately comprise a Medical and Health Officer, a Dental Officer, a Health Sister, a Public Health Inspector, a Hospital Assistant, ten assistant nurses, five Public Health overseers and twenty five midwives together with supporting staff.

In rural areas the Health Officer would be responsible for preventative public health measures and would employ his own subordinate staff, paid from federal funds, who would perform organisational and supervisory functions connected with sanitation, housing, cleanliness of shops, restaurants, slaughter houses, and markets, water supply, sewage and refuse disposal, vector control, food hygiene and health education. In town areas the subordinate staff would be employed by the municipal authorities but would be directed in their activities by the Health Officer.

Facilities and Costs

The two proposed Rural Health Units would together include two main health centres, one of which would be combined with a 50-bed rural hospital located in the Regional Centre, eight health sub-centres

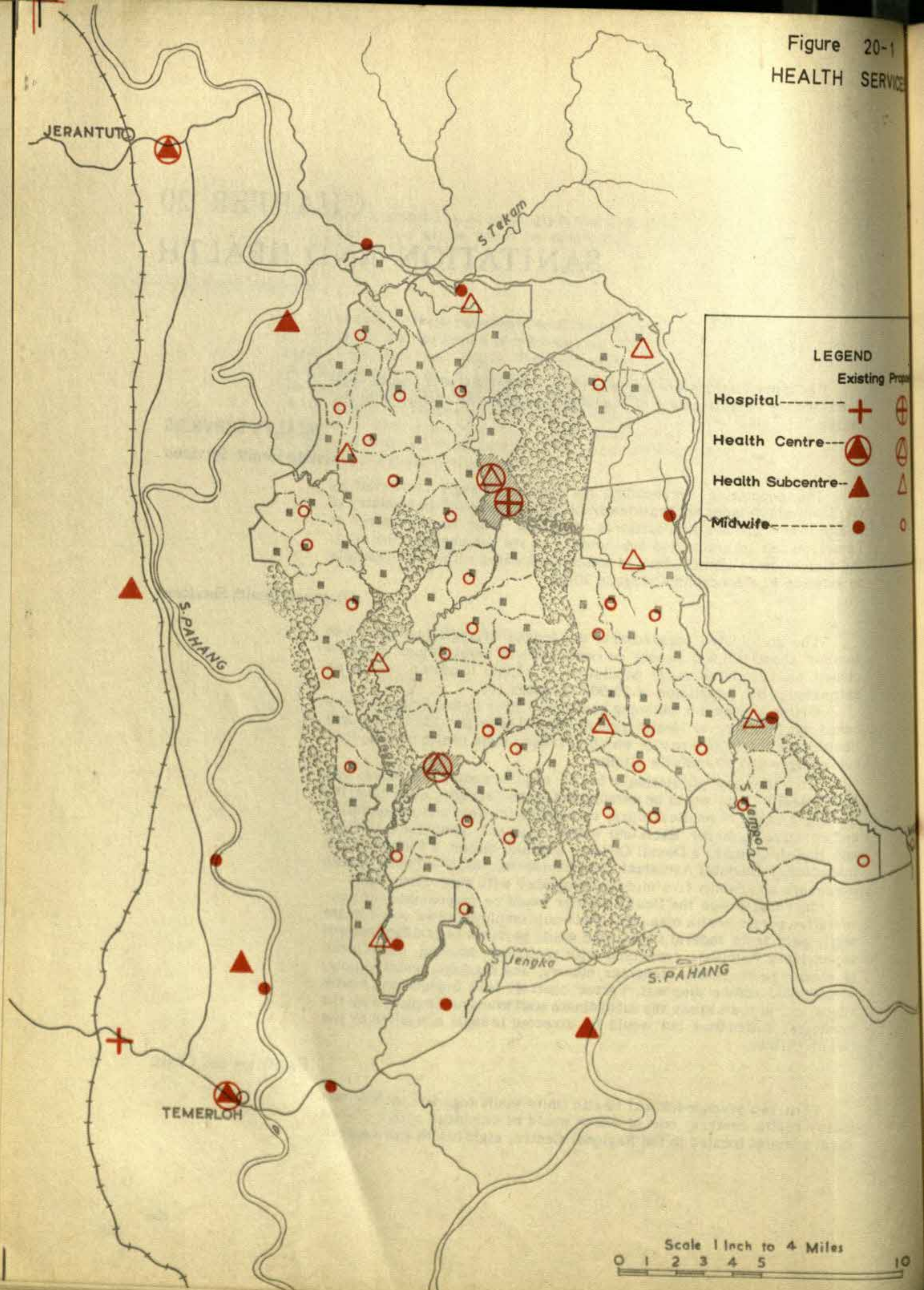


Figure 20-1
HEALTH SERVIC
LEGEND
Existing
Hospital
Health Centre
Health Subcentre
Midwife
JERANTUT
S. Tekam
S. PAHANG
S. Jengka
S. PAHANG
S. Tembeling
TEMERLOH
Scale 1 Inch to 4 Miles
0 1 2 3 4 5
10

and thirty three midwife clinics (in addition to the Triangle's four existing clinics). Three midwives would be stationed at the hospital, one at each main health centre, one at each health sub-centre, and one at each midwife clinic (Fig. 20 - 1).

The main health centres would consist of an administrative block, clinic building, garages, store and staff quarters; the health sub-centres each a clinic building, garage, store and staff quarters; and the midwife clinics of a clinic and quarters.

The total capital cost of establishing two Rural Health Units (less the cost of existing midwife clinics) is estimated to be M$4,433,000 (Table 20 - 1).

Table 20 - 1
Estimated Cost of Health Services

Description	Unit Cost M$	Capital Cost M$
2 Rural Health Units	1,216,500	2,433,000
1 Fifty-bed Rural Hospital	2,000,000	2,000,000
		4,433,000

The combined annual operating costs are estimated at M$1,670,000. Details of capital and operating costs are given in Appendix 20 - 1.

Phasing

Construction of the facilities would follow project development with priority given to the midwife clinics followed by the health sub-centres. The construction of the main health centres and the hospital would be phased with the southwest town and Regional centre development.

SANITATION

Facilities for sewage disposal should meet World Health Organization standards 1) for the avoidance of pollution of foodstuffs and domestic water supplies by direct or insect-borne contact with sewage, and for the suppression of unpleasant odours and other nuisances. At the time of clearing of each area, Health Department assistance should be obtained to determine safe and acceptable locations of latrines and seepage pits.

Agricultural Areas

The standard pit latrine is recommended for settler family use. The estimated construction cost is M$75 per unit based on the use of contract labour, central pre-casting of concrete slaps and foot pads, and prefabricated wooded superstructures. Comparative studies of pit latrines and bore hole latrines indicated that the slightly higher initial cost of pit latrines is off-set by their longer life, lower replacement costs and ease with which they are kept clean and free from flies.

Indoor water closets and cesspools are recommended for those houses which would have piped water main connections. The estimated cost per installation is M$612, which is 25 per cent less than that of an alternative septic tank system which it functionally resembles; the two metnods are equally efficient in the small sizes needed for individual families.

Indoor water closets and septic tanks are recommended for schools. Water closets should be provided at the rate of one per 20 students and staff. Sosts are estimated at M$22.60 per student, which is 10 per cent more than for cesspool installations; this is off-set by cleaner, more hygienic operation under school conditions.

The cost of rural sanitation facilities are estimated to be M$ 1,931,000 (Table 20 - 2).

Table 20 - 2
Summary of Costs of Sanitary
Disposal Facilities in Agricultural Areas

Classification	No. of facilities served	Unit Cost M$	Total Cost M$
Settler and Staff housing in Settlement Units	9514	75	714,000
Government Staff Housing	1033	612	632,000
Schools	48	varies	555,000
Allowance for mosque and Balai Rayat	-	LS	30,000
			1,931,000

Town Areas

Efficient sewage disposal is much more important in towns than in agricultural areas, due to the higher population densities. Indoor water closets are recommended where houses are provided with running water; the types of disposal and treatment facilities would depend on the house location.

Ultimately off-site sewage disposal systems are recommended for construction in the towns because the anticipated average population densities of the commercial districts and of parts of the residential districts is expected to be about 20 families per acre. Estimated capital costs of three systems have been compared (Table 20 - 3).

The estimated capital costs of the three alternative systems given in Table 20 - 3 are very approximate and are given to indicate a range of investment which would ultimately be required. When town plans are sufficiently detailed and topographic data are available, the types of system can be more accurately investigated. It would not be necessary however, to install modern sewage disposal systems until the towns have grown sufficiently to warrant them. Initially individual house and office block septic tanks will be adequate, but town planning must include provision for eventual installation.

Table 20-3
Alternative Sewage Disposal Systems
(M$)

Systems	Town of 4,000 population	Town of 12,000 population
1) Sewers and sewage treatment plant serving the entire town	770,000	2,740,000
2) Sewers and sewage treatment plant serving the areas of dense population and intermediate areas. Individual disposal facilities for less populated areas.	616,000	2,200,000
3) Sewers and sewage treatment facilities for each area of dense population. Individual disposal facilities for less populated areas.	675,000	2,250,000

Public Health Regulations

Federal and State regulations for the control of sewage disposal in rural and urban areas do not exist. Regulation is normally accomplished in municipalities by means of bye-laws such as those of the Klang Municipality 1). Some control is also possible under the provisions of the Water Supply Enactment, section 32 2). It would be necessary however for FLDA to establish its own bye-laws for rural areas. These would have to be drawn for the towns as well, until their own municipal organizations were established.

Industrial Waste

The liquid industrial wastes (effluent) of palm oil mills and rubber factories may be discharged into the nearest streams providing care is taken not to render unpalatable domestic water supplies derived from downstream intakes. Effluent discharge from palm oil mills will be negligible but that from the rubber factories may amount to 6,000 gallons per hour.

To avoid contamination of water supplies during periods of low stream discharge, rubber factory effluent discharge points should be at least one mile above water supply intake points and the catchment areas of the streams above the intake should not be less than 15 square miles. Alternatively, ponding of effluents could be resorted to if complaints of unpalatable water are received from downstream domestic water users; about 100,000 gallons of storage would be required for each factory if effluent is not to be passed directly into the streams during water supply pumping hours. The earthworks and appurtenant structures for each storage reservoir would cost about M$10,000 providing suitable dam sites are available near the factories.

CHAPTER 21
EDUCATION

Education is a key objective of the First Malaysia Plan; within the Jengka Triangle educational facilities are to be provided at all stages from primary level to teacher training.

Planning Criteria

Basic criteria for educational planning have been provided by the office of the Chief Educational Officer of the State of Pahang (Table 21 - 1).

Table 21 - 1
Criteria for Schools

Description	Primary School		Secondary School		Upper Secondary School	
	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
Area Required (acres)	-	10	-	10	30	45
Number of children in the school	300	1,000	480	960	480	960
Number of children in one classroom	20	40-50[1]	30	40	30	40
Number of classrooms	7	15	12	24	12	24

1) 40 pupils in standard IV - VI, 50 in standard I - III.

The following working information was also provided:

Primary Schools - should be within the size range given in Table 21 - 1, but with a preference for 400 children (co-educational). Primary and secondary school size would be based on 40 children per classroom.

Secondary Schools - An input of 70 per cent of primary school children should be used to estimate the number of classrooms required. Secondary schools should be of four types; academic, technical, agriculture and trade, and should be co-educational.

Upper Secondary School - An input of 5 - 10 per cent of the primary school children should be used to estimate the number of classrooms required. Upper secondary schools should be attached to acasemic schools and some should include agricultural training.

Teacher Training School - One teacher training school (National type) should be provided for the Jengka Triangle.

Other Schools - None required.

Teaching and Staff - Teaching should be based on one session per day. Teacher accommodation should provide for 1:2 teachers per classroom plus headmaster for primary schools, and 1.43 plus headmaster for secondary schools.

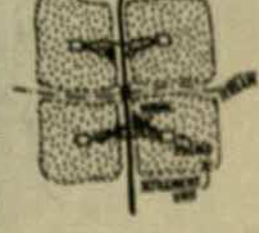
Primary Schools

Primary school classroom space has been planned to provide a place in school for all children of primary school age, estimated to be approximately 26 per cent of the rural population. Additional classroom capacity (10 per cent) was added for the children of FLDA staff, teachers, shopkeepers, and others living in the villages. It was assumed that 25 per cent of the total town population would attend primary schools.

The size of the primary school population is affected by the areas and by the sizes of individual small holdings. If these factors change, then the school population would be affected correspondingly. For the settlement unit and small holding size recommended, two settlement units would normally share one 400 - student primary school but final sitting of settlement unit primary schools would depend on the numbers of villages served by each school, on topography and on other factors. Several methods of siting primary schools were considered; the most suitable school sites would be apart from the villages but with good access to them and to the main roads; they would be set in quiet rural surroundings (Figure 21 - 1).

Figure 21-1

PRIMARY SCHOOL LOCATION RELATED TO VILLAGES



Primary schools need not be electrified but they should have water service.

For the Jengka Triangle as a whole 56 new primary schools are planned as well as additions to three existing schools within FLDA schemes and construction of two additional schools on those schemes (Figure 21-2). They would accomodate over 25,000 children. In total, 617 new primary school classrooms would be required, in addition to the 22 existing classrooms in FLDA schemes.

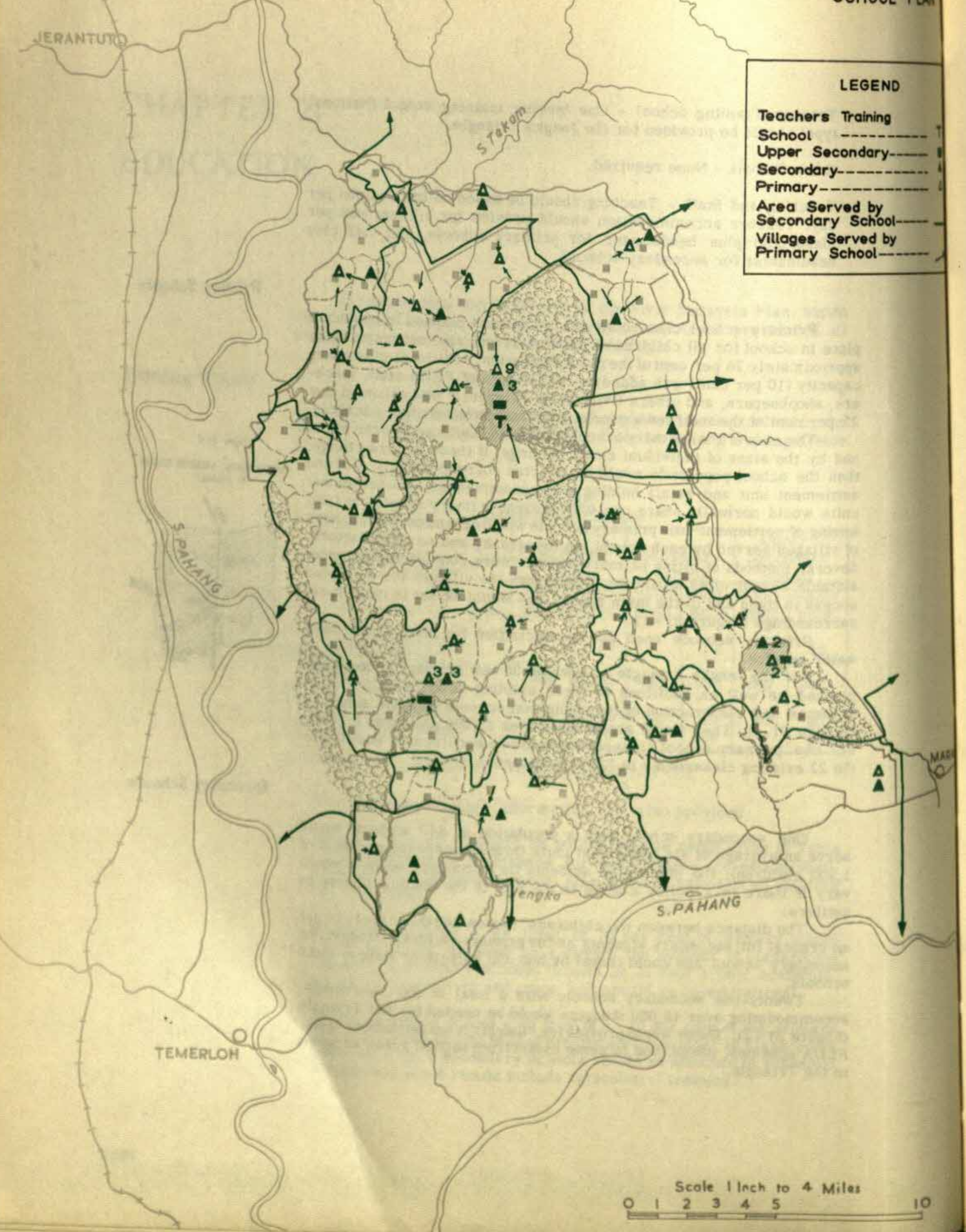
Secondary Schools

One secondary school with a population of 840 students would serve an average of six settlement units (primary school population of 1,200 children); the number of students for secondary schools would vary if there is a policy change in the size of the holding allotted to settlers.

The distance between the childrens' homes and the schools is not so critical for secondary students as for primary children; students of secondary school age could travel by bus and bicycle or walk to their schools.

Twenty-one secondary schools with a total of 460 classrooms, accommodating over 18,000 students would be needed for the Triangle (Figure 21 - 2). These would provide for students from settlement units, FLDA schemes, towns, and to some extent from settled areas adjacent to the Triangle.

Figure 21-2
SCHOOL PLAN



Upper Secondary Schools

Three upper secondary schools with 60 classrooms accommodating an estimated 2,400 students would be located within the Jengka Triangle; one in each of the proposed new towns (Figure 21 - 2). These schools would require boarding facilities for students whose homes are located beyond reasonable commuting distance. They would be available to students from both rural and town areas, including settled areas on the Triangle's fringe.

Upper secondary schools would be electrified and would require water service. The upper secondary school sites would be between 30 and 45 acres in size; large enough to accommodate agricultural training activities.

Teacher Training School

Educational authorities have indicated a need for a National-type teacher training school within the Triangle; this facility would accommodate 600 students and would be placed in the regional centre.

Existing FLDA Schemes

The recommendations for primary and secondary schools given in this chapter include schools for the children of the five FLDA schemes currently under development. There are 22 classrooms available in three schools located on the schemes at present. Based on the planning criteria used in this report, 70 additional primary school classrooms would be required in these schemes; there would also be needed 86 secondary school classrooms.

Costs

The estimated initial capital costs for the Jengka Triangle educational facilities, including both schools and teachers' housing, are M$25,570,000, and the estimated annual operating costs are M$37,850,000, (Appendix 21-1). These estimates are based on unit costs obtained from the Ministry of Education and the Public Works Department.

Phasing

The establishment of rural primary and secondary schools would follow project development and would be built at the same time as their associated villages. The upper secondary schools and the urban primary and secondary schools would be built as soon as urban services such as roads, electricity and water become available, and consistent with population growth in the towns. The teacher training school would be built at a time to be selected by the Ministry of Education; it is assumed for construction during the Triangle's development period.

CHAPTER 22

TELECOMMUNICATIONS AND ELECTRIC POWER

TELECOMMUNICATIONS

Modern telecommunications services are vital to the orderly implementation of the Jengka Triangle and to its efficient management and operation. Services are required between main centres of activity within the Triangle and between Triangle centres and external points at an early stage for effective control of the complex development and construction effort.

Criteria for planning communications services in the Jengka Triangle, and recommendations on sizes and types of installations needed, were provided by the Telecommunications Department of the Ministry of Works, Posts and Communications.

Existing Facilities

Existing telephone facilities on the periphery of the Jengka Triangle are as follows:

20 lines - Temerloh exchange to Kampong Awah
6 lines - Maran exchange to Chenor Estate and Ulu Jempol
2 lines - Jerantut exchange to Sungai Tekam

All of these are overhead pole lines and in some areas are subject to frequent interuptions of service due to external damage; they are of insufficient capacity to serve even the initial stages of development.

Proposed Telephone Service

In accordance with FLDA policy a public telephone call box for settler's use and separate telephone lines to FLDA offices, would be provided in all settlement unit villages.

In towns provision would be made for telephone service to FLDA and other government agencies, industries, and commercial and residential subscribers.

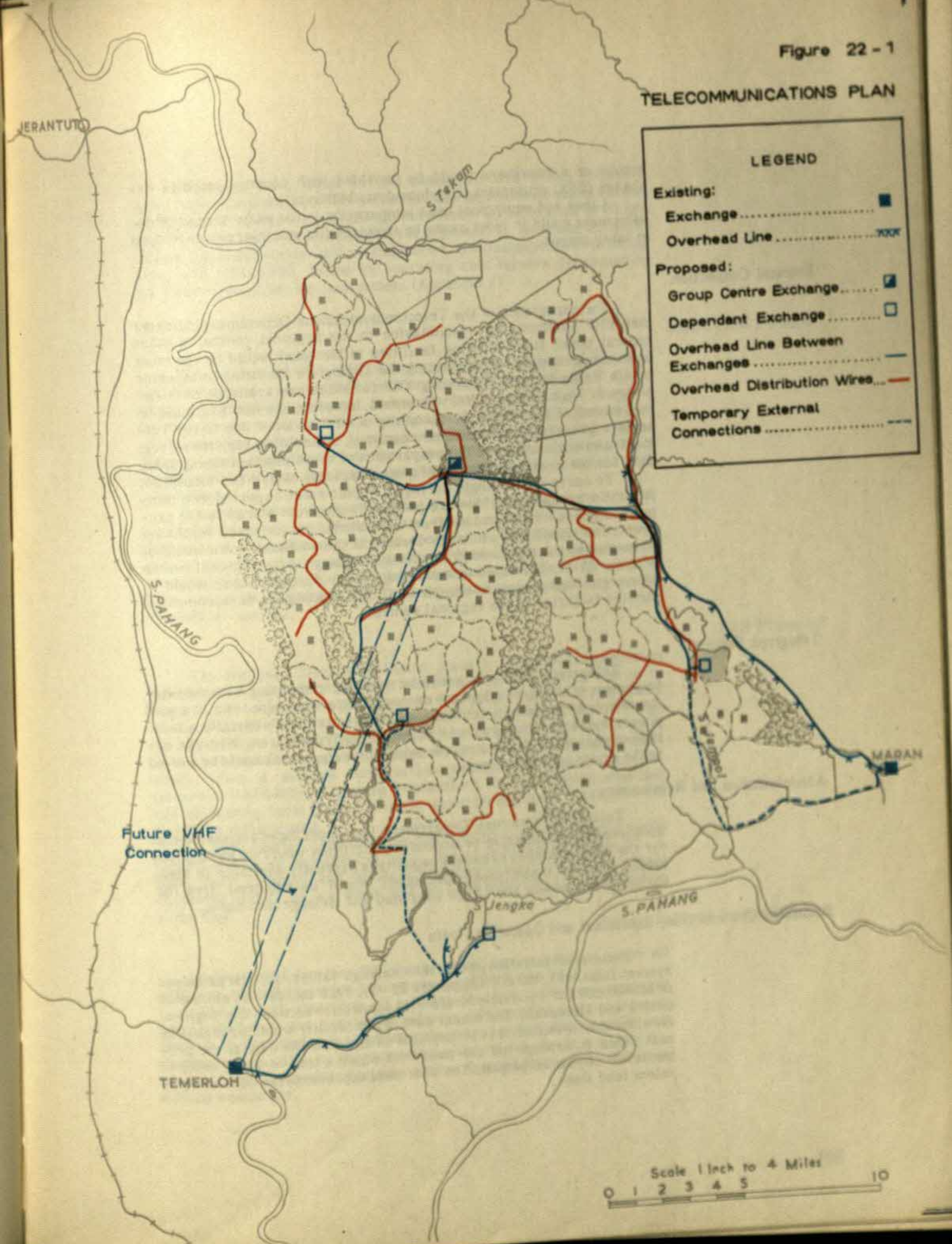
The basic service network would provide nearly 250 telephones in agricultural areas and over 350 telephones in the towns and at industrial points (Figure 22-1). Provision would be made for future expansion of service in all areas.

A group centre exchange containing automatic dialing equipment would be established in the regional centre; it would support dependent exchanges located in the proposed southeast and southwest towns and at a rural site in the northwest portion of the Triangle.

Connections between the group centre exchange and the dependent exchanges would be by overhead land lines. Calls between dependent exchanges would be routed through the group centre. Distribution lines to individual subscribers would be by underground cable in the towns and by overhead land lines in the agricultural areas. In addition, isolated

Figure 22 - 1

TELECOMMUNICATIONS PLAN



groups of subscribers would be provided with country-satellite exchange (CSX) equipment to reduce distribution costs.

Lines and equipment used temporarily in the early stages of development could in most cases be salvaged for use in areas developed at later stages.

External Connection

The experience of the Telecommunications Department indicates that VHF (microwave) transmission to the regional centre, of other central point, from existing facilities in Mentekab would be the most economical method of connecting the Triangle's facilities to exterior points From Mentekab, existing VHF facilities are available to other points in West Malaysia. Very little data, however, are now available on the technical feasibility of installing a VHF system due to the Triangle's present jungle covered condition. Final planning, therefore, must await clearing and the preparation of more detailed topographic data for the area between the proposed regional centre and Mentekab.

To serve the Triangle during its implementation period, two temporary overhead land lines are proposed; one from Maran to the proposed southeast town, and one from Temerloh to the proposed southwest town. The dependent exchange located in the southeast town would be connected to the proposed group centre exchange at the regional centre (Figure 22-1). The dependent exchange in the southeast town would be fitted with temporary telegraph facilities pending the development of similar facilities in the regional centre.

Telegraph Service

Teleprinter services would be needed commencing with the establishment of the first telephone exchange in the southeast town. As with the telephone system, it would be necessary to establish initially a temporary system utilising a land line connection from Maran. With the establishment of VHF circuits, the teleprinter equipment would be moved to the group centre exchange.

Administration and Maintenance

Telecommunications Department personnel have estimated that additional administrative or accounting facilities would not be required for the new exchanges as excess capacity is currently available in Mentekab. Twenty maintenance personnel would be required, five for exchange equipment and 15 for overhead and underground lines.

Estimated Construction, Equipment and Operating Costs

Estimated installed costs, less salvage values, for the proposed system total M$2,900,000 (Appendix 22 - 1). This includes an allowance of M$600,000 for a possible future VHF connection between the regional centre and Mentekab. The actual cost of this facility would probably be considerably less, but it is impossible to estimate the cost at the present since it depends on the ease with which a line-of-sight route to Mentekab can be developed. The cost used represents the cost of equivalent land lines.

Estimates were based on unit costs provided by the Telecommunications Department. The estimates are approximate and have been developed for budget and planning purposes. An allowance of 25 per cent has been added to all estimates for engineering, contract administration and supervision, and contingencies. Estimated annual operating costs are M$123,000, based on operating cost factors developed by the Telecommunications Department (Appendix 22 - 1).

ELECTRIC POWER

The equipment and methods of power generation, transmission and distribution recommended are in accordance with National Electricty Board (NEB) practice. Proposals for supplying the Triangle's electric power requirements are based on the use of local diesel electric generating plants. The development of local hydro-electric power sources was considered but was rejected because of the relatively small estimated future power demands of the Triangle and their wide separation.

Existing electric power facilities in the Triangle are very limited. Small diesel-electric generators are in use at the FLDA Ulu Jempol Scheme and at an adjacent oil palm estate and sawmill. However none of these facilities has excess capacity. A diesel electric power supply is available at Temerloh, west of the Sungai Pahang, but it is too remote from the main centres of future Triangle power demand to provide economical service.

NEB Planning

The National Electricity Board plans a 132-KVA transmission line from its proposed Bentong hydro-electric generating station to Kuantan and other East Coast centres. The project is tentatively listed for construction between 1970 and 1975. The line would pass through the southern part of the Triangle; there may be opportunities to connect to it the proposed southeast and southwest towns and adjacent industries. When a definite construction schedule is established, the economic feasibility of making connections to the transmission line and relocating local diesel electric generating plants already built, should be investigated.

A preliminary alignment for the transmission line, which would minimize loss of agricultural land, has been shown in Figure 22 - 2. When land clearing and development operations take place, a final alignment should be surveyed and the land reserved for construction of the line.

Primary Industry Power Supplies

Power requirements for the proposed forest industry, palm oil mills and rubber factories are summarised in Table 22-1.

The capital costs for all primary industry power supplies have been included in the respective industry construction cost estimates, since it is expected that all these industries would generate their own electric power. This is necessary in the case of the forest industry because of the extremely variable power demand from saws and other milling equipment.

Palm oil mills are usually designed to produce steam from combustible wastes; this is first used to drive alternators and then for bunch sterilization.

Table 22 - 1
Primary Industry Power Requirements [1]

Description	Operating Requirements Peak Demand (KW)	Peak Operation hours day	Power Sources
Forest Industry	1500	16	Diesel electric generating units at factory site.
Palm Oil Mills			
A	1020	16	(Steam powered alternating
B	675	16	(units at each mill site,
C	900	16	(operated by combustion of
D	675	16	(fruit waste.
E	675	16	
Rubber Factories			
G	150	24	(Diesel electric generators
H	180	24	(at each factory
J	150	24	(
K	150	24	(

1) Based on mill and factory supplier's data.

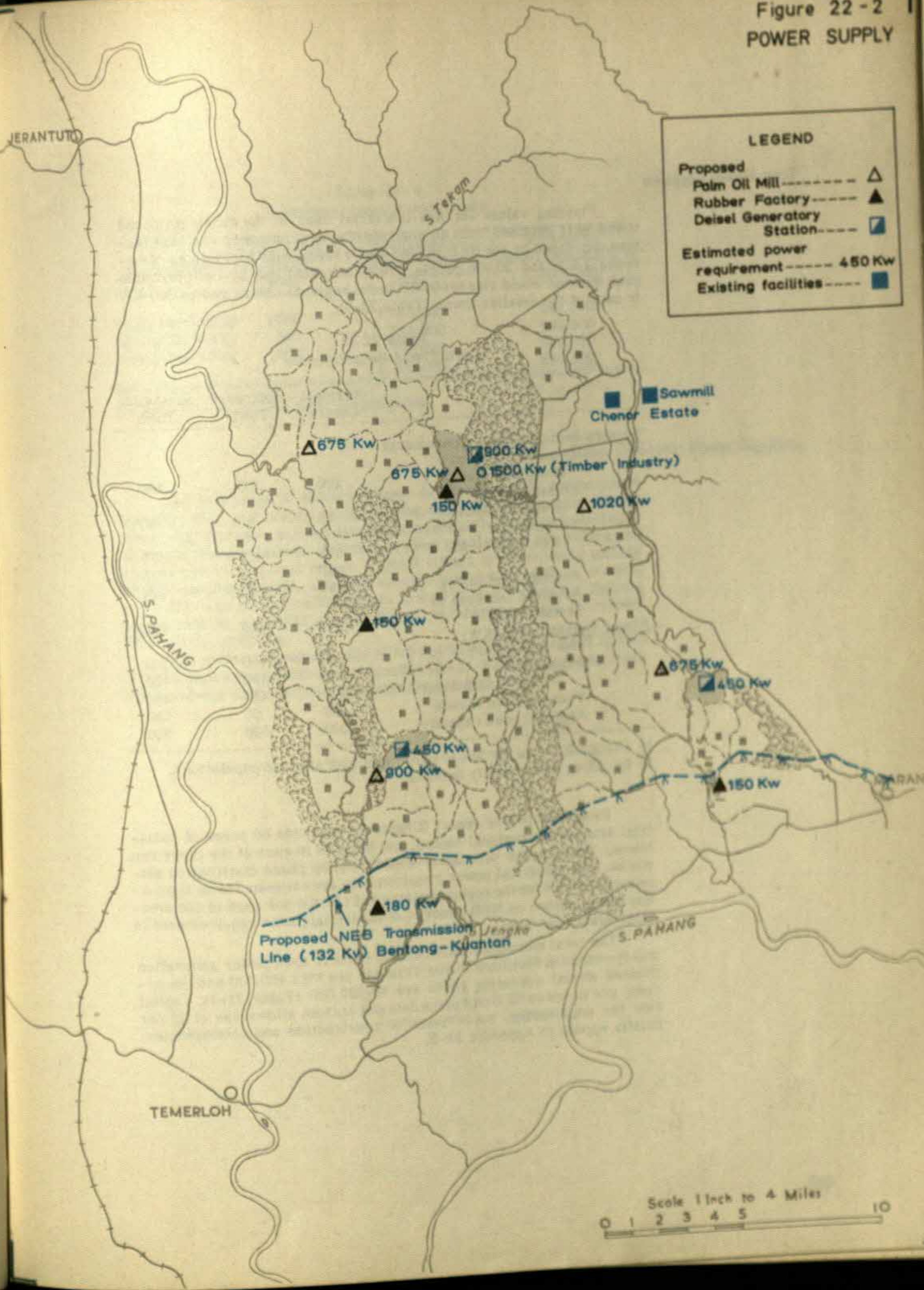
Diesel electric generators and electric distribution equipment are provided as part of the operating equipment of rubber processing factories. Due to the proximity of the rubber factories to other generating units in the Triangle, however, cost comparisons were made to determine the feasibility of replacing this equipment with transmission lines from nearby towns. Power requirements and comparative costs of the alternative systems of generation and transmission are summarised in Table 22-2. This comparison indicates that in the case of Factory J, located adjacent to the regional centre, an estimated saving of M$50,000 might be possible if electric power could be obtained from the town source. The advantages of connecting Factory J to the regional centre's supply should be considered when the factory is to be built (1981).

Table 22 - 2
Comparative Capital Costs of Electric Power Supplies for Rubber Factories

Factory	Plant Capacity tons D.R.C./day	Power required (KW)	Capital cost of factory generated power [1] (M$)	Estimated Capital cost of power transmitted from nearby town (M$)
G	30	150	255,000	265,000
H	36	180	300,000	325,000
J	30	150	255,000	205,000
K	30	150	255,000	290,000

1) Based on factory supplier's prices.

Figure 22 - 2
POWER SUPPLY



Town Power Supplies

Planning values for non-industrial uses in the three proposed towns were obtained from an analysis of power consumed and load factors developed by the NEB in 1963-64 for towns with populations of between 1,000 and 20,000 people. These indicated that by 1990 probable peak demand would rise to 600 KW in the regional centre and to 300 KW in each of the smaller towns (Table 22-3).

Table 22 - 3
Town Power Requirements [1]

	Regional Centre	Southeast Town	Southwest Town
Factors (non-industrial consumers)			
Domestic demand (Kwh/user/year)	200	200	200
Street lighting (Kwh/user/year)	45	60	60
Commercial (Kwh/user/year)	375	475	475
	620	735	735
Average load factor	39%	32%	32%
Assumed increase in demand to 1990	50%	50%	50%
Power Demand 1990 (KW)			
Non industrial	600	300	300
Industrial [2]	300	150	150
sub-total	900	450	450
Transmission losses	100	50	50
Regional peak capacity	1000	500	500

1) Using NEB data for Malaysian towns with similar populations.
2) Including water supply demand.

Proposals in this report (Chapter 16) provide 60 acres of industrial sites in the regional centre, and 30 acres in each of the other two towns. These areas ultimately would require phase distribution networks. The industrial power requirements are estimated to be approximately 300 KW for the regional centre and 150 KW for each of the smaller towns, based on NEB records of industrial power requirements in other Malaysian towns.

The total estimated construction costs of town power generation and distribution facilities in the Triangle are M$3,400,000 and the estimated annual operating costs are M$520,000 (Table 22-4). Capital costs are based on NEB unit price data and include allowances of 25 per cent for engineering, supervision of construction and contingencies; details appear in Appendix 22-2.

Table 22-4
Estimated Town Power Costs

Area Served	Peak Plant Capacity (KW)	Estimated Capital Costs (M$)	Estimated Annual Operating 1) Costs (M$)
Regional Centre	1000	1,850,000	240,000
Southeast Town	500	775,000	140,000
Southwest Town	500	775,000	140,000
		3,400,000	520,000

1) Based on estimated 1990 consumption.

Rural Domestic Power Supplies

The provision of electric power in the villages is not proposed initially. With increasing settler income, however, a demand for village power will probably arise. Consideration should be given to installation of small diesel-electric generators when rural users are willing and able to pay for electric power. Typical village systems would include 28-KW generator sets, 100-watt current limiters in settlers' houses, and a 500-watt peak metered supply to staff houses. Power for lighting only would be available from 6:00 p.m. to midnight; based on current FLDA rural practice.

The estimated capital cost is M$40,000 per village, based on National Electricity Board data (Appendix 22-2). Annual operating costs for a 6-hour daily service are estimated at M$5,550.

CHAPTER 23

OTHER PUBLIC SERVICES

For the comprehensive development of an area as large as Jengka, having no public services of any kind available initially for its relatively large planned population, a complete range of public administrative and operational services and facilities will have to be provided by appropriate agencies of the National or State Governments. The basic requirements for roads, water supplies, health, sanitation, education, electric power and telecommunications have been discussed in preceding chapters and recommended plans for each prepared. A broad range of additional public services will also be needed. Discussed here, and incorporated in the Jengka plan, are requirements for police, postal and fire services, as well as provision for Government admistration, including the need for offices and staff housing.

POLICE SERVICES

The Royal Federation of Malaysia Police Force is divided into 10 Police Contingents, which are subdivided into 86 Police Districts or Sub-Districts each of which contains an average of seven Police Stations or Police Posts. Based on 1963 establishment figures, one constable should meet the police requirements of about 350 people, and one Police District organization should suffice for about 100,000 people.

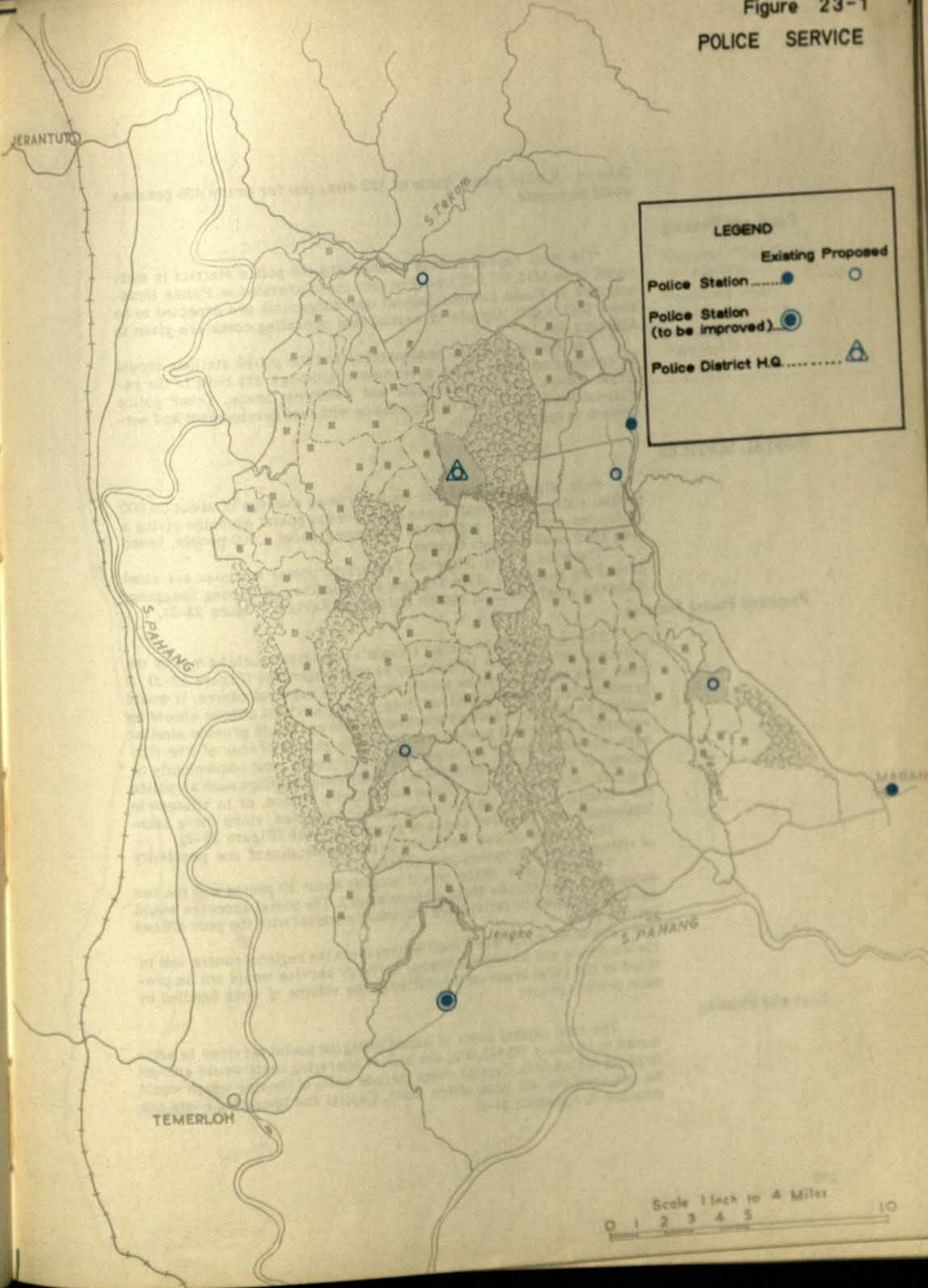
Existing police facilities in the vicinity of the Jengka Ttiangle consist of police stations at Kampong Awah and Maran and a police post at Sungai Jerik, all administered through Police District headquarters in Temerloh.

Proposed Police Facilities

Criteria used for planning police facilities in the Jengka Triangle were based upon normal police organizational requirements for a population of 100,000 people. Allowance was made for the likelihood of a low incidence of crime and a correspondingly low demand for police protection in the Triangle compared with elsewhere in West Malaysia, because the rural population will be carefully selected and initially subjected to relatively close supervision by FLDA staff.

Based on discussions with police officials, it is proposed that a new Police District be formed for the Jengka Triangle containing a district headquarters in the regional centre and six type 'A' police stations (Figure 23 - 1). Police stations would be established in the proposed southeast and southwest towns; the existing station at Kampong Awah would be enlarged; a new station would be provided at the Ulu Jempol FLDA scheme to replace the Sungai Jerik police post; a new station would be built at the Sungai Tekam FLDA scheme; and the existing station at Maran would be incorporated in the proposed Police

Figure 23-1
POLICE SERVICE



District. A total police force of 220 men; one for every 450 persons, would be needed.

Costs and Phasing

The total capital cost of establishing the police district is estimated to be M$2,267,000 based on unit costs provided at Police Headquarters in Kuala Lumpur; annual operating costs are expected to be about M$714,000. Details of capital and operating costs are given in Appendix 23 - 1.

The Police District headquarters and the police stations should be constructed when other government buildings are built in the regional centre and the southeast and southwest towns. Other police stations would be phased in accordance with land development and settlement in nearby projects.

POSTAL SERVICES

Post offices in Malaysia each serve an average of about 30,000 people; villages and small towns are served by postal agencies giving a restricted service to population averaging about 4,000 people, based upon 1963 establishment figures.

There is a post office at Temerloh; postal agencies are sited around the periphery of the Triangle at Kuala Krau, Kampong Sanggang, Kampong Awah, Kerdau, Maran and Sungai Kertam (Figure 23-2).

Proposed Postal Services

The requirements of the Triangle's population would be met by the provision of three post offices and 24 postal agencies (Figure 23-2). A main post office should be established in the regional centre; it would provide a full range of postal services. Subsidiary post offices should be located in the southeast and southwest towns and would provide similar services. The postal agencies would serve groups of four of five villages; providing postal services only. They would most conveniently be located in villages containing other government buildings such as police stations, schools, FLDA offices and midwife clinics, or in villages in the vicinity of palm oil mills and rubber factories, since these establishments will be heavy users of postal services (Figure 23-2).

Mobile post offices would not be needed because of the proximity of villages to the proposed post offices.

The main post office would employ about 20 people and the two subsidiary post offices about 10 people each. The postal agencies would each be operated by individuals who would contract with the post offices for the work.

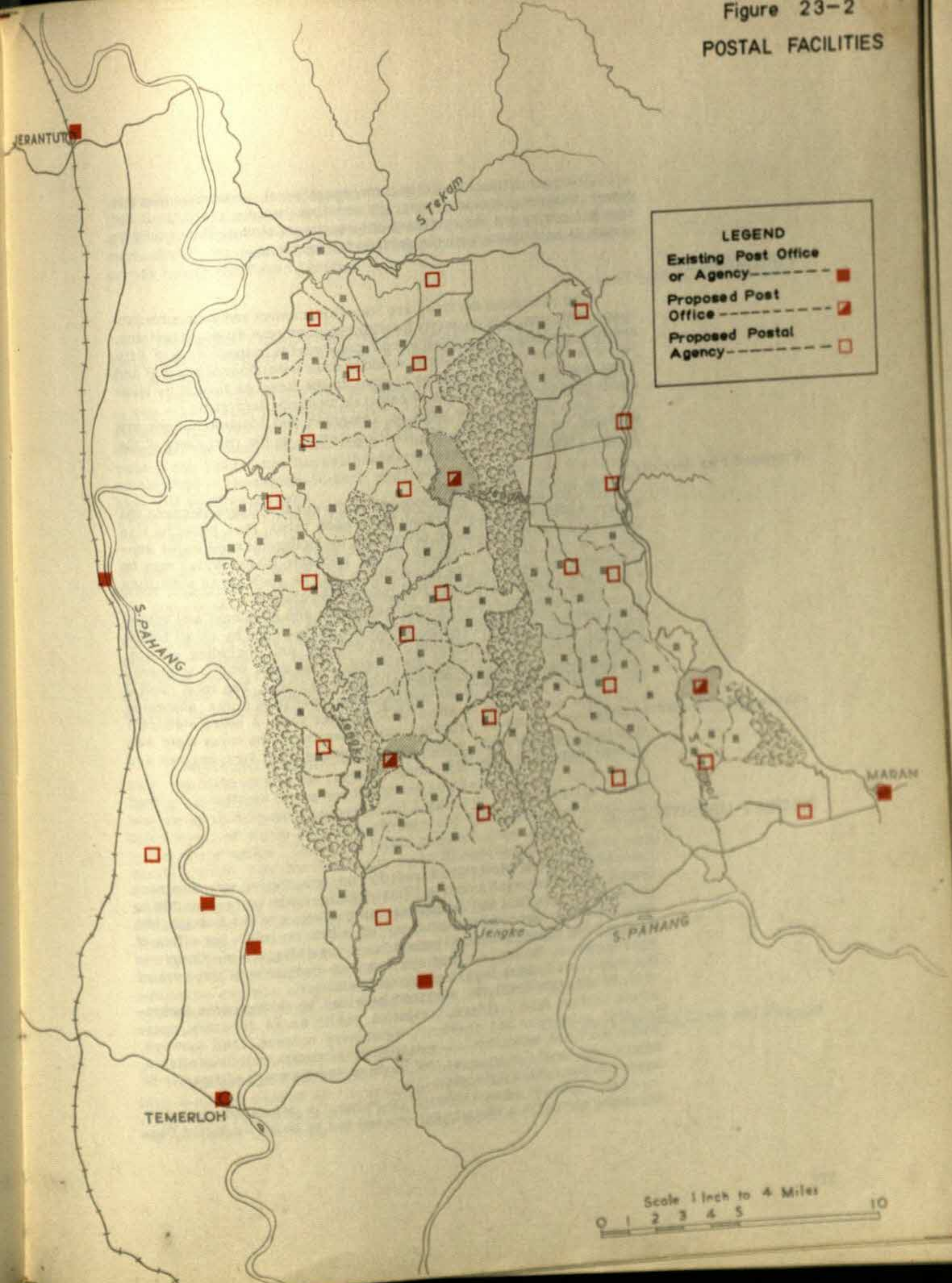
Postmen would make mail deliveries in the regional centre and in the southeast and southwest towns; delivery service would not be provided in the rural areas until justified by the volume of work handled by each postal agency.

Cost and Phasing

The total capital costs of establishing the postal services is estimated to be about M$440,000; the annual operating costs would amount to about M$166,000. Capital costs include costs of housing which would be required for all post office staff. Capital and operating costs are detailed in Appendix 23-2.

Figure 23-2

POSTAL FACILITIES



The post offices would become operational as soon as electric power, water supplies and telegraph services become available in the regional centre and the southeast and southwest towns. They would be staffed in accordance with the demand for services.

FIRE SERVICES

Fire protection services are State Government and local authority responsibilities, Advice on fire fighting requirements, firemen training, and fire prevention is available from the Federal Inspectorate of Fire Services. Preventive measures would be dealt with under Municipal and Town Board Legislation and by clauses in the licences issued by local authorities for shops, places of entertainment and factories.

Town fire services exist at Temerloh and Mentekab; none are provided for the villages and FLDA schemes on the periphery of the Jengka Triangle.

Proposed Fire Services

No fire protection is proposed for the rural villages because the houses would be well separated from each other, thus reducing fire risk, and because the cost of protection, including enlarged water supplies, is too great in relation to the probable losses which may be sustained. In place of fire protection it may be possible to substitute some form of group property fire insurance scheme.

Fire protection for the regional centre and southeast and southwest towns should be provided during the early years by small foam-equipped fire engines, costing M$35,000 per unit including garage, office, housing and ancillary equipment; three units would be needed for the regional centre and one each for the two towns. The total capital cost would be about M$105,000 and the annual operating costs, assuming a 10-man staff would be about M$35,000 per year. A more elaborate fire service should be provided later when the towns form their own municipal councils; and would include conventional fire engines and boosted town water supplies.

DISTRICT ADMINISTRATION

The States of Malaysia, except Perlis, are divided into administrative districts, each under a District Officer who is responsible to the State Government for the general adminstration of the district. His duties include land administration, for which he holds the office of Collector of Land Revenue; jurisdiction in the Magistrates Courts in his capacity of First Class Magistrate; and co-ordination of the work of the State Government departments in his district.

At district level the services provided by Government departments include land drainage, irrigation, public works, forestry, agricultural extension and research, veterinary science, land surveys, social services, education, co-operative development, religious affairs, health, and local Government. All of these services will ultimately be needed in the Jengka Triangle.

The District Administration of Pahang is organised into eight Districts each with a District Officer and one or more Assistant District Officers. Most of the Jengka Triangle is situated in the Temerloh District and is administered from the District office at Temerloh; the north west corner however lies within the Jerantut District and is administered from Jerantut and a small segment in the extreme southeast corner lies in the Pekan District

Proposed District Administration

The Jengka Triangle involves a very large development effort and there will be need for a full range of administrative services specific to it at district level.

These should preferably be based in Jengka, and capable of providing the closest coordination with FLDA. For these reasons, it is recommended that a new District should be formed which would embrace all the land east and north of the Sungai Pahang and south and west of the Tekam and Berkelah forest reserves; with a District Office established in the regional centre, and District sub-offices in the southeast and southwest towns. The District Officer and one Assistant District Officer would be stationed in the regional centre; one Assistant District Officer would be stationed in each town.

The new District would have an ultimate population in the order of 120,000 to 130,000 people. This includes the estimated rural and urban population of the Triangle development area (105,000), as well as the population living on the periphery of that area. Based on present administrative practice in Pahang a population of this size would need the services of three District Officers and five Assistant District Officers. It is suggested, however, that only one District Officer and three Assistant District Officers should in fact be assigned during the formative years of development because the ultimate population may not actually be reached for 20 or 25 years.

Other Government Departments

The district organizations of Government departments should have their headquarters in the regional centre, with the larger organizations having sub-offices in the southeast and southwest towns. In total, there may be up to 900 people engaged in all aspects of administration at district level, of whom 30 senior officers and 500 junior staff would require office space. These are initial requirements. Based on current establishment data for Malaysia, up to 20 separate departments may eventually wish to establish offices in the new district: personnel might ultimately total about 1,500 staff of all grades with about 40 division I and II officers in senior positions. The staff costs of district organisations of Government departments could be about M$3,000,000 per year initially, but those costs have not been included in the financial analyses of this report, and are not detailed in this Chapter. These estimates exclude all police and the executive staff of the health and education departments, but would include district officers and their staffs.

Office and Housing Costs and Phasing

It is assumed that Public Works Department standard office buildings would be used by all Government staff. These structures provide three office floors each 25 feet wide, divided for construction and costing purposes into modules 10 feet long. Each module can house six office staff based on a floor space of 125 square feet per man and costing M$4,600 per capita, inclusive of office furnishings and equipment.

Five buildings, each 180 feet long (18 modules) and costing in total about M$2,500,000 would be needed to meet initial government office requirements. Three buildings would be constructed in the regional centre and one each in the southeast and southwest towns.

It is assumed that housing would be required for 50 per cent of the initial government staff; costing about M$1,700,000 in the regional centre and M$400,000 each in the southeast and southwest towns.

It is assumed that housing would be required for 50 per cent of the initial government staff; costing about M$1,700,000 in the regional centre and M$400,000 each in the southeast and southwest towns.

It is assumed that office blocks and government housing included in these estimates would be built during the period of town development (Chapter 16), and in accordance with the needs of the various departments.

LOCAL GOVERNMENT

Local councils form the local authority in the towns and villages of Malaysia, serving populations of from 2,000 to 16,000 people. They consist of elected members who are advised in their work by the District Officers. The councils operate mainly in the fields of public health, communications and water supply with assistance from government technical departments. Revenue is derived from property rates, licencing, service charges and state government grants.

Local councils function in the towns of Temerloh, Jerantut and Maran, as well as in the villages of Sanggang, Kuala Krau, Kerdau and Chemor.

Local Councils in the Triangle

It is expected that local councils would be formed in the regional centre and the southeast and southwest towns; in the large existing FLDA schemes at Sungai Tekam, Kampong Awah, Sungai Nerak, Bukit Tajau and Ulu Jempol; and for groups of three or four settlement villages, giving sufficient population to form viable units.

It is estimated that the regional centre council would require 4,000 square feet of office space; the southeast and southwest town councils would each require 1,500 square feet; and the village councils each about 1,000 square feet. The costs for office facilities for the councils are in included in town and village development costs.

The proper functioning of the councils is dependent upon the establishment of district offices and the various Government technical departments within the proposed new District. The councils in the regional centre and the towns would probably be elected as soon as these services became available; the establishment of the rural councils would follow project development but probably with a delay of several years while the settlers work under relatively close FLDA supervision.

CHAPTER 24
PHASING OF DEVELOPMENT

The effective development of the Triangle as a whole during the next 12 years will be achieved only if the complex of operations is phased in an orderly sequence which takes account of limitations imposed by climate and scarcity of resources. If this is done the consequent implementation of the plan will result in the maximum financial and economic bebefit.

The most efficient system of development requires that the development programme should be correlated with the phasing of the logging operation. The development programme has been planned not only to promote a successful timber enterprise but to accomodate realistic operational targets for FLDA and other agencies associated with it in the development of Jengka.

Location of Phases

Since oil palm provide a greater and quicker return than rubber the development of oil palm land has been given priority to that of rubber land. This principle provides benefit for the forest industry in that large areas considered more suitable for rubber in the centre of the Triangle also have large timber volumes. If these areas are left to the last Jengka timber can be processed over a given period with a reduced plant capacity and capital investment.

The large area of suitable oil palm land on the east side of the Triangle and the benefits of continuing development near the FLDA Ulu Jempol oil palm scheme determined the location of the first project. Initial development in this area also allows agricultural development to take place without resulting in serious losses of valuable timber prior to the implementation of the recommended forest industry.

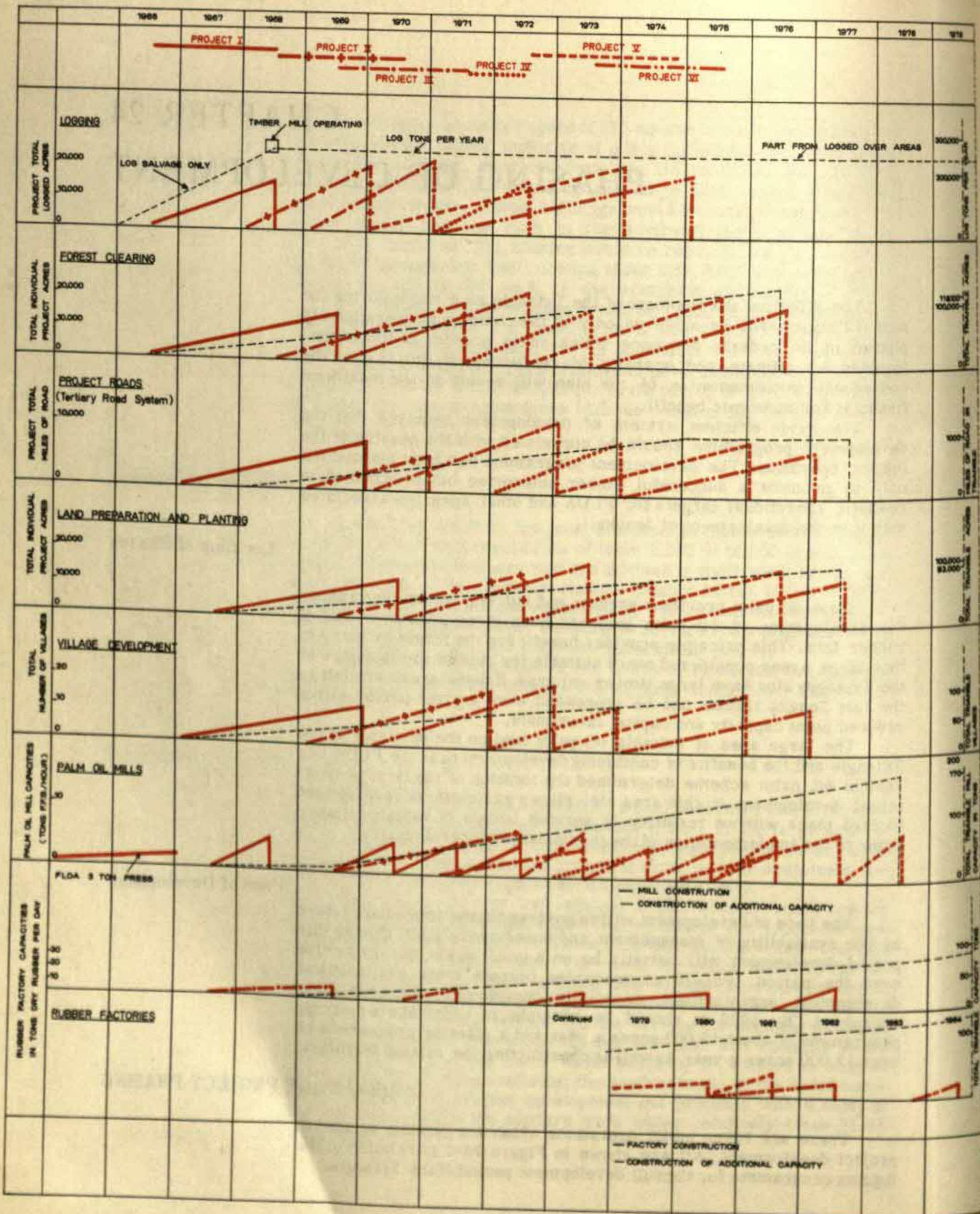
Pace of Development

The pace of development will be governed in the immediate future by the availability of management and supervisory staff. During this period development will initially be on a small scale, but it can rise over the period 1967-70 as resources become more available and development organisations, especially contractors, increase their capacities. By 1970 it should be possible to undertake a clearing programme of about 15,000 acres a year and a planting programme of over 12,000 acres a year, as well as constructing the related facilities.

SUMMARY OF PROJECT PHASING

There are seven major operations which are directly related to project development. All are shown in Figure 24-1 in relation to the logging programme for the full development period of the Triangle.

Figure 24 - 1
Summary of Project Phasing



Forest Clearance

Forest clearance is critical in the implementation of project development. The speed at which it is undertaken is governed in part by contractor and management capacity and in part by the economic advantages derived from rapid development. The gross acreages to be cleared annually are set out in Table 24-1.

Table 24-1
Annual Forest Clearance Programme
(gross acres cleared)

	1966/7 [1]	1967/8	1968/9	1969/70	1970/1	1971/2	1972/3	1973/4	1974/5	1975/6	1976/7	Total [2] New Land
Project I	4,800	8,600	1,300									14,700
Project II			9,600	6,100	3,600							19,300
Project III				7,700	11,500	3,000						22,200
Project IV						11,800	4,600					16,400
Project V							8,400	4,600	8,600			21,600
Project VI								7,800	2,400	9,700		19,900
Total cleared	4,800	8,600	10,900	13,800	15,100	14,800	13,000	12,400	11,000	9,700		114,100

1) 1st July - 30th June
2) Does not include land added to existing FLDA Schemes (800 acres)

Planting

The phasing of the planting operation which also includes all aspects of land preparation is governed by the weather and the need to confine planting to the period from September to December. A small subsidiary programme may however be undertaken in March and April. The locations of areas planted annually are shown in Figure 24-2. The annual net planting acreages are set out in Table 24-2; they follow one year behind land clearance and are smaller because provision has been made for village areas, roads and unusable land.

During the build up period to mid 1970 all of Project I and most of Project II would be planted, a total of 20,000 acres. By mid 1973, 80 per cent of the oil palm land in the Triangle would be planted. In the later years of Jengka development, the larger acreages of rubber (Projects V and VI) would be developed and planted.

In the last three or four years of development a continuing reduction in acreages cleared and planted has been assumed. In this period alternative phasing and development plans may become possible; these include either independently or in combination:

1. Early development of the land suitable for oil palms in the Tekam area.
2. Private sector development of the rubber land in Project V and VI.
3. Large annual planting programmes during this period.

Figure 24 - 2

PHASING OF DEVELOPMENT

Table 24-2
Annual Planting Programme
(net acres planted)

	1966/7 [1]	1967/8	1968/9	1969/70	1970/1	1971/2	1972/3	1973/4	1974/5	1975/6	1976/7	Total New Land	Total FLDA	Total [2] Project
Project I														
Oil Palm		4,000	6,400	1,100								11 500	5,200)	17,300
Rubber			600									600	)	
Project II														
Oil Palm				7,900	2,900							10,800	)	19,400
Rubber					2,000	2,800						4,800	3,800)	
Project III														
Oil Palm					6,300	9,400	700					16,400	)	24,400
Rubber							2,400					2,400	5,600)	
Project IV														
Oil Palm							9,700	3,800				13,500	)	16,800
Rubber												-	3,300)	
Project V														
Oil Palm								6,900				6,900	)	17,200
Rubber									3,600	6,700		10,300	)	
Project VI														
Oil Palm									6,400			6,400	)	15,800
Rubber										1,900	7,500	9,400	)	
Total Oil Palm		4,000	6,400	9,000	9,200	9,400	10,400	10,700	6,400			65,500		
Total Rubber		-	600	-	2,000	2,800	2,400	-	3,600	8,600	7,500	27,500		
Total Planted		4,000	7,000	9,000	11,200	12,200	12,800	10,700	10,000	8,600	7,500	93,000	17,900	110,900

1) (1st July - 30th June)
2). Does not include land added to existing FLDA Schemes (800 acres)

As Jengka develops and as future development plans materialize the later stages of Jengka should be reconsidered in the light of these alternatives. Evidence suggests that the incorporation of the Tekam area into the Jengka Triangle development plan would be of considerable agricultural and economic benefit to FLDA and the economy. Plans for the inclusion of Tekam should therefore be given immediate and serious consideration.

The alternative phasing of projects mentioned here would not affect the pace of forest exploitation. Early development of Tekam instead of the rubber land in Projects V and VI, however, would require a transfer of logging operations in 1974 from Jengka to those areas in the Tekam forest reserve which have a high development priority.

Village Development

The development of villages must begin as soon as land can be made available so that staff and settlers may arrive in time to assume responsibility for crop maintenance. The development of villages is phased to take place during a three year period in all projects except Project IV (Figure 24-1). Some flexibility can however be provided in the completion of villages because settler intake can be distributed over several months.

Processing Facilities

The phasing of the nine processing plants required for Jengka is summarised in Figure 24-1. The phasing-in of new capacity, however, should be constantly reappraised in the light of changes in the rate or location of development and in the level of expected yields.

Palm Oil mills - Planning of the first phase of the mill at Ulu Jempol is already underway. Planning of the second stage should take place immediately so that installation of an additional seven tons capacity can be completed by mid 1968. Construction of the later stages of Ulu Jempol mill and the planning of Project II's mill should be started in mid-1969. Thereafter planning and installation of capacity for Projects III to VI should take place evenly over the next nine years to mid 1978. In most years during this period annual capacity of 15-25 tons must be installed.

Rubber factories - FLDA is already committed to the fairly immediate construction of processing factories for the rubber already planted in its four rubber schemes in Jengka. Until mid-1969 the volumes involved do not appear to justify construction of an FLDA facility. To process latex from mid-1969 onwards, one 12 ton per day first phase rubber factory should be installed in the Kampong Awah/ Sungai Nerek area during 1968/9. This requires detailed survey and planning during 1967. This factory should be installed in three phases for completion as a 36 ton per day factory by mid-1973. During 1973-7 planning and construction of a second 30 ton per day factory near Bukit Tajau should take place. The two factories required at present for Projects V and VI should be constructed over a five year period from mid 1979.

Project Roads

Timely construction of the tertiary road system which forms the basic project transportation network is vital to successful implementation. Initially these roads, supplemented by logging spur roads, provide the network for access and supervision of contractor activity; later they become supervision roads for management of settlers during the crop maintenance period; finally they become the harvest roads along which fresh fruit bunches and latex will be carried. Tertiary roads should be phased for construction immediately following forest clearance (Figure 24-1). Primary and secondary roads which are more closely related to Triangle development as a whole than to projects are discussed separately in a subsequent section.

Schools

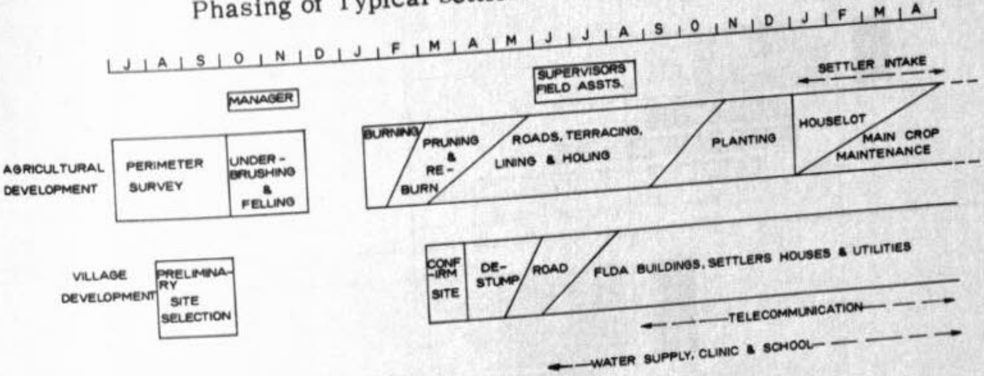
It is assumed that schools in project areas would be built generally at the same time as the villages are developed. It is important that rural schools be available when settlers join the projects, or soon thereafter. Failure to provide schools on time may lead to social problems of serious concern to management and may prejudice the chances of successful settlement.

SETTLEMENT UNITS

The phasing of the operations that make up a typical settlement unit involves two groups of operations. The first is concerned with the preparation of the primary crop land and the planting of the crop. The second comprises all the tasks necessary to develop the village. Figure 24-3 shows diagrammatically the sequence of all these operations. For agricultural operations a critical deadline is the completion of the felling programme so as to gain maximum benefit from the succeeding dry period (January). Also critical is the need to complete land preparation work by September of any year so that the optimum planting period (September-December) can be used.

Settler intake is scheduled to be completed during four months. Contractor responsibility for field tasks is assumed to cease when the initial weedings of the newly planted crop are completed. Thereafter crop maintenance becomes the responsibility of settlers under the supervision of management staff.

Figure 24 - 3
Phasing of Typical Settlement Unit



The site of the village cannot practicably be confirmed until the forest is removed. De-stumping should begin as soon as possible thereafter, followed by road construction in the village area. Construction of settlers houses can be phased in at this time also and can be extended for as long as 11 months, provided always that sufficient numbers of houses are available for incoming settlers.

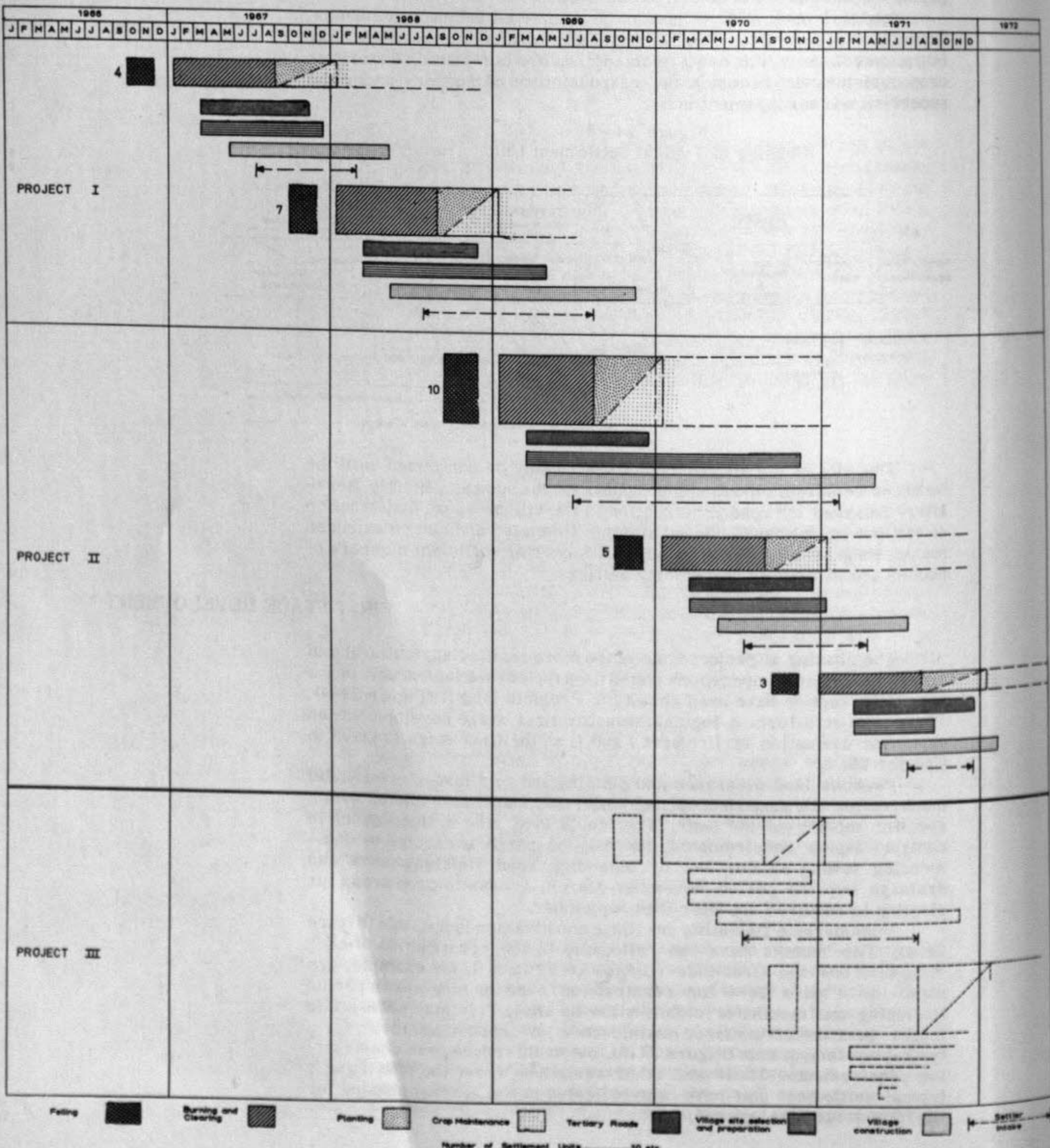
FIRST STAGE DEVELOPMENT

The phasing at project scale of the more detailed agricultural and village development operations stated for a typical settlement unit in the preceding section have been shown for Projects Iand II (Figure 24-4). These projects form a logical area for first stage development; an economic evaluation of Projects I and II as the first stage is given in Chapter 26.

Because land clearance and planting and to a lesser extent road construction are dependent upon weather, they must be completed within specific months of the year. This could give rise to fluctuations in contract labour requirements, but may be partly overcome by commencing felling earlier and by extending road finishing work and drainage into the period November-March. Access to crop areas for planting is required not later than September.

Considerable flexibility in village construction is possible (Figure 24-4). Two months have been allocated to the construction of each village. Thus the first four villages of Project I, for example, are shown in Figure 24-4 for construction over a nine month period (including one month for mobilisation on site). This may necessitate longer periods of contract maintenance of crops than shown for a typical settlement unit (Figure 24-3), but would reduce peak construction requirements. These and other variations from the phasing of a typical settlement unit have been indicated in the general phasing for the first stage development.

Figure 24 - 4
Phasing of First Stage Development



OTHER FACILITIES AND SERVICES

Although all projects are capable of independent implementation, in the aggregate they create a demand for facilities and services which must be developed at Triangle level. Shown on Figure 24-5 are the broad phasing requirements for seven major elements of Triangle development. These are:

Health Services	Telecommunications
Police Facilities	Town Schools
Postal Facilities	Government Offices and Housing
	Primary and Secondary Roads

Figure 24 - 5
Phasing of Triangle Facilities and Services

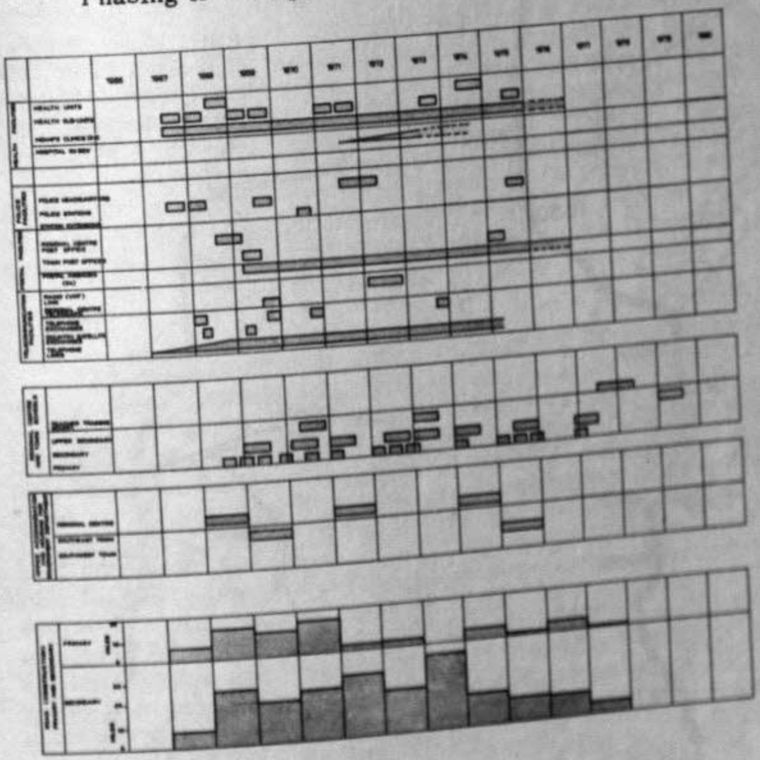
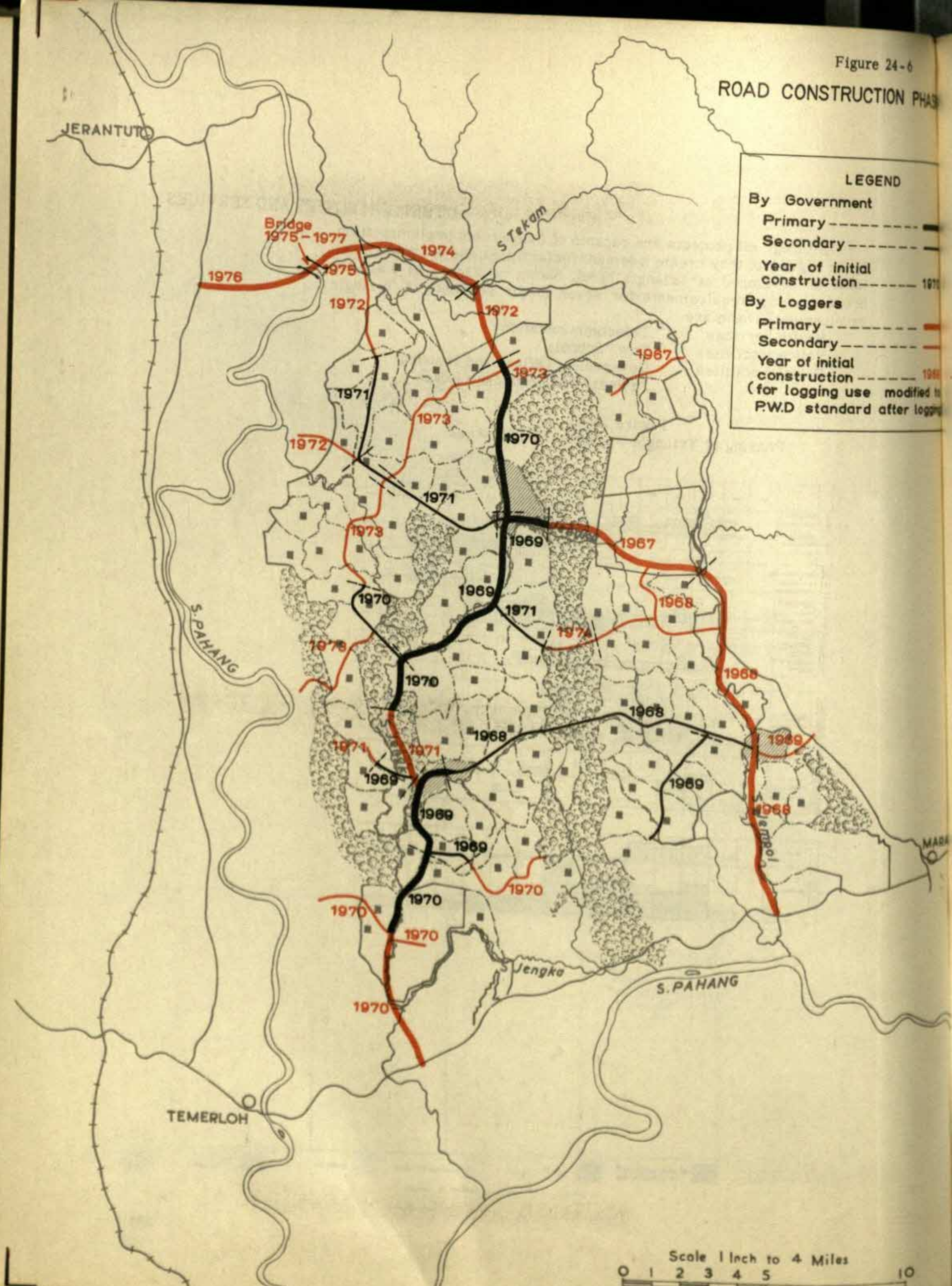


Figure 24-6

ROAD CONSTRUCTION PHA[S



While most town schools serve mainly the town populations, in several instances the numbers of primary schools in towns have been increased to serve the immediate surrounding rural areas. Upper Secondary Schools and the Teacher Training School, all located in towns, would serve the entire Triangle.

The locations of annual phases of the primary and secondary road construction programme are shown in Figure 24-6. Construction of the Triangle's permanent network of these roads has been integrated with the construction of logging roads and the responsibility for initial construction of various road segments is also shown in the figure.

There is an immediate need to provide adequate access to the main centres of operations in 1967 and 1968. These are Projects I and II and the site of the regional centre. A primary road built by the Government during these years would link the regional centre to National Route II in the south, passing through both projects. In 1968 also, secondary road construction by the Government would develop internal access within these projects. At the same time a secondary road connection westwards would be developed between Projects II and III as part of the logging programme.

In 1970 the primary north/south route through the Triangle would reach National Route II at Kampong Awah FLDA scheme. It would also be extended as a logging road northwards from the regional centre into Project IV, meeting the Jerantut-Maran road two years later.

TOWNS

The urban centres of the Triangle would develop in conjunction with the rural communities and roads and services which will support them. To do so they will require certain basic services and utilities including site preparation, roads, water supplies, electric power and sanitation. It has been assumed that the towns will grow of their own volition and according to demand and the phasing of town development has not been planned in detail. Instead, an equal annual capital expenditure to cover the provision of services and utilities over a twelve year period (1968/69 - 1979/80) has been assumed in the financial analysis. There is particular need for the regional centre and the southeast town to be established at least in part by the 1968/69. The regional centre must have a high priority in the phasing programme because it provides the base for the forest industry, for FLDA headquarters staff, for other government departments, and for a range of necessary services and organisations.

CHAPTER 25

MANAGEMENT FOR IMPLEMENTATION AND OPERATION

Successful implementation of the many aspects of development for the entire Triangle involves not only control of costs and strict adherence to schedules but careful integration of a number of activities some of which have a critical impact on the timing and success of others. This calls for a high standard of staff capability at all levels and an overall organisation which can efficiently coordinate all major activities.

Central direction and close administration of an agreed policy by an organisation with direct control over the facilities necessary for its purposes are required. The management responsible for this task should therefore have a high degree of autonomy, subject to general policy direction from the FLDA Board.

In making this recommendation it has been assumed that the present FLDA headquarters staff will have increasing responsibility for administering a number of smaller but expanding schemes and that it may also have the additional task of supervising the investigation and development of further large scale settlement prospects. FLDA headquarters must however remain responsible for broad policy and the general pattern and pace of Jengka development and its finance, and possibly also for matters of important public significance such as staff terms and final approval of major contracts.

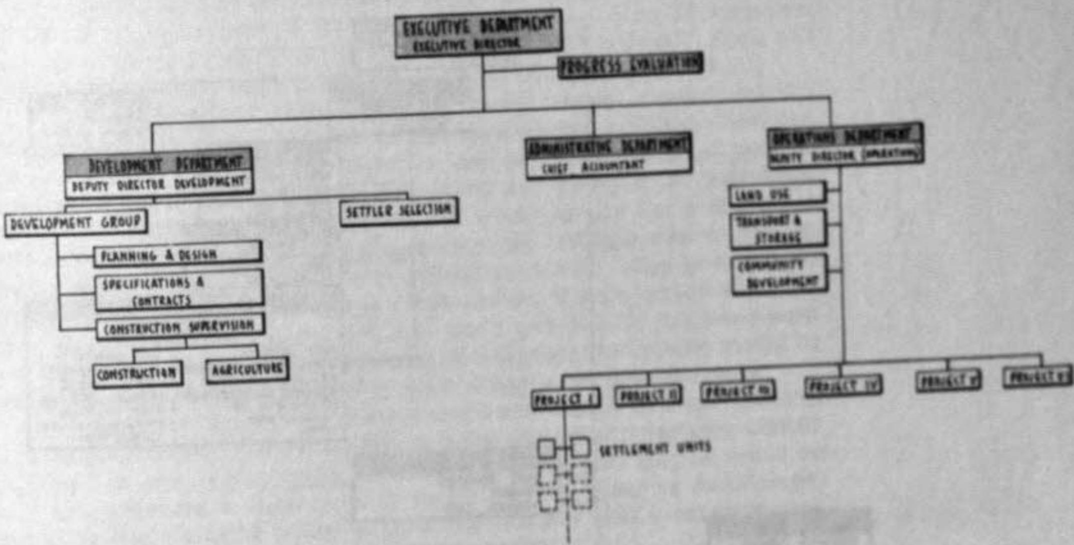
It is envisaged that Jengka development and operation would be controlled by a small board of management whose chairman would be the chairman of FLDA, at least in the early years. He would be supported by two other members of the FLDA Board having special knowledge of land development on a large scale.

The chief executive to the Jengka board would be the Executive Director, responsible for implementing the Master Plan. He should be appointed soon after the adoption of the plan. He and his staff should be located in the Triangle from the outset, if necessary in temporary accommodation, and should continue to reside there.

The outline structure of the management organisation envisaged for Jengka is given in Figure 25-1. It illustrates the chain of responsibility from Triangle Headquarters through Project headquarters to Settlement Units and the various functional responsibilities at each of these levels.

The major tasks of Triangle management would be twofold; the transitory task of planning, coordinating and directing development activities up to the completion of main crop planting and the continuing duty of directing and administering Jengka operations and providing certain centralised services. Upon the timely and competent completion of the first task will depend the attainment of the longer term objectives of the second. For this reason the management structure for the Triangle is broadly divided into a Development Department and an

Figure 25 - 1
Outline Management Structure



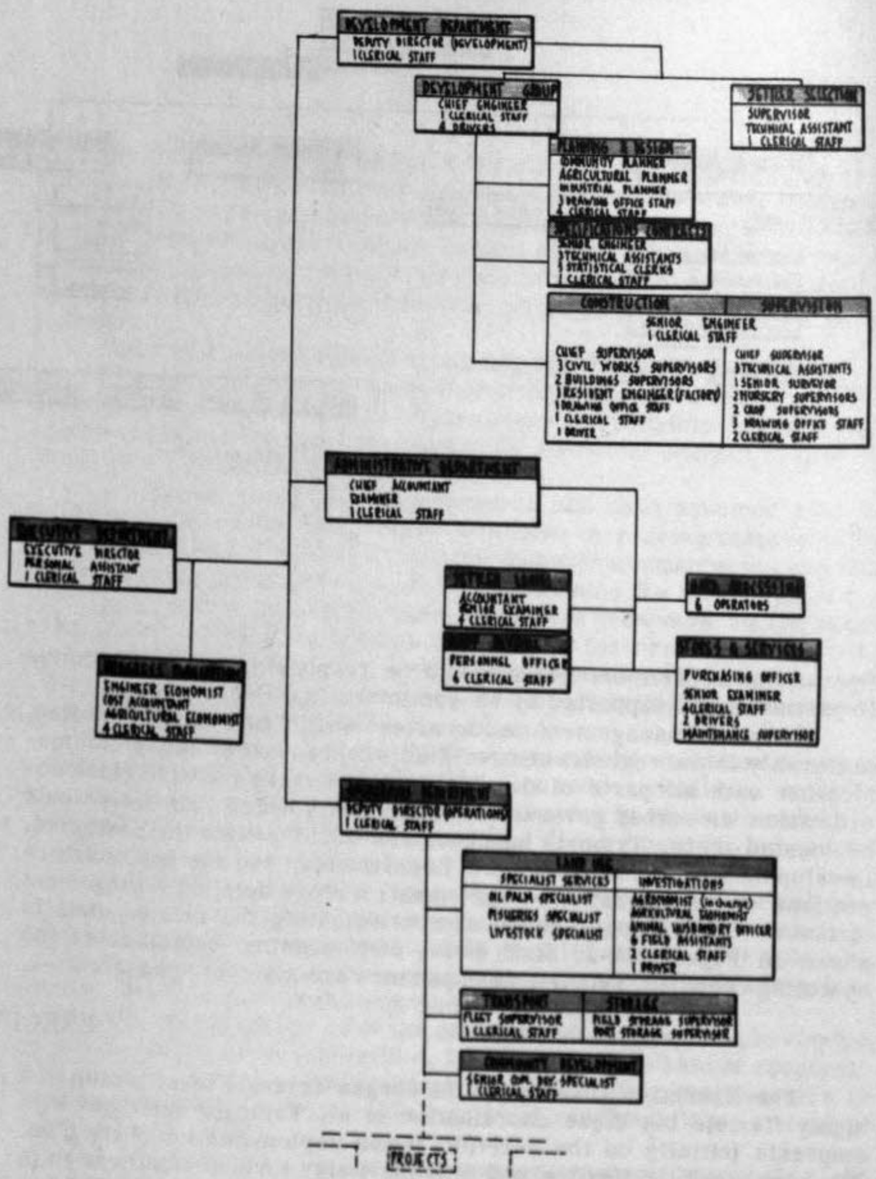
Operations Department which would be responsible to the Executive Department, and supported by an Administration Department.

Jengka's management headquarters should be centrally located, preferably in the regional centre. This would assure effective communication with all parts of the Triangle and make possible close co-ordination with other government departments which ultimately would be located there. Triangle headquarters would contain the Executive, Development and Administrative Departments, and the headquarters sections of the Operations Department. A more detailed management structure for Triangle headquarters indicating the related staff is shown in Figure 25-2. Staff lists, staff phasing, capital costs and operating costs for Triangle headquarters are given in Appendix 25-1.

EXECUTIVE DEPARTMENT

The Executive Director of the Jengka Triangle must establish a highly flexible but close coordination of all Triangle activities with emphasis initially on the carefully timed implementation of the plan. The plan itself is flexible and will inevitably involve modification in the light of experience. The essential requirement is that evidence indicating the need for change should be revealed without delay so that corrective action can be taken. A Progress Evaluation Section directly responsible to the Executive Director is proposed (Figure 25-2). Its duty would be to keep him constantly informed of progress in all aspects and stages of development and operation, to assess the adequacy of progress and to make recommendations for its improvement.

Figure 25 - 2


DEVELOPMENT DEPARTMENT
DEPUTY DIRECTOR (DEVELOPMENT)
1 CLERICAL STAFF
DEVELOPMENT GROUP
CHIEF ENGINEER
1 CLERICAL STAFF
4 DRIVERS
SUPERVISOR
TECHNICAL ASSISTANT
1 CLERICAL STAFF
PLANNING & DESIGN
COMMUNITY PLANNER
AGRICULTURAL PLANNER
INDUSTRIAL PLANNER
3 DRAWING OFFICE STAFF
SENIOR ENGINEER
3 TECHNICAL ASSISTANTS
3 STATISTICAL CLERKS
1 CLERICAL STAFF
CONSTRUCTION
SUPERVISION
SENIOR ENGINEER
1 CLERICAL STAFF
CHIEF SUPERVISOR
3 CIVIL WORKS SUPERVISORS
2 BUILDINGS SUPERVISORS
1 RESIDENT ENGINEER (FACTORY)
1 DRAWING OFFICE STAFF
1 CLERICAL STAFF
1 DRIVER
CHIEF SUPERVISOR
3 TECHNICAL ASSISTANTS
1 SENIOR SURVEYOR
2 NURSERY SUPERVISORS
2 CROP SUPERVISORS
3 DRAWING OFFICE STAFF
2 CLERICAL STAFF
ADMINISTRATIVE DEPARTMENT
CHIEF ACCOUNTANT
EXAMINER
1 CLERICAL STAFF
EXECUTIVE DIRECTOR
PERSONAL ASSISTANT
1 CLERICAL STAFF
ENGINEER ECONOMIST
COST ACCOUNTANT
AGRICULTURAL ECONOMIST
4 CLERICAL STAFF
ACCOUNTANT
SENIOR EXAMINER
4 CLERICAL STAFF
PERSONNEL OFFICER
6 CLERICAL STAFF
6 OPERATORS
STORES & SERVICES
PURCHASING OFFICER
SENIOR EXAMINER
4 CLERICAL STAFF
2 DRIVERS
MAINTENANCE SUPERVISOR
DEPUTY DIRECTOR (OPERATIONS)
1 CLERICAL STAFF
SPECIALIST SERVICES
INVESTIGATIONS
OIL PALM SPECIALIST
FISHERIES SPECIALIST
LIVESTOCK SPECIALIST
AGRONOMIST (in charge)
AGRICULTURAL ECONOMIST
ANIMAL HUSBANDRY OFFICER
6 FIELD ASSISTANTS
2 CLERICAL STAFF
1 DRIVER
TRANSPORT
STORAGE
FLEET SUPERVISOR
1 CLERICAL STAFF
FIELD STORAGE SUPERVISOR
PORT STORAGE SUPERVISOR
COMMUNITY DEVELOPMENT
SENIOR COM. DEV. SPECIALIST
1 CLERICAL STAFF
PROJECTS

Although development will take place project by project, the highly specialised team functions of planning, design and construction of each project should be undertaken centrally, as a continuous process and as an integral part of the whole. For this function a development group consisting of sections for planning and design, specifications and contracts, and construction supervision is proposed (Figure 25-2).

The Planning and Design Section would be responsible for the orderly evolution of the Plan as a whole, preserving a balance between such operations as timber utilisation and land clearance and related development of roads, utilities and other services for the individual projects in their sequence. The Section would assure the preparation of final drawings and design of all aspects of the Triangle's development. Thus a key function of it would be of coordination with other government departments, for example Survey and Public Works, which would be directly involved in development. For work on which other government departments are unable to contribute final design, the Section would be responsible for directing the activities of engineering consultants.

Since much of the construction work associated with agricultural development of the type envisaged in Jengka involves relatively simple engineering and layout tasks, it is probable that the Section would be able to undertake a considerable range of final planning and design, including the siting of villages, layout of tertiary roads, terraces and platforms and preparation of planting diagrams.

The Planning and Design Section would work closely as well with manufacturers on those elements of development, such as prefabricated house and office erection, which may not require design, but which would involve carefully scheduled orders placed sufficiently in advance to assure delivery when required.

The Development Group would also include a Specifications and Contracts Section. In addition to preparation of contract documents for a range of individual contracts, there would be a requirement for modification of existing specifications, or preparation of new ones to meet Jengka conditions and schedules. This Section in coordination with Planning and Design should consider at all times the advantages of grouping work items so as to offer larger contracts and assist in the growth of effective local contractor organisations.

For actual construction, supervision of some elements could be provided by other government departments (Public Works for primary and secondary roads, for example) and by consultants. A Construction Supervision Section would be needed, however, to provide direct site supervision of such critical tasks as clearing, holing, planting, and village development.

Within the Development a Settler Selection Group would also be established. Its function would be to assure the orderly selection of settlers in coordination with other participating agencies and their scheduled movement to the Triangle.

All component sections of the Development Department should be established as soon as possible after a decision is made to implement the Master Plan. The need for them to be on site may require the provision of temporary of mobile accommodation until a permanent headquarters is built. At all stages of development there would remain a need for flexibility and mobility, especially in the supervision of key contract operations such as planting. This may require radio communication, adequate field vehicles, and mobile field offices and quarters.

Although the principal planning and development function would be the responsibility of the Triangle headquarters organisation it is important that the Project Managers concerned and their staff should participate. It is sound in principle that a Project Manager should be involved in planning the unit of which he is later to be in charge and desirable that his field staff should help in supervising the preparatory field operations to their satisfaction. It would seem appropriate that up to the completion of primary crop planting, project field staff should come under the direction of the Development Group who would work in close collaboration with the Project Managers. At the conclusion of the development phases the Project Managers would assume full and direct control of their projects and the Development Group would move to the next one.

Operations Department

The responsibilities of the Development Department would end with the completion of planting the last project. The Operations Department would provide the central line of operational management extending from Triangle headquarters to settlement units (Figure 25-2).

Headquarters Section

At Triangle headquarters, the Operations Department would have the continuing task of directing and coordinating the major policy activities of the projects, and providing for them certain specialised technical and advisory services.

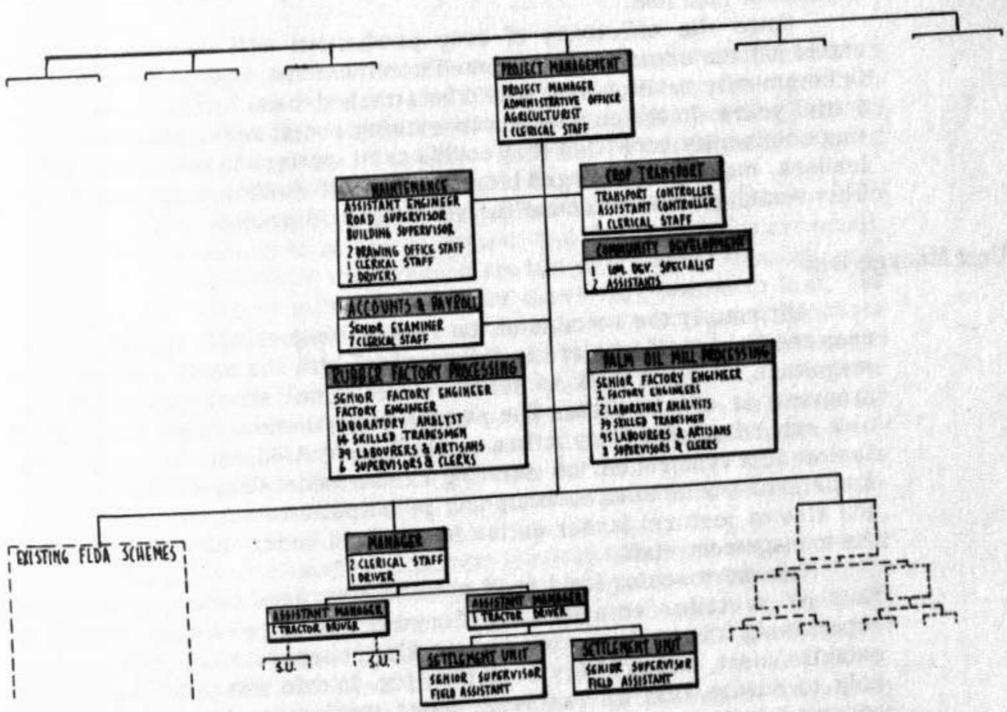
The Land Use Section is particularly important. It would furnish technical advice to projects on crop agronomy, land use practices, fish farming and the like. Much of this technical knowledge would be obtained by keeping in touch with appropriate research and experience outside the Triangle. This would be supplemented by practical information of specific application to Jengka conditions provided by a small investigation staff working within the Section.

Other headquarters sections of the Operations Department include Community Development and Product Transport and Storage. The latter would be concerned mainly with the coordination of all aspects of handling palm oil, palm kernel and rubber, including arrangements for contract transportation, scheduling of movements to ports, and control of product inventories.

Project Management

The concept of the project is that it would be capable of independent implementation and economically viable as a unit. The six proposed projects would thus be planned individually, or possibly in groups of two as has been suggested for the first stage development of Jengka (Chapter 26) and would generally have their own processing facilities. Project Managers should have a high degree of executive autonomy within the Operations Department; they would be subject to instructions directly from the Deputy Executive Director (Operations) and the Executive Director. The management components of the projects with related staff are shown in Figure 25-3. Staff lists and phasing for projects, together with capital and operating costs are given in Appendix 25-2.

Figure 25-3



STAFF TOTALS

PROJECT HEADQUARTERS	
PROJECT MANAGER	6
TRAINEE PROJECT MANAGER	3
ADMIN. OFFICER	6
AGRICULTURIST	6
TRANSPORT CONTROLLER	6
ASSISTANT TRANSPORT CONT.	6
COMMUNITY DEV. OFFICER	6
ASST. COM. DEV. OFFICER	12
ASST. ENGINEER	6
ROADS SUPERVISOR	6
SENIOR EXAMINER ACCTS.	6
CLERICAL etc.	108

SETTLEMENT UNITS (97 UNITS)	MAX.	ULTIMATE
MANAGERS	36	[illegible]
ASST. MANAGERS	76	61
SENIOR SUPERVISORS	148	99
FIELD ASSISTANTS	55	102
CLERICAL etc.	151	120
COMBINED TOTAL	466	397

Project managers should be appointed in time to assist the Planning and Design Section to plan the projects. They should be consulted about the recruitment and appointment of staff.

Key functions at project management level would include factory and mill operations and crop transport. These are vital aspects in oil palm areas and must be closely coordinated. A capable transport controller would be needed to arrange contract hauling services, schedule transport, supervise transport operations, and provide effective liaison with settlement unit managers and staff.

Agricultural extension specialists should be assigned to the headquarters of the projects to advise settlers and settlement unit staff on methods of efficient crop production. They would be in close touch with the Investigation Section at Triangle headquarters and would be the Project Managers' principal assistants in supervising the technical aspects of land use.

Since the efficiency of crop production will depend to a great extent on the creation of contented communities, specialist personnel in community development would be attached to each project during the initial years. In the course of supervising social services and generating community activities they could assist settlers in selection of their leaders, making the villages increasingly self-sufficient in this respect. This would gradually reduce the need for paid project staff.

Settlement Unit Management

Ultimately the success of the Jengka Project will depend largely upon the field staff who are in daily contact with the smallholders. The magnitude of their task in terms of technical efficiency and human progress is considerable. The pattern of settlement units lends itself to a subordinate staff structure of Managers, Assistant Managers and Senior Supervisors on the existing FLDA model (Figure 25-3). Field Assistants would also be assigned, principally to record crop yields, and also to perform lesser duties in the field under the supervision of the management staff.

The more senior field staff should be engaged before clearing is finished in order to assist the Construction Supervision Section in supervising the contractors undertaking conservation, cover crop establishment, and primary crop planting. In this way field staff would help to ensure that all the early basic work is well done, and would become familiar with the character of the land for which they would be responsible. This is the foundation of good farming.

It is important that the field management staff should as far as possible be free from administrative and clerical responsibilities. The proposed structure provides for this. Much of the administrative work both in accounting and loan supervision would be distributed between project and Triangle headquarters staff. At the settlement level clerical staff should be employed to keep essential records only. The short distances between settlements and project headquarters would enable project administrative staff to visit settlement units for the payment of wages and loans and for collection of additional accounting information.

ADMINISTRATIVE DEPARTMENT

At Triangle headquarters centralised accounting procedures utilising modern techniques of data collection, storage and computation are desirable. An Administrative Department is proposed which would provide this service for all elements of the Triangle undertaking, including settler accounts (Figure 25-2). In this way, accounting loads at settlement unit and project level would be reduced, progress reports prepared more rapidly and more detailed cost accounting and cost control achieved. Other functions of the Department would be payroll, personnel, control of inventories, and supervision of maintenance of FLDA staff housing, offices and other facilities. The objective of the Administrative Department would be to assist project and settlement unit management staff in the performance of the primary production responsibility by relieving them of ancillary functions that can be efficiently handled centrally.

STAFF REQUIREMENTS

The principal staff positions and the numbers of staff shown in Figures 25-2 and 25-3 represent a substantial addition to the FLDA establishment. Nearly 40 professionally qualified staff would be required during the next 10 years, and over 110 technically trained managers and assistant managers would be needed.

For several posts, such as that of Executive Director, as well as certain key positions in the Development and Operations Departments, and possibly the project managers of the initial projects, suitable local personnel with the requisite experience may be impossible to find. The First Malaysia Plan anticipates such a situation arising and proposes where a need exists that personnel from other countries be engaged temporarily. It is recommended that the need for such immediate assistance should be considered, most particularly in regard to the post of Executive Director. Provision for this contingency has been made in the financial analyses of the Plan. In the longer term however this and all other posts should be filled by recruitment of local personnel.

Where external staff assistance is necessary steps should at once be taken to recruit trainees locally. The use of project managers from external sources, for example, was assumed in Projects I, II and III. Trainee project managers assigned to these projects would later control Projects IV, V and VI.

Adequate facilities exist in West Malaysia through its University for graduate training of staff for these senior professional posts, and through its technological institutions for technical training of junior staff.

The greatest numbers of personnel are required at settlement unit level. It is proposed that Managers should initially control two of three settlements totalling approximately 2,000 to 2,500 acres, depending upon individual size and location of settlements and managerial capability. Later this number may be increased to three, four or more depending upon circumstances. For purposes of estimation, an ultimate responsibility for approximately four settlements has been assumed. Assistant Managers are each allocated one settlement at the outset but an ultimate responsibility for two has been assumed. The numbers of Senior Supervisors have been assessed on a primary relationship of one for every 50 settlers decreasing ultimately to one for every 100 settlers. The density of staffing at settlement unit is set intentionally high until both staff and smallholders are capable of efficiently fulfilling their functions. The wisdom of this attitude has been proven elsewhere and the sooner efficiency of operation is achieved, the sooner can staff densities be substantially reduced, even perhaps beyond the levels assumed. The project management staff shown in Figure 25-3 are the expected levels when these reductions have taken place.

At the settlement level the most suitable training for managers, assistant managers and senior supervisors is provided in the Diploma Course of the College of Agriculture. The rapidexpansion of the College's training facilities which is now underway and the anticipated establishment of a new College on the East Coast will ensure that sufficient diplomates come forward to meet the annual needs of Jengka. Graduate personnel could also fill managerial posts at settlement unit level; for those capable of accepting greater responsibilities, periods of attachment to settlements provide good practical grounding for the future. Field experience is also important in the training of newly recruited settlement unit staff. The present arrangements whereby this can be provided by estates should be further developed, and FLDA schemes in production should afford the same facilities.

For field assistants the Certificate Courses of the Schools of Agriculture, and those in rubber and oil palms at the College of Agriculture are suitable. By the time field assistants are required in large numbers these existing facilities and additional ones which are expected to be added should meet Jengka's needs.

The facilities available at MARA College for business training ensure that the Jengka intake can be met in respect of administrative staff such as accounts examiners and clerks, stenographers and typists.

The existing in-training courses provided for staff by FLDA, the Rubber Research Institute of Malaya and other research organisations afford opportunities for field personnel to keep abreast of technical changes and improvements. As Jengka develops and staff numbers increase these facilities will require expansion.

STAFF PHASING

Triangle Headquarters

At Triangle headquarters certain responsibilities should be assumed with the minimum of delay. In particular the Executive Director and staff of the Development Department should be in post as soon as possible (Figure 25-4). The investigation staff, because of their long term programme and the Chief Accountant, because of the immediate need for accounting and stores control should start work soon after development operations have commenced.

The assignment of remaining personnel in Triangle headquarters should follow broadly the timing of the development. As development and implementation progress, however, certain categories of staff will disappear. With the completion of crop planting in all projects the responsibilities of the Development Group will end, except for those of the resident construction engineer who will remain until all palm oil mills and rubber factories have been built.

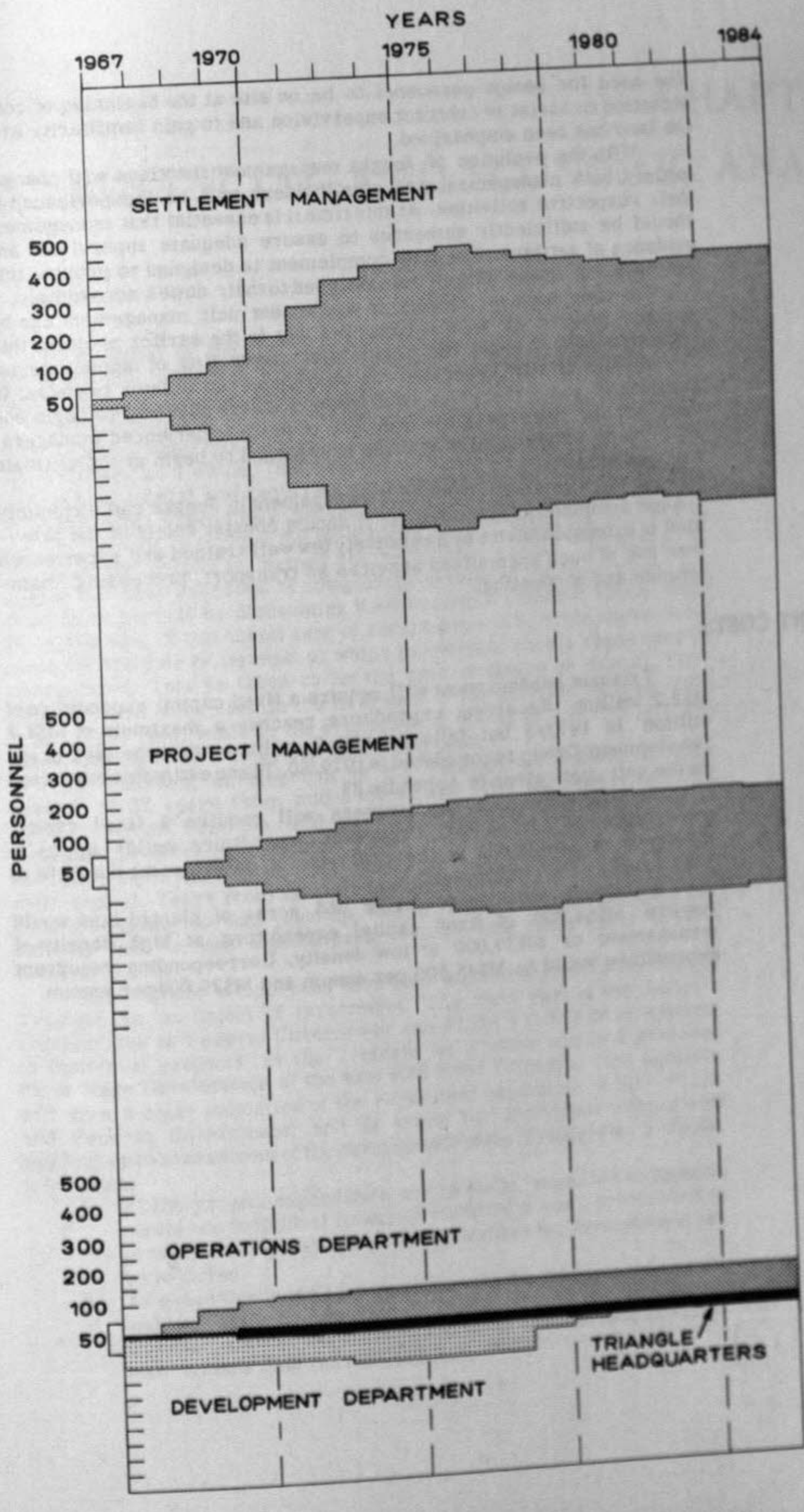
Within the Operations Department community development personnel would have a temporary function only. It is implicit in their work that they prepare the settlers for greater responsibilities, introduce them to a wide range of home and social activities and assist in developing potential leaders. Thereafter the initiative to sustain social development should come from the settlers.

A summary of the intake of all Triangle Staff is given in Appendix 25-4.

Project and Settlement Unit Management

At project and settlement unit management levels, staff build-up would be closely tied to construction and development (Figure 25-4).

Figure 25-4
STAFF PHASING



The need for senior personnel to be on site at the beginning of construction to assist in contract supervision and to gain familiarity with the land has been emphasised.

With the evolution of Jengka management functions will change. Initialy both management and smallholders will be inexperienced in their respective activities. At this time it is essential that management should be sufficiently numerous to assure adequate supervision and guidance of settlers. The staff complement is designed to provide this and different levels of staff are assigned to their duties accordingly.

In time however, levels of settlement unit management can be reduced (Figure 25-4). It is proposed that in the earlier projects this reduction should begin two years after harvesting of tapping starts. The surplus of staff generated can be transferred to later projects. In projects IV and V therefore, staff reductions are assumed to begin one year earlier because of the presence of more experienced managers. In Project VI the level of staffing is assumed to begin at the ultimate reduced density.

It is believed that the role of management in Jengka can ultimately change completely. In the future, it should consist solely of the provision of extension advice by a relatively few well trained and experienced men and of such specialised services as transport, processing, maintenance and accounting.

MANAGEMENT COSTS

Triangle headquarters will require a fixed capital expenditure of M$2.2 million. Recurrent expenditure reaches a maximum of M$1.8 million in 1972/3 but falls to M$0.9 million when the task of the Development Group is completed in 1979/80. These estimates are based on the unit costs given in Appendix 25.

A typical project headquarters will require a fixed capital expenditure of M$568,000. Recurrent expenditure builds up to a maximum of M$403,000 in the fifth year of development but falls to M$305,000 by the twelth year.

A typical settlement unit of 965 acres of planted land would require M$64,000 of fixed capital expenditure at high density of management or M$39,000 at low density. Corresponding recurrent expenditure would be M$48,500 per annum and M$29,000 per annum.

CHAPTER 26

FINANCIAL AND ECONOMIC ANALYSIS

The object of the financial and economic analaysis is to assess the individual financial viability of each project and the economic justification for developing the Triangle as a whole.

Throughout the analysis income and expenditure are assessed with a view to determining the net cash flow of individual projects and the Triangle as a whole, "net cash flow" being the difference between total annual capital and recurrent expenditure and total annual revenue. In years when expenditure exceeds revenue, finance will be required and this period is termed the investment period. When the reverse is the case the period is termed the repayment period. The return on capital has been assessed by comparing the value of the investment and repayment periods by discounting them at rates of interest which range on either side of the actual rate of return expected. From these comparisons the rate of interest at which investment equals repayment is interpolated. This is taken to be the rate of return on capital. Four interest rates were used in the first part of the analysis ranging from 6 to 12 per cent, while in the evaluation at social prices five interest rates varying from 7 to 25 per cent were used.

In analysing development of the Triangle as a whole, a "plan period" of 32 years from mid 1966 to mid 1998 has been taken. Mid 1998 coincides with the mid point at which the first crop cycle of individual projects is completed. Extension of the period analysed will have an insignificant effect on the return on FLDA and Federal Government capital. Years from 1st July to the following 30th June have been used throughout so that planting, which is the critical operation for relating income and expenditures, should take place early in each accounting year.

Two methods of approach have been used in analysing the Jengka Triangle as an object of investment. The main part of the analysis concentrates on Federal Government and FLDA's return on investment in individual projects, in the Triangle as a whole and in a proposed First Stage Development of the east side of the Triangle. This analysis will give a clear indication of the repayment capacities of both FLDA and Federal Government, and is made for individual components building up to assessment of the development of the Triangle as a whole. It includes:

1. FLDA project expenditure and revenue, assessed to demonstrate the individual financial viability of each project and to provide a comparison by which priorities for development can be selected.
2. An assessment of FLDA investment in the Triangle as a whole and its ability to contribute to the cost of development of installations and services essential to agricultural development on new land (infrastructure).

3. Analysis of the expenditure and revenue of other government departments. This enables an assessment to be made of the cost of infrastructure and demonstrates the importance of revenues from forest exploitation.
4. The return to the Federal Government as a whole where the net cash flows of FLDA and the other government departments are combined.
5. Assessment of the effect of Jengka on the international balance of payments and analysis of the Triangle's foreign exchange requirements.
6. A brief analysis of the return on capital of a First Stage Development on the east side of the Triangle.

The latter part of the analysis identifies the return to capital after valuing all revenue and expenditure at prices which reflect their social value, or opportunity cost to the economy as a whole. This analysis provides a measure of the benefit to the economy of developing Jengka and provides a criterion for assessing its priority in using public capital for economic development.

After assessing the financial and economic justification of the Jengka Triangle, an assessment is made of the financing requirements of FLDA and Federal Government. This also includes an analysis of their ability to fulfil an assumed programme of loan repayment from surpluses realized from Jengka.

FLDA PROJECT EXPENDITURE AND REVENUE

Project Capital Expenditure

The estimated capital expenditure required for each project is shown in Table 26-1. The total FLDA capital expenditure for the Triangle as a whole would be about M$240 million. This includes three types of capital expenditure which are shown in more detail and by years in Appendix 26-1. These are the fixed capital expenditure for actual development work, working capital, and those elements of expenditure for maintenance, settlers' income, and management which are incurred during the period of crop immaturity. Components of each type of capital expenditure are as follows:

I Fixed Capital

a) Agricultural development including site preparation (forest clearance, terracing, platforming, drainage, destumping, etc); planting of rubber trees and oil palms and the establishment of cover crops; construction of tertiary roads; and construction of settlers' houses.

b) Structures and equipment for administrative and management purposes at field offices and project headquarters. The costs of similar structures and equipment at Triangle headquarters are shown separately. Triangle Headquarters expenditure is included in the analysis of the Triangle as a whole; it has not been apportioned to individual projects.

c) Structures and equipment for the processing of latex and FFB, including latex collection facilities. This includes an apportionment of the cost of processing factories sited on surrounding FLDA schemes which will take in Jengka produce for processing. This consists primarily of a share of the Ulu Jempol oil palm mill which will process oil palms from Project I.

Table 26 - 1

FLDA Project and Triangle Total Capital Expenditure 1966/7-1987/8, M$ million

	Project I	II	III	IV	V	VI	Triangle Head-quarters	Triangle Total [3]
1. Fixed Capital								
a) Agricultural Development	8.2	10.1	12.4	9.3	10.1	9.6	-	59.7
b) Management	1.4	1.5	2.0	1.6	1.6	1.3	2.2	11.6
c) Processing	5.8	7.6	8.4	6.8	8.3	1.5	0.7 [1]	39.1 [2]
Total Fixed Capital	15.4	19.2	22.8	17.7	20.0	12.4	2.9	110.4
2. Working Capital	3.1	3.8	4.5	3.2	3.6	3.2	-	21.4
	18.5	23.0	27.3	20.9	23.6	15.6	2.9	131.8
3. Immature Period Expenditure								
a) Crop Maintenance	2.1	3.3	3.4	2.2	4.0	3.6	-	18.6
Road Maintenance (Tertiary) and Transport	1.0	1.0	1.3	1.3	0.9	0.8	-	6.3
c) Settler Income	3.8	5.6	6.3	4.1	7.3	6.7	-	33.8
	6.9	9.9	11.0	7.6	12.2	11.1	-	58.7
d) Management	4.7	5.5	6.7	5.7	5.2	4.1	17.5	49.4
	30.1	38.4	45.0	34.2	41.2	30.8	20.4	239.9

1) Palm oil installation at Port Swettenham
2) An additional M$4.8 million will be required to complete factory construction sited on FLDA Schemes
3) Shown itemized in Appendix 26 - 1

2 Working Capital

Working capital is required to finance the processing and marketing operations and other recurrent expenditure. It has been assessed on the basis of M$8 per acre required in the initial year of development. As production rises working capital requirements are assumed to be equal to the f.o.b. value of three months output. At full production, working capital requirements are assumed to remain constant, or fall as production of rubber falls off.

3 Expenditure incurred during the period of crop immaturity

a) Crop maintenance expenditure on fertiliser, weedicides and settlers' tools from planting until the end of the first year of production (up to fourth year after planting of oil palms and sixth year after planting of rubber)

b) Expenditure on the maintenance of tertiary roads and ex-field transport during the investment period of each project.

c) Settlers' income during the same period which is used for crop maintenance.
d) Expenditure on field and project management staff and other administrative costs during the investment period of each project. Similar expenditures on Triangle Headquarters are shown and treated separately in the analysis of the Triangle as a whole.

The capital expenditure in each project varies in proportion to size and in the proportion of oil palm to rubber planted within each project. High capital expenditure in processing occurs in projects I - V which have palm oil mills. High levels of expenditure on settler income and crop maintenance occur in projects V and VI where the effect of the long period of immaturity in rubber is significant.

Excluding capital investment in processing factories, in management during the immature period, in Triangle headquarters and in working capital the average capital cost per planted acre is about M$1,375. This compares with recent expenditure levels by FLDA of M$1,250 - 1,400 per planted acre on small schemes (Appendix 26-1).

Project Recurrent Expenditure

Recurrent expenditure includes costs to FLDA of all operations after the period of crop immaturity and during crop production:

1. Crop maintenance, through the provision of fertiliser and tools to settlers.
2. Harvesting, including the maintenance of tertiary roads, and the transportation to the processing plant from the field (FFB) or from collection stations (latex).
3. Processing and marketing, including maintenance and operating costs (as well as staff salaries and other emoluments) associated with the processing of latex and FFB, and forwarding charges i.e. the costs of moving rubber, palm oil and palm kernels from the processing plant to on board ship at Port Swettenham.
4. Management, which covers maintenance and operating costs (as well as staff salaries and other emoluments) associated with field offices and with project headquarters. Triangle headquarters costs are shown separately and are treated as a project overhead in the analysis of the Triangle as a whole.
5. Settler income assumed to rise from M$1,200 in the second year of production to M$1,800 per annum by the end of the first crop cycle in each project.

Table 26 - 2 shows annual recurrent expenditure in each project after full production has been reached. This level is achieved early in Project I because it is almost entirely an oil palm project; later projects with large rubber acreages do not reach full production until the late 1980's. Most recurrent expenditure is constant during full production, apart from minor changes in expenditures on processing and marketing in later years. Settler income however, rises throughout each project's first crop cycle which is assumed to be 25 years. Total recurrent expenditure rises to M$41.1 million by 1997/8.

Table 26-2
FLDA Project and Triangle Annual Recurrent Expenditure 1)
at Full Production M$ million

	Project I	II	III	IV	V	VI	Triangle Head-quarters	Triangle Total 3)
1. Crop Maintenance	1.0	1.1	1.5	1.1	1.0	0.9	-	6.6
2. Harvesting Roads and Transport	0.6	0.5	0.7	0.5	0.5	0.5	-	3.3
3. Processing and Marketing	1.4	1.5	2.0	1.5	1.4	0.9 2)	-	8.7
4. Management	0.7	0.8	0.9	0.8	0.9	0.8	0.9	5.8
	3.7	3.9	5.1	3.9	3.8	3.1	0.9	24.4
5. Settler Income 1985/6	2.1	2.6	3.1	2.2	2.6	2.4	-	15.0
Total Recurrent Expenditure 1985/6	5.8	6.5	8.2	6.1	6.4	5.5	0.0.9	39.4
6. Settler Income 1977/8	2.2	2.8	3.4	2.4	3.1	2.8	-	16.7
Total Recurrent Expenditure 1997/8	5.9	6.7	8.5	6.3	6.9	5.9	0.9	41.1
Start of Full Production	1979	1982	1983	1982	1985	1989		1989

1) Excludes land taxes payable to the State of Pahang at M$6 per acre.
2) At full production in 1989 expenditure should be M$1.2 million. At Triangle level in 1989 this rise of M$0.3 million is offset by falling expenditure on rubber processing and marketing in Project II.
3) Itemized in detail in Appendix 26-2

Phasing of Project Capital and Recurrent Expenditure

The phasing of project capital expenditures has been computed on the basis that all development operations from felling to lining and holing take place in the year of clearing (Year 0) and that the construction of tertiary roads also takes place in the same year. Planting is assumed to be the first operation of Year 1. The preparation of the village area and construction of settler houses also take place in this year. Production from planted oil palms is assumed to commence in the fourth year after three complete years of immaturity and to reach full production in the eleventh year. The immature period of rubber is taken as five full years from planting - tapping commencing in the sixth. Full production of rubber is taken to occur in the fourteenth year.

The phasing plan used assumes that each project would be developed in the order and pattern shown in Chapter 15. This assumes that the first 4,000 acres of Project I would be planted in the second half of 1967 and would produce small quantities of fresh fruit bunches in 1970/1.

Project Revenue

The annual revenue from individual projects is shown in Table 26-3 for the period from the first year of production of Project I (1970/1) to full production in Project VI (1985/6) and at five yearly intervals thereafter. Expected f.o.b. prices for oil palm and rubber products are also shown for selected years in Table 26-3. Estimated project revenue is the f.o.b. value of rubber, palm oil and palm kernels less the value of duties and cesses. It is assumed that FLDA will become eligible like private estates for a refund of that part of the rubber cess assigned for replanting purposes.

Table 26 - 3
FLDA Project 1) and Triangle Revenue M$ million

Project	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	1983/4	1984/5	1985/6	1990/1	1995/6	1997/8
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	10.2	10.1	10.0	9.9	9.4	9.2	9.2
II	-	-	2 2	5.1	8.0	9.3	10.5	11.5	12.2	12.5	12.6	12.6	12.5	12.4	12.3	12.2	11.6	11.2	11.2
III	-	-	-	1.7	6.0	10.1	12.9	14.0	14.9	15.3	15.5	15.6	15.5	15.6	15.2	15.3	14.4	14.1	14.1
IV	-	-	-	-	-	2.6	6.4	9.6	10.4	11.0	11.2	11.4	11.5	11.5	11.2	11.1	10.5	10.4	10.4
V	-	-	-	-	-	-	1.8	3.5	5.8	6.7	8.6	10.5	11.7	12.7	13.1	13.4	13.1	12.7	12.5
VI	-	-	-	-	-	-	-	1.6	3.2	4.7	5.2	6.9	8.7	9.8	10.6	11.1	11.3	11.0	10.8
Less: Transfer Payment [1]	-	-	-	-	-	-	(0.4)	(0,3)	(0.6)	(0.7)	(0.8)	(0.8)	(0.8)	(0.9)	(0.9)	(0.9)	(0.9)	(0.9)	(0.9)
TOTAL	1.2	4.1	9.4	16.3	24.4	32.7	42.1	50.9	56.7	60.1	62.7	66.5	69.3	71.2	71.5	72.1	69.4	67.7	67.3

Expected f.o.b. Price [2]				
M$ per ton	1970/1	1980/1	1990/1	1997/8
Palm oil	550	450	405	400
Palm kernels	350	300	277	275
M cents per lb.				
Rubber	60	50	46	45

1) Incomes per acre for years 1970/1 - 2000/1 shown in Appendix 26 - 3
2) Revenue included in Projects IV and V for processing of oil palm from Projects V and VI. M$0.4 million 1976/7 applies to revenue from Project IV. Thereafter transfer payments apply to revenue from Project V.

Levels of revenue are a function of project size and the proportion of oil palm land. The speed at which revenue is generated is again dependent on the proportion of oil palm land and on the project's individual phasing pattern. Thus Project IV, being developed over 2 years and being all oil palm, generates a large and rapid income by comparison with other projects.

The effect of falling prices in both rubber and oil palm products has the effect of depressing incomes per acre in the later projects. This reduces the value of inter project comparisons made using these patterns of revenue.

Return on Capital of Individual Projects

Using the project revenues and expenditures summarised in Table 26 - 1, 26 - 2 and 26 - 3, the net cash flows for each project have been computed and are shown in Figures 26 - 1 to 26 - 6 up to 1998. The periods of cash flow for the earlier projects finish 3 to 4 years before the end of the plan period as a whole. Those for the later projects finish 3 to 4 years after the end of the plan period. The composition of the cash flows of each project are shown in Appendix 26 - 3. In addition to the expenditure summarised in Tables 26 - 1 and 26 - 2 the project cash flows include small sums for each project provisionally set aside to meet land taxes which may become payable to the State of Pahang.

These consist of a premium of M$60 per acre paid as the crop comes into production and an annual rent of M$6 per acre thereafter. These provisional costs are based on tax levels charged at present in other States.

Projects I, III and IV generate substantial surpluses immediately after the end of their respective investment periods. Projects II, V and VI with their higher proportion of rubber require a longer period to reach peak levels of surplus. All projects suffer declining surpluses in the later years of their first production cycles.

Using the discounting process, rates of return on capital for individual projects have been interpolated (Appendix 26-8) and are shown in Table 26-4. The factors affecting the return on capital are complex. Size and a high proportion of oil palm acreage tend to increase the return on capital. Early development enjoys higher product prices, but this is counteracted in some degree by the greater density of management planned for the first years of the earlier projects. These factors result in a fairly narrow range of profitability.

Table 26-4
Return on FLDA Capital by Projects

Project	Planted Acreage	Percent Oil Palm	Investment Period	Repayment Period	Percent Return on Capital [1]
I	12,100	95	1966 - 1973	1973 - 1994	11.1
II	15,600	69	1968 - 1974	1974 - 1996	10.6
III	18,800	87	1969 - 1975	1975 - 1997	11.0
IV	13,500	100	1971 - 1977	1977 - 1999	10.5
V	17,200	40	1972 - 1978	1978 - 2000	9.7
VI	15,800	40	1973 - 1980	1980 - 2001	9.4

1) See Appendix 26 - 8

The rates of return shown in Table 26 - 4 indicate that all projects will be able to make a contribution to Triangle Headquarters and infrastructure in that they show a substantial margin in excess of 6 to 7 per cent. This is the rate of return that would be required, if each project was to break even by recovering its own development expenditure. Even projects V and VI, in which a high proportion (60 per cent) of land is planted to less profitable rubber, make returns to capital of 2.5 - 3 per cent in excess of the minimum return that would be required for them to break even. This is mainly due to a reduced density of management in these projects.

Comparison of Projects

In addition to the foregoing project analysis, which have included the effects of falling commodity prices, a comparison of projects has also been made wherein these distorting factors have been largely removed. By this means a fair comparison between projects can be

Figure 26 - 1

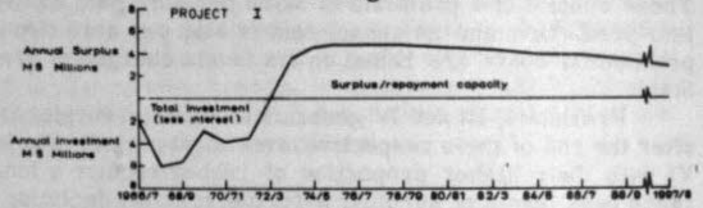


Figure 26 - 2

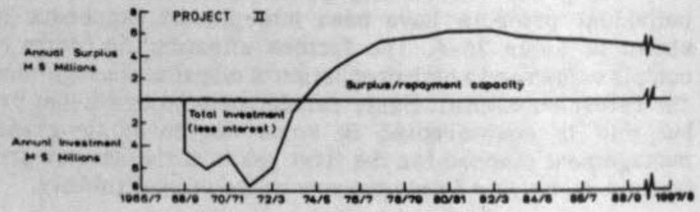


Figure 26 - 3

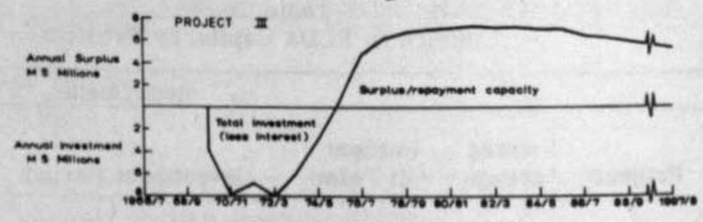


Figure 26 - 4

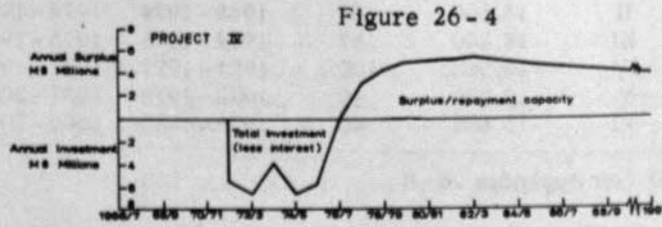


Figure 26 - 5

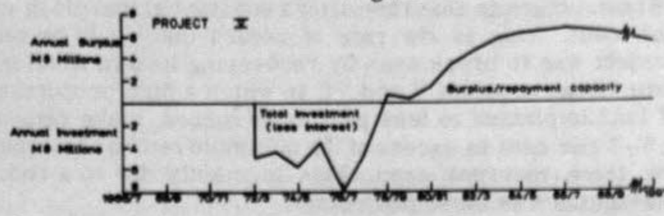
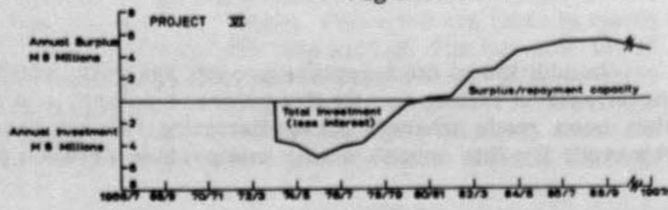


Figure 26 - 6



made and priorities for investment in individual projects can be demonstrated. While the cash flows during the investment period have been left unadjusted, revenues from all projects during the repayment period have been assessed using the oil palm product prices ruling from 1975 to 1982 for the seven years to full production and at constant incomes per acre thereafter. The rubber prices used assumed a similar planting date to oil palms. Incomes during the eight years to full production are assessed at prices ruling from 1977 to 1985 and at constant incomes per acre thereafter. The rates of return on capital from this analysis were significantly higher than those shown in Table 26-4. This is caused by the assumption of constant rather than falling incomes.

The cash flows and rates of return on capital for the comparisons on these bases are shown in Appendix 26-4.

The analysis revealed a much wider range of profitability than demonstrated in Table 26 - 4 for the condition of falling prices. Projects V and VI became clearly less profitable than the other four. While Projects I and III reamained the best investment, Project IV being 100 per cent oil palm was only slightly inferior to them. Project II was shown to have a return to capital, lower but within one per cent of Project IV.

This analysis showed clearly the advantages of phasing Projects V and VI last. However, it also revealed that were it not for special factors which determine the location of the first phase, Project III would have a high priority as a first stage project. Chapter 15 provides some alternative phasing plans for the later years of development in Jengka. With projects V and VI making less good use of investment funds than the other projects which have higher proportions of land planted to oil palms, the alternatives suggested in Chapter 15 should be seriously considered either separately, or in combination.

FLDA Full Triangle Development

Expenditure, Revenue and Cash Flow - The FLDA capital cost of development of the Triangle as a whole (Table 26 - 5) is the total of the capital cost of all projects plus capital expenditure on Triangle head-quarters. The total capital expenditure by FLDA required to bring all projects into production would be about M$240 million. Of this total about M$170 million would be needed during the seven years 1970/1 - 1976/7 and expenditure would rise to a peak of M$31.2 million in 1972/3.

Recurrent expenditure rises throughout the production period from 1970/71 onwards (Table 26 - 6). Settlers' income which forms over 50 per cent of recurrent expenditure after 1982 also rises steadily throughout the period. All other recurrent expenditure remains constant after 1985/6. Transfer payments, consisting of revenues accruing to projects having processing plants, and expenditures incurred by those without plants, have been excluded. Triangle revenue comprises the total of revenue from all six projects shown in Table 26 - 3.

Total annual expenditures both capital and recurrent are shown in Table 26 - 7. The expenditure by FLDA for State land taxes is shown separately. The FLDA revenue from the Triangle has been set against this total expenditure to give the net cash flow. This is shown in Figure

26 - 7 and forms the basis of all financial requirements and repayment capacity. To demonstrate the effects of price changes in the primary commodities, Figure 26 - 7 also shows the effect on cash flow of a rise and fall of 10 per cent in prices received by FLDA.

Figure 26 - 7
FLDA Triangle Cash Flow

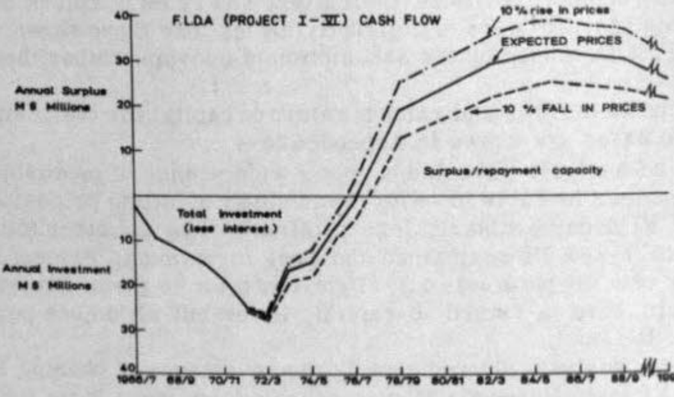


Table 26 - 5
FLDA Total Capital Expenditure
For Full Triangle Development in M$ million

1. FIXED CAPITAL	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	1982/88	Total 1) 1966/7-1987/8
a) Agricultural Development																		
Land Preparation	0.9	1.5	2.0	2.5	2.7	2.6	2.3	2.2	1.9	1.7	-	-						20.3
Crop Establishment	0.2	0.9	1.4	1.9	2.2	2.3	2.2	2.2	1.9	1.2	0.6	-						17.0
Tertiary Roads	0.5	0.8	1.0	1.1	1.2	1.3	1.2	0.9	0.4	0.4	0.3	-						9.1
Settlers' Houses	-	0.6	1.0	1.3	1.6	1.7	2.7	1.1	1.7	0.5	1.1	-						13.3
	1.6	3.8	5.4	6.8	7.7	7.9	8.4	6.4	5.9	3.8	2.0	-						59.7
b) Management																		
Field Offices	0.1	0.6	0.5	0.7	0.9	1.0	0.8	0.5	0.5	0.3	0.1	0.1						6.1
Project Headquarters	-	0.5	0.5	0.6	-	0.5	0.6	0.5	-	-	-	0.1						3.3
Triangle Headquarters	-	1.9	0.2	0.1	-	-	-	-	-	-	-	0.1						2.2
	0.1	3.0	1.2	1.4	0.9	1.5	1.4	1.0	0.5	0.3	0.1	0.2						11.6
c) Processing																		
OnTriangle Processing	-	-	-	-	-	4.0	6.7	2.2	4.8	4.2	4.0	2.7	0.1	0.9	0.7	0.7	0.6	31.6
Peripheral Processing	-	-	1.1	-	2.0	2.1	1.3	-	0.4	-	0.6	-	-	-	-	-	-	7.5
	-	-	1.1	-	2.0	6.1	8.0	2.2	5.2	4.2	4.6	2.7	0.1	0.9	0.7	0.7	0.6	39.1
Total Fixed Capital	1.7	6.8	7.7	8.2	10.6	15.5	17.8	9.6	11.6	8.3	6.7	2.9	0.1	0.9	0.7	0.7	0.6	110.4
2. WORKING CAPITAL	-	0.1	0.1	0.1	0.4	0.9	1.5	1.9	2.4	2.5	2.6	2.3	1.6	0.9	0.8	1.1	2.2	21.4
Fixed and Working Capital	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
3. IMMATURE PERIOD EXPENDITURE																		
Agricultural Expenditure:																		
a) Crop Maintenance	-	0.1	0.3	0.5	1.1	1.6	1.8	1.9	1.9	2.3	2.2	1.7	1.2	1.0	0.7	0.3		18.6
b) Harvesting and Roads	-	0.1	0.2	0.3	0.5	0.8	0.7	0.9	0.8	0.5	0.7	0.5	0.3	-	-	-		6.3
c) Settler's Income	-	0.2	0.8	1.5	2.3	3.1	3.6	3.7	3.7	3.6	3.2	1.6	1.6	1.2	1.0	0.5		33.8
	-	0.4	1.3	2.3	3.9	5.5	6.1	6.5	6.4	6.4	6.7	5.4	3.1	2.2	1.7	0.8		58.7
d) Management																		
Project O and M	0.2	0.7	1.4	2.1	2.9	3.8	4.0	4.4	3.8	2.8	2.9	2.1	0.8	-	-	-		31.9
Triangle Headquarters O and M	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	2.0	2.8	3.8	4.6	5.5	5.8	6.2	5.6	4.6	4.6	2.1	0.8	-	-	-		49.4
Total Immature Period Expenditure	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	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) See Table 26 - 1 and Appendix 26 - 1
2) The immature period applies to projects individually and continues until the second year of production, or where project revenue exceeds expenditure

Table 26 - 6
FLDA Recurrent Expenditure during production at full Triangle Development[1] M$ million

	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
Agriculture															
Crop Maintenance	-	0.3	0.9	1.6	2.4	3.1	4.1	5.0	5.6	5.6	5.8	6.2	6.6	6.6	6.6
Harvesting Roads and Transport	-	-	0.5	0.5	0.9	1.2	1.5	2.3	2.6	3.0	3.1	3.2	3.3	3.3	3.3
Settler's Income	-	0.5	1.3	3.0	3.9	5.3	6.8	8.3	10.0	10.5	11.6	13.0	15.0	15.7	16.7
	-	0.8	2.7	5.1	7.2	9.6	12.4	15.6	18.2	19.1	20.5	22.4	24.9	25.6	26.6
Management															
Projects O and M	-	-	1.0	0.9	1.9	3.1	2.7	3.7	4.4	5.2	5.0	5.0	4.9	4.9	4.9
Triangle O and M	-	-	-	-	-	-	-	1.5	1.2	1.0	0.9	1.0	0.9	0.9	0.9
			1.0	0.9	1.9	3.1	2.7	5.2	5.6	6.2	5.9	6.0	5.8	5.8	5.8
Processing															
Processing O and M	0.2	0.5	1.2	2.0	3.1	4.1	6.1	6.6	7.7	8.3	8.8	9.0	9.6	9.6	9.6
Less: Transfer Payments	-	-	-	-	-	-	0.4	0.3	0.6	0.7	0.8	0.8	0.9	0.9	0.9
	0.2	0.5	1.2	2.0	3.1	4.1	5.7	6.3	7.1	7.6	8.0	8.2	8.7	8.7	8.7
Total	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

1) See Appendix 26 - 2.

Table 26 - 7
FLDA Expenditure, Revenue and Cash Flow Full Triangle Development M$ million

	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
Expenditure																			
Capital[1]	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[2]	-	-	-	-	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					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	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
Revenue[3]	-	-	-	-	1.2	4.1	9.4	16.3	24.4	32.7	42.1	50.9	56.7	60.1	62.7	66.5	72.1	69.4	67.3
Net Cash Flow Deficit[4]	2.7	9.3	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	23.9	26.3	31.9	28.7	25.6

1) See Table 26 - 5 2) See Table 26 - 6 3) See Table 26 - 3
4) The total deficit from 1966/7 to 1976/7 is M$149.9 million

From Table 26 - 7 it can be seen that FLDA's investment period will be 11 years from 1966/7 to 1976/7 after which FLDA would generate a cash surplus from the Triangle as a whole, although investment would still continue in individual projects (V and VI). The total investment required would be about M$149 million which represents the sum of accumulated cash flow deficits 1966/7 - 1976/7. This sum, plus interest, is the FLDA financial requirement for Jengka.

The annual cash surplus would rise to M$31.9 million by 1985/6. Estimated cash surplus would fall to M$25.6 million per year by the end of the plan period as a result of rising settler incomes and falling commodity prices.

Return on capital - Using the discounting process FLDA would obtain a return of 9.1 per cent (Appendix 26-8) on its investment at the level of settler income proposed. This represents a very adequate return in view of the likely interest rate on capital of 6 - 7 per cent and would allow the Triangle as a whole to provide a surplus after loan repayment for Triangle infrastructure, or other FLDA development. The effect of a 10 per cent rise and fall in the prices expected to be obtained by FLDA would be significant. The return on capital with prices 10 per cent higher throughout the period than those expected would be 11.4 per cent. A similar fall by 10 per cent would reduce the return on capital to 6.4 per cent (Appendix 26-8).

OTHER GOVERNMENT DEPARTMENTS

Analysis to all other government departments as a single entity has been made to show the cost of providing infrastructure for the whole Triangle and to demonstrate the importance of certain aspects of development which come outside the scope of FLDA.

Infrastructure Expenditure

Expenditure on infrastructure has been divided into three groups: (1) urban, (2) rural, and (3) expenditure on education, health and public administration which has been termed 'rural and urban'. The components of each of these groups are described in the following paragraphs. Expenditure on fixed capital and long term recurrent expenditure are shown for each of these groups in Table 26 - 8. In Table 26 - 9 annual total expenditure on infrastructure is shown for the period 1967 - 82; the constant recurrent expenditure on infrastructure incurred from 1982/3 onwards is also indicated.

Table 26 - 8
Cost of Infrastructure at Full Development in M$ million

	Urban Expenditure: Fixed Capital	Urban Expenditure: Recurrent 1978/9 onwards
Site Preparation	4,900	-
Town Roads	7,500	157
Water Supply	2,320	148
Telecommunications [1]	2,900	123
Postal Services [1]	440	166
Police 1)	2,270	714
Electric Power	3,400	520
Sanitation and Drainage	3,430	35
Airport	1,150	41
Miscellaneous	1,000	96
	29,310	2,000

	Rural Expenditure: Fixed Capital	Rural Expenditure: Recurrent 1977/8 onwards
Primary and Secondary Roads	28,459	1,200
Village Water Supply	13,252	1,164
River channel improvement	20	70
Village Community Facilities	1,579	313
	43,310	2,747
Plus 10% to cover other miscellaneous services		275
		3,022

	Rural and Urban Expenditure: Fixed Capital	Rural and Urban Expenditure: Recurrent
Health	4,433	670
Education	25,570	37,850
Public Administration	5,000	250
	35,003	39,770 [2]

1) These also provide limited services for the rural area.
2) Excluded throughout the economic and financial analysis.

Urban Infrastructure - Urban infrastructure expenditure comprises the fixed capital required to develop the three towns planned for Jengka and includes site preparation, town roads, sanitation, water supply and electric power (Chapter 16). Fixed capital and recurrent expenditures for urban infrastructure include some items which will also serve the rural areas. These include telecommunications, police, and postal services. The total fixed capital investment is M$29.3 million.

The phasing programme assumes equal annual expenditure of fixed capital for urban infrastructure over a 12 year period from 1968/9 to 1979/80 (Table 26 - 9). The recurrent expenditure required to operate these services is assumed to rise until 1978/9. Thereafter expenditure is estimated to be M$2.0 million annually.

Table 26 - 9

Cost of Infrastructure by years to 1981/2 - For Full Triangle Development M$ million (Expenditure by Other Government Departments)

	Total Fixed 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	Onwards
Urban																	
Capital Expenditure	29.3	-	2.5	2.4	2.5	2.4	2.5	2.5	2.4	2.5	2.4	2.4	2.4	2.4	-	-	-
Recurrent Expenditure	-	-	.4	.7	.7	1.4	1.4	1.4	1.6	1.7	1.7	1.9	2.0	2.0	2.0	2.0	2.0
		-	2.9	3.1	3.2	3.8	3.9	3.9	4.0	4.2	4.1	4.3	4.4	4.4	2.0	2.0	2.0
Rural																	
Capital Expenditure	43.3	2.1	4.7	2.8	3.9	6.6	4.6	4.9	3.4	4.1	4.9	1.3	-	-	-	-	-
Recurrent Expenditure	-	.2	.4	.6	.8	1.2	1.5	1.8	2.0	1.5	2.8	3.0	3.0	3.0	3.0	3.0	3.0
		2.3	5.1	3.4	4.7	7.8	6.1	6.7	5.4	6.6	7.7	4.3	3.0	3.0	3.0	3.0	3.0
Rural and Urban																	
Capital Expenditure only :-																	
Schools and Health Centres	30.0	-	2.2	2.2	2.1	2.2	2.1	2.2	2.1	2.1	2.2	2.2	2.1	2.1	2.1	2.1	-
Administrative Buildings	5.0	-	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5	-	-	-	-	-
		-	2.7	2.7	2.6	2.7	2.6	2.7	2.6	2.6	2.7	2.7	2.1	2.1	2.1	2.1	-
	107.6	2.3	10.7	9.1	10.5	14.3	12.6	13.3	12.1	13.4	14.5	11.3	9.5	9.5	7.1	7.1	5.0
Rural and Urban Recurrent Expenditure Education, Health and Public Administration		-	0.2	4.0	7.8	11.8	15.6	19.5	23.3	27.2	30.8	34.5	35.8	36.8	37.8	38.8	38.8

Rural Infrastructure - Rural infrastructure expenditure consists mainly of the construction, operation and maintenance of the primary and secondary road network and the water supply units for the settlement unit villages. Fixed capital expenditure in rural infrastructure amounts to M$43.3 million. A small allowance (M$1.6 million) has been made for river channel improvement and for such village community facilities as recreational areas, markets, meeting halls and religious buildings.

Phasing of road and water supply expenditure has been made on the basis of the road construction programme in Chapter 18; the construction programme for settlement water supply follows the phasing of settlement units. In phasing fixed capital expenditure for other items, equal instalments over an 11 year period from 1967/8 to 1977/8 have been assumed. Phasing of total fixed capital expenditure is shown in Table 26 - 9.

Recurrent expenditure on rural infrastructure consists principally of maintenance of roads and operation of the water supply. This latter function, although in practice a State as opposed to Federal Government responsibility, has been included. Its cost has been offset by including, as Federal revenue, the income received from the rural population for the operation of the service. Recurrent expenditure is assumed to reach a long term level of M$3.0 million by 1977/8, and is assumed to remain constant thereafter.

Rural and Urban Infrastructure - The category rural and urban infrastructure requires special treatment and consists of expenditure on education, health and public administration. Since settlement in Jengka will involve development of new land, fixed capital expenditure in building new schools, health centres and public department offices represents a true cost of new land development. Consequently these have been included in the total expenditure used to assess the return on capital for Jengka. This capital expenditure amounts to M$35.0 million and has been phased evenly over a 14 year period from 1968/9 to 1981/2.

The recurrent expenditure incurred for education, health and public administration rises with the investment in buildings to M$39.8 million annually by 1981. This expenditure is shown in Tables 26 - 8 and 26 - 9. It is excluded throughout the economic and financial analyses because the operation of these services is not considered to represent an additional cost incurred as a result of Jengka development. This expenditure will be offset by the transfer of teachers, doctors, and government staff from elsewhere in Malaysia. Were there additional expenditure to the Federal Government for operations of these services, it would arise from a policy of national improvement in them.

It is recognized that some proportion of the recurrent rural and urban expenditure is a true charge to development of new land. This consists of the expenditure incurred on maintaining the buildings whose cost has been included as a fair charge on development. It has not been possible to identify this expenditure; it is not considered to be significant.

Total fixed capital expenditure of other government departments on infrastructure is estimated to be M$107.6 million. Recurrent expenditure is assumed to rise between the years 1968/9 and 1978/9 to M$5.0 million per year and to remain constant thereafter.

Revenue

The revenue received by other government departments is shown in Table 26 - 10. The principal sources of revenue are:

1. Export duties at 7.5 per cent on the f.o.b. value of palm oil and palm kernels and at 4 per cent on the f.o.b. value of rubber. Additional revenue will be received from the non-refundable element (7/8 cents per lb) of the total rubber cess of $5\frac{3}{8}$ cents per lb levied on exports. FLDA is assumed to receive the remaining 4.5 cents per lb.
2. Sundry taxes including additional commercial vehicle taxes, which will accrue as contractors acquire lorries to transport Jengka commodities outside and within the Triangle.
3. Import duties, half the value of which is estimated to accrue from the M$10 per ton on artificial fertiliser. Malaysia is not self sufficient in artificial fertiliser and additional imports will be required whether FLDA buy local or imported supplies. The other half is estimated to accrue from import and excise duties on such things as fuel and other dutiable

commodities used in Jengka. Port Swettenham Authority will also receive M$1.50 per ton of cargo sent through the port.

4. Revenue from the sale of urban land varying in amount from residential, commercial and industrial land within the three towns. This is expected to amount to M$15.6 million received evenly over the period within which expenditure is incurred on urban development.
5. Revenue from supplying certain public services has also been included. These comprise charges for telecommunications, electricity supply and postal services. Also included as a Federal Government item is the revenue to be received for operating the rural and urban water supplies. This has been included to offset the cost of operation.
6. Company Taxes including taxes on profits made by the timber industry; these are expected to total about M$39 million, most of which will be received in the eight years from 1970/1 - 1977/8. Taxes from other industry are assumed to be comparable to those received from the timber industry. However, it is assumed that profits and taxes from other industry will rise by 1981/2 to nearly 50 per cent of the 1977/8 level in the timber industry and to 100 per cent of this level by the end of the plan period 1998.

Table 26 - 10
Revenue to Other Government Departments
from Full Triangle Development - M$ million

	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 to 1997	1997/8
Federal Government																
Export Duties and non-refundable cesses	-	-	-	0.1	0.3	0.7	1.3	2.0	2.7	3.4	4.1	4.5	4.8	5.0	rising	5.1
Motor Vehicle Taxes	-	-	-	0.3	0.3	0.3	0.3	0.3	0.6	0.6	0.6	0.6	0.6	0.9	rising	1.3
Import Duties	-	0.1	0.2	0.2	0.2	0.4	0.4	0.5	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Port Charges	-	-	—	-	-	0.1	0.1	0.1	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.3
Sale of Urban Land	-	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	-	-	-
Public Services [2]	0.1	0.3	0.6	0.7	1.1	1.2	1.4	1.5	1.8	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Company Taxes:																
Timber Industry	0.3	1.5	2.6	2.8	3.1	3.6	4.3	4.6	4.6	4.6	4.6	2.3	-	-	-	-
Other Industry	-	0.4	0.5	0.7	0.7	1.0	1.1	1.2	1.4	1.6	1.7	1.9	2.0	2.1	rising	4.6
	0.4	3.6	5.2	6.1	7.2	8.6	10.3	11.6	13.1	14.1	15.1	13.5	11.6	10.9	rising	13.9
State Revenue [1]																
Timber Royalties	0.3	2.2	2.3	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	1.1				
Land Taxes	-	-	-	0.4	0.6	0.8	0.9	1.1	1.3	1.3	1.0	0.7	0.9	1.2	0.6	0.6
	0.3	2.2	2.3	2.6	2.8	3.0	3.1	3.3	3.5	3.5	3.2	1.8	0.9	1.2	0.6	0.6

1) Excluded in assessing Government repayment capacity.
2) Including State Water Supply.

Due to the rapid generation of revenues from taxes on timber profits, revenue to other government departments rises rapidly to M$10.3 million by 1973/4 and reaches a peak of M$15.1 million in 1977/8. After a decline in revenue to M$10.9 million in 1980/1, revenue is expected to rise steadily throughout the rest of the plan period.

The revenues assumed to accrue to the State of Pahang are shown separately in Table 26 - 10. These arise from royalties from timber extracted in the logging operation and from land taxes on agricultural land. These have been excluded from any analysis of repayment capacity since Federal Government is unable to acquire any direct revenue from the State government, or to effect savings by reductions in Federal Government grants to State government.

Cash Flow and Return on Capital

The cash flow of other government departments as a single entity is shown in Figure 26 - 8. The investment period will be ten years from 1967 to 1977 during which M$32.7 million would be required to finance the cash deficit, not including interest.

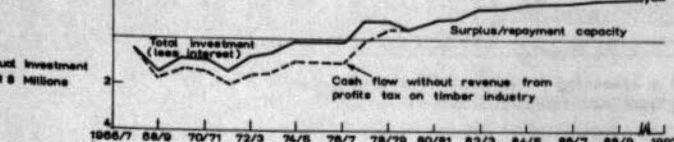
The discounting process gives a return on capital of 9.1 per cent to other government departments (Appendix 26 - 8). This provides a clear margin over the 6 - 7 per cent return that would be required to enable revenues to provide adequate repayment capacity.

The expenditure on construction of schools, health centres and public offices forms a large part of investment. If this expenditure is excluded from the investment, a return on capital well in excess of 12 per cent is estimated.

The importance of the taxes from timber as government revenue must be emphasized. Exclusion of these taxes from revenue reduces the return on capital to 4.5 per cent which would be insufficient to provide financial viability. The contribution to profitability of revenue from timber profits is very significant because it makes substantial reductions in the investment required for development of the essential infrastructure.

The implications of this analysis are that provision of infrastructure for Jengka can be justified without drawing on FLDA surplus. Provision of infrastructure is financially sound by itself regardless of the system of agricultural development either by the public, or private sector. This arises as a direct result of efficient forest exploitation.

Figure 26 - 8



Analysis to the Federal Government as a whole has been made to demonstrate the combined effect of the investment and revenues from both agricultural development by FLDA and the provision of infrastructure by other government departments. The Federal Government capital expenditure for the Triangle as a whole, which includes the capital expenditure of FLDA to bring all Projects into production (M$239.9 million) and the capital expenditure of other government departments to provide infrastructure (M$107.6 million), is estimated at M$347.5 million.

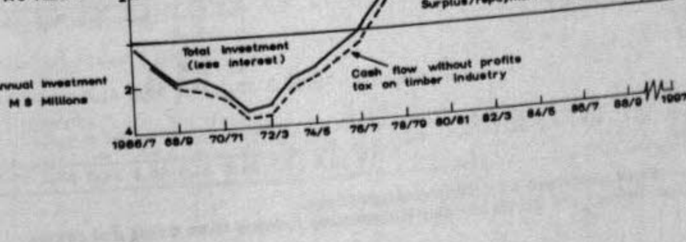
Since it is likely the Federal Government will be the receiving and repaying agency for any external loan, it is important to assess its own repayment capacity. The combined cash flows of FLDA and other government departments are shown in Table 26-11 and in Figure 26-9. The investment period would be for 11 years from 1966/7 to 1976/7 during which a total of about M$182 million would be required to finance the cash deficit. Requirements for investment would build up steadily to reach a peak of M$32.3 million in 1971/2.

Table 26 - 11
Federal Government Revenue,
Expenditure and Cash Flow - Full Triangle Development
M$ million

	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
Expenditure																			
FLDA 1)	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
Other Government Departments 2)	-	2.3	10.7	9.1	10.5	14.3	12.6	13.3	12.1	13.4	14.5	11.3	9.5	9.5	7.1	7.1	5.0	5.0	5.0
TOTAL	2.7	11.6	22.6	23.5	30.6	43.6	49.5	46.4	51.4	53.3	57.2	52.1	46.7	47.3	45.9	47.3	45.2	45.7	46.7
Revenue																			
FLDA 3)	-	-	-	-	1.2	4.1	9.4	16.3	24.4	32.7	42.1	50.9	56.7	60.1	62.7	66.5	72.1	69.4	67.3
Other Government Departments 4)	-	0.4	3.6	5.2	6.1	7.2	8.6	10.3	11.6	13.1	14.1	15.1	13.5	11.6	10.9	11.3	12.6	13.1	13.9
TOTAL	-	0.4	3.6	5.2	7.3	11.3	18.0	26.6	36.0	45.8	56.1	66.0	70.2	71.7	73.6	77.8	84.7	82.5	81.2
Net Cash Flow Deficit	2.7	11.2	19.0	18.3	23.3	32.3	31.5	19.8	15.4	7.5	1.1	-	-	-	-	-	-	-	-
Surplus	-	-	-	-	-	-	-	-	-	-	-	13.9	23.5	24.4	27.7	30.5	39.5	36.8	34.5

1) Table 26 - 7
2) Table 26 - 9
3) Table 26 - 3
4) Table 26 - 10

Figure 26 - 9



The Federal Government would first realize a cash surplus in 1977/8. This would rise to M$24.4 million within the next two years and thereafter rise to a peak of M$39.5 million in 1985/6 before declining as a result of falling f.o.b. prices to the end of the plan period.

The return on capital to Federal Government is 9.1 per cent (Appendix 26-8), given the levels of settler income proposed in this report. This represents an adequate margin over expected rates of interest on international, or government borrowing of 6 - 7 per cent. The exclusion of timber taxes reduces the return to 7.8 per cent which provides only a small margin over market rates.

If allowance is taken for a rise or fall of 10 per cent in revenue to FLDA only - no corresponding rise in export duties is assumed - the return to the Federal Government would be 11.0 per cent, or 6.9 per cent respectively. This suggests that the repayment capacity of the Federal Government is adequate even in adverse circumstances. The worst situation of 10 per cent lower prices and no revenue from timber tax enables a return of 5.8 per cent to be achieved.

In conclusion, the development of the Triangle appears sound as an object of investment of Federal funds in that it generates ample repayment capacity. It would require a combination of very adverse factors to render it financially unsound. Given expected prices and revenues from timber taxes, Jengka should be able to release funds, after repayment commitments, for public investment elsewhere in Malaysia.

FOREIGN EXCHANGE

Fixed capital expenditure required for full Triangle development has a very low foreign exchange content. FLDA's total imports of fixed capital are estimated at M$24.5 million (Table 26-12). Development of infrastructure by other government departments will require a further M$31.4 million of imports. The foreign exchange component of fixed capital expenditure is shown in Appendix 26 - 5.

Table 26 - 12
Foreign Exchange Expenditure and Income
Full Triangle Development - M$ million

	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	1997/8	Total Fixed Capital
FLDA																
Fixed Capital	0.7	0.9	1.4	0.6	1.6	3.6	4.7	1.5	2.7	2.5	2.0	1.6	0.2	0.2	-	24.5
Capital Renewals [1]	-	-	-	-	-	-	0.2	0.1	0.1	0.1	0.2	0.4	0.2	0.2	0.2	
Other	-	0.1	0.2	0.4	0.8	1.4	2.1	2.7	3.3	4.1	4.7	4.9	4.9	4.9	4.9	
Other Government Departments																
Rural	-	0.8	1.5	0.8	1.3	2.3	1.6	1.8	1.1	1.5	1.8	0.5	-	-	-	15.2
Urban + Rural and Urban	-	-	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
	0.7	1.8	5.0	3.1	5.1	8.6	10.0	7.4	8.2	9.5	10.1	8.7	6.7	6.6	4.9	55.9
Revenue (f.o.b. value [2] Oil Palm products and Rubber)	-	-	-	-	1.3	4.4	10.2	17.6	26.3	35.3	45.5	55.1	61.0	64.8	72.6	
Foreign Exchange																
Deficit	0.7	1.6	5.0	3.1	3.8	4.2	-	-	-	-	-	-	-	-	-	
Surplus	-	-	-	-	-	-	0.2	10.2	17.7	25.8	35.4	46.4	54.3	58.2	67.5	

1) Mainly vehicles; treated elsewhere as recurrent expenditure.
2) FLDA revenue from Rubber and Oil Palms plus Government revenue from duties and cesses.

In estimating the foreign exchange component of expenditure other than fixed capital and capital renewals 75 per cent of annual FLDA expenditure on crop maintenance has been assumed. This takes account of imports of fertiliser and sprays and makes some provision for the imports of fuel oils in a crude or refined state.

The Jengka Triangle would be a large earner of foreign exchange. Total f.o.b. revenue which is the sum of FLDA revenue plus the value of duties and cesses received by government rises rapidly from M$1.3 million in 1970/1 to M$35.3 million in 1975/6. By 1981/2 Jengka would be earning over M$70 million in foreign exchange and will continue in excess of this level until the end of the plan period.

The foreign exchange balance of Jengka development is shown in Table 26-12. Jengka would have an adverse affect on the balance of payments for 6 years from 1966/7 - 71/2. Thereafter Jengka would become a net foreign exchange earner despite continuing imports of fixed capital. With small foreign exchange requirements and a large foreign exchange surplus earned in later years, Jengka would become a very profitable development on foreign exchange criteria.

FIRST STAGE DEVELOPMENT

An analysis was made of the repayment capacity of the eastern part of the Triangle (Projects I and II) because it is particularly suited to consideration as the First Stage Development. The income and expenditures which make up the cash flow for this development are shown in Table 26 - 13. Expenditure includes an apportioned cost of the Ulu Jempol palm oil mill. It also includes Triangle headquarters, since development in this area would require this level of management from the outset. Infrastructure expenditure includes roads and water supply systems for Projects I and II as well as the urban investment in the southeast town.

Table 26 - 13

First Stage Development Expenditure Income and Cash Flow M$ million

	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	1985/6	1990/1	1994/5
Federal Government																		
Expenditure																		
FLDA Projects I and II [1]	1.9	6.2	10.2	8.8	9.8	15.1	15.4	11.9	12.2	11.8	12.1	11.8	11.9	12.1	12.0	12.4	12.7	12.7
Triangle Headquarters [4]	0.8	3.1	1.7	1.8	1.8	1.8	2.0	1.8	1.8	1.8	1.7	1.3	1.1	0.8	0.9	0.9	0.9	0.9
	2.7	9.3	11.9	10.6	11.6	16.9	17.4	13.7	14.0	13.6	13.8	13.1	13.0	12.9	12.9	13.3	13.6	13.6
Infrastructure [2]	-	2.1	4.7	2.6	2.2	0.4	-	-	-	0.1	-	0.1	-	-	-	-	-	-
Rural Capital	-	-	-	0.5	0.5	-	0.5	0.5	-	0.5	0.5	-	0.5	0.5	-	-	-	-
Urban Capital	-	-	2.7	-	1.5	1.5	-	1.3	-	1.2	-	0.6	0.3	0.3	0.3	-	-	-
Rural and Urban Capital	-	2.1	7.4	3.1	4.2	2.0	0.5	1.8	-	1.8	0.5	0.7	0.8	0.8	0.3	-	-	-
Recurrent Expenditure	-	0.1	0.3	0.7	0.9	1.1	1.2	1.1	1.2	1.2	1.2	1.2	1.2	1.2	1.3	1.2	1.2	1.2
	-	2.2	7.7	3.8	5.1	3.1	1.7	2.9	1.2	3.0	1.7	1.9	2.0	2.0	1.6	1.2	1.2	1.2
Total	2.7	11.5	19.6	14.4	16.7	19.9	19.1	16.6	15.2	16.6	15.5	15.0	15.0	14.9	14.5	14.5	14.8	14.8
Revenue																		
FLDA	-	-	-	-	1.2	4.1	9.4	14.6	18.4	20.0	21.4	22.5	23.0	23.1	23.0	22.1	21.0	20.4
Other Government [2]	-	-	0.4	0.8	1.3	1.3	2.2	2.6	2.6	3.3	3.4	3.1	3.5	3.5	3.1	3.1	3.0	2.9
Total	-	-	0.4	0.8	2.5	5.4	11.6	17.2	21.0	25.3	24.8	25.6	26.5	26.6	26.1	25.2	24.0	23.3
Net Cash Flow Deficit	2.7	11.5	19.2	13.6	14.2	14.6	7.5	-	-	-	-	-	-	-	-	-	-	-
Surplus	-	-	-	-	-	-	-	0.6	5.8	6.7	9.3	10.6	11.5	11.7	11.6	10.7	9.2	8.5

1) Appendix
2) Appendix 26 - 6
% 3) Table 26 - 3
4) Excludes M$0.7 millions 1970/1 apportioned to Triangle as part of Port Swettenham installation.

FLDA's capital expenditure in the First Stage Development would be M$81.4 million; Federal Government's capital expenditure, which includes that of FLDA, would be M$108.8 million.

Details of the infrastructure expenditure are shown in Appendix 26 - 6. The investment period would be seven years from 1966 to 1973, for both FLDA and Federal Government. The total investment by Federal Government including FLDA would be M$83.3 million to finance cash flow deficits. FLDA investment would be M$65.8 million over the same period.

To Federal Government the return on capital would be 6.8 per cent (Appendix 26-8). Although this appears marginal compared to likely market rates, it demonstrates that full Triangle headquarters could be repaid out of the first stage. Repayment of Triangle headquarters by the First Stage Development in this way would increase the repayment capacity of future second and third stage projects.

To FLDA the return on capital would be 7.4 per cent. This represents a small but adequate margin over market rates of interest.

In conclusion, investment in the eastern half of the Triangle in Projects I and II provides a sound first stage undertaking. In addition it provides the framework for development of the rest of the Jengka Triangle at more favourable rates of return, since later stage developments would not be burdened with further investment in Triangle headquarters and in addition would have the benefits of revenue from forest exploitation.

EVALUATION AT SOCIAL PRICES

In large scale public sector projects, evaluation at social prices is important. It provides a measure of the effectiveness with which the project uses scarce national resources of which capital is the most significant in this context. The benefits and costs have been valued where possible at their opportunity or social values so as to provide a true measure of the inputs and outputs of the project. This analysis concentrates on the return to capital, rather than on assessments of benefit: cost criteria. A direct benefit - cost comparison has been excluded from the analysis presented here since the criterion of benefit - cost requires critical assumptions on the opportunity cost of capital. Precise assessment of the true opportunity cost of capital is especially important if benefit - cost criteria are to be used in comparisons of developments in which widely different time patterns of benefits and cost obtain.

Social Prices

In the evaluation at social prices benefit and cost have been derived from the data presented in the previous analyses. Benefits from full Triangle development at social prices are shown in Table 26 - 14 for 1967/8 - 1981/2 and at 5 yearly intervals thereafter. Benefits from agriculture include the f.o.b. value of rubber and oil palm production and the retail values of houselot produce sold. The net output of the forest industry after adjusting for internal sales between its components is also included.

Table 26-14

Benefits at Social Prices in M$ million

	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 -	199768
Agriculture																		
Revenue to FLDA [1]	-	-	-	1.1	4.1	9.4	16.3	24.4	32.7	42.1	51.0	56.5	60.0	62.6	66.6	72.1	69.5	67.5
Export Duties and Cess [2]	-	-	-	.1	.3	.8	1.3	2.0	2.6	3.4	4.1	4.5	4.8	5.0	5.2	5.7	5.3	5.1
(f.o.b. value of oil palm products and rubber)				1.3	4.4	10.2	17.6	26.4	35.3	45.5	55.1	61.0	64.8	67.6	71.8	77.8	74.8	72.6
Value of Houselot Products sold							.1	.1	.2	.3	.4	.6	.7	.9	1.0	1.4	1.9	2.1
Forest Industry																		
Net Sales [3]	5.1	23.5	28.3	28.3	28.3	28.3	28.3	28.3	28.3	28.3	28.3	14.0	-	-	-	-	-	-
Less: Sale of Houses to FLDA [4]	-	1.7	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0								
	5.1	21.8	26.3	26.3	26.3	26.3	26.3	26.3	26.3	26.3	28.3	14.0						
Other Industry	-	1.7	2.2	2.7	3.2	4.2	5.3	6.4	7.5	8.6	9.7	10.8	11.9	13.0	14.1	18.1	23.1	28.3
Total Benefits	5.1	23.5	28.5	30.2	33.9	40.7	49.3	59.1	69.3	80.7	93.5	86.4	77.4	81.5	86.9	97.3	99.8	103.0

1) From Table 26-3
2) From Table 26-10
3) From Chapter 10
4) See Table 26-15

Estimated benefits from other industry in Jengka are shown. These were estimated to rise to 50 per cent of the level of forest industry benefits by 1981/2 and to equal the forest industry's annual benefits by the end of the period. The investment in other industry was assumed to be equal to that of the forest industry, but distributed over a 23 year period. These assumptions as to benefits of other industry have the effect of raising the return on capital of Jengka (SMP, see below) by about 1.25 per cent (Appendix 28-8).

Cost at social prices is shown for a similar period to benefits in Table 26-15. Cost is based on the expenditure at market prices used throughout this report with a number of special adjustments.

Table 26-15

Cost at Social Prices in M$ million

	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
Agriculture	2.7	9.3	11.9	14.4	20.1	29.3	36.9	33.1	39.2	39.9	42.8	40.8	37.0	37.7	38.7	40.2	40.1	40.8	41.8
Infrastructure (other Govt. Depts.)	-	2.3	10.7	9.1	10.5	14.3	12.6	13.3	12.1	13.4	14.5	11.3	9.5	9.5	7.1	7.1	5.0	5.0	5.0
Forest Industry [3]																			
Capital	1.8	9.8	11.1	3.1	.1	1.5	2.0	.6	.1	1.2	1.5	.3	-						
Recurrent		4.2	12.6	13.2	12.7	12.0	11.8	11.7	11.8	11.8	11.8	11.8	5.9						
Exported Profits		.3	2.0	3.6	3.8	4.0	3.9	3.6	3.5	3.4	3.5	3.4	1.7						
	1.8	14.3	25.7	19.9	16.7	17.5	17.1	15.9	15.4	16.4	16.8	15.5	7.6	-	-	-	-	-	-
Other Industry																			
Capital	-	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	-
Recurrent	-	-	1.3	1.5	1.7	1.9	2.3	2.7	3.1	3.5	3.9	4.3	4.7	5.1	5.5	5.9	7.5	9.5	11.8
	4.5	27.3	51.0	46.3	50.4	64.4	70.9	66.4	71.2	74.6	79.4	73.3	60.2	53.7	52.7	54.6	54.0	56.7	58.6
Less:																			
Cost of Houses to FLDA [1]			1.7	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	-	-	-	-	-	-	-	-
Transfer Payments [2]			.1	.2	.9	1.3	1.5	1.7	2.6	2.7	2.4	2.0	2.1	2.6	2.8	2.4	2.7	2.7	2.6
Settler Income		.2	.8	1.4	2.3	3.5	4.9	6.7	7.8	9.3	11.4	11.1	11.6	11.8	12.6	13.6	14.9	15.9	16.7
		.2	2.6	3.6	5.2	6.8	8.4	10.4	12.4	14.0	15.8	13.1	13.7	14.4	15.4	16.0	17.6	18.6	19.3
Total Cost	4.5	27.1	48.4	42.7	45.2	57.6	62.5	56.0	58.8	60.6	63.6	60.2	46.5	39.3	37.3	38.6	36.4	38.1	39.3

1) See Benefits at Social prices
2) Import duty, Port Charges, Motor Taxes and State Land Taxes all included in Cost to FLDA.
3) See Chapter 10

In assessing the cost of Jengka at social prices all taxes on inputs such as import duties, land taxes and motor vehicle taxes have been excluded, as have the additional profits made from the increased use of fixed installations such as Port Swettenham. The opportunity cost of settlers' labour has been assumed to be zero in that production in the rural areas is unlikely to be affected by their transfer into Jengka. The opportunity cost of management is clearly higher than its market price. However, it has been assumed that the cost of unskilled and lower echelons of the management structure, whose opportunity cost is likely to be over-valued at market prices, offset the undervaluation of the higher levels of management.

Return on Capital (SMP)

The return on capital using social prices for the inputs and outputs - often termed the Social Marginal Productivity of capital (SMP) - has been calculated using the discounting process. At expected prices, SMP is about 15 per cent. A 10 per cent variation in f.o.b. prices throughout the plan period results in a range of SMP from 13.4 per cent to 16.3 per cent. In view of the scale of the project, an SMP of 15 per cent indicates a very fair use of capital for economic development (Appendix 26 - 8).

As in the preceding analyses at market prices, the benefits from forest exploitation are important at social prices. Exclusion of benefits and cost from forest exploitation reduces the expected SMP to 12.5 per cent. This would represent only a marginal use of scarce capital. The importance of the efficient forest exploitation must again be emphasised. Clearly some benefit could accrue from organised logging of the type already practised in West Malaysia. This however, would be considerably lower than highly intensive exploitation combined with a timber processing complex.

The inclusion of an additional area to the north in Tekam was also analysed so that the additional benefits of forest exploitation and further regional development in agriculture could be assessed. The analysis was based on a combination of projects in Jengka which reflected the recommended land use pattern in Tekam. This is shown in Appendix 26 - 7. The analysis assumed development of projects identical to Projects I and II, with equivalent infrastructure, but no town. Development was assumed to start immediately after completion of development of Project VI and a 10 per cent fall in prices from those prevailing in Projects I and II was assumed. As a marginal addition to the Jengka development, investment in Tekam appeared good, with an SMP of 18.5-19.5 per cent. This would cause a small overall rise in the SMP for the whole regional development.

CONCLUSION

Development of Jengka at expected prices with full forest exploitation represents a beneficial use of national resources. It also makes a very satisfactory contribution to net foreign exchange earnings. It provides large scale development of new land which in itself is essential to rapid development in West Malaysia in the future. When fully developed Jengka will provide the nucleus for further investments in development around its boundaries. The inclusion of Tekam into the development complex has very strong economic advantages and the phasing programme should be reappraised in the light of a decision to develop the area.

Efficient timber exploitation appears so important to development of new land on a large scale as to be a necessity. Future large scale land development should be closely linked to forest exploitation of this type.

The distribution of income from Jengka allows both FLDA and Federal government ample margin for repayment of loans at normal market rates while generating a surplus in the middle of the repayment period.

This surplus could be distributed to settlers in the form of higher cash income, if warranted by price and cost trends; alternatively, it could be used very effectively for financing future development.

FINANCING

This section assesses the financial requirements and repayment capacities of both FLDA and the Federal Government in implementing full development of Jengka.

The financial requirements are derived from the deficit cash flows of expenditure over income used in the economic and financial analysis (Tables 26 - 7 and 26 - 11). These are based on 1966 prices in Malaysia and it is assumed from past experience that internal inflation over the next ten years will not be significant. With the low foreign exchange component, rises in cost of imported items are not expected to be important. In the case of palm oil mills which have a high foreign exchange component, costs may be substantially reduced if local industry is employed (Chapter 15).

Included in the requirements for finance is a proportion of both the Port Swettenham palm oil installation and processing factories situated in the surrounding FLDA schemes which process rubber and oil palm for Jengka projects. An additional M$4.8 million will be required to finance complete construction of these factories and installations. This has been excluded in assessing financing requirements.

In Table 26-16 the disbursement of loans to finance development for the whole Triangle is shown, sub-divided to indicate Federal Government expenditure including FLDA, and FLDA expenditure only. Alternative rates of interest at 6 and 7 per cent, are shown in the Table.

The Federal Government would require a loan of M$182.1 million disbursed over 11 years from 1966/7 to 1976/7, until net surplus cash flow would begin (Table 26 - 11). Accrued interest over this period would amount to M$72.7 million charged at 6 per cent and M$87.7 million charged at 7 per cent. Thus the Federal Government's total investment by mid-1977 would be between M$255 million and M$270 million depending on the rate of interest charged.

FLDA would require a loan (via Federal Government) of M$149.4 million over a similar 11 year period. Interest would accrue to M$57.9 million at 6 per cent and M$69.6 million at 7 per cent. This would make FLDA's total investment by mid-1977 between M$207 and M$219 million depending on whether the loan bears a 6 or 7 per cent interest charge.

The capacity of both Federal Government and FLDA to repay the loans shown in Table 26 - 16 are given in Figures 26 - 10 and 26 - 11. In both instances the cash surplus in the first year of the repayment period (1977/8) would not be large enough to pay even interest on the loans. Interest would therefore have to be accrued in this year and this would have the effect of increasing the loans shown in Table 26-16 by M$12-19 million, depending on the rate of interest charged. At least one year's grace when neither interest or capital is repaid would therefore be required.

Table 26 - 16
Financing for full Triangle Development in M$ million

	Federal Government (incl. FLDA) Expenditure					FLDA Expenditure only				
		Interest at 6%		Interest at 7%			Interest at 6%		Interest at 7%	
Year	Amount	Interest	Total	Interest	Total	Amount	Interest	Total	Interest	Total
1966/7	2.7	0.1	2.8	0.1	2.8	2.7	0.1	2.8	0.1	2.8
1967/8	11.2	0.5	11.7	0.8	12.0	9.3	0.4	9.7	0.5	9.8
1968/9	19.0	1.4	20.4	1.7	20.7	11.9	1.1	13.0	1.3	13.2
1969/70	18.3	2.6	20.9	3.1	21.4	14.4	2.0	16.4	2.3	16.7
1970/71	23.3	4.0	27.3	4.8	28.1	18.9	3.1	22.0	3.6	22.5
1971/2	32.3	6.0	38.3	7.1	39.4	25.2	4.6	29.8	5.4	30.6
1972/3	31.5	8.2	39.7	9.8	41.3	27.5	6.4	33.9	7.7	35.2
1973/4	19.8	10.3	30.1	12.3	32.1	16.8	8.1	24.9	9.7	26.5
1974/5	15.4	11.9	27.3	14.3	29.7	14.9	9.6	24.5	11.5	26.4
1975/6	7.5	13.3	20.8	16.1	23.6	7.2	10.8	18.0	13.1	20.3
1976/7	1.1	14.4	15.5	17.6	18.7	0.6	11.7	12.3	14.4	15.0
Total Loans to 30.6.1977	182.1	72.7	254.8	87.7	269.8	149.4	57.9	207.3	69.6	219.0

Figure 26 - 10
Repayment of Federal Government Loan

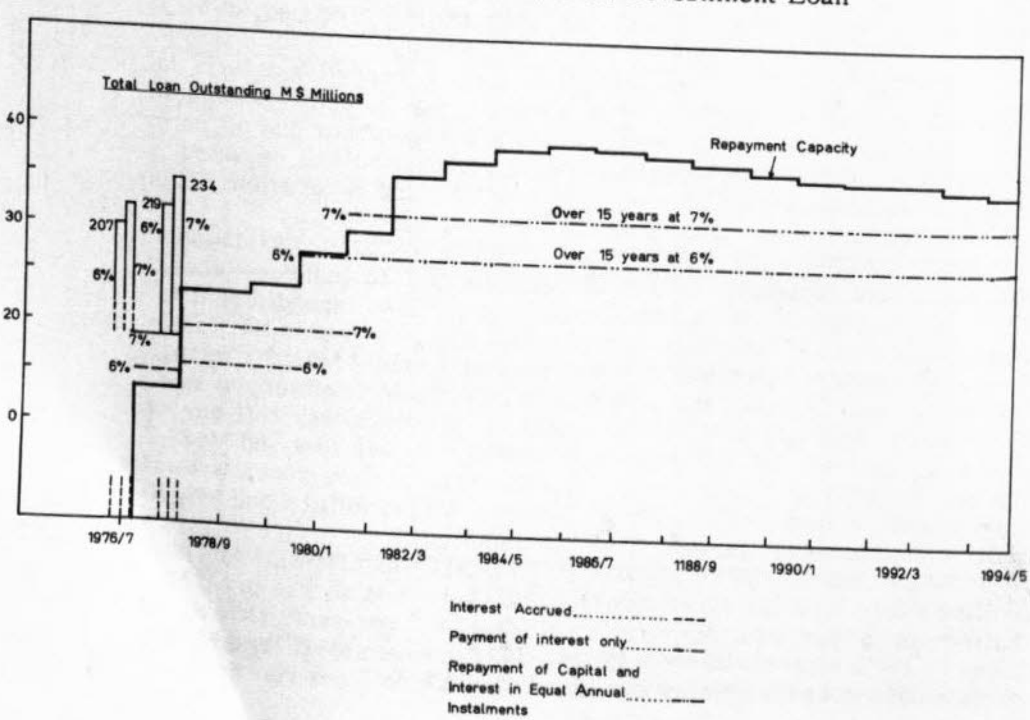
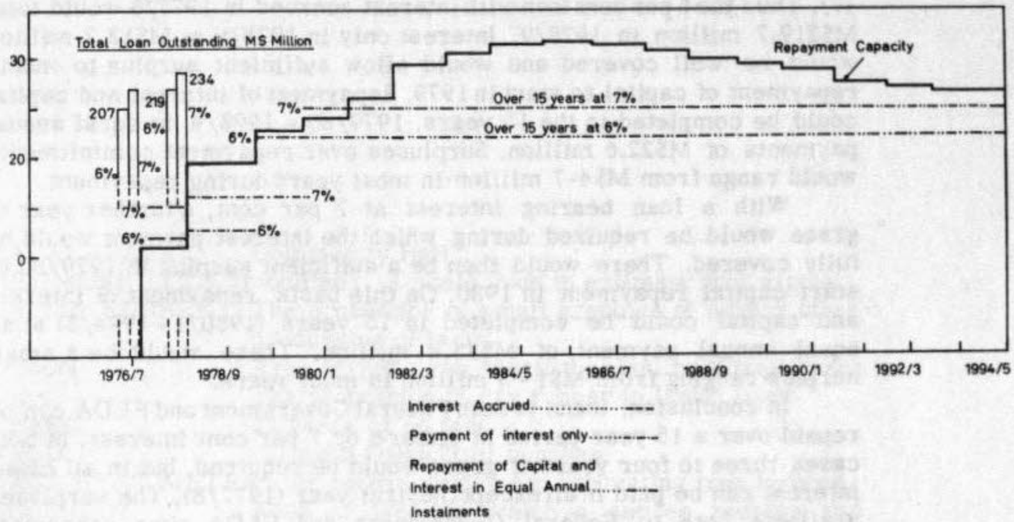


Figure 26 - 11
Repayment of FLDA Loan



Federal Government Repayment - The Federal Government loan would stand at M$270 million in mid-1978, given a six per cent interest charge and assuming interest is accrued in 1977/8 (Table 26 - 17). The cash surplus would be sufficient to pay interest at M$16.2 million thereafter. Assuming a 15 year repayment of interest and capital on this loan, at six per cent, the equal annual payment would be M$27.8 million. Repayment on this basis can not begin until 1980/1; it would be completed in 1994/5. Thus an additional 2 years grace would be required during which interest only would be repaid. During repayment there would be a surplus in most years of M$7 - 11 million.

With the loan bearing interest at 7 per cent interest payments from mid-1978 are fully covered. However, an additional year of grace would be needed before repayments of capital can be made over 15 years. Interest only would be paid at M$20.2 million per year from 1978/9 - 1980/1. Repayments of interest and capital could be completed over a 15 year period repaying M$31.7 million per year from 1981/2 to 1995/6. During repayment there would be a surplus of M$4 - 7 million over commitments in most years.

Table 26 - 17
Summary of Assumed Repayment Programme

	Federal Government 6%	Federal Government 7%	FLDA 6%	FLDA 7%
Loan at mid 1977 repayment (1977/8) (M$ million)	254.8	269.8	207.3	219.0
Interest accrued (1977/8) (M$ million)	15.3	18.9	12.4	15.3
Loan at mid 1978	270.1	288.7	219.7	234.3
Grace Periods (years)				
No repayment of interest, or capital	1 (1977/8)	1 (1977/8)	1 (1977/8)	1 (1977/8)
Payment of interest only	2 (1978-1979/80)	3 (1978/9-1980/1)	1 (1978/9)	2 (1978/9-1979/80)
Interest Amount from 1978/9 (M$ Millions)	16.2	20.2	13.2	16.4
Repayment over 15 years				
Equal interest and capital in annual payments (M$ million)	27.8	31.7	22.6	25.8
First year	1980/81	1981/2	1979/80	1980/81
Final year	1994/5	1995/6	1993/4	1994/95

FLDA Repayment - FLDA's repayment capacity is very similar to that of the Federal Government. In repaying loans at either 6 or 7 per cent, however, a one year shorter grace period is possible (Table 26-17). Thus the 6 per cent loan with interest accrued in 1977/8 would total M$219.7 million in 1978/9. Interest only in 1978/9 at M$13.2 million would be well covered and would allow sufficient surplus to enable repayment of capital to start in 1979. Repayment of interest and capital could be completed in the 15 years, 1979/80 - 1993/4, at equal annual payments of M$22.6 million. Surpluses over repayment commitments would range from M$4-7 million in most years during repayment.

With a loan bearing interest at 7 per cent, a further year of grace would be required during which the interest payment would be fully covered. There would then be a sufficient surplus in 1979/80 to start capital repayment in 1980. On this basis, repayment of interest and capital could be completed in 15 years (1980/1 - 1994/5) at an equal annual payment of M$25.8 million. There would be a small surplus ranging from M$1 - 5 million in most years.

In conclusion, loans to both Federal Government and FLDA can be repaid over a 15 year period at either 6 or 7 per cent interest. In both cases three to four years of grace would be required, but in all cases interest can be paid in all except the first year (1977/8). The surpluses available both to Federal Government and FLDA after repayment commitments have been met would be adequate to provide not only a margin of safety, but also to release funds for public, or FLDA investment elsewhere.

GLOSSARY

BALAI RAAYAT Community Hall
BILTMORE STICK (modified) A scale used to estimate tree girths
CRUMB RUBBER The production of small granules of rubber after processing of latex
DUSUN Area of land given overto the planting of fruit trees
D.r,c, The proportion of dry rubber in liquid latex
CHAIN 22 yards or 66 feet
F.F.B. Oil palm fresh fruit bunches
HAGA HYPSOMETER An optical device for estimating tree heights
HOUSELOT Area of land on which a settler resides and cultivate crops on a small scale
IMMATURE PERIOD The number of years between the planting of a crop and commencement of production
LOPAK Semi-swamp land
MANDOR Labour foreman
PAYA Permanent swamp land
PLATFORMS Individual areas of levelled land on steep land on which oil palms are planted
PADANG Open area of land within a village or other urban centre usually devoted to recreational purposes
RENTIS Surveyed trace lines cut through the forest
SHOPHOUSES A ground floor shop with one or more residential floors above
SURAU A small mosque

ECONOMIC TERMS

CAPITAL EXPENDITURE Expenditure incurred by FLDA on labour, material and skills needed to develop land and bring it into production. Expenditure incurred by other government departments on structures, buildings installations and equipment
RECURRENT EXPENDITURE Expenditure incurred which is not classed as capital expenditure. This includes capital renewals such as the purchase of vehicles
CASH FLOW or NET CASH FLOW Income less expenditure or where expenditure exceeds income, expenditure less income. The former case is termed cash surplus or surplus, the latter case cash flow deficit or deficit. Neither income nor expenditure include interest
INVESTMENT PERIOD The period when expenditure exceeds income i.e. the period of cash flow deficits

REPAYMENT PERIOD The period when income exceeds expenditure i.e. the period of cash flow surplus

INVESTMENT The total investment is the sum of the cash flow deficit during the investment period

DISCOUNTING PROCESS Calculation to establish at what rate of interest the cash flow surplus during the repayment period will equal the cash deficits during the investment period

DISCOUNT/COMPOUND Compounding / discounting establishes by factors calculated by a formula what sum would be received after a given period, if it was invested at a given rate of interest and if the interest each year was added to the interest. Compounding assumes that the initial sum is unity. Thus the factors used in compounding rise from unity as the years from the datum point elapse while the factors used in discounting decline from unity

PRESENT WORTH The sum of cash flow, income or expenditure either for a single year or for a period of years discounted or compounded at a given rate of interest to a fixed point in time

RATE OF RETURN ON CAPITAL The rate of interest at which the present worth of income and expenditure or surplus and deficit cash flows are zero. At this rate of interest the surpluses in the repayment period will just cover the repayment with interest on the outstanding balance of a loan where interest is accrued during the investment period at this same rate of interest

SOCIAL PRICES Price level used to assess the true value of income and expenditure to the economy as a whole. Usually used in the form of adjustments to market prices to reflect the opportunity cost or value in alternative employment of labour, management or investment funds. Taxes, transfer payment and internal profits are also excluded in valuing expenditure or income at social prices

S. M. P. Social Marginal Productivity of capital. The rate of return on capital calculated from income and expenditure valued at social prices

f.o.b. "free on board" Used here as the value on which all exports are recorded. The f.o.b. price is taken as the actual export price and the value that the economy will receive in foreign exchange for the sale

RURAL and URBAN This denotes items of infrastructure expenditure which will be used by both rural and urban population and will be sited in both rural and urban areas. It comprises schools, Health centres and public administrative buildings

GROSS MARGIN Crop revenue less the expenditure which is required solely for the purpose of growing that crop. This can be shown annually or in terms of present worth discounted over the period of a perennial crop production cycle.

FARM GROSS MARGIN The annual cash flow to the farmer. This denotes the farmers income or expenditure before charging costs of his own labour, management or interest

REFERENCES

A list of some of the principle references used is given here. The list does not include the many references in journals that were referred to nor the standard text books employed.

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