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KEMENTERIAN PERTANIAN MALAYSIA

**UPGRADING OF IRRIGATION & DRAINAGE SCHEMES
IN
BALIK PULAU AND SEBERANG PERAI
PULAU PINANG**

**INTERIM REPORT FOR
BALIK PULAU
AUGUST 1981**

BINNIE DAN RAKAN (M)
KUALA LUMPUR

in association with

HUNTING TECHNICAL SERVICES LTD.
UNITED KINGDOM

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UPGRADING OF IRRIGATION & DRAINAGE SCHEMES

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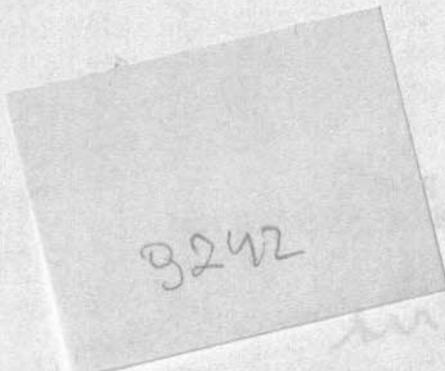
BALIK PULAU AND SEBERANG PERAI

PULAU PINANG

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AUGUST 1981



BINNIE DAN RAKAN (M)
KUALA LUMPUR

in association with

HUNTING TECHNICAL SERVICES LTD.
UNITED KINGDOM

The Secretary General,
Ministry of Agriculture,
Jalan Swettenham,
Kuala Lumpur.

BIL. TUAN:
BIL. KAMI: 303

21st August 1981

Tuan,

Upgrading of Irrigation and Drainage Schemes
in Seberang Perai and Balik Pulau - Pulau Pinang

We have pleasure in submitting the Interim Report for Balik Pulau, as part of the above study. The corresponding report for Seberang Perai was submitted on 10th August 1981.

This report was held back to allow of the inclusion of results of the socio-economic survey of the area, which was commissioned by the Steering Committee on 16th April 1981. We shall be pleased to discuss the report at your convenience.

Yang benar,
BINNIE DAN RAKAN (MALAYSIA)

AKM/PN.

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J. Pert.	Jabatan Pertanian (Department of Agriculture)
LPN	Lembaga Padi Negara (National Padi Board)
LPP	Lembaga Pertubuhan Peladang (Farmers' Organisation Authority)
MADA	Muda Agricultural Development Authority (Kedah & Perlis)
MARDI	Malaysian Agricultural Research and Development Institute
MMS	Malaysian Meteorological Service
MOA	Ministry of Agriculture
MPPF	Majlis Perbandaran Pulau Pinang (Penang Island Municipal Council)
NEP	New Economic Policy
PBA	Pihak Berkuasa Air (Penang Water Authority)
RISDA	Rubber Industry Smallholders Development Authority
RC	Reinforced concrete
SEPU	State Economic Planning Unit
SERD	State-economic Research Unit
TMP	Third Malaysia Plan
TOR	Terms of Reference

Abbreviations used in this report

CHO	Constant head orifice
CSDS	Coconut Smallholders Development Scheme
DOA	Department of Agriculture (Jabatan Pertanian)
DID	Drainage & Irrigation Department (see JPT)
FAMA	Federal Agricultural Marketing Authority
FMP	Fourth Malaysia Plan
FSL	Full Supply Level
IADP	Integrated Agricultural Development Project
JKR	Jabatan Kerja Raya (Public Works Department)
JPBK	Jabatan Perancang Bandar & Kampong (State Town & Country Planning Dept.)
JPT	Jabatan Parit dan Taliair (Drainage & Irrigation Dept.)
J. Pert.	Jabatan Pertanian (Department of Agriculture)
LPN	Lembaga Padi Negara (National Padi Board)
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RC	Reinforced concrete
SEPU	State Economic Planning Unit
SERU	Socio-economic Research Unit
TMP	Third Malaysia Plan
TOR	Terms of Reference

Abbreviations used in this report

(continued)

Sg.	Sungai
Kg.	Kampung
ac	acres
ch	chains
ft	feet
gt	gantangs (1 gt = 5.6 lb of rice)
ha	hectares
in	inches
km	kilometres
kg	kilograms
L	Litres
lb	pounds
m	metres
mi	miles
m-m	man-month
s, sec	seconds
T	metric tonnes

EXECUTIVE SUMMARY AND RECOMMENDATIONS

(the recommendations are listed at the end of this section)

S.1 This report gives the results of studies to the end of July 1981 and includes provisional recommendations in matters of engineering design, agricultural improvements and development programme.

S.2 Socio-economic studies were commissioned in May 1981 as an addition to the Terms of Reference. The survey was carried out in June 1981 and 270 households were sampled. Analysis of the results of this survey has been hampered by the illness of our Rural Sociologist, Prof. Mohd Taib Osman, but a report on it is included in this interm report. The time required to carry out and interpret the survey caused the submission of this report to be set back from 30th June to the present date.

S.3 The principal contents of this report are summarised below, using the same order as that of the main sections: (references to sub-sections of the main report are given in brackets).

Water resources (2.2) and requirements (5.2)

S.4 There is insufficient water for double cropping of padi in all areas, even though the total area of padi land has been already reduced, mainly through conversion to coconut plantations, from 1,126 ha to 902 ha (2,782 ac to 2,228 ac). The future irrigable area is further reduced to 870 ha by urban expansion. The water available in the dry season will be again reduced by the proposed urban development at Balik Pulau town. It is proposed to exploit fully the available flow in Sg. Kongsu, Sg. Rusa and Sg. Air Puteh/Air Itam, as well as that in the three streams currently used - Sg. Pinang, Sg. Burung and Sg. P. Betong.

S.5 By breaking up the irrigated areas into five units, each supplied by one of the above streams - Sg. Kongsu and Sg. Burung are operated together - and by use of efficient distribution canals it is estimated that :

either the following crops could be irrigated:

Main season:	rice	100%	(870 ha)
Off season:	rice	46%	(400 ha)

or, more realistically, a cropping pattern on the following lines could be irrigated:

Main season:	rice	100%	(870 ha)
Off season:	rice	34%	(300 ha)
	maize and)	66%	(570 ha)
	vegetables)		

Groundwater (2.3)

S.6 There are significant resources in shallow sand aquifers which are already used on a very small scale by non-irrigation users. Sub-surface exploration and test pumping would be needed to give a quantitative assessment, but it is not thought that the expense of developing ground water is commensurate with the small potential benefit (i. e. conversion of some off season maize areas to padi).

Soils (2.4)

S.7 All soils in the area are suitable for rice cultivation, although certain coastal areas are spongy in texture and badly require improved drainage. Acid sulphate conditions are not found in the padi areas, and are unlikely to exist in the coastal reclamation strips either.

Land values and development (3.4)

S.8 Land acquisition prices for the Sungai Burung scheme have been estimated by the Federal Valuation office. Similar estimates for the other scheme areas will be obtained in the final report stage. Sg. Burung scheme values range from \$4,000 to \$20,000 per acre, excluding road frontage land.

Effects of urban development (chapter 3)

S.9 The catchment of Sg. Burung is scheduled to have 42% of its area (4.8 km^2) used for urban development in due course. This urbanised area is assumed, conservatively, to contribute nothing to dry weather stream flow in the future. It will have a converse effect on storm flows and cause a sharp increase in the future flood peak discharge. The reduced area, contributing to stream flow in the dry season, of all sources aggregated however remains 90% of the natural area even after all urban development has taken place, and therefore the quantity of irrigation water is not unduly affected.

S.10 Urban development is likely to lead to pollution of watercourses. We consider that treated domestic sewage effluent, and industrial effluent if any, should be piped to a discharge point below the irrigation intakes. The Sg. Burung is the most suitable river to receive sewage effluent due to the absence of habitation or secondary use of the water in the lower reaches.

Existing agriculture (chapter 4)

S.11 Abandoned land extent has increased from about 13% of the project area in 1974 to over 70% now. Damage by pests and a severe shortage of labour are given as the reasons for abandonment. No other crops are grown except padi in the gazetted padi areas, but 20% of the official scheme areas have been converted to coconut.

S.12 Yields of padi recently have been between 2.5 and 2.6 T/ha (400 and 420 gt/ac) which lie between the yields reported in Seberang Perai Utara and Seberang Perai Tengah. The degree of mechanisation is small compared to the mainland and combine harvesters are not used. Many varieties of padi are grown, and quite often seeds are mixed. The varying padi maturity periods which result, in fields in close proximity, reduce the ability of farmers jointly to plan their irrigation and field drying out operations. Rice is grown in nurseries and transplanted throughout the area.

S.13 Possibly the most serious shortcoming in the system is the almost complete absence of any uniform cropping timetable. Padi can be seen at all stages of cultivation. This detracts from yields for a number of reasons and provides a perennial source of food for rats.

S.14 The State DOA (Jabatan Pertanian) has an extension service to padi farmers. The number of Agricultural Technicians is relatively high. The Lembaga Pertubuhan Peladang (LPP) has one co-operative in Balik Pulau with a membership now estimated at 55% of all farm families. No LPP schemes for rehabilitation of abandoned land have yet been started.

Cropping pattern (chapter 5)

S.15 Double cropping of padi should be synchronised to make best use of the weather patterns and water available, to permit proper water control in the fields and efficient prediction of demand, as well as for many independent reasons, such as removal of permanent food supplies to pests, and ability to shut down irrigation systems for maintenance. The dry season land preparation should start in early March with harvest in July and August. The main season land preparation should start in August with harvest in December to February (Fig. 5.1).

S.16 We recommend that schemes are cultivated in three operating blocks, with a two-week delay separating the start of each operation in each block. Land preparation in any one block would be spread over 6 weeks. Peak padi water requirements at the intakes are estimated at 1.7 L/s/ha.

S.17 In the off-season maize and vegetables are expected to cover a larger area than rice. Their water demand is less than for rice and their growth period is shorter, thus permitting staggering of peak demands with a consequent large increase in the area cultivated compared with the rice which it replaces. Peak intake requirements for maize or vegetables are estimated at 1.08 L/s/ha.

S.18 It is not thought that the vegetable market would justify cultivation of an area larger than 150 ha, and in addition the farming skills required are higher than for rice or maize, so vegetables are not for the majority. Maize production for grain has a large demand in Malaysia and grain maize cultivation can be fully mechanised. A portion of the maize area, suggested as one quarter, could be grown with varieties suitable for fresh cobs, which have a higher return.

Irrigation schemes (chapter 6)

S.19 The present irrigation schemes have intakes on three streams; two of these require modifications. The canals are unlined at present and incur large seepage losses, increased on account of canal size being larger than necessary. Parts of the area have been irrigated by controlled drainage only, and parts are badly in need of improved drainage. It is intended to construct new intakes on streams which are not fully exploited, and to reconstruct all canals with smaller, lined cross-sections and improved access beside them.

S.20 The existing infrastructure at kampong and field level is generally inadequate, particularly if mechanisation is to be utilised to a greater degree and direct sowing of rice introduced. The criteria for improvements to the infrastructure are made specifically to meet the requirements for the water control necessary for these practices.

S.21 The irrigated areas generally are already divided naturally into small units. For improved management and water control measurement devices should be provided at every offtake. Main supply canals should be lined, and unlined quaternary canals should be provided to give a direct supply to as many farms as possible.

S.22 The drainage system should parallel the canal network with quaternary (or 'field') drains serving the individual farms. Tertiary drains require to be improved and improvements in some areas are necessary to the main drains. The use of controlled drainage for irrigation purposes should be discouraged except for short periods during presaturation of the fields.

S.23 Primary access to most of the schemes is good but better access into the irrigation areas is required for farm machinery, and for the transport of fertilizers and grain. The preliminary proposals are for access adequate for large combine harvesters to be provided into every tertiary unit along the tertiary canal. The capital costs of providing this level of access however are high, and the proposed level of access facilities may have to be downgraded.

S.24 Preliminary costs are given for implementation of the above improvements based on study of the sample area. Excluding land acquisition the tertiary development work would cost about \$6,900 per hectare (6.4). These figures, scaled up for the whole of the major schemes and with allowance for other work necessary, amount to a total, including engineering charges but excluding land acquisition, for the two schemes of \$11.5 million.

Reclamation areas (section 4.4)

S.25 The JPT have constructed new coastal bunds covering the whole sea frontage of the Sg. Burung and Sg. Pinang schemes, as well as at a site south of Kg. Pantai Acheh. Plans for development of these areas by Government agencies are uncertain except in the central area, Kampong Benteng Melayu, and to date mangrove forest has been left in place behind the new bunds in nearly all cases. Aquaculture and some housing are proposed at Kg. Benteng Melayu. We consider that clearing of any of these areas for agriculture should be carefully reconsidered since, firstly, the region already has sufficient problems in sustaining viable agriculture on the main areas inland, and secondly the mangrove forest is a basic resource of the country which plays a vital role in the marine ecological system.

Socio-economic survey (chapter 7)

S.26 A full survey has been carried out with sampling of 270 households. In addition supplementary questionnaires were filled in by 55 owners of padi land and 190 dependents (young adults) living in the area and working at non-farm jobs.

S. 27 The data received includes family ages, sizes and education and forms of tenancy. Over half (62 %) are tenant farmers. The leading problem causing failure of the present padi farming was held to be pests, principally rats.

S. 28 A majority were in favour of double cropping of rice if the land could be rehabilitated, and a large proportion of the dependents also said they would be interested in returning to work on rehabilitated land (2.6.4). Over half of the heads of household would be willing to participate in some form of group co-operative which actually farmed the land.

S. 29 Landlords also were receptive to the proposal to introduce co-operative farms. The question of how to distribute farming profit as between landlord and tenant needs careful study, and it is not a matter which the questionnaire method will solve.

S. 30 The principal conclusion is that the majority wish to continue growing padi, and not alternative crops, although coconut and vegetables are accepted as a consequence of water shortage. Better management of the land is strongly desired in order to return to productive agriculture, and there is a clear disposition towards letting the government take responsibility for the management as well as the rehabilitation.

Agricultural improvements and future organisation (chapter 8)

S. 31 The most pressing need is to establish an effective new form of farming organisation to operate padi cultivation in rehabilitated, usually now abandoned, areas. We propose a system of farming in units of 50 to 100 hectares (250 - 500 acres) which, for identification purposes, are termed "group farms". Grouping farming is envisaged as covering the whole of the currently abandoned or uncultivated areas, while on the other hand a few existing smallholders are expected to remain farming as at present.

S. 32 Limitations of soil and water have led to selection of a limited number of cropping patterns, based on rice as the principal crop. Direct

sowing is expected to expand rapidly from its present experimental stage in the State. Labour requirements and costs are based on the assumptions of transplanting by hand in smallholder areas and direct sowing in group farm areas. Land preparation will be fully mechanised in both cases.

S. 33 A machinery service centre is recommended as essential for the group farm requirements, with some spare capacity available for smallholders. This would operate a total of 12 tractors, 4 combine harvesters and smaller units (8.7).

S. 34 Farming enterprises analysed are:

double rice	-	smallholders
double rice	-	group farms (mechanised)
rice, maize and vegetables	-	group farms (mechanised)

It is assumed that padi yields for smallholders with the project will rise over three years from 3.35 T/ha average per crop to 4.3 T/ha average (530 gt/ac to 680 gt/ac). For group farms a four year growth to 4.0 T/ha average (640 gt/ac) is assumed.

S. 35 Our farm budgets are analysed for smallholdings of 0.75 and 0.6 ha. The incomes for owner operators would range from \$3,331 to \$2,665 per annum depending on farm size, while for tenant farmers the cash return is much less due to the system of paying rent in kind. Unless this can be changed tenant farmer incomes would only be between \$1,400 and \$1,100 per annum (8.5).

Development plan (chapter 9)

S. 36 A preliminary development plan for infrastructure improvement is presented; this will be expanded in the final report. The plan requires early establishment of an agricultural pilot area to pioneer the group farming concept in padi areas currently abandoned. It is shown that

construction of irrigation, drainage and access improvements could be completed by December 1984. This time-table requires that the necessary survey and design work should start not later than December 1981 and April 1982 respectively.

particular provided care is taken to avoid pollution of the rivers used for irrigation. The water estimates into which F 240 water may be accepted.

2.2. 2.3

4.2 Cropping of land throughout Project area should be to a uniform rotation, controlled selection, consistent rotation and synchronized by the operating authority. Nearly half the area can sustain double cropping of paddy.

5.2, 5.3

4.3 The alternative crops should be grown in heavy or light soils, principally those which are suitable for the market demand will permit (suggested as 140 ha)

5.2, 5.3

4.4 Schemes to be installed in three operating blocks, with 2-week delay between starting dates for each.

6.2

4.5 Changes are needed in irrigation systems, which, with improvement of access roads from the village, would significantly reduce costs.

6.2

4.6 The irrigated areas should be reorganized as five small schemes, each depending on separate source waters.

6.2

4.7 Irrigation should be operated as a unit with flow measurement at each canal outlet.

6.2

Recommendations

Section

- R.1 Proposed urban development at Balik Pulau town will not have very adverse effects on agriculture provided care is taken to avoid pollution of the rivers used for irrigation. The urban extension into Mukim F (450 acres) may be accepted. 3.2, 3.3
- R.2 Cropping of padi throughout Project area should be to a uniform timetable, controlled and synchronised by the operating authority. Nearly half the area can sustain double cropping of padi. 5.2, 5.3
- R.3 Alternative crops should be grown in the dry season, principally maize, with as much vegetables as the market demand will permit (suggested as 150 ha) 5.2, 5.3
- R.4 Schemes to be cultivated in three operating blocks, with 2-week delay between starting dates for each. 6.3
- R.5 Changes are needed to the irrigation systems, which, with improvement of access roads beside canals, involve significant cost. 6.2
- R.6 The irrigated area should be rearranged as five small schemes, each depending on separate source streams. 6.2
- R.7 Irrigated areas to be operated as tertiary units, with flow measurement devices at each canal offtake. 6.3

Recommendations (continued)

	Section
R. 8 Canals need to be reconstructed; they should be concrete lined, and preferably have a canal-side road able to carry combine harvesters.	6.3
R. 9 Unlined quaternary canals should be provided to give irrigation supply directly to as many farms as possible.	6.3
R. 10 New tertiary and quaternary drains are required.	6.3
R. 11 The proper use of the reclaimed coastal areas needs study, and agricultural development should not be encouraged until the problems of the existing areas are seen to be solved.	4.4
R. 12 Farms in areas now abandoned should be organised on a group basis, each group occupying a tertiary unit of 50 ha to 100 ha.	8.3
R. 13 Group farms would be fully mechanised and should practice direct sowing of padi seed as soon as possible.	8.3
R. 14 A new machinery service centre should be set up to service the group farms.	8.7
R. 15 For early implementation of a development plan, the necessary survey and design work should start shortly.	9.2

1. INTRODUCTION

1.1 Objectives

1.1.1 The terms of reference (TOR) state that the principal objective of the study is "to formulate and implement proposals for the upgrading of irrigation, drainage and access facilities for each of the irrigation schemes in the project area, with the aim of raising efficiency, improving farm and water management and providing the necessary pre-conditions for increased productivity and farm incomes". In addition the addendum to the TOR requires the Consultants to study improvements necessary to raise the productivity of the JPT drainage areas.

1.1.2 The most effective and probably the only way to raise farm incomes for all padi farmers and retain them on the land is to educate them in making the best use of the facilities and inputs becoming available so as to increase their rice production with the lowest practicable input of labour, and especially with the least possible amount of hard manual work in the fields. To this end the report lays strong emphasis on mechanization and, for areas already abandoned, on new forms of working groups of farmers.

1.1.3 The supplementary activities which have been mentioned from time to time - aquaculture, poultry and livestock, or horticulture - will remain available to certain farmers depending on their location, aptitud and inclination as possible sources of additional income. However it appears unlikely that these activities will ever become adopted by more than a minority of farmers for purposes of augmenting family income, although possession of poultry and fruit trees at their houses is obviously beneficial. In this report we show that poultry is not a profitable new enterprise.

1.2 Progress and Logistics

1.2.1 Since submission of the Inception Report in March 1981 work on the study of Balik Pulau areas has proceeded in parallel with work on Seberang Perai schemes. At a Steering Committee meeting in April 1981 and at another Committee in May 1981 the Consultants were asked to include socio-economic work in the studies, which had not been allowed

for in the original programme. We were specifically requested to delay submission of this Interim Report to a date at which the socio-economic studies could be included, and as a result the present date of 21st August 1981 was proposed by us early in June. (The original Agreement required submission of Interim Reports on 30th June 1981).

1.2.2

At the time when results of the survey questionnaires had been processed and were available for interpretative evaluation, our Rural Sociologist, Prof Mohd Taib Osman, unfortunately become seriously ill and was confined to hospital for several weeks, (around 25th July to 10th August). His assistant, Dr Wan Kadir Yusuf, supplied us with draft tables summarizing the results of the survey, on which our agricultural proposals are founded. In this circumstances Prof Mohd Taib's own contribution to the present report has been severely limited, but it is hoped he will be able to provide an improved sociological report at the draft final stage.

1.2.3

Apart from some early problems with office accommodation and equipment the study has proceeded smoothly. Very good co-operation has been received from State Officials of all agencies concerned with the study, and from Federal Officers in Kuala Lumpur.

1.2.4

Aerial photo-mozaics at a scale of 1:6,336, based on 1977 photography, were supplied to us to cover the majority of the Seberang Perai padi schemes. No corresponding photo-mozaics are available for Balik Pulau. This has made field work there more demanding, but at this stage there is no longer any need for aerial photographs for the study. However if the engineering design stage is to commence soon, as recommended in Chapter 9, we suggest that aerial photographs are obtained now; they should preferably be at the 1,6336 scale. Two copies of all photographs or mozaics should be provided to the designers, so as to permit one copy being used in the field for survey and inspection, while the other is retained in the office in good condition.

2. STUDY OF RESOURCES

2.1 Climate
rainfall

2.1.1 Like most areas in the west coast, Balik Pulau experiences two maxima in the annual rainfall pattern, being associated with the S. W. monsoon (April - May) and the N. E. monsoon (September - November). An important feature of the rainfall pattern is its variability from month to month and year to year; the rains can be very localised and short outbursts of intense storms are common. The mean annual rainfalls of the two recording stations (see 2.2.1) in Balik Pulau, are 2,907 and 2,806 mm. Six stations of relevance are listed below:-

<u>Station name</u>	<u>Mean annual rainfall in mm</u>
Bayan Lepas Met. Stn.	2,388
Sg. Pinang Main Canal (Balik PULau)	2,907
Bagan Air Itam Gate (B.P.)	2,806
Agricultural Station, Air Itam	2,613
Penang Hill	3,111
Penang Town	2,535

A more detailed quantitative analysis of the rainfall pattern is discussed in Sections 2.2.4 to 2.2.6.

relative humidity

2.1.2 The mean monthly relative humidity ranges from 74.4% in January to 86.2% in October although the lowest value of 27% has been recorded in 1973. A summary of the data is shown in Table 2.1b.

temperature

2.1.3 The mean monthly temperature of the study area shows little variation ranging from 27.7°C in March and April to 26.4°C in September and October (Table 2.1c). The diurnal range is relatively low, the highest value being 8.9°C for the month of February.

wind systems

- 2.1.4 During May, the south-westerly winds prevail and remain dominant until the end of August. Wind direction changes to north-easterly towards the end of the year when the weather is influenced by the north-east monsoon which starts in September and ends in December.

evapotranspiration

- 2.1.5 The forest evaporation map published by the JPT shows that evapotranspiration over the study area is about 1,524 mm annually. Records from the Bayan Lepas meteorological system show only minor variations (max. about 15%) from year to year (Table 2.1d). However, there is some correlation of evaporation with the seasonal rainfall pattern.

2.2 Surface Water Availability

data collection

- 2.2.1 From a hydrological viewpoint, a good network of hydrometric stations is important. On this score, the distribution of such stations in Balik Pulau can be said to be relatively satisfactory. Because of the need to monitor historic events, rainfall in particular, the JPT has been the major source for data collection. The other source for hydrometeorological data is the Malaysian Meteorological Service. A list of the available stations is shown below:-

<u>Station name</u>	<u>Station No.</u>	<u>Grid reference</u>	<u>Period of record</u>
Bayan Lepas Met. Stn.	5202021	QX 539867	1933 - 1980
Sg. Pinang Main Canal	5302001	QX 472972	1959 - 1977
Bagan Air Itam Gate	5302002	QX 460929	1945 - 1977
Agricultural Stn., Air Itam	5402011	QX 553979	1942 - 1977
*Penang Hill	-	-	1962 - 1975
*Penang Town	-	-	1962 - 1975

Source: JPT
*MMS

The locations of rainfall stations are shown in Fig. 2.1.

2.2.2 The number of streamflow stations in Pulau Pinang is relatively small. The only catchment areas being gauged are Sg. Teluk Bahang, Sg. Pinang West and Waterfall Catchment. The data from Pinang West is for only a limited period. As such, transposition of data becomes necessary for river flow calculations for the ungauged catchment areas. Sg. Teluk Bahang was chosen for transposition because of the availability of data and physiographic attributes. The catchment lies north of the study area and has a good series of streamflow data which have been analysed for the period 1953 - 1975. The waterfall area has its catchment on the east side of the main island watershed.

2.2.3 In areas where point rainfall and evapotranspiration data are lacking, regional hydrological data are derived from isohyets, isopleths and evaporation isolines published by JPT in the form of Hydrological Procedures and Water Resources Publications. The publications that have been referred to are:-

- 1) Hydrological Procedure No. 1 (ref.5)
- 2) Hydrological Procedure No.12 (ref.6)
- 3) Water Resources Publication No. 2 (ref. 25)

data analysis

rainfall

2.2.4 Among the six rainfall stations listed, Bagan Air Itam Gate and Sg. Pinang Main Canal are situated within the study area. However, Bagan Air Itam Gate station was selected to be representative for the Balik Pulau area for analysis since it is more centrally located (Fig. 2.1).

2.2.5 Probability analyses have been carried out to determine mean and 1-in-5-year low rainfall values for both monthly and '10-day' periods (These latter periods have been taken as divisions of the calendar months with the third period being 8, 10 or 11 days depending on the month.) Ten-day period rainfalls have been used in the calculation of irrigation requirements as, with the limitations of available water,

the detailed pattern of requirements particularly for rice is critical during the low river-flow months of March and April. Results for the mean monthly and 1-in-5-year rainfall values of Bagan Air Itam Gate station are shown in Table 2.2. As might be expected from the double monsoon climatological pattern the mean values show double maxima in the annual rainfall pattern (months of April and October). This is more clearly seen diagrammatically (Fig. 2.2). The 1-in-5-year monthly values are much lower than their respective means. However, they show a somewhat similar pattern to the mean (Fig. 2.2). Results for the 1-in-5-year 10-day rainfall values of Bagan Air Itam Gate station are shown in Table 2.3.

2.2.6 The average of the 1-in-5-year 10-day rainfalls for a particular month are, as might be expected, somewhat lower than the 1-in-5-year monthly value. However as discussed in Section 5.2.6 the 'reservoir' of standing water in the fields makes the use of 10-day values for estimating the effective rainfall unrealistically severe for flooded-rice irrigation. The monthly totals have therefore been used but, as requirements have been calculated on a 10-day basis, they have been divided into values for use over the 10-day periods. To introduce some degree of variation into the 10-day values adopted for design and to reflect the general pattern of the dry year rainfall, the adopted values have been adjusted in proportion to the calculated 1-in-5-year 10-day values.

runoff

2.2.7 For runoff analysis, the study areas have been delineated into river basins corresponding to the rivers from which irrigation abstractions may be taken. These sources are Sg. Pinang, Sg. Rusa, Sg. Air Puteh, Sg. Kongsu, Sg. Burung and Sg. P. Betong (see Table 2.4) and their catchments have been delineated from 1:25,000 topographic maps.

2.2.8 For runoff analysis, it is always preferable that actual records for the respective catchment areas be utilised. However, because none of these catchments are monitored, it is necessary to transpose data from Sg. Teluk Bahang as noted in 2.2.2. Transposed flows in a particular

river are taken to be proportional to those of Sg. Teluk Bahang in the ratio of the average annual flows (AAF) of the two rivers. The AAF's are estimated using a simple water balance equation:-

$$R = P - E$$

where,

R = runoff

P = precipitation/rainfall

E = evapotranspiration

(storage is assumed constant)

2.2.9 The Sg. Teluk Bahang catchment has an area of 11.5 km² upstream of the gauging station. Mean monthly flows, monthly flows with 80% probability of exceedence and 10-day flows with 80% probability of exceedence have been calculated. 10-day flows have been assessed only for the months of February, March, April and May which, as discussed in Chapter 5, is the critical period for irrigation requirements. These flows are summarized in Table 2.5.

2.2.10 The transposed flows for the natural and unurbanized catchments in Balik Pulau are given in Tables 2.6, 2.7 and 2.8.

urbanisation of catchments

2.2.11 A more detailed discussion of the effect of urban development in the catchments, particularly of Sg. Burung, is given in Section 3.2. It is not possible to give a very accurate assessment of how the dry-weather flows would be affected but we consider it is possible that urban development of part of a catchment might reduce dry-weather flows by that proportion of the catchment so developed i.e. no dry-weather runoff from urban areas. We have therefore estimated the 1-in-5-year flows for the catchments affected by urban development on the basis of an 'effective', or 'reduced' catchment; the reduction corresponding to the area of urban development. The areas of urban development in each catchment are given in Table 2.9 and the 1-in-5-year monthly flows for all the rivers including the effect of urbanisation, are summarized in Table 2.8.

2.3 Hydro-geology

introduction

- 2.3.1 Field studies and desk assessments have been carried out to appraise the potential of developing ground water in the Balik Pulau area. The JPT consider that ground water could, if available, provide valuable supplementary resources necessary for the irrigation needs of the area.

review of existing data and report

- 2.3.2 A review of existing data and reports indicates that very little information is available either on the geology or hydrogeology of the Island. Lenk Chevitch's 1959 report (ref. 8) on ground water potential in selected areas, and the Geological Surveys notes appear to be the only hydrogeological sources of data. As regards geology, no published map of the area exists although a few university higher degree studies have been carried out. These, however cover selected small parts of Penang Island. Discussions with the Universiti Sains Malaysia revealed that some geophysical investigations have been undertaken in the Balik Pulau, Pantai Acheh and Bayan Lepas areas. The Penang Development Corporation has had 28 boreholes constructed near Kebun Besar (Relau Agricultural Station) for prawn hatcheries but only a few were successful. Boreholes were also drilled by Lee Rubber Factory at Paya Terubong but these were found to be unsuccessful.

existing ground water use

- 2.3.3 Our field visits revealed that there are two operational tubewells in Genting used for supplying a crocodile farm and one at Sg. Pinang for supplying water to a chicken farm. Apart from these there are numerous dug wells which have centrifugal pumps set up to extract water for supplying small factories. It was not possible to obtain data on actual yields of these sources but estimates have been made based on number of hours pumped and sizes of suction pipe and engine used. A sand quarry near Balik Pulau was visited. It shows the geology of the alluvial deposits and inflowing ground water being pumped.

potential aquifers

- 2.3.4 In Balik Pulau area the potential aquifers that may be developed consist of coarse-grained sands derived from the weathering of the steep granite massive. The sequence of recent geological events has caused the accumulation of coarse sands derived from the parent rock material close to the steep granite slopes. These grade to fine sands towards the coast, where marine silt, clays and muds are deposited and indeed are continuing to be laid down at present
- 2.3.5 In general there are unlikely to be extensive resources of ground water in the granite massive except where there are shatter or fault zones. Two such locations were seen from where the springs that issue have been trapped for domestic water supply either by the local population or by assistance from the Ministry of Health. In Pulau Pinang the granite massive occupies almost all land above the 150 ft contour while land below the 50 ft contour makes up the coastal plain which partly consists of potential aquifer material. Apart from these two land forms there are the permatangs (Malay for raised storm beach), which are found within the coastal plain in north-south trending lines, which also consist of clean medium to fine-grained sand. These form small localised aquifers and only provide adequate supplies for domestic use, in individual houses.
- 2.3.6 Because of the lack of time and of existing suitable boreholes, proper pumping tests could not be carried out to assist with estimating the yields of future boreholes. Two dug pits were, however, pumped down in order to obtain an indication of the rate of inflow into these pits. These tests have provided tentative permeability figures of 150 m/d in the Pulau Betong area and 12 m/d in the Bukit Kechil area (Sg. Pinang). However, the overall permeability of the aquifer is likely to be less.
- 2.3.7 The Pulau Betong area is considered representative of the coarse-grained sands while Bukit Kechil represents the more fine-grained sand. The equivalent transmissivity of the aquifer can be calculated if the thickness of the aquifer is known. The University of Science Department

of Geophysics studies suggest that the bedrock (i.e. granite) is at a depth in excess of 45 m below surface in the Pulau Pinang area.

2.3.8 Estimates of probable ranges of aquifer parameter have been made. These indicate transmissivities to be between $75 \text{ m}^2/\text{d}$ to $150 \text{ m}^2/\text{d}$ with maximum aquifer thickness ranges from 35 to 40 m. The lower range of the yield of such an aquifer is $900 \text{ m}^3/\text{d}$ while the upper range is $2,200 \text{ m}^3/\text{d}$ for a well constructed production borehole.

2.3.9 It appears likely that a potential aquifer of thickness around 30 m exists in the area. This takes into account an unsaturated zone and a lower weathered granite zone (impermeable). The relationship between such an aquifer and the sea water is unknown at present but it is possible that near the coast the aquifer may contain saline water. Therefore production boreholes would have to be sited in such a manner as to minimise the saline intrusion which may exist. The annual replenishable resources available for development can be calculated by making an assessment of annual infiltration. The figures given below are tentative and would need to be revised following further field investigation of the aquifer.

estimates of resources available

2.3.10 An estimate of annual ground water resources can be made by accounting for the potential aquifer recharge that would percolate to the water table. Recharge multiplied by the area of outcrop gives the annual resources.

2.3.11 The electrical conductivity survey and soils map was used to assess the area of outcrop of the sands and differentiate it from that of the marine and other clays. It should be noted that the period of field surveys was during a time of exceptionally high rainfall, April/May 1981, and therefore the conductivities may not be representative of true ground water conditions. These indicated the following areas:-

Area of outcrop of sands	22 km ²
Area of outcrop of clays contributing leakage into sands	7 km ²

2.3.12 An annual recharge of 300 mm per annum was assumed to be applicable to the sands. An estimate of leakage from the overlying clays and some contributions from the granite rock mass were also made. The calculations suggest an annual renewable resource of $7 \times 10^6 \text{ m}^3$.

further exploratory investigations

2.3.13 Exploratory work is required to locate the extent of the potential sand aquifer and also to test the quality and quantity of water that may be obtained from boreholes. In order to obtain the maximum amount of information, boreholes should be drilled either by reverse circulation or percussion drilling methods. During construction water samples would have to be regularly tested together with bailer tests to assess the yield and quality. The design of production boreholes should await the results of exploratory drilling.

conclusions and recommendations

2.3.14 Field investigations revealed the presence of shallow ground water of low electrical conductivity in the alluvial sands of the area. In the Balik Pulau area a potential sand aquifer exists from which a replenishable resource of about $7 \times 10^6 \text{ m}^3/\text{annum}$ may be exploited. There is likely to be some additional water available in storage, however, but its exploitation may cause saline intrusion to occur over a period of time.

2.3.15 Groundwater can be pumped by means of boreholes whose depths will have to be at least 30 m (100 ft). The boreholes will require screens and possibly gravel packs and for low rates of abstraction, i.e. less than 15 L/s (0.3 mgd), centrifugal end-suction pumps would be required. The water is likely to have dissolved H_2S and some problems with iron deposition may be encountered, leading to possible clogging of well screens and pipes unless proper measures are taken to counteract them.

2.4 Soils

2.4.1 The area under study consists of the padi areas of Sg. Burung and Sg. Pinang schemes with a nominal total area of 1,125 ha (2,780 ac), plus an area of 200 ha (500 ac) at Pantai Acheh which consists of mangrove swamp now partly reclaimed.

2.4.2 Soils in the area comprise the following series:-

- Kranji (class 4)
- Kuala Kedah/Tebangau association (class 2)
- Rudua/Rusila association
- other colluvia/alluvia near the hills

Samples were taken for the present study as shown on Figure 2.3, consisting of three sites in the coastal mangrove forest of Pantai Acheh outside the new bund, two sites in the Sg. Burung scheme and one site in the Sg. Pinang scheme. The last three are all in the K. Kedah/Tebangau soils area; this soil series occurs throughout all areas in which padi is cultivated, except for the isolated part in Mukim E nearest Balik Pulau town. This 32 ha is in the much more permeable, sandy, "permatang", material of the Rudua/Rusila.

2.4.3 Figure 2.3 also shows locations of 52 samples taken by MARDI in the K. Kedah/Tebangau. The pH values obtained from these samples (Appendix A) establish that this soil is not potentially acid sulphate. Test results for the six samples taken in the present study are summarised on Table 2.12. It can be seen that the pH of the mangrove forest soils remains high after incubation. Therefore it can be stated that acidity problems do not exist anywhere in the project scheme areas.

2.4.4 The soil group boundaries shown on Figure 2.12 are taken from the unpublished semi-detailed survey by the DOA. The boundary between the Kranji and the K. Kedah/Tebangau is shown on the original map as lying along the line of the existing older JPT bunds - (not the bunds currently under construction at Sg. Burung or recently constructed at Sg. Pinang and Pantai Acheh).

2.4.5 The CEC values of samples taken from the padi areas varied from 18-25 meq/100 gm averaging around 20 meq/100 gm soil and these soils may be considered as suitable for padi and a wide range of annual crops, with improved drainage. The main textural type in this area is a clay soil. At an earlier stage in our studies the extensive cultivation of bananas, with papaya, was considered. The soils would be suitable for this crop, given sufficient field drainage at depths of 0.6 - 1.0 m. Improved drainage is also necessary for rice cultivation, and when carried out it would immediately rectify problems currently encountered with machinery on the soft, spongy soils in the coastal strips.

2.4.6 Fertilizer recommendations for padi and for other annual crops will be provided in the Draft Final Report. The irrigation water analyses data have yet to be assessed. The information on potassium content is of special significance in the drawing up of the K input in the fertilizer schedule for padi.

2.4.7 We are concerned at the large scale of reclamation work in mangrove swamp recently carried out and still in progress. In view of the shortage of farm labour - a dominating factor in any agricultural proposals for Balik Pulau - we do not understand the rationale for enlarging the agricultural land area at the expense of the mangrove swamp resource. Mangrove plays a key part in the ecosystem involving prawns, fish, crabs etc. The importance of this is explained in Appendix B. In view of the above points we would recommend that mangrove areas be left in their natural state, unless there are very strong reasons for destroying them.

2.5 Land

- 2.5.1 The Balik Pulau plain extends for 11 km north-south on the west coast of Penang Island, and it has a maximum width of some 3½ km. The whole of this area lies below the 50 ft contour and only one hill, Bukit Kechil, intrudes on the plain apart from spurs of the main mountain mass to the east. These spurs are very limited in extent and the area forms a symmetrical triangle with the sea coast as its base and Balik Pulau town located nearly 4 km inland as its apex.
- 2.5.2 The land is, or has been, cultivated with padi for most of the areas nearer the sea, in a strip one to two km wide. Further east there are tree crops and kampong land. The padi perimeter contains sizeable pockets of coconut plantations, and unreclaimed swamps close to the numerous small rivers.
- 2.5.3 Considerable urban development westward from Balik Pulau town is planned (3.2). Smaller urban growth centres are expected to develop around the small villages of Sg. Rusa, Sg. Pinang and Pulau Betong. The effort of these developments on the agriculture and its water supplies is discussed in Section 3.3.
- 2.5.4 Geologically the plains are made up of sandy alluvium derived from the decomposed granite of the main mountain mass, which nearer to the sea is overlain by marine deposits of silt or clay, principally clay. The boundary is shown on the soils map, fig. 2.4, as the inland limit of Kuala Kedah soil type. Raised storm beaches of sand, permatangs, occur over the marine muds, and a major permatang runs straight for 6 km nearly north-south dividing the Sg. Burung padi areas in two. The sandy deposits near the hills form a potential ground water reservoir and in at least one area sand is quarried by hydraulic methods, as for tin mining.
- 2.5.5 Coastal reclamation works have been undertaken in several stages and over much of the coast three boundary lines, located progressively further westward, may be seen. Care is needed to distinguish land between one line and another, given that published maps are not up-to-date. Agriculture in the strip between the first and second lines within

Sg. Burung frontage is at present limited to stunted and unproductive coconut trees (about 80 ha). The second line bund is understood to have been constructed in the 1930's and another is currently under construction.

2.5.6 Within the frontage of the Sg. Pinang scheme a new reclamation bund was completed in 1969. This encloses 170 ha of land in a strip about 400 m wide and 4 km long. Detailed plans have been made for this area, but apart from a very small cleared zone at the north end, it remains occupied by mangrove trees and other swamp vegetation (see section

2.5.7 A similar area, nominally 200 ha, has more recently been bunded around the mangrove swamp south of Kg. Pantai Acheh, forming the northern limit of the project area. Reclamation of the area within the bund is currently limited to a plot near the road in which fill has been placed prior to housing construction. In the rest of the area the mangrove is still growing.

Table 2.13 Age Structure of Balik Pulau Agricultural Population

Age groups (years)	Percentage of persons
Below 15	27.3
15 - 19.9	12.7
20 - 24.9	15.2
25 - 29.9	8.1
30 - 34.9	11.4
35 - 39.9	12.1
40 - 44.9	12.7
45 and above	16.7
Total	100.0

2.6 Labour Availability

2.6.1 The labour situation in Balik Pulau under existing agricultural conditions is affected very adversely by the non-availability of continuous employment or a steady monthly income in farming. With the right price and other inducements, it may be possible to acquire and retain labour within agriculture.

2.6.2 The 1979 Socio-economic Survey by the MOA showed that 61 persons from 67 farm households reported working full-time on farms while another 31 persons from 36 households worked on farms part-time. This means that 9% of the farms did not have a full-time worker at all. As expected, the majority of the working age group find employment off the farms. Sixty-six persons from 62 of the sampled households reported working full-time in non-farm occupations, while another 19 persons from 18 households worked in non-farm jobs part-time. The nature of the non-farm jobs of these people will be discussed below.

2.6.3 Our own socio-economic survey in Balik Pulau gave a figure of 5.6 as the average family size for the sample of 270 farmers interviewed. The age structure of the population, as revealed by the sample, is given in Table 2.13.

Table 2.13 Age Structure of Balik Pulau Agricultural Population

Age groups (years)	Percentage of persons
Below 16	27.3
16 - 19.9	12.7
20 - 25.9	15.5
26 - 30.9	8.1
31 - 40.9	11.4
41 - 50.9	12.1
51 and above	12.9
Total	<u>100.0</u>

As seen from the Table, over a quarter of the rural population are children below 16 years of age who cannot yet enter the labour market. More than half the population (55.5%) are below 26 years old, and only 25% are over 40 years. The average age of household heads is 52.8 years. Interviews with 190 non-agricultural workers from the same households showed that 75% of them work as factory labour while 11.6% work as labourers in the public sector; 80% of them were in the 18 - 30 years age group.

2.6.4 When asked for their views on padi cultivation as a means of earning a living, 30% of these off-farm workers considered padi farming as a low-paying occupation while 48% considered it as sheer drudgery. It is safe to say that the 78% of those interviewed were in fact saying that the low income from padi farming under existing conditions is not commensurate with the drudgery involved. However, when asked if they would participate in group farming after the land is rehabilitated, only 11% said they would not. The majority would participate either as shareholders only (37.4%), as employees only (21.1%) or in both capacities (30%). Thus we have at least half of these youths saying that they would be willing to provide the labour required in group farming. Many expressed the desire to find employment in their own kampongs and thereby cut down on travelling time to, and food expenses at, the factories. Realistically, they would be willing to stay back if a steady monthly income is assured. Sixty-six percent said they will stay back if the group farm can offer them a salary and conditions of service which are comparable with their present employment. Female workers, however, showed slightly less enthusiasm to return to the farm, with only 59% saying "yes", against 74% of the males.

2.6.5 Table 2.14 gives average monthly incomes earned by various categories of off-farm workers in the sample. Surprisingly, the results show that a person working as a government labourer was earning more than a factory worker in Balik Pulau. Group farming, if established, will have to take cognizance of the salaries earned by the various categories of workers as shown in the table in order to attract and retain the good workers on the farm. It may be noted that, on the average, female workers earned slightly less (\$199) than male workers (\$232).

Table 2.1a Bayan Lepas Station: Rainfall record (mm)

	Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
<u>Rainfall (mm)</u>														
Mean Monthly	1951 - 1980	68.2	93.5	135.4	211.3	247.9	180.5	205.2	236.5	345.0	384.3	253.4	112.9	2474.1
Highest Monthly	1951 - 1980	210.8	223.0	336.0	389.4	506.2	290.5	380.2	419.3	629.3	647.4	481.6	325.9	3253.2
Year of Highest		1961	1952	1952	1972	1958	1978	1951	1968	1980	1970	1964	1969	1970
Lowest	1951 - 1980	0.8	3.3	15.1	16.8	63.5	73.4	30.5	92.2	189.5	141.0	45.5	22.1	1965.7
Year of Lowest		1955	1968	1977	1963	1974	1979	1977	1954	1962	1960	1971	1954	1979
<u>Number of Raindays</u>														
Mean	1951 - 1980	7	9	12	17	18	13	15	16	19	23	19	12	181
Highest		14	16	21	24	22	19	21	24	24	28	27	22	215
Year of Highest		1 67	1951	1952	1953	Sev.	Sev.	1968 1979	1980	1953 1964	1968	1963	1965	1966
Lowest	1951 - 1980	1	1	1	8	13	7	5	8	12	17	6	2	151
Year of Lowest		1976 1976	1970	1972	1963	1976	1951 1955	1977	1961	1959	1960 1979	1971	1979	1979

Sev. Several occasions

Table 2.1b Bayan Lepas Station: Relative humidity records (%) (1968 - 1980)

Data Description	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
24 Hr. Mean	74.4	75.8	79.1	83.1	84.3	84.0	83.4	84.1	85.7	86.2	84.0	79.3	81.9
Mean Daily Max	93.2	94.8	96.5	97.6	97.8	97.0	97.6	97.8	98.3	98.2	97.2	94.5	96.8
Mean Daily Min.	53.2	53.2	56.1	62.2	63.9	63.5	62.5	63.1	64.9	63.4	63.4	59.1	60.9
Lowest Min.	30	34	27	39	46	47	45	45	46	50	37	31	27
Year of Lowest Min.	1979	1973	1973	1977	1972	1975	1973, 1978	1974, 1978	1973	1970	1978	1968	1973

Table 2.1c Bayan Lepas Station: Temperature records ($^{\circ}$ C) (1968 - 1980)

Data Description	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
24 Hr. Mean	27.0	27.4	27.7	27.7	27.5	27.3	27.0	26.4	26.4	30.5	26.5	26.7	27.0
Mean Daily Max.	31.8	32.3	32.4	31.9	31.6	31.3	31.1	31.0	30.6	30.5	30.8	31.1	31.4
Mean Daily Min.	23.1	23.4	23.7	24.9	24.1	23.8	23.5	23.4	23.4	23.3	23.3	23.3	23.5
Highest Max.	34.7	35.7	35.6	34.6	34.4	33.9	33.6	33.4	33.3	33.7	33.4	33.9	35.7
Year of Highest Max.	1979	1973	1973	1977	1973	1972	1977	1976	1972	1972	1972	1977	1973
Lowest Min.	18.7	20.4	20.9	21.4	21.4	21.0	20.6	21.1	21.3	21.0	21.1	21.0	18.7
Year of Lowest Min.	1972	1977	1969	1972	1972	1976	1971	1971	1978	1974	1971	1978	1972

Table 2.1d Bayan Lepas Station: Mean monthly evaporation (mm)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1974	126.1 * (31)	127.8 (28)	149.6 (31)	119.2 (30)	112.5 (31)	111.3 (30)	108.0 (31)	102.0 (30)	85.5 (28)	92.0 (31)	78.7 (30)	121.9 (31)
1975	129.7 (31)	115.7 (26)	110.5 (30)	139.4 (29)	98.5 (28)	83.2 (26)	106.3 (30)	109.9 (29)	86.2 (24)	75.2 (23)	92.4 (28)	97.6 (28)
1976	148.9 (29)	144.2 (29)	118.2 (27)	112.9 (28)	95.5 (31)	109.7 (30)	119.8 (31)	116.1 (30)	83.9 (26)	84.5 (29)	93.8 (30)	122.1 (31)
1977	131.6 (29)	129.9 (27)	144.4 (27)	138.7 (28)	116.0 (28)	103.2 (26)	146.6 (31)	124.4 (31)	102.3 (27)	109.4 (27)	125.0 (30)	132.3 (30)
1978	138.7 (31)	143.4 (26)	144.6 (29)	122.6 (28)	117.4 (29)	90.6 (27)	103.0 (30)	89.5 (29)	85.3 (29)	93.0 (29)	108.9 (30)	140.6 (31)
1979	146.8 (31)	131.9 (28)	157.4 (31)	120.4 (30)	117.7 (31)	121.5 (30)	119.6 (31)	124.0 (30)	106.7 (30)	111.4 (30)	115.0 (29)	168.4 (31)
1980	176.2 (31)	149.6 (29)	137.6 (31)	143.1 (30)	117.4 (29)	109.9 (30)	110.3 (30)	100.1 (30)	103.8 (27)	96.7 (30)	101.3 (30)	113.4 (31)
Mean (1974-1980)	145.3	138.2	145.0	132.5	116.3	109.7	117.7	113.5	102.9	103.4	103.7	130.2

* brackets denote number of days recorded

Table 2.2 Bagan Air Itam Gate : Rainfall data in mm

Month Data description	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean	92.5	95.7	181.3	326.3	259.1	201.4	210.1	246.1	380.7	475.2	300.7	142.2
1 in 5 yr	35.6	20.3	76.2	162.6	175.3	127.0	147.3	152.4	221.0	292.1	193.0	71.1
Minimum	11.9	0.0	36.6	23.1	147.1	91.7	0.0	76.7	158.5	246.1	129.0	12.2
Maximum	340.1	214.6	346.2	371.1	450.1	364.7	412.5	468.4	708.4	763.5	488.7	302.0

Table 2.3 Bagan Air Itam Gate : 10-day rainfall with 80% probability exceedence (mm)

Month Data description	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1st 10-day	3.81	0.0	15.2	30.5	40.6	12.7	5.08	43.2	53.3	58.4	68.9	22.9
2nd 10-day	5.1	1.3	10.2	38.1	55.9	30.5	25.4	27.9	60.9	91.4	62.2	2.54
3rd 10-day	0.0	2.5	35.6	30.5	25.4	34.3	36.8	31.7	58.4	92.7	30.5	13.2

Table 2.4 : Catchment Characteristics

Catchment	Total catchment area (km ²)	Mean annual rainfall (mm/yr)	Mean annual forest evapotranspiration (mm/yr)	Mean annual runoff (mm/yr)	AAF (m ³ /s days)
Sg. Pinang	9.90	2845	1524	1321	151
Sg. Rusa	4.00	2845	1524	1321	61
Sg. Air Puteh	5.15	2845	1524	1321	79
Sg. Kongs	9.70	2845	1524	1321	148
Sg. Burong	11.30	2845	1524	1321	173
Sg. P. Betong	2.10	2845	1524	1321	32
Sg. Kongs & Sg. Air Puteh	16.00	2845	1524	1321	244

Table 2.5 : Sg. Teluk Bahang Flow Characteristics

Monthly flows (m³/sec. days)

Period	J	F	M	A	M	J	J	A	S	O	N	D
Mean monthly	15	10	10	11	15	13	14	15	20	27	28	21
1 in 5 yr min monthly flow	12	9	8	8	12	10	11	11	15	20	21	16

10-day flows (m³/s)

Period	February			March			April			May		
	1st 10	2nd 10	3rd 10	1st 10	2nd 10	3rd 10	1st 10	2nd 10	3rd 10	1st 10	2nd 10	3rd 10
1 in 5 yr min 10 day flows	1.0	0.9	0.7	0.8	0.7	0.9	0.8	0.7	0.7	1.0	1.1	1.1

Table 2.6 Transposed mean monthly flow in m^3/s . x days

Balik Pulau catchment	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1. Sg. Pinang	11.2	7.8	7.8	8.1	11.4	9.5	10.6	11.6	15.0	20.5	20.9	15.6
2. Sg. Rusa	4.4	3.1	3.1	3.2	4.5	3.7	4.2	4.6	5.9	8.1	8.2	6.2
3. Sg. Air Putih	5.8	4.0	4.1	4.2	5.9	4.9	5.5	6.0	7.8	10.7	10.9	8.1
4. Sg. Kongsi	11.1	7.7	7.7	8.0	11.2	9.4	10.5	11.4	14.8	20.2	20.6	15.4
5. Sg. Kongsi at road bridge (includes Air Putih)	18.3	12.7	12.7	13.3	18.6	15.5	17.3	18.9	24.6	33.5	34.1	25.5
6. Sg. Burong	13.0	9.0	9.0	9.4	13.2	11.0	12.3	13.4	17.4	23.8	24.2	18.1
7. Sg. P. Betong	2.4	1.7	1.7	1.7	2.4	2.0	2.3	2.5	3.2	4.4	4.5	3.3

Table 2.7 Transposed 1 in 5 yr minimum monthly flow in $m^3/s \times \text{days}$

Balik Pulau catchment	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1. Sg. Pinang	9.45	6.60	6.00	5.70	8.85	7.50	7.20	7.50	11.25	15.00	15.75	11.70
2. Sg. Rusa	3.72	2.60	2.36	2.24	3.48	2.95	2.83	2.95	4.43	5.90	6.19	4.60
3. Sg. Air Putih	4.91	3.43	3.12	2.96	4.60	3.90	3.74	3.90	5.85	7.80	8.19	6.08
4. Sg. Kongsı	9.32	6.51	5.92	5.62	8.73	7.40	7.10	7.40	11.10	14.80	15.54	11.54
5. Sg. Kongsı at road bridge (includes Air Putih)	15.43	10.78	9.80	9.31	14.45	12.25	11.76	12.25	18.37	24.50	25.72	19.11
6. Sg. Burong	10.96	7.66	6.96	6.61	10.27	8.70	8.35	8.70	13.05	17.40	18.27	13.57
7. Sg. P. Betong	2.02	1.41	1.28	1.22	1.89	1.60	1.54	1.60	2.40	3.20	3.36	2.50

Table 2.8a Transposed in 1 in 5 yr minimum monthly flow in m³/s.

Balik Pulau catchment	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1. Sg. Pinang	0.30	0.23	0.19	0.19	0.29	0.25	0.23	0.24	0.37	0.48	0.52	0.38
2. Sg. Rusa	0.12	0.09	0.08	0.07	0.11	0.10	0.09	0.09	0.15	0.19	0.21	0.15
3. Sg. Air Putih	0.16	0.12	0.10	0.10	0.15	0.13	0.12	0.13	0.19	0.25	0.27	0.20
4. Sg. Kongsi	0.30	0.23	0.19	0.19	0.28	0.25	0.23	0.24	0.37	0.48	0.52	0.37
5. Sg. Kongsi at road bridge (includes Air Putih)	0.50	0.38	0.32	0.31	0.47	0.41	0.38	0.39	0.61	0.79	0.86	0.62
6. Sg. Burong	0.35	0.27	0.22	0.22	0.33	0.29	0.27	0.28	0.43	0.56	0.61	0.44
7. Sg. P. Betong	0.06	0.05	0.04	0.04	0.06	0.05	0.05	0.05	0.08	0.10	0.11	0.08

Table 2.8b 1 in 5 yr minimum monthly flow (m^3/s) (after allowing for urban development)

Balik Pulau catchment	Net catchment (after urbanization) in km^2	Month											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Sg. Pinang	9.90	0.20	0.16	0.13	0.13	0.19	0.17	0.15	0.16	0.25	0.32	0.35	0.25
Sg. Rusa	3.50	0.11	0.08	0.07	0.10	0.09	0.08	0.08	0.08	0.13	0.17	0.18	0.13
Sg. Kongsı	(i) 8.95 (ii) 8.87	0.28 0.27	0.22 0.21	0.18 0.17	0.17 0.17	0.26 0.26	0.23 0.23	0.21 0.21	0.22 0.22	0.34 0.34	0.44 0.44	0.48 0.47	0.34 0.34
Sg. Kongsı at road bridge (includes Air Putih)	(i) 15.25 (ii) 15.06	0.47 0.47	0.37 0.36	0.30 0.30	0.29 0.29	0.44 0.44	0.39 0.39	0.36 0.36	0.38 0.37	0.58 0.58	0.75 0.74	0.82 0.81	0.59 0.58
Sg. Burong	(i) 7.95 (ii) 6.50	0.25 0.20	0.19 0.16	0.16 0.13	0.15 0.13	0.23 0.19	0.20 0.17	0.19 0.15	0.20 0.16	0.31 0.25	0.39 0.32	0.43 0.35	0.31 0.25

Note: - (i) and (ii) denotes the two stages of urbanization in Balik Pulau as designated by the Majlis Perbandaran Pulau Pinang.

- PBA abstract 1.5 mgd from Sg. Pinang, i.e. $0.08 m^3/s$. Thus, total available flows must be reduced by this amount and the available field flows by $0.05 m^3/s$.

Table 2.9 : Areas of Urban Development

Catchment	Total area (km ²)	Area of urban development (km ²)	% of total catchment
Sg. Pinang	9.92	0.02	0
Sg. Rusa	4.00	0.50	12.5
Sg. Air Puteh	5.15	-	-
Sg. Kongsii (i)	9.70	0.75	7.7
(ii)		0.83	8.6
Sg. Kongsii & (i)	16.00	0.75	4.7
Sg. Air Puteh(ii)		0.83	5.2
Sg. Burong (i)	11.30	3.35	29.6
(ii)		4.80	42.5
Sg. P. Betong	2.10	-	-

Note: (i) Approved area of urban expansion
(ii) Includes possible additional area

Table 2.10

Water quality analyses (samples taken in March 1981)

Chemical analysis (mg/litre)	Sg. Burung at J.P.T. headworks	Sg. Air Itam (Sg. Kongsi) at d/s of Jalan Bharu road bridge	Sg. Air Itam (Sg. Kongsi) at d/s of Jalan Sg. Pinang road bridge
Time sample taken	11.05 am	12.15 pm	3.00 pm
Date sample taken	6.3.81	6.3.81	6.3.81
pH at 26°C	5.9	6.2	6.3
Electrical conductivity (umhos/cm ³)	50	40	45
Nitrate nitrogen	0.37	0.31	0.41
Chloride (as Cl ⁻)	5.0	3.0	3.0
Sulphate (as SO ₄ ⁼⁼)	18.5	14.0	8.0
Total solids dried at 105°C	55	40	45
Suspended solids dried at 105°C	30	20	20
Dissolved solids	25	20	25
Iron (as Fe)	0.1	0.10	0.1
Total Hardness as CaCO ₃	5	5	5
Manganese (as Mn)	Not detected	Not detected	Not detected
Sodium (as Na)	9.4	4.6	4.4
Calcium (as Ca)	1.2	1.2	1.6
Magnesium (as Mg)	0.49	0.49	0.24
Potassium as (k)	1.9	1.8	1.9
Boron (as B)	Not detected	Not detected	Not detected

Table 2.11

Water quality analyses (samples taken in April 1981)

Chemical analysis (mg/litre)	Sungai Kongsu at intake	Sungai Burong at JPT Headworks	Sungai Pinang d/s of read bridge
Time sample taken	11.30 am	2.00 pm	6.05 pm
Date sample taken	17.4.81	20.4.81	17.4.81
pH at 26°C	6.8	6.7	6.4
Conductivity (unhos/cm ³)	45	45	25
Nitrate nitrogen	0.70	0.38	0.17
Chloride (as Cl ⁻)	5.0	5.0	5.0
Sulphate (as SO ₄ ⁻⁻)	9.5	0.8	0.6
Total solids dried at 105°C	50	100	50
Suspended solids dried at 105°C	10	45	40
Dissolved solids	40	55	10
Iron (as Fe)	0.1	1.0	<0.10
Boron (as B)	Not detected	Not detected	Not detected
Manganese (as Mn)	" "	" "	" "
Potassium (as K)	2.2	2.4	1.6
Sodium (as Na)	5.4	5.0	3.5
Calcium (as Ca)	4.0	4.0	3.0
Magnesium (as Mg)	0.1	0.6	0.2
Hardness (as CaCO ₃)	5.0	10	5.0

Table 2.12

(a) REPRESENTATIVE SOILS OF BALIK PULAU SCHEMES

Occupation	Clay	Silt	Sand	Clay + $\frac{1}{2}$ Silt	Textural Type
				Index	
Sg. Burong (1)	63	27	10	76	Clay
Sg. Burong (2)	67	32	2	83	Clay
Sg. Pinang	54	34	12	71	Clay

Samples at 6" - 12" depth

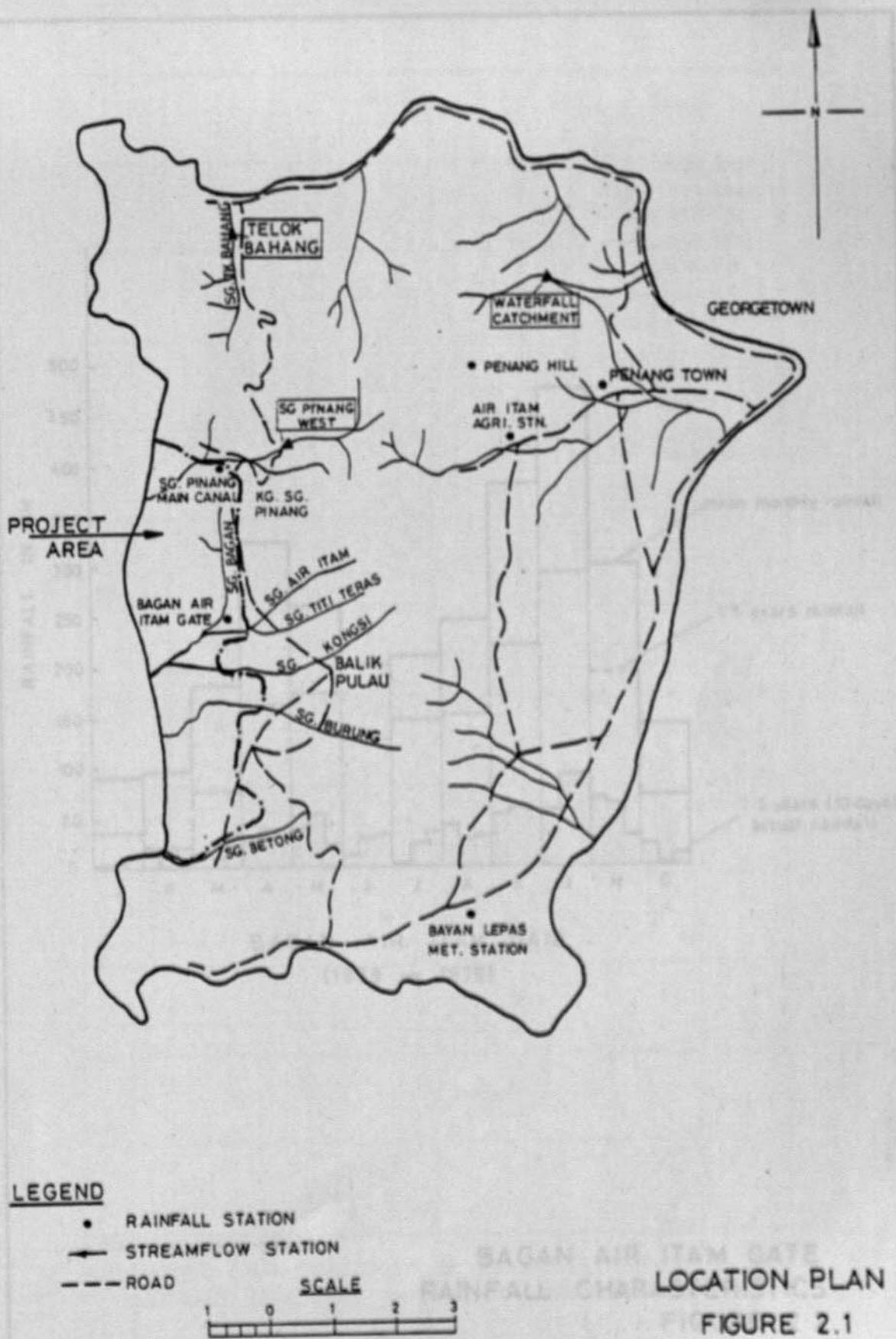
(b) pH DETERMINATIONS IN DIFFERENT LOCATIONS IN THE MANGROVE FORESTS NEAR PANTAI ACHEH

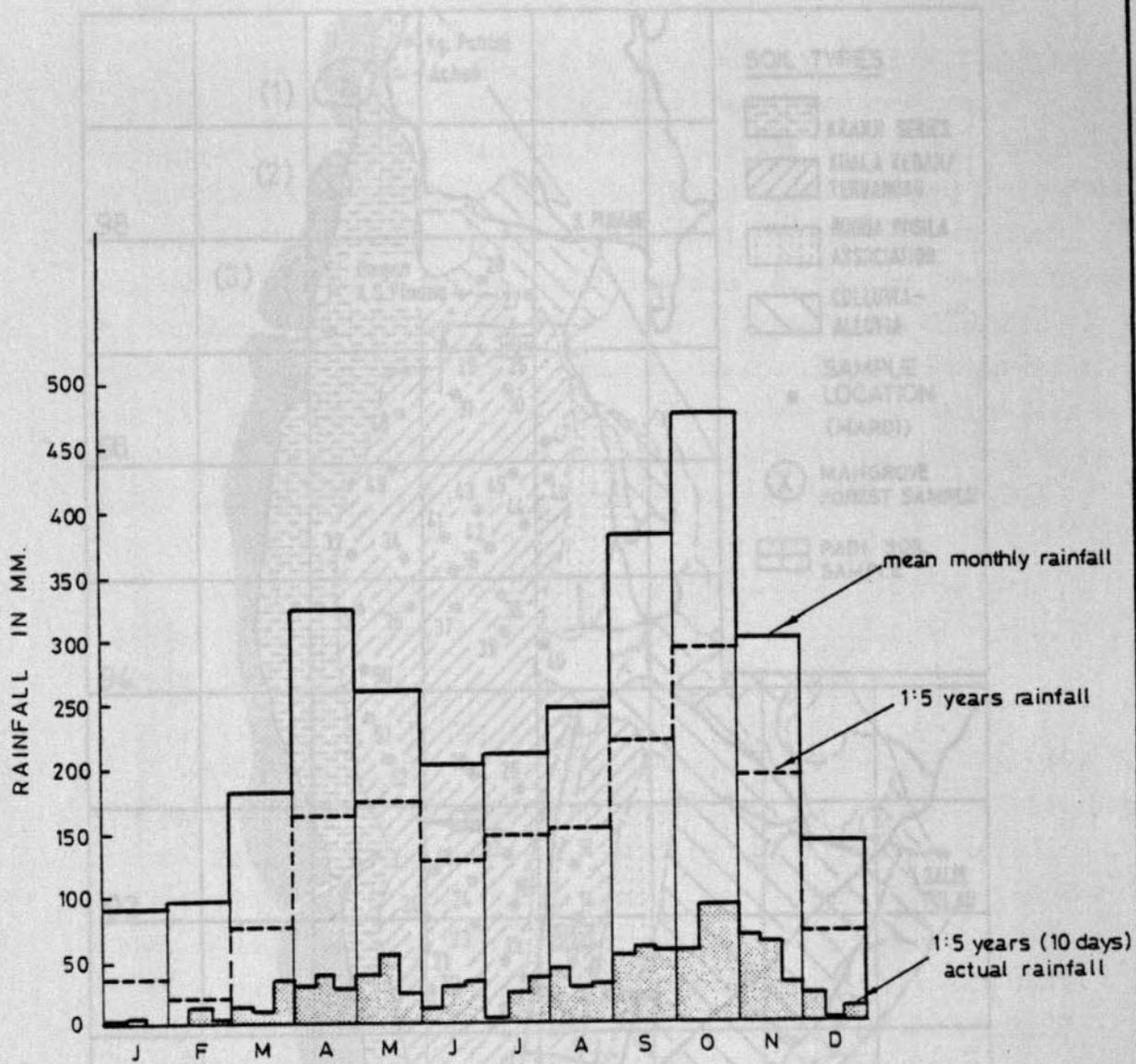
	Sample 1		Sample 2		Sample 3	
	Fresh	After Incubation	Fresh	After Incubation	Fresh	After Incubation
(a)	7.4	7.3	6.9	6.7	7.9	7.7
(b)	7.3	7.1	7.1	6.7	7.9	7.9
(c)	7.8	7.6	7.2	6.4	7.8	7.7

(a), (b) and (c) refer to the 0-6, 6-12 and 12-18 in fractions

Table 2.14 Average monthly income by categories of occupation

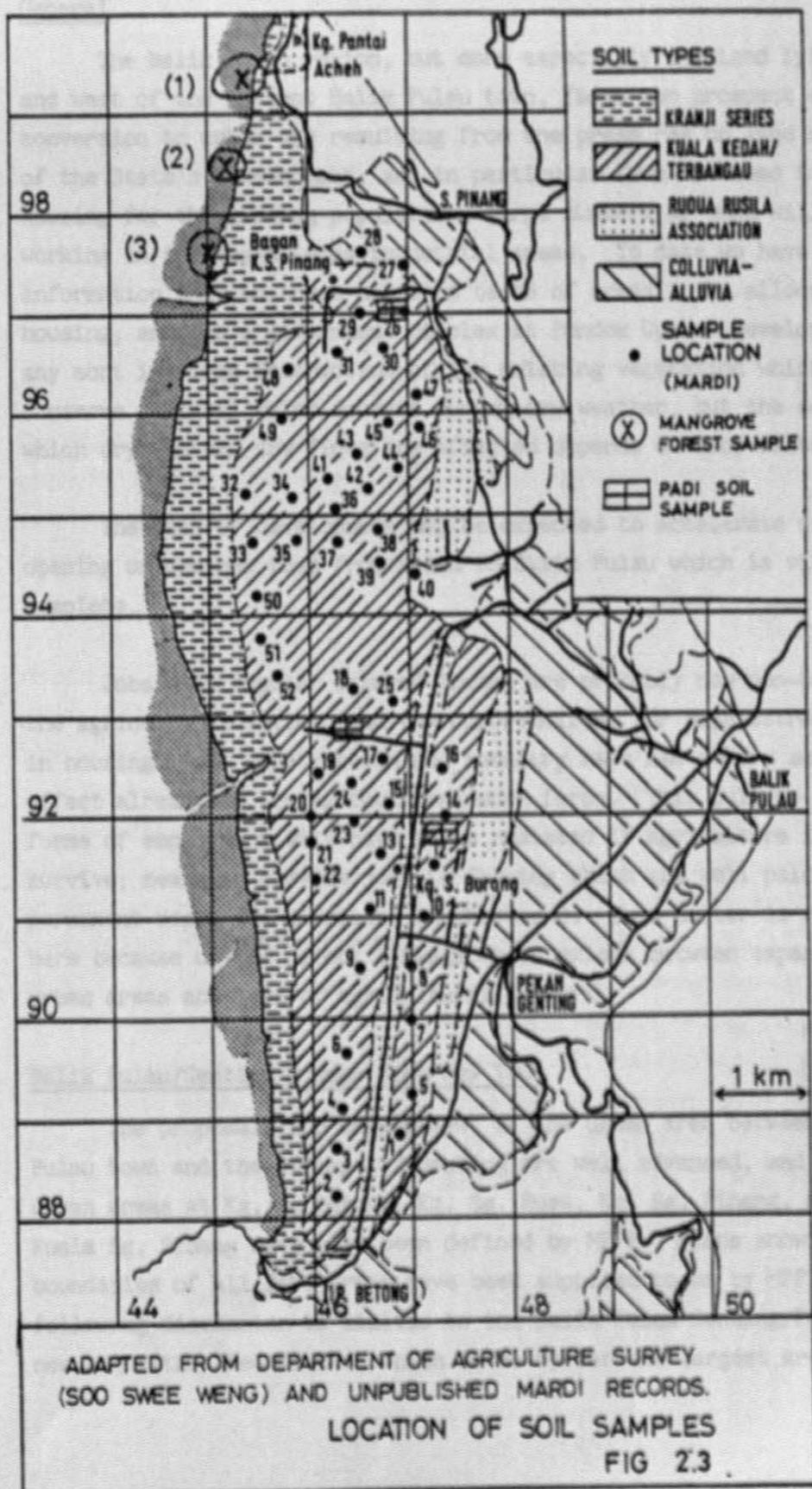
Occupation	Mean Monthly Income (\$)	No. in Sample
Factory worker	191.75	143
Government labourer	276.59	22
Clerk	316.00	5
Policeman	312.00	5
Teacher	690.00	1
Executive	632.00	2
Misc. group	213.89	9
All	216.72	187
Missing information : 3 Mean Income - Male : M\$232.35 - Female : M\$199.00		





BAGAN AIR ITAM GATE
(1959 - 1975)

BAGAN AIR ITAM GATE
RAINFALL CHARACTERISTICS
FIGURE 2-2



3. EFFECTS OF PROPOSED URBAN DEVELOPMENT

3.1 General

3.1.1 The Balik Pulau region, but more especially the land lying south and west of the present Balik Pulau town, faces the prospect of conversion to urban use resulting from the pressures on land resources of the State's development, and in particular from the need to provide housing for the growing population, large numbers of whom will be working in the Bayan Lepas industrial areas. To date we have received information only on these needs in terms of areas to be allocated to housing, and for a government complex at Pondok Upeh. Development of any sort involves destruction of the existing vegetation which acts to conserve natural water sources during dry weather, but the degree to which dry weather dry flows are affected depends on many factors.

3.1.2 The pace of development may be expected to accelerate with the opening of the new road from Relau to Balik Pulau which is virtually complete.

3.1.3 Jobs with regular assured income are probably now non-existent in the agricultural sector, and the opportunities for such attractive jobs in housing, road construction and industry have had a very serious effect already on the agricultural work force. This pull to the new forms of employment will have to be resisted if agriculture is to survive; means to provide jobs in farming which are well paid on a permanent basis are discussed in Chapter 8. This matter is raised here because of the direct linkage which exists between expansion of urban areas and loss of agricultural labour.

3.2 Balik Pulau/Genting/Pondok Upeh New Town

3.2.1 The proposals for enlargement of the urban area between Balik Pulau town and the village of Genting are well advanced, and enlarged urban areas at Kg. P. Betong, Kg. Sg. Rusa, Kg. Sg. Pinang, and Bagan Kuala Sg. Pinang have also been defined by MPPP. Plans showing the boundaries of all five areas have been supplied to us by MPPP, but the following discussion is limited to the Balik Pulau/Genting/Pondok Upeh new town (the "New Town"), which forms by far the largest area.

3.2.2

The New Town area is made up of three units, as indicated on Fig. 1.1. They are:-

	<u>ha</u>	<u>ac</u>
a) Main development area	330	816
b) Pondok Upeh complex	79	196
Sub-total	409	1,012
c) Possible further extension to development area (Mk E)	184	455
Total	593	1,467

The distinction between (a) and (c) above is not made on a plan prepared by the State Director, Town and Country Planning (JPBK), of the New Town and its roads etc. (Plan No. P1/4342) which shows the whole 593 ha within "proposed urbanised limit".

3.2.3

The 184 ha given in (c) above and on Fig. 1.1 as "possible further extension" includes the irrigated padi area known as Pokok Kenanga (32 ha), which has been referred to in 2.4.2 as having more permeable soil than the remainder of Sg. Burung scheme. This last fact means that it has a water demand out of proportion to its size, and its removal from the future scheme would release water to irrigate a larger area nearer the coast. The removal of Pokok Kenanga from the irrigation scheme constitutes a 4% reduction in scheme area, but a larger reduction in the total water requirement. On the other hand the inclusion of the 184 ha of Mukim E within the New Town reduces the Sg. Burung dry weather flow by about 20% (assuming zero contribution from the area). This figure however is misleading since the flows of all rivers flowing through the project areas must be treated together. Our proposals for better use of the surface water are based on full utilisation of all the rivers, and on this basis the reduction due to loss of the 184 ha is only 6% or 7% of the total dry weather flows. Furthermore this reduction in flow only affects the off-season cultivation, and it does not cause any land to become unused in the off-season, but merely produces a switch from padi to maize.

3.2.4 We understand that a number of building development applications to the MPPP relate to this 184 ha area, and that they are being held up pending decisions on the IADP. In view of the reasoning above we see no justification for objecting to the inclusion of the 184 ha in the New Town boundary.

3.3 Catchment - Effects on Runoff and Pollution

3.3.1 When urbanization takes place on a systematic scale, the density of houses and shops increases and paved roads, drains and sewage systems will be constructed, replacing dirt roads and open drains. These structures inevitably increase the impervious surface of the area and have important effects on rainfall-runoff relationships.

3.3.2 Investigations carried out by researchers on developed and undeveloped (forested) catchments have confirmed the following changes to rainfall-runoff relationships as a result of development:-

- A higher frequency of flood flows in developed catchments, with higher peak discharges.
- Low flows in developed catchments are much lower than in undeveloped ones.

3.3.3 Higher runoff is experienced in the developed catchments because of the replacement of natural forest or foliage cover with construction of concrete-lined drains, open concrete spaces, paved roads and grass surfaces which accelerate the rapid outflow of rainwater to discharge outlet points, thus giving very little time for water to infiltrate into the ground. Wilson (ref. 26) found that the magnitude of mean annual flood is increased by about $4\frac{1}{2}$ times after urbanization. Such factors cannot be immediately transposed to Penang but they give an idea of the potential for change.

3.3.4 In the Johor Tenggara Report (ref. 27) the study concluded that "the change from forest catchment to rubber or oil palm plantation increases the peak storm runoff by about two times". Conversely it was found that minimum flows from forested catchments were between two and five times as great per unit area as the flows from plantation catchments.

3.3.5 Since conversion from forest to plantation use could have a reduction as great as from 100% to 20% in the dry weather flows it is clear that conversion from a plantation/belukar mixture to fully urbanized conditions could have at least as large an effect. In the absence of any quantitative data on the urban development runoff changes we have preferred to adopt the case of a no-runoff contribution from specifically urban areas in drought conditions.

3.3.6 The New Town area will however remain an important part of the catchment system in a different way. Infiltration of rainfall below ground in the hill catchments follows an underground seepage path and the majority of this water can be expected to exit as "springs" in the flat ground adjoining the hillsides. When much of this flat ground is being developed this effect must be allowed for by the town planners and design engineers. Housing should not be sited very close to the intersection of level and sloping ground, but a perimeter road with grass verges and good surface drainage would be appropriate. For the same function of receiving "spring" water, the urban drainage channels should be of reasonable depth and, if they have an impervious lining, it should be stopped off well below the ground surface.

3.3.7 Apart from the reduction of minimum flows and increase in floods due to a change over from an undeveloped to a developed catchment, the water quality of the river could also be seriously polluted by possible industrial and domestic products such as oil, detergent, sewage and sludge. In general terms, the different types of effect which effluent discharges may introduce to a river are:-

- i) demand for oxygen
- ii) toxic substances
- iii) non-toxic inorganic substances
- iv) pollution by matter in suspension
- v) heat
- vi) biological pollution

3.3.8 Because the contribution to pollution problems as a result of urbanization is so significant, an example of water quality analysis for another Malaysian river is given as an illustration. The river is

Sg. Damansara, located in the vicinity of the Subang International Airport in the State of Selangor. Its catchment was formerly cultivated with rubber trees and about 30% of the catchment area has been cleared for housing development. Water quality analyses were done by the Ministry of Environment. Results recorded in 1980 were examined and chemicals not usually found in natural catchments were detected as follows:-

- Oil and grease - ranging from 1 to 56 ppm
- Phenol - ranging from 0.06 to 3 ppm
- Detergent (MBAS) - ranging from 0.1 to 6.8 ppm
- Sulphates - ranging from 0.3 to 5.0 ppm
- Phosphates - ranging from 0.06 to 1.14 ppm

Source: Ministry of Environment

3.3.9

The capacity of a river to deal with pollution depends upon:-

- (a) The discharge rate, i.e. the degree of dilution afforded to the effluent.
- (b) The reaeration rate, this is proportional to the turbulence of the river, which is dependent on the river's rate of fall and the bed's roughness, and the surface area compared with the cross-sectional area of the river.
- (c) The flora of the river, mud deposits and the clarity of the water.

In the case of the Sg. Burung and Sg. Kongsil the proposed or actual irrigation intakes are so close to the future New Town that (b) and (c) will have little or no chance to take effect. However this fact may be taken advantage of since it should be possible, by use of quite short lengths of covered sewer, to discharge all the New Town's effluent at points downstream of the irrigation intakes. This would avoid polluting the irrigation water but would introduce effluent to a watercourse which, in dry weather, may be expected to have little or no discharge for dilution purposes. We therefore recommend that all sewage undergoes full treatment to ensure sanitary conditions within the irrigation and drainage areas.

3.3.10

On the other hand, storm runoff from the urban areas, and sullage water which is customarily discharged into surface drains in Malaysia, may yield a significant increase in the flows and should be returned to the irrigation source rivers upstream of the intakes. Precautions should be taken to ensure that possibly harmful effluent from garages and commercial premises is confined to the sewage system.

3.3.11

Although there is no suggestion as yet that industry will be established in Balik Pulau and generate possible effluents which are harmful to irrigation use, and although a portion of well treated domestic sewage effluent may not be harmful for irrigation use, we recommend that urban planning should be based on the method of separate sewage and storm water systems, with treated sewage effluent being piped to a discharge point on Sg. Burung downstream of the irrigation intake. Sg. Kongsí, which borders the New Town on the north, is much less suitable as an effluent receiver since its lower tidal reaches are used intensively by the fishing community for their boats. This is a conditional recommendation made in the absence of detailed knowledge of urban drainage proposals, and it is subject to any later full study which may be made of likely effluent quality and quantities. Many means are available for mitigating ill effects of pollution from urban and industrial sites, but this topic is beyond our Terms of Reference. It is presumed that all proposals for disposal of urban effluent would be subject to the approval of the JPT.

3.4 Land Acquisition

3.4.1

Improvement of the irrigation and drainage systems and access to the fields will require the acquisition of strips of farm land for the new rights of way through padi areas and, in a few instances across roads or existing village garden/orchard land. Detailed estimates of the land prices in the Sg. Burung area have been prepared for use in this study by the Federal Valuation Office (Pejabat Penilaian dan Perkhidmatan Harta). The estimates are on the basis of actual valuations made when lots of land changed ownership. Similar prices will be obtained for Sg. Pinang before the draft final report.

3.4.2

Land fronting on black-topped roads is estimated at "over \$20,000 per acre", while bendang (padi) land lots at least four layers in from any road is only estimated to be worth \$4,000 to \$5,000 per acre. This layer concept appears to be of great significance in land pricing. As a general rule the bendang lots are well laid out from an irrigation viewpoint - long rectangular shape - which means the third layer lots start 25 - 30 chains (500 - 600 m) from the road, and land acquisition may well have to be nearer than this to a road, say in the second layer lots.

3.4.3

The data received is summarized in Table 3.1. It is observed that prices are much lower than obtained from the Butterworth office of Pejabat Penilaian for the Kulim scheme, where the lowest figure remote from roads was \$13,000 per acre. The prices given of course assume continued use as padi fields: there is no "development value" attached.

Table 3.1 Sg. Burung Scheme Land Prices

Direction from, and name of, nearest road	Distance from road: layer metres (chains)	Price \$ per acre
<u>W of Jln Baru Rd</u>		
(a) N of Sg. Jln Baru	3rd 500 (25)	5,000 -8,000
(b) between Sg. Jln Baru and Sg. Nipah		No values
(c) S of Sg. Nipah	3rd 350 (18)	6,000 -10,000
	4th 500 (25)	4,000 -6,000
<u>E of Jln Baru Rd</u>		
(d) between Sg. Kongsi and Sg. Burung	4th 600 (30)	10,000 -11,500
(e) Sg. Burung to Sg. Nipah Rd	3rd 400 (20)	13,000
(f) Sg. Nipah Rd to P. Betong Rd	2nd 200 (10)	15,000 -20,000
	3rd 300 (15)	10,000 -15,000
(g) S W corner of Sg. Pinang scheme	>4th - -	5,000

4. EXISTING AGRICULTURE

4.1 General

4.1.1 The areas cultivated for padi in recent years are less than those given as the size of the schemes in official documents, due to encroachments mainly by coconut plantations, and the fact that about 80 ha forming the first reclamation strip (4.4.1) within Sg. Burung was officially included in the padi total. As re-measured on JPT plans the gross areas available for padi cultivation (including all recently abandoned land) are:-

	<u>Revised totals</u>	<u>Nominal totals</u>
Sg. Burung scheme	422 ha (1,042 ac)	525 ha
Sg. Pinang scheme	480 ha (1,186 ac)	601 ha
	<hr/>	<hr/>
	902 ha (2,228 ac)	1,126 ha

902 ha is only 80% of the nominal total of 1,126 ha.

4.1.2 In 1974 it was estimated that about 121 ha (300 ac) were abandoned,* and in subsequent years the extent of areas abandoned became progressively larger, until by 1980 the abandoned areas had increased to 648 ha (1,600 ac) made up of 283 ha (700 ac) in Sg. Burung and 365 ha (900 ac) in Sg. Pinang. (See Table 4.1).

4.1.3 The progressive decline in cultivated area is attributed to manpower shortage as a result of rapid industrial and urban development. Uneconomic farm size is another factor contributing to the shrinkage of land area under rice cultivation in Balik Pulau.

* Definition: The definition of "Tanah Rang" or abandoned padi land in so far as it applies to the State of Penang is "padi land which has not been cultivated for four (4) consecutive seasons (double cropping areas) or two (2) consecutive years (single cropping areas)". This definition has been accepted by the Jawatan Kuasa Penyelarasan Kementerian Pertanian Negeri Pulau Pinang on 7.3.79.

Table 4.1 Acreages of Padi Land under "Tanah Rang" in Balik Pulau
(see footnote on previous page)

Year	Area abandoned		% total padi area
	Ha	Ac	
1974	121	300	13
1975	186	460	21
1976	202	500	22
1977	61	150	7
1978	486	1,200	54
1979	486	1,200	54
1980	648	1,600	72

4.2. Area Cultivated

4.2.1 The cultivated areas, percentages of rice land cultivated, and yields of padi for Sg. Burung and Sg. Pinang in the last five main season and off-seasons are summarized in Tables 4.2 and 4.3. The figures must be treated with reserve since the 20% shortfall in gross cultivable area referred to in 4.1.1 has been allowed for on the arbitrary assumption that actual tanah rang areas were correctly reported, and therefore cultivated areas are obtained by difference from revised scheme totals.

4.2.2 In the Sg. Burung scheme the main season's cultivated areas have progressively declined in the last five seasons 1976/77 to 1980/81 from 422 ha to only 55 ha. In terms of percentage of total rice land, the decline was from 100% to 13%. In the Sg. Pinang scheme, the decline was from 480 ha down to 200 ha or from 100% to 42% for the main season over the same period. Some off-season padi was grown in the Sg. Burung scheme in 1976, 1978 and 1980 seasons only.

4.2.3 The average yield of padi for the five main seasons was 2,530 kg/ha (403 gt/ac) in the Sg. Burung scheme and 2,637 kg/ha (420 gt/ac) in the Sg. Pinang scheme. Considered together, padi yield is lower than that which the soils in the areas are capable of, and this is attributed to poor standard of padi husbandry and the prevalence of pests.

4.3 Land Tenure in Balik Pulau

4.3.1 The socio-economic survey conducted in May/June 1981, in which a sample of 270 farm households were selected, revealed that slightly over 62% of the farmers were "pure tenants", having no land of their own. Just over a quarter of the sample were owner-operators solely cultivating the land they own. Slightly over 5% were renting in land to augment their own. The remainder of the sampled households belong to the "pure landlords" (2.2%), "landlord-cum-farmers" (renting out part of their land) and an "undetermined" category.

4.3.2 The highest percentage of tenants (71.0%) were cultivating on the west side of the Jalan Baru in Sg. Burung, where only 15% of the farmers were owner-operators. Sg. Pinang had the highest percentage (28%) of owner-operators compared to Sg. Burung East (27%) and Sg. Burung West (15%).

4.3.3 Individual tenancy histories have lasted between 2 and 60 years. The average length of time for this kind of arrangement was 17.4 years. Only about 19% of the farmers had been renting for 2 - 5 years. The most common period was 6 - 10 years (24%). The results of the survey did indicate that there was a fair amount of stability in tenurial relationships in Balik Pulau since most (57%) of the tenancy arrangements were over 10 years old. This suggests that the majority of the landowners were not interested in farming the land themselves and would probably be willing to rent out their land for indefinitely long periods.

4.4 Reclaimed Areas

Sg. Burung scheme

4.4.1 Two reclamation areas can be distinguished on the coast line between Sg. Jalan Baru (Sg. Kongsil) and Sg. P. Betong which corresponds to the Sg. Burung scheme area (see Figure 1.1). The first one, shown as "coconut areas" on the figure comprises 76 ha inside the existing bund. This land has been cultivated for 4 or 5 years by a private co-operative. As mentioned elsewhere it is planted with coconut trees which are stunted and unproductive. It is a gazetted padi area which

has been improperly converted to coconut. It would therefore be legally correct to include it in the scheme padi area, and our exclusion of it on practical grounds accounts for part of the difference in areas given in 4.1.1.

4.4.2 The 76 ha area mentioned above suffers from a defect in the construction of the coastal bund in that the borrow pit was located on the seaward side of the bund and is therefore of no use as a drain to the reclaimed land. New longitudinal drains have been constructed (Parit Kampong Enam) but they appear too shallow to satisfy the leaching and drainage requirement. These factors may excuse the occupiers of the land from not growing padi, and they certainly contribute to the poor state of the coconut cultivation. Saline intrusion may also be continuing at the northern limit of the area because the tidal gate there remains located inland of the existing bund line.

4.4.3 In order to rectify the drainage situation described in 4.4.2 the JPT are currently constructing new bunds to seaward of the existing one. These bunds will enclose substantial areas of mangrove swamp which will be divided into three parts by tidal inlets connecting to the tidal gates, on the existing bund line, of Sg. Burung and Sg. Nipah. We understand that detailed proposals have not been formulated for future use of these areas and therefore they are subject to our general comments on preservation of mangrove swamp (2.4, 4.4.8 and Appendix B).

Sg. Pinang scheme and Kampong Benteng Melayu

4.4.4 On the Sg. Pinang coast line also two reclamation areas may be distinguished. The first, inner one, consists of 87 ha of padi land, nominally single cropped. It is stated to be individually owned, although on the plans it is recorded as one lot: "Kampong Melayu, 216 acres". This area extends between Sg. Bagan Air Itam and a point south of Sg. Pinang. The bund round this area was constructed in the 1930's.

4.4.5 The outer reclamation area is enclosed by bunds constructed in 1969, but still remains covered with mangrove swamp vegetation except for about one hectare at its north end. This is the "Kampong Benteng Melayu Drainage Area", 158 ha, and it is the only part of the Balik Pulau

coastal areas which is listed as a drainage area. It would appear that the plans for development of this area have suffered delays, and the soil leaching process has been impeded in the last 12 years due to blocking of the drainage outlets.

4.4.6 The only land within Kg. Benteng Melayu which has so far been cleared or developed is a small plot of one hectare adjoining the north end bund which fronts on Sg. Pinang. On this land laterite fill has been placed with the intention of building facilities for fishermen. There is also a very long new timber landing stage on Sg. Pinang connected to this land by walkways. The landing stage is not yet in use.

4.4.7 A large part of the drainage area is designated for an aquaculture development under the auspices of MAJUIKAN. This was reported on by consultants in 1960 (ref. 28), and the project is expected to be implemented, covering a maximum of 100 ha. This will be in the northern part of the drainage area, but separated from the fishermen's complex mentioned above by a 22½ ha reservation for housing and a 12½ ha reservation for cash crops (pineapples, etc). We have not been given a timetable for these developments.

4.4.8 The balance of the Kg. Benteng Melayu drainage area is a lot of 23 ha at the southern end which is designated for agricultural use, to be developed last in point of time. We recommend that no mangrove clearing be done within this area until successful results are achieved with the agriculture in the cash crop area to the north and the "coconut area" of Sg. Burung (4.4.1). When a successful agricultural system has been established in those areas, and if there is a demand for new land by farmers, then detailed plans for use of this area may be prepared.

4.4.9 Pantai Acheh scheme (nominally 202 ha - 500 ac)

The reclaimed area south of Kg. Pantai Acheh is included within the IADP areas. At present the mangrove swamp remains over the whole area except for a platform of fill near the north end which is designated for housing (12 ha). We understand that there are no detailed plans as

yet for development of the rest of the area. As with Kg. Benteng Melayu we provisionally recommend that no mangrove clearing be done until other coastal areas are successfully converted to agriculture, or alternative projects such as aquaculture are demonstrated on the other sites as viable.

4.4.10

One possibility for making use of the area would be to create a nature park, with access and facilities both for scientific study and tourist interest in the mangrove swamps and their natural systems. The remaining mangrove area is about 100 ha. The balance of area to make up the nominal total of 500 acres probably consists of properties near the original swamp limit on the landward side, land occupied by the bund and borrow pit, and possibly some land outside the bund.

4.5

Horticulture

4.5.1

The Penang State Government has encouraged the padi farmers in this area to grow orchids as an additional income item to them through the selling of orchid cut flowers and/or seedlings/plantlets. To further prove the Government's desire, the State Department of Agriculture has allocated a substantial orchid growing subsidy for the participating farmers. The orchid subsidy includes the supply of 6 orchid varieties per participant together with a foliar fertilizer and an insecticide and a fungicide. The 6 orchid varieties supplied are:-

- (1) JVR x Chu Lai Kuen
- (2) Walter Omae
- (3) Maggie Ooi
- (4) Christine No. 1
- (5) James Storei
- (6) Oncidium Goldiana

4.5.2

During visits to this area, it was found that most of the farmers seemed to be living in above-average conditions judging from their houses. However, most of these houses stand on sandy soil and are surrounded by either tall fruit trees or coconut palms or both. A visit to an orchid-growing participant revealed that this participant did not have the necessary knowledge of orchid growing although he might have

an interest in it. This lack of knowledge in orchid growing and production was also seen at another recent participant's house. This is clearly one major problem countering the success of orchid growing by the padi farmers.

- 4.5.3 The orchid varieties that were supplied are commonly accepted and sold in the local and oversea markets and they are of two categories. One category requires a certain degree of shading for their culture while the other requires an open area where they can receive plenty of sunshine for their growth and floral development. Thus, since the participants' houses are mainly surrounded by fruit trees and coconut palms the growth and development of the orchid plants are poor and uneconomical.

prospects and suggestions

- 4.5.4 Orchid growing by the padi farmers as envisaged by the Penang State Government to add to their income is feasible provided that the participants really have a real interest in orchids and also have a strong knowledge of orchid growing. At the same time, Government officers from the Department of Agriculture who are in direct contact with these participating farmers must also have an in-depth knowledge of orchid culture, maintenance, production and marketing so that they can solve, if possible, the orchid growers' problems on the spot.
- 4.5.5 Regarding the techniques of orchid growing and production, the participants and other interested farmers together with the Government agents should be given a comprehensive course or training before they really go into depth in the actual "large-scale" growing of orchids. This training can be organized by the Department of Agriculture at its Relau Station.
- 4.5.6 The aim of the farmers growing orchids is to be able to sell their products at least locally at a reasonable price. At the moment, the marketing of orchid flowers by the farmers concerned is very unorganized. Regarding the marketing of cut flowers of orchids and plantlets, it is suggested that a system of transportation and marketing should be planned for these farmers. There is a role here for the Lembaga Pertubuhan Peladang (LPP) and FAMA.

4.5.7

The only other flowers which may also be valuable in this context are anthuriums. They could be introduced to interested farmers because anthuriums are relatively easy to grow and maintain, and the market is good.

Year Season	Area (ha)	Cultivated Area	Total (ha)	Year Season	Cultivated (ha)	Cultivated Area	Yield (kg/ha)
1975/76	420	100	2,000	1976	100	40	200
1976/77	421	100	2,000	1977	100	40	200
1977/78	421	100	2,000	1978	100	40	200
1978/79	421	100	2,000	1979	100	40	200
1979/80	421	100	2,000	1980	100	40	200
Average yield			2,000				200

Table 5.2. Anthurium Production

Year Season	Area (ha)	Cultivated Area	Total (ha)	Year Season	Cultivated (ha)	Cultivated Area	Yield (kg/ha)
1975/76	420	100	2,000	1976	100	40	200
1976/77	421	100	2,000	1977	100	40	200
1977/78	421	100	2,000	1978	100	40	200
1978/79	421	100	2,000	1979	100	40	200
1979/80	421	100	2,000	1980	100	40	200
Average yield			2,000				200

Table 4.2 Sg. Burung Cropping Data

Main Season	Area Cultivated (ha)	% Cultivated Area	Yield kg/ha (G/ac)	Off-Season	Area Cultivated (ha)	% Cultivated Area	Yield kg/ha (G/ac)
1976/77	422	100	2,511 (400)	1976	186	44	283 (45)
1977/78	422	100	2,605 (415)	1977	-	-	-
1978/79	187	44	2,825 (450)	1978	61	14	2,982 (475)
1979/80	104	25	2,825 (450)	1979	-	-	-
1980/81	55	13	1,883 (300)	1980	100	24	1,883 (300)
Average yield			2,530 (403)				1,714 (273)

Table 4.3 Sg. Pinang Cropping Data

Main Season	Area Cultivated (ha)	% Cultivated Area	Yield kg/ha (G/ac)	Off-Season	Area Cultivated (ha)	% Cultivated Area	Yield kg/ha (G/ac)
1976/77	480	100	3,139 (500)	1976	-	-	-
1977/78	480	100	2,511 (400)	1977	-	-	-
1978/79	454	95	2,825 (450)	1978	-	-	-
1979/80	423	88	2,511 (400)	1979	-	-	-
1980/81	200	42	2,197 (350)	1980	-	-	-
Average yield			2,637 (420)				- -

5. WATER REQUIREMENTS AND AVAILABILITY

5.1 Cropping Patterns

5.1.1 Unlike the Seberang Perai irrigation schemes where water shortages may occur only about 1 year in 5 and then only for a period of 3 or 4 weeks at the start of the off-season rice crop, in Balik Pulau, even in an average year, there will be inadequate water to enable an off-season rice crop to be planted on all the irrigable area. This is illustrated in Table 5.1 which shows the areas of rice that can be cultivated with the available water in each month of the year, using the resources presently utilized and also the total surface water resources of Balik Pulau.

5.1.2 Abstractions are presently taken by JPT mainly from Sg. Pinang and Sg. Burung with two small areas fed from Sg. Betong and Sg. Kongsi respectively - the latter of these two serving an area, Pokok Kenanga, which will probably be absorbed into the urban expansion of Balik Pulau (see Chapter 3). Utilising just these presently exploited resources there is inadequate water for even a single crop over the whole of the potential padi area (870 ha - see Section 5.3.1), and as noted above even making use of the entire surface water resources (i.e. the additional flows in Sg. Rusa, Sg. Air Puteh and Sg. Kongsi) it is not possible to irrigate the off-season rice crop. The shortage is such that delaying the start of the off-season crop, as proposed for Seberang Perai, will not enable the entire area to be planted.

5.1.3 It is necessary therefore that if irrigated agriculture is to be continued or re-introduced over the whole of the potential area, other cropping patterns requiring less water must be considered. The desirability of crops requiring irrigation and the possible combinations of such crops are discussed in Chapter 8. The conclusions of that study are that there should be approximately 150 ha of mixed vegetables, with as much area as possible planted with a second rice crop and the remaining area with maize.

5.1.4 The timing of the second, off-season, rice crop is fairly critical if the harvest is to be completed before the rains of September. The irrigation requirements are highest during the presaturation period at

the start of the season and because of the limitations on water availability during February, March and April, it is desirable to delay the start of presaturation and field preparation as late as possible. Ideally the season, with a 125-day rice variety, would commence with field preparation towards the end of March and finish with harvesting at the beginning of August, however in order to spread the peak water requirements and the labour and machinery requirements over as long a period as possible we propose a programme in 3 schedules as illustrated in Figure 5.1. This is identical to the one proposed for Seberang Perai and discussed in more detail in the Interim Report for Seberang Perai (ref. 29).

- 5.1.5 The main season rice crop is more flexible with fewer limitations on the timing. We have based water requirements calculations on the programme shown in Figure 5.1. with a '140-day' rice variety. A break of about 3 weeks has been allowed following the off-season harvest.
- 5.1.6 There are a considerable number of vegetables that may be grown and we have not attempted to lay down detailed programmes. They are of varying growth periods and at any time it is assumed that there would be a combination of different vegetables at varying growth stages.
- 5.1.7 Maize has a shorter growth period than rice - approximately 90 days. It can therefore be planted later than the off-season rice crop and still be harvested before the rains in September. In order to maximize the area of 'off-season' rice it is necessary to delay the start of any maize until most of the area of rice has been presaturated and the peak total requirement is past. This requires the planting of maize to be delayed until mid-April or a staggered planting beginning at the end of March.
- 5.1.8 A provisional programme for these combinations of crops is shown in Figure 5.2. Preferably there should be no irrigation requirement during February to allow for maintenance of the irrigation systems, however with the flexibility inherent in the vegetable growing it might be possible to delay any maintenance in such areas to enable one vegetable crop after the main season and before the cessation of irrigation supply.

5.2 Irrigation Requirements

rice

5.2.1 The total water requirements for rice in Balik Pulau are taken as the same as in Seberang Perai. A detailed discussion of the methods of calculation and the parameters chosen is given in ref. 29.

5.2.2 Water requirements during the presaturation period have been calculated in accordance with the method laid out in the DID (JPT) Information Paper No. 2 (ref. 16) assuming the following parameters:-

period of presaturation (for one irrigation block) - 20 days

presaturation requirement - 100 mm in average year
- 150 mm for 1-in-5-year case

water layer: prior to transplanting - 100 mm
75 mm drained off immediately before transplanting and re-applied over 20 days following transplanting.

percolation loss assumed zero during presaturation (with control of drainage water levels); thereafter 2 mm per day.

5.2.3 The crop consumptive use, following transplanting, has been calculated by reference to the evapotranspiration of short green grass (ET_0) with the use of a crop factor (k_c) particular to the crop and its growth stage. i.e. the consumptive use, $ET = k_c \cdot ET_0$. The crop factors used are given in Table 5.2 and adjusted in Table 5.3 by 'weighting' for the variation in growth stage within an irrigation block. ET_0 values have been taken from the published data for Bayan Lepas meteorological station.

5.2.4 Table 5.3 summarizes the water requirement calculation. Values are expressed in mm/day average over each 10-day period. The peak average field water requirement of one irrigation block is 17.4 mm/day (presaturation requirement) which is equivalent to 2.0 L/s/ha. With the effect of staggering the irrigation blocks, the peak field water requirement averaged over a whole scheme reduces to about 14 mm/day.

5.2.5

A significant part of the total water requirement can be provided by direct rainfall on the fields. That proportion of the rainfall that can be utilized to reduce the irrigation requirement is termed the effective rainfall. As discussed in ref. 29 we have adopted a simple criterion:-

- During presaturation, when many of the fields are empty or only partially full, the effective rainfall is taken as 75% of the 10-day period total of actual rainfall.
- During the remainder of field preparation and subsequently when the water layer is being built up and some storage is available in most fields: 60% of actual rainfall.
- For the remainder of the crop calendar when the water depth is limited - 50% of actual rainfall.

In addition, however, to take some account of the reduction of effectiveness of intense rainfall, a further criterion has been established based on the USDA method (summarized in ref. 17). From their data (relevant to dry, or 'upland', crops - not strictly applicable to flooded rice) a curve has been plotted relating efficiency percentage to total monthly rainfall for a crop of average monthly ET of about 150 mm. The actual effective rainfall has been taken as the lower of the two criteria applicable to the field condition.

5.2.6

Because of the water stored in the standing layer in the fields a deficit of total supply in one 10-day period is not critical (a total absence of rainfall in one period during the critical months would represent an average reduction in the depth of the water layer of less than 2 cm.) We consider therefore that for the design 1-in-5-year case the total monthly rainfall values are applicable rather than the more severe combination of individual 10-day 1-in-5-year values. For the irrigation requirement calculation the monthly totals have been divided into 10-day values as described in Section 2.2.6, based on the rainfall data as analysed from the station at Bagan Air Hitam (2.2.4).

5.2.7 Field irrigation requirements for the 1-in-5-year rainfall case (i.e. field water requirements less effective rainfall) are indicated in Table 5.3 for each of the irrigation schedules, together with the average field requirements, assuming 3 equal-sized irrigation blocks. Total intake requirements must take into account losses from the distribution systems and inefficiencies in the control and distribution of the flow. At times of water shortage with particular effort being made to minimize wastage, fairly high efficiencies should be achievable. For the 1-in-5-year design conditions, the following efficiencies have therefore been assumed:-

tertiary systems	- 80%
main and secondary distribution systems	- 85%

i.e. an overall efficiency of 68%.

The peak 10-day field irrigation requirement for this case is estimated at 9.6 mm/d and the intake requirement at 14.4 mm/d, equivalent to 1.7 L/s/ha (41 acres/cusec).

5.2.8 For the average year using mean monthly rainfalls the peak average monthly field and intake requirements are 0.70 L/s/ha and 1.03 L/s/ha respectively. For this case it is likely water control will be less rigorous and we have therefore assumed an overall system efficiency of 60%.

5.2.9 As discussed in ref. 5.1 we consider that there will be no significant changes to the peak irrigation requirements or to the pattern of requirements, with the introduction of direct seeding techniques.

vegetables

5.2.10 As noted in 5.1.6 no specific programme for vegetable cropping is proposed. Instead it is assumed that at any time, from the harvest of the main rice crop in January to the start of field preparation for next main season rice crop in August, there will be a mix of different vegetables, at various growth stages and with various areas of each vegetable planted. Accordingly a simplified approach to estimating the

water requirements has been adopted. For calculation of peak field requirements it is assumed that in each period any individual field may have its crop at the stage requiring its maximum amount of water. For estimating total requirements for a large area, it is assumed that the average requirement is 80% of the peak field requirement.

5.2.11 Water requirements for the vegetables are calculated as the consumptive use - the percolation losses are taken into account by the use of an 'irrigation application efficiency' and in the estimation of effective rainfall. Crop factors for various vegetables are plotted in ref. 5.1 for Seberang Perai using data from ref. 17. The peak values of all are found to be close to 1.1 and this value has been adopted for calculation of the peak field requirement. Evapotranspiration values have been taken from the Bayan Lepas published data.

5.2.12 Peak field water requirements are shown on Figure 5.3, and compared to the effective rainfall to establish the irrigation requirement. Because of the small variation in evaporation values year by year the total water requirement is taken as the same for both the 1-in-5-year case and the average year. The effective rainfall however is much higher in the average year, and based on average monthly values is adequate to meet the water requirements of the vegetable crop in the 8 months from April to November. (If 10-day values are considered it is probable that some irrigation is necessary during June and July). For the 1-in-5-year case where 10-day rainfalls have been considered, irrigation is required throughout the whole of the period during which vegetables are programmed to be grown (January to August).

5.2.13 Effective rainfall has been calculated in accordance with the method proposed by USDA (ref. 17). "True" 1-in-5-year low rainfalls have been used for each 10-day period. They have not been adjusted as has been done for rice (5.2.6). Peak irrigation requirements occur during the first period of February when the 1-in-5-year effective rainfall is zero. The peak crop irrigation requirement is 4.7 mm/day, equivalent to 0.55 L/s/ha.

5.2.14 Field application efficiencies are taken as 60% giving a peak field irrigation requirement (i.e. the irrigation duty) of 0.92 L/s/ha. Distribution efficiencies are taken as discussed in 5.2.7 i.e. 68% overall in the 1-in-5-year case. Hence the peak intake requirement is

$$\frac{0.92}{0.68} \times 80\% = 1.08 \text{ L/s/ha}$$

maize

5.2.15 The irrigation requirements for maize are similar to a short period vegetable. The only difference in the calculation in this case is that the programming of the maize crop is more rigidly fixed, and the variation in irrigation requirements can be more accurately determined.

5.2.16 Crop factors adopted for the maize are shown in Table 5.2 and crop water and irrigation requirement shown in Figure 5.4 for three timings of the maize. For estimation of total irrigation requirements we have assumed a combination of two of the schedules - i.e. planting would be spread over a period of up to one month. Average irrigation requirements for schedules A + B, and B + C are given in Table 5.4.

5.3 Areas of Crops scheme areas

5.3.1 The areas in the two schemes, available for irrigated agriculture, have been measured from plans at 1:6,336 (8 chains to 1 inch). These gross areas are:-

Sg. Pinang	-	480 ha	(1,186 acres)
Sg. Burung	-	422 ha	(1,042 acres)

These values are less than those quoted in the Terms of Reference - 600 ha (1,483 acres) and 498 ha (1,230 acres), respectively. In the Sg. Burung scheme this difference is accounted for by a block of 76 ha behind the existing flood bund which is planted with coconut, and it appears that several areas in the Sg. Pinang scheme have been similarly converted from nominal padi land.

- 5.3.2 Part of the Sg. Burung scheme, 32 ha in Pokok Kenanga, is likely to be absorbed by the urban expansion of Balik Pulau. For estimation of cropped areas, it is assumed therefore the gross area in the two schemes is 870 ha (2,145 acres).
- 5.3.3 There are areas within the scheme boundaries, such as areas of nipah palm, that could be developed for irrigation, and areas converted to coconut and other crops that might conceivably be converted back. However in view of the shortage of water we do not recommend any expansion of the irrigation areas.
- 5.3.4 Based on our studies in Seberang Perai (ref. 29) we estimate the net cropped area as being about 90% of the measured gross areas and for calculation of water requirements we have taken the net area as being 95% of the gross.
- available flows
- 5.3.5 As can be seen from Table 5.1, using only the presently utilized surface water sources - Sg. Pinang, Sg. Burung, and Sg. Betong - there is adequate water to irrigate about 550 ha with the main season rice crop (based on the 1-in-5-year criterion) and about 180 ha with an off-season crop. If as much area as possible is to be irrigated then it is necessary to make use of all the surface water resources in Balik Pulau - i.e. to abstract from Sg. Kongsu, Sg. Rusa and Sg. Air Puteh as well. The following discussion assumes the use of water from all these sources.
- 5.3.6 Of the total flows in all these rivers it is assumed 15% is not abstracted, allowing for inefficiencies in the intakes and some compensation water downstream, although the requirement for this is limited as the intakes are not far from the coast and only Sg. Rusa has significant habitation downstream of the possible intake site, in the non-tidal reach of the river. In addition an allowance of $0.08 \text{ m}^3/\text{s}$ (1.5 m.g.d.) is made for the PBA priority abstraction from Sg. Pinang upstream of the irrigation intake. The total available flows shown in Table 5.1 are the net flows available for irrigation.

5.3.7 With all these sources the total available flow is adequate for only about 400 ha of double-cropped rice (based on the 1-in-5-year criterion) assuming no other irrigation. However it is considered desirable to have about 150 ha of vegetables so the potential double-cropped area of rice is less than this. Table 5.5 gives a breakdown of the water requirements and possible irrigated areas of vegetables, rice and maize in the off-season. With allowance for 150 ha of vegetables, the area of rice is maximized. There is adequate total water available to irrigate the whole area for the main season rice crop.

5.3.8 Table 5.5 indicates that with the 1-in-5-year condition there is adequate water for only about 245 ha net (258 ha gross) of off-season rice crop, based on the average monthly requirement, or 222 ha net during the period of peak requirement at the beginning of April. However we consider it reasonable to design for a gross area of off-season rice higher than this. Firstly, there is some spare water available in March. Thus the presaturation period for the whole rice area (assumed over 3 schedules) could be reduced and the peak requirement brought forward, thus reducing the demand in April. Secondly it would be possible in the dry years to delay the maize crop until the end of April. If there is no requirement for irrigation of maize in April then the irrigable area of rice increases to about 345 ha gross. We propose therefore a gross area of double-rice cropping of about 300 ha.

summary

5.3.9 Making use of all the surface water sources in Balik Pulau it is possible to irrigate the following areas of crops:-

Main season: rice	827 ha (net); 870 ha (gross)
Off-season : vegetables	150 ha (net); 158 ha (gross)
rice	285 ha (net); 300 ha (gross)
maize	392 ha (net); 412 ha (gross)

The actual areas may be slightly different from this, in particular the areas of rice will be proposed as complete irrigation units and will therefore be dependent on the physical limits of these areas.

groundwater

5.3.10

Some groundwater potential exists in Balik Pulau (Section 2.3) but is unlikely to be of sufficient quantities to significantly affect the irrigation proposals. In view of the fact that it is possible to obtain an off-season crop over the whole scheme (vegetables, rice or maize) we do not consider that groundwater need be investigated as a possible supplementary source for irrigation in view of relatively high costs of such supply. Groundwater however may have potential for potable water supply and so reduce the increasing demands on the surface water sources.

storage

5.3.11

Consideration has been given to the possible augmentation of low flows from storage and one or two possible sites exist for the construction of a reservoir of suitable volume, in the upper catchment of Sg. Kongsı in particular. However two factors suggest that the construction of such a reservoir cannot be justified. Firstly the surface deposits in the valley floors are mainly sands and it might be expensive to provide an adequate cut-off to prevent major seepage losses. A full geological investigation would be required to check on this, which is beyond the scope of this study. Secondly it is unlikely, in any case, that the project would be economically viable if a considerable additional capital cost were added to the investment for little additional benefit. Furthermore, in view of the uncertainties over the social factors affecting the successful outcome of the project implementation, we consider that capital expenditure should be kept to a minimum. We do not propose therefore to investigate the possibilities of storage further.

Table 5.1 : Possible areas of rice cropping

Catchment	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1. Sg. Pinang, Sg. Burong and Sg. Betong	Total available average flow (m ³ /s)	0.51	0.37	0.33	0.36	0.53	0.45	0.49	0.74	0.99	1.04	0.75
	Possible area of rice in average year (ha)	(870)		375	350	815	703	(870)	(870)	(870)	(870)	(870)
	Total available 1-in-5 year min. flow (m ³ /s)	0.41	0.31	0.25	0.25	0.39	0.33	0.30	0.53	0.71	0.77	0.54
	Possible area of rice, 1 year in 5 (ha)	(870)		219	179	448	398	(870)	544	589	(870)	771
2. Sg. Pinang, Sg. Burong, Sg. Betong, Sg. Rusa, Sg. Kongsi and Sg. Air Puteh	Total available average flow (m ³ /s)	1.08	0.79	0.72	0.76	1.08	0.94	0.99	1.49	2.00	2.12	1.50
	Possible area of rice in average year (ha)	(870)		818	738	(870)	(870)	(870)	(870)	(870)	(870)	(870)
	Total available 1-in-5 year min. flow (m ³ /s)	0.87	0.66	0.54	0.54	0.77	0.71	0.65	1.09	1.44	1.56	1.11
	Possible area of rice, 1 year in 5 (ha)	(870)		474	306	(870)	855	(870)	(870)	(870)	(870)	(870)

Notes: 1. Flows are assessed for catchments with maximum extent of proposed urban development.

2. Available flows taken as 85% of calculated river flows.

3. Allowance made for PBA priority abstraction of 0.08 m³/s (1.5 mgd) from Sg. Pinang.

4. Calculated areas of rice assume no other irrigated agriculture.

5. Maximum area available is 870 acres.

Table 5.2 : Crop Factors

R I C E				M A I Z E	
'125-day' varieties		'140-day' varieties		10-day period	k _c
10-day period after transplanting	k _c	10-day period after transplanting	k _c		
1	Transplanting	1.25	1	Transplanting	1.25
2	Vegetative growth	1.25	2	Vegetative growth	1.25
3		1.29	3		1.28
4		1.36	4		1.32
5	Reproduction	1.40	5		1.38
6		1.35	6		1.39
7	Heading	1.27	7	Reproduction	1.33
8		1.19	8		1.26
9	Ripening	0	9	Heading	1.18
10	Irrig. discontinued harvesting	0	10	Irrig. discontinued	1.1/0
			11	Ripening	0
			12	Harvesting	0
					0.75
					0.75
					0.85
					1.05
					1.10
					1.10
					1.10
					1.03

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Table 5.4 : Maize Irrigation Requirements

Schedule	March		April			May			June		
	2	3	1	2	3	1	2	3	1	2	3
	(mm/d)										
A : Crop irrigation required	-	0.9	1.2	1.2	2.4	1.5	0.4	2.4	3.1	-	-
B : "	-	-	1.2	0.8	1.6	1.4	0.4	2.4	3.3	2.0	-
C : "	-	-	-	0.8	1.2	0.7	0.3	2.4	3.3	2.2	1.6
(l/s/ha)											
A + B : Average field required	-	0.09	0.23	0.19	0.39	0.28	0.08	0.46	0.62	0.19	-
Average intake required	-	0.13	0.34	0.28	0.57	0.41	0.12	0.68	0.91	0.28	-
B + C : Average field required	-	-	0.12	0.15	0.27	0.20	0.07	0.46	0.64	0.41	0.15
Average intake required	-	-	0.18	0.22	0.40	0.29	0.10	0.68	0.94	0.60	0.22

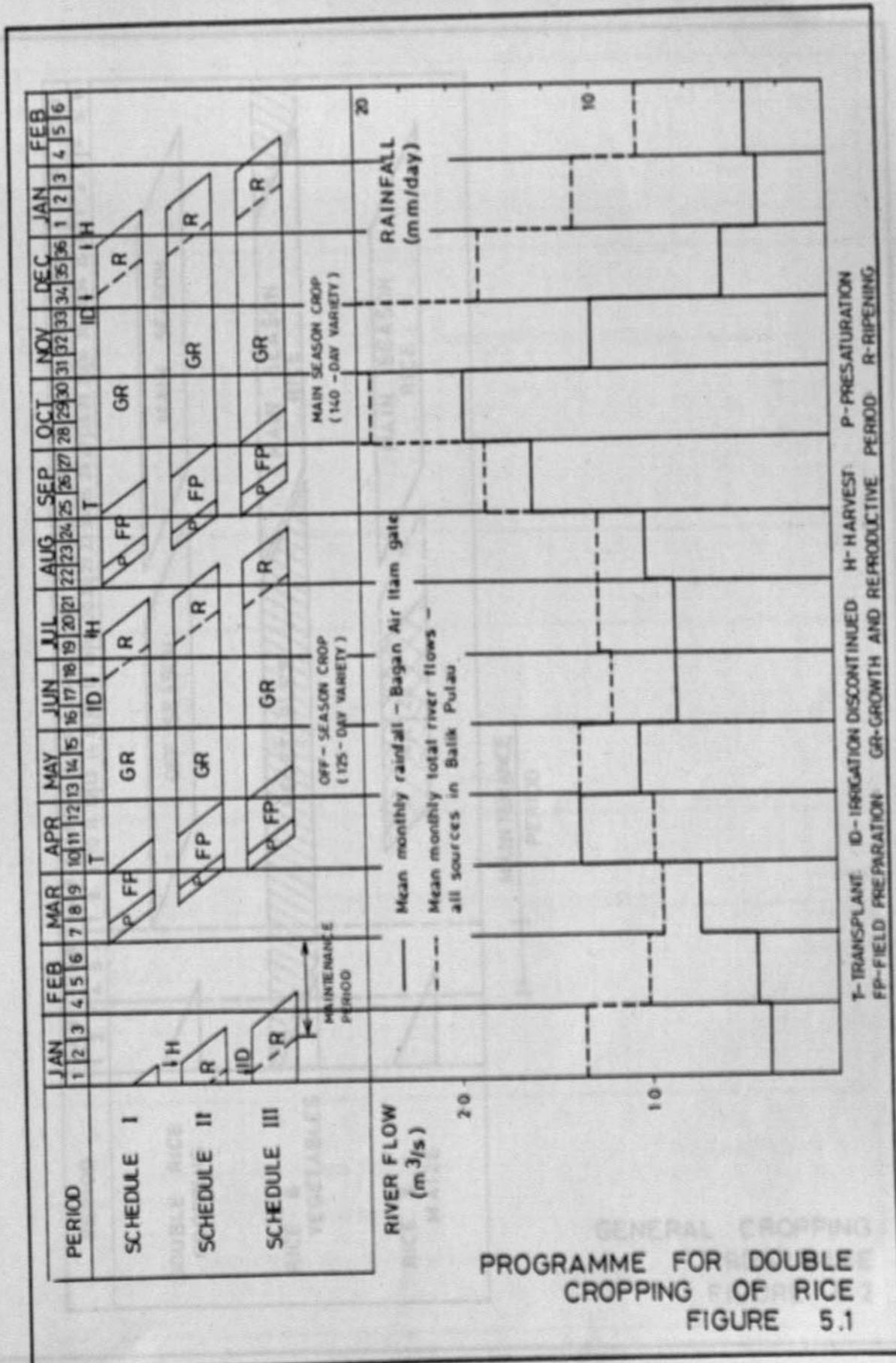
Notes: 1. Field application efficiency taken as 60%

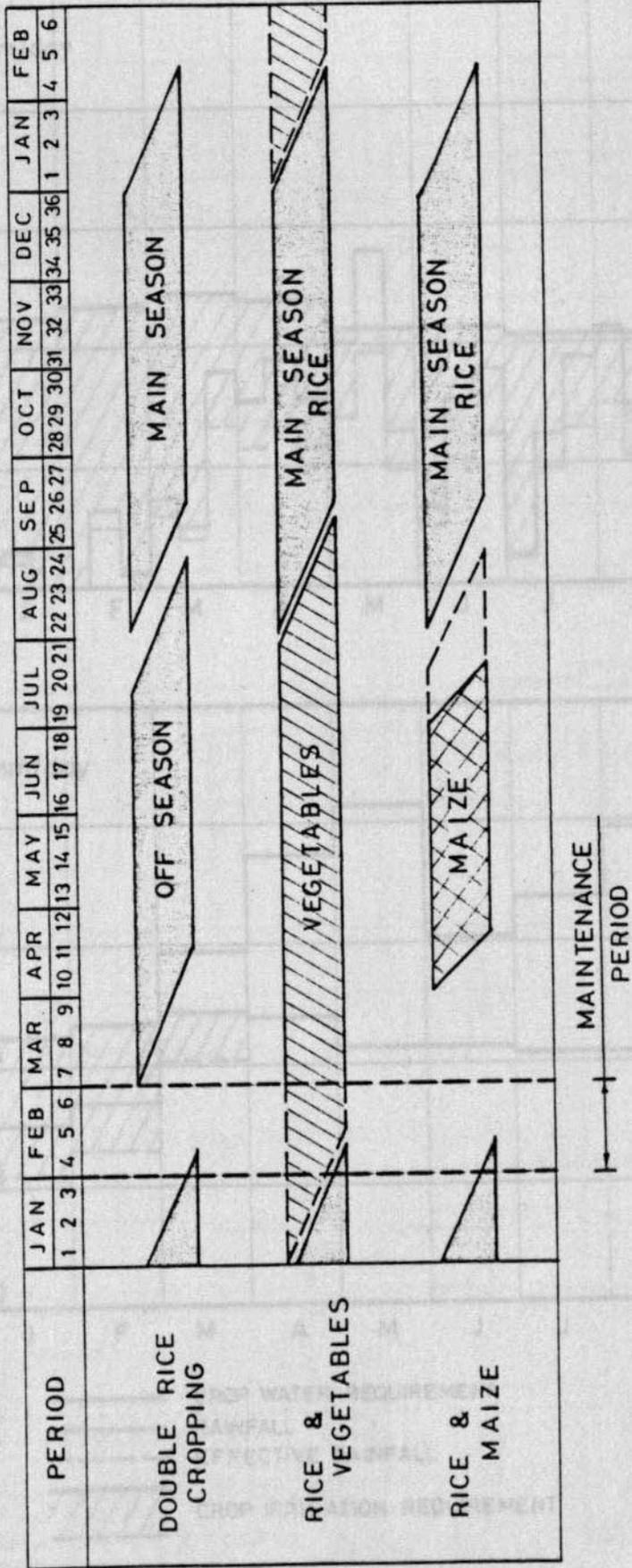
2. Distribution efficiency taken as 68%.

Table 5.5 : Off-season Cropping Areas

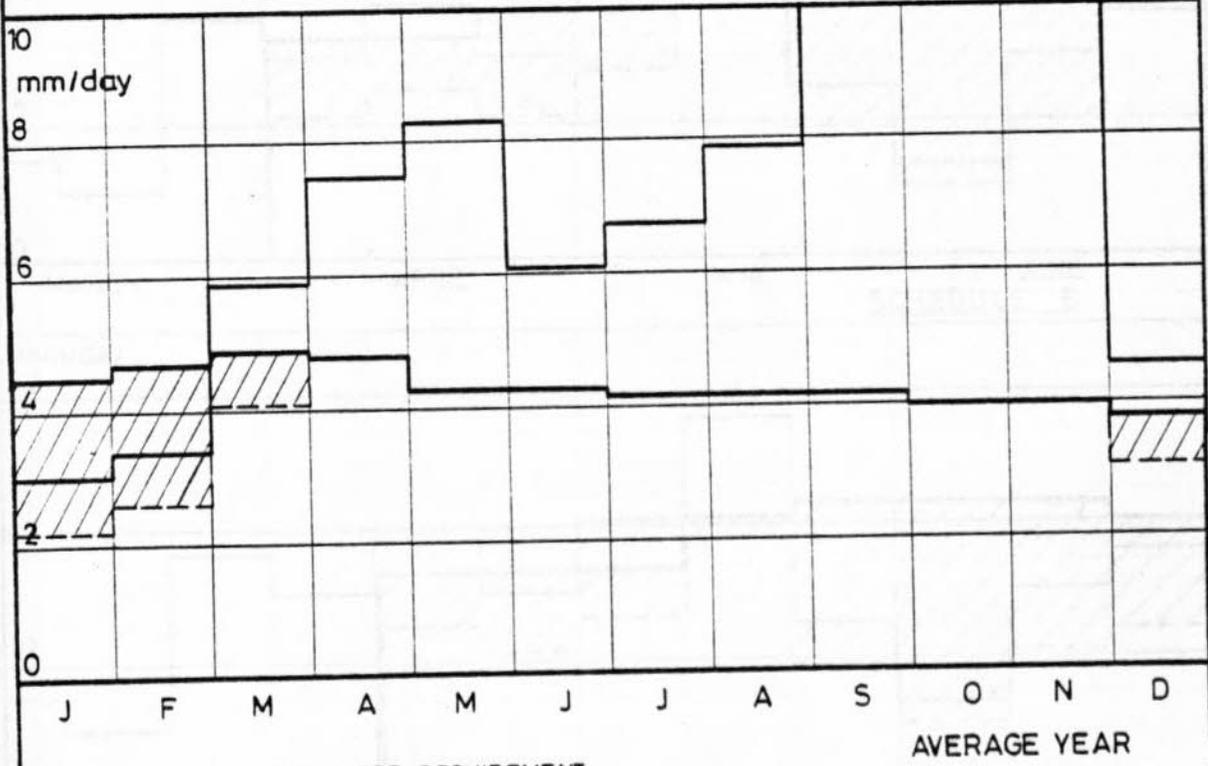
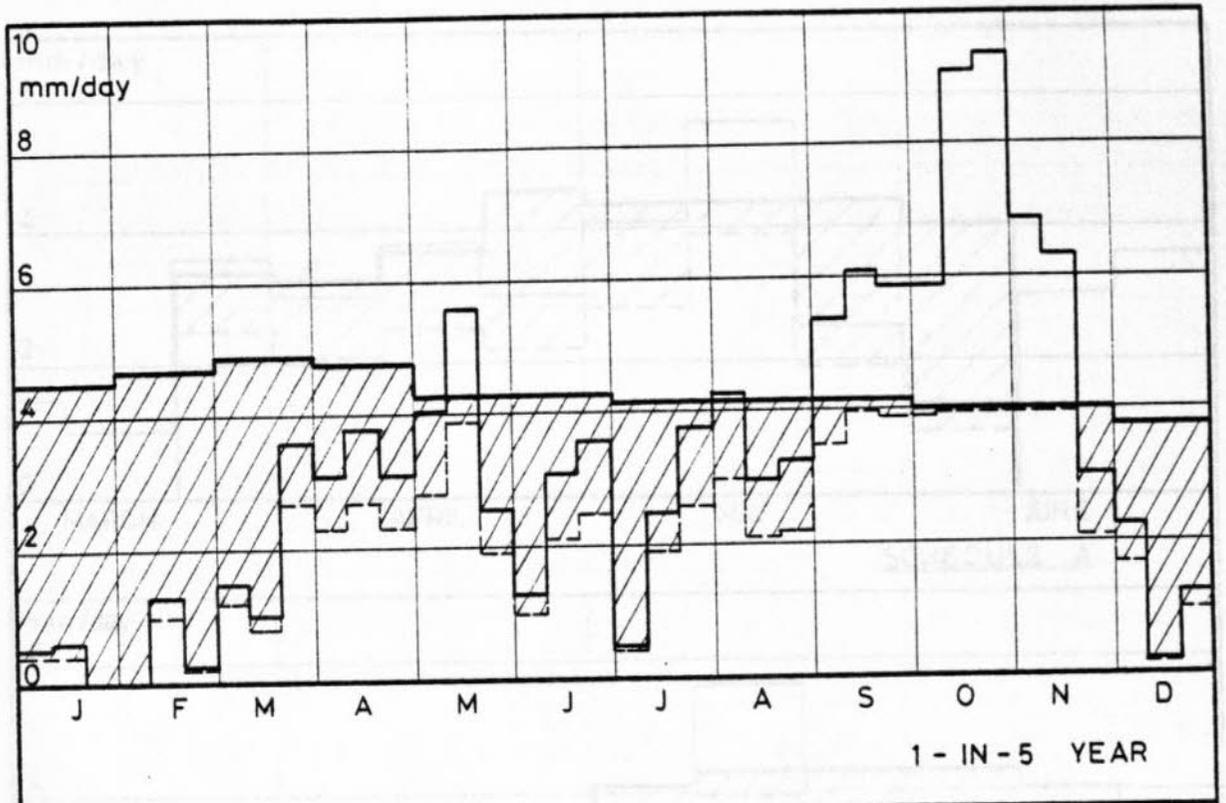
	March	April	May	June	July
Total available flow (m^3/s) (1-in-5 year av. monthly)	0.54	0.54	0.77	0.71	0.71
Vegetables: unit reqmt. ($l/s/m$)	0.79	0.51	0.33	0.57	0.61
total reqmt. (m^3/s) (150ha)	0.12	0.08	0.05	0.09	0.09
Net available flow for 677 ha ⁽¹⁾ rice + maize	0.42	0.46	0.72	0.62	0.62
Rice : unit reqmt. ($l/s/ha$) (1-in-5 year av. monthly)	1.14	1.40 (1.70) ⁽²⁾	0.87	0.83	0.14
Maize : unit reqmt. ($l/s/ha$) (1-in-5 year av. monthly - schedules B + C)	-	0.27 (0.18) ⁽²⁾	0.36	0.59	-
Irrigable area of rice ⁽³⁾ (ha)	368	245 (222) ⁽²⁾	677 ⁽⁴⁾	677	677

- Notes: 1. Net area assumed for water requirement calculation
= $(870 \times 0.95 - 150)$ ha
2. Peak rice requirement during first period of April
and corresponding maize requirement
3. Assuming remainder of area cropped with maize
4. Total available area can be cropped with rice.



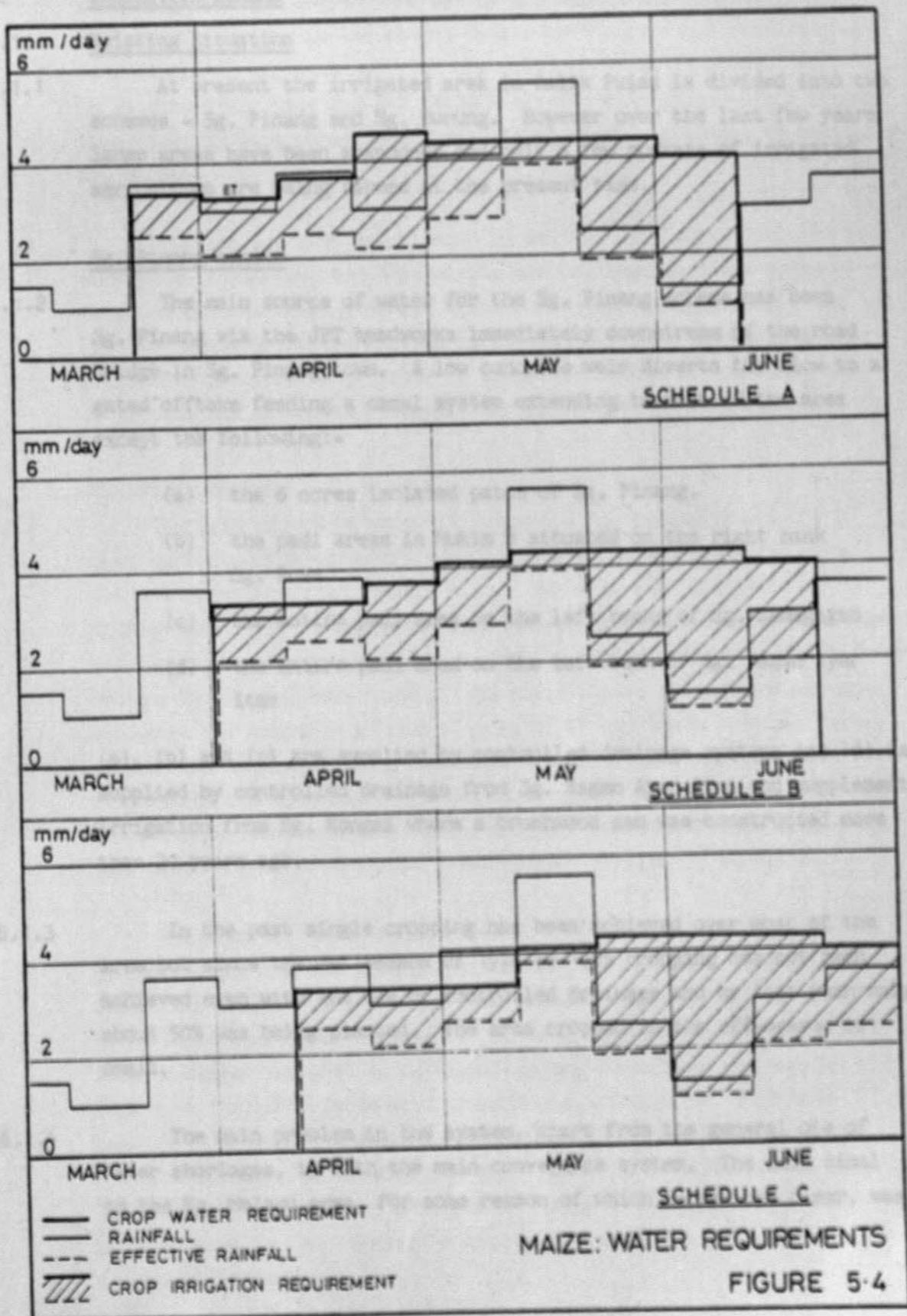


GENERAL CROPPING PROGRAMME
 FIGURE 5.2



- CROP WATER REQUIREMENT
- RAINFALL
- - - EFFECTIVE RAINFALL
- /// CROP IRRIGATION REQUIREMENT

VEGETABLE CROPS
WATER REQUIREMENTS
FIGURE 5-3



6. IRRIGATION SCHEME

6.1 Existing Situation

6.1.1 At present the irrigated area in Balik Pulau is divided into two schemes - Sg. Pinang and Sg. Burung. However over the last few years large areas have been abandoned and only a few pockets of irrigated agriculture are being farmed at the present time.

Sg. Pinang scheme

6.1.2 The main source of water for the Sg. Pinang scheme has been Sg. Pinang via the JPT headworks immediately downstream of the road bridge in Sg. Pinang town. A low concrete weir diverts the flow to a gated offtake feeding a canal system extending to most of the area except the following:-

- (a) the 6 acres isolated patch of Sg. Pinang.
- (b) the padi areas in Mukim B situated on the right bank Sg. Rusa
- (c) the entire padi area on the left banks of Sg. Samagahah
- (d) the entire padi area on the left bank of Sg. Bagan Ayer Itam

(a), (b) and (c) are supplied by controlled drainage systems and (d) is supplied by controlled drainage from Sg. Bagan Ayer Itam and supplemental irrigation from Sg. Kongsil where a brushwood dam was constructed more than 30 years ago.

6.1.3 In the past single cropping has been achieved over most of the area but since the wet season of 1978/79 100% cropping has not been achieved even with the use of controlled drainage and by last year only about 50% was being planted. The area cropped in the off-season is small.

6.1.4 The main problem in the system, apart from the general one of water shortages, is with the main conveyance system. The main canal to the Kg. Melayu area, for some reason of which we are not clear, was

re-routed from its course parallel to Sg. Samagahah, to a more westerly route through the Pascot Estate (see Figure 6.1). This area, we understand, was once padi but has been converted to coconut with an extensive drainage system. Apparently there is considerable seepage loss from the main canal into these drains causing problems in supplying Kg. Melayu.

6.1.5 Problems are also experienced in most of the isolated blocks with supply, if irrigated, and both supply and drainage in those areas supplied by controlled drainage systems. As discussed in detail in ref. 29 with regard to Seberang Perai, controlled drainage does not allow adequate control of water in individual plots and we would aim to provide all areas with separate irrigation and drainage systems.

Sg. Burung scheme

6.1.6 The main source of water is presently Sg. Burung from which a major gated control structure diverts flow south and westwards into the distribution system (Figure 6.2). There is also a right bank offtake supplying a small area between Sg. Burung and Sg. Kongsii. There are two supplementary supplies - a small weir and offtake on Sg. P. Betong feeding into the southern end of the distribution system, and a pumped intake on Sg. Kongsii supplying an area of 32 ha, Pokok Kenanga, north-east of the main Sg. Burung headworks. The irrigation system does not extend into the long south-western block which, when cultivated in the past, was supplied by controlled drainage. Several of the other areas have used controlled drainage to supplement irrigation supplies.

6.1.7 The area of Pokok Kenanga lies within an area of very sandy surface soils, and due to high percolation losses has a very high water requirement. The present pump capacity is $0.17 \text{ m}^3/\text{s}$ (6 cusec) total which should be adequate for an area of about twice the size of Pokok Kenanga, but even so difficulties are found with the supply. Thus even though it is an area presently cultivated we would have reservations about recommending continued irrigation in view of the serious shortages of water elsewhere. However, as discussed in Chapter 3, it lies within an area proposed for urban development and, with this alternative use likely, we cannot recommend its continued use for irrigated agriculture.

6.1.8 Problems elsewhere are similar to those in the Sg. Pinang scheme with supply and drainage problems. The controlled drainage area in the south-west has been abandoned for many years and recently cultivation has ceased on much of the remainder. Although this is probably due mainly to the loss of labour to jobs in the industrial areas around Bayan Lepas the limitations of the existing irrigation and drainage systems have accelerated the process.

6.2 Proposals for Development of Water Resources

6.2.1 As discussed in Chapter 5, the existing water sources are not adequate to enable irrigated agriculture over the whole potential area, particularly as the urban expansion between Balik Pulau and Genting is likely to further reduce the available flows. It is proposed therefore to make full use of all the available surface water sources - namely, the presently utilized rivers together with Sg. Rusa and Sg. Air Puteh (which becomes Sg. Bagan Air Hitam in its lower reaches).

6.2.2 These proposals in effect create a number of smaller virtually independent schemes. We have considered linking the schemes and sources with transfer canals but this would complicate the management and operation and increase the capital cost. Therefore the areas supplied by each source are generally kept discrete except where an easy connection can be made, which would give additional flexibility at times of low flows. The main exception to this is the supply from Sg. Kongsu which will feed only a small area directly with the bulk of the supply being delivered into Sg. Burung at the headworks for use in the Sg. Burung area.

6.2.3 The drawback to the proposal for independent small schemes is that the areas supplied by each source are determined by the existing irrigation units and cannot be exactly matched to the available flows. This will be considered in more detail in the Final Report and may require minor changes to the proposals and the areas of each crop. In particular the area of double cropping of rice should be defined. For convenience of management we prefer this to be in a single block and we propose a centrally located area as shown in Figures 6.1 and

6.2, totalling 289 ha gross. This area is presently supporting most of the rice cultivation that is being undertaken. The major part will be supplied from Sg. Burung and Sg. Kongsu, with the northern block of 62 ha supplied from Sg. Bagan Air Hitam.

Sg. Pinang

6.2.4 The areas supplied from Sg. Pinang will be the most north-eastern blocks, totalling about 280 ha. The existing intake and headworks will be utilized although some modifications should be made to the structure - at present there is a low section in the weir for which the stop logs are missing, and there is a tendency for the intake to silt up. Proper flushing facilities should be provided.

6.2.5 The existing main canal will be used as far south as Sg. Rusa. Thereafter we propose the main canal should be re-routed back to its old course away from Pascot Estate, rejoining the existing route east of the Kg. Melayu area. New canals will supply the areas between Sg. Rusa and Sg. Pinang.

6.2.6 Access should be provided into the area along the main canal route and possibly along the existing, older bund from Kg. Kuala Sg. Pinang.

Sg. Rusa

6.2.7 This source is not presently used and a new headworks will be needed. Control structures are required on Sg. Rusa - possibly just a low weir - and on Sg. Samagahah which acts as an overflow channel at present, and is apparently the old course of Sg. Rusa before it was diverted directly seawards.

6.2.8 A small pumping station is required with a capacity of about 90 L/s - say 2 No. pumps at 50 L/s (1.76 cusecs) supplying an area of about 88 ha. This is the area either side of Sg. Rusa east of the Sg. Pinang main canal and a further block on the right (western) bank of Sg. Samagahah.

6.2.9

The distribution system would be in two parts with a higher command level required to supply the former areas. The latter area would be fed by a canal parallel to the Sg. Pinang canal. The two systems could be integrated with the Sg. Rusa pumping station supplying directly into the Sg. Pinang, canal however for simplicity of management we prefer the systems to be separate as discussed in 6.2.2; the block being fed is only of tertiary unit size and should be independently operable. However a single gated connection should be provided to enable supply to this area from Sg. Pinang if adequate water is available, thus reducing pumping costs. The full supply level (FSL) in the Sg. Pinang system should be high to command this area though this will need to be checked at the design stage when survey is available.

Sg. Air Puteh (Sg. Bagan Air Hitam)

6.2.10

At present both Sg. Air Puteh and Sg. Kongsil flow into the Paya Chow area but the main drainage channels within this estate are not clearly defined and need to be re-aligned. Two alternatives are possible for the use of Sg. Air Puteh flows:-

- (i) The existing drainage pattern would be maintained, with water from Air Puteh eventually joining Sg. Kongsil and discharging into Sg. Jalan Baru, and a single pumped intake would be provided from upstream of a new tidal gate/headworks by the road bridge. Part of the flow would be diverted southwards into the Sg. Burung scheme and part northwards to supply the two blocks either side of Sg. Bagan Air Hitam, with a conveyance structure, either flume or inverted syphon, across this river.
- (ii) Sg. Air Puteh would be diverted into Sg. Bagan Air Hitam and the separate gravity intake, between the two irrigation blocks, would be provided to supply just these areas. The pumped intake on the Kongsil would still be required but would supply southwards only.

6.2.11

The proposal shown on Figures 6.1 and 6.2 is for the second of these alternatives, however detailed designs and costings have not been completed and this proposal will be reviewed in the Final Report.

Sg. Kongs

- 6.2.12 The existing intake on Sg. Kongs supplies only Pokok Kenanga although the canal does ostensibly lead to Sg. Burung and could be used to transfer water from Sg. Kongs into the Sg. Burung scheme. However if, as is likely, urban development extends west of Pokok Kenanga then this canal would pass through the urban area. This is not very satisfactory and since a major control structure would in any case be required across the Sg. Kongs to ensure maximum abstraction efficiency at times of low flow we propose that a new intake should be constructed downstream.
- 6.2.13 The most suitable location for this appears to be upstream of the road bridge as described in 6.2.10 (1). A gated control structure to restrict tidal intrusion would be required (this cannot be lower down Sg. Jalan Baru because of the use made of this river by fishing boats). Sg. Kongs would be straightened and the channel improved, with the pumping station located on the left bank. A pumping capacity of between 200 and 250 L/s is required and it may be possible to use the two pumps from the existing intake (total 212 L/s - 6 cusecs).
- 6.2.14 A transfer canal is required to discharge into Sg. Burung upstream of the headworks. The route of this can conveniently follow the line of the existing canal supplying, from Sg. Burung, the area between Sg. Burung and Sg. Kongs (Padang Kemunting). The levels are presently being checked but the length of this canal is short and it appears that with a minor raising of the downstream banks it is possible to reverse the direction of flow. The area of Padang Kemunting would be supplied from this transfer canal. A control structure would be required at the Sg. Burung end of this canal to replace the existing offtake.

Sg. Burung

- 6.2.15 The Sg. Burung scheme would remain essentially as at present. However the loss of flow in Sg. Burung by urbanization of the catchment will be more than replaced by the flows transferred from Sg. Kongs and the distribution system will be extended into the south-western block which has never had irrigation supply.

6.2.16 The existing gated headworks and left bank intake will remain although it may be necessary to modify the control gates to enable a higher command level to be maintained. The total area normally supplied from Sg. Burung (and Sg. Kongs) will be about 260 ha although it would be possible to supply the south-eastern block if water is available - we propose normally to supply this area from Sg. Betong.

6.2.17 A number of new drains will be required, particularly in the south-western block where the present drainage channel will be converted to a canal.

Sg. Betong

6.2.18 There is an existing small headworks and intake on this river supplying supplementary flows into the southern end of the existing Sg. Burung system. We understand this intake is being redesigned by the state JPT to alleviate flooding problems said to be associated with the existing structure.

6.2.19 We propose that about 80 ha be normally supplied from this source using the existing canal alignments. A control structure will be provided on canal from Sg. Burung at the boundary between the areas supplied from each source.

6.3 Criteria for Tertiary Infrastructure

6.3.1 A detailed discussion of the requirements and criteria for the infrastructure, necessary to provide adequate water control and access, is given in ref. 29. The main recommendations are:-

- (i) The schemes should be operated on a 3-schedule system with a total stagger of 1½ months: 2 weeks between each schedule.
- (ii) Each scheme should be divided into approximately equal blocks, each block to follow one of the schedules.
- (iii) Tertiary units should be between 40 ha and 100 ha with an optimum size of about 50 ha. Flow control with measurement should be provided at the tertiary offtake.

(iv) Layouts of tertiary distribution and drainage systems should be based on the existing layout of farms. To provide the best control of water for the likely increased degree of mechanization each farm should have direct access to a supply canal and to a drain; however with the existing farm layouts this is not practicable in all cases.

(v) Irrigation supply and drainage points should be provided to each 'quaternary' unit - an area of between 5 and 10 ha within which farmers must co-operate and closely follow the same cropping schedule.

(vi) Where reasonable, supply and drainage should be from and to quaternary/field canals and drains. Farm-to-farm flow should generally be limited to three farms or 300 m. Farms adjacent to tertiary canals and drains may in some cases have direct access to the tertiary channels.

(vii) Tertiary canals should have concrete lining. Quaternary canals would be unlined. Quaternary offtakes should have gated control with a flow measurement device.

(viii) Road access suitable for combine harvesters should be provided along main and secondary canals and the major drainage channels. Road access along tertiary canals and maintenance tracks along tertiary drains are desirable but may not be economically justifiable.

6.3.2

Although these recommendations were established primarily for the larger schemes in Seberang Perai, the basic concepts are generally applicable in Balik Pulau. However the main difference between the mainland schemes and those on the island is that the latter are already broken up into a number of small blocks equivalent to tertiary units. These are of irregular size varying from less than 20 ha to a maximum of about 90 ha. The proposals on tertiary size and scheduling of irrigation blocks may not be directly applicable, particularly in the latter case, with the complications of various crops in the 'dry' season.

6.3.3 However the layout of farms is generally more regular than in Seberang Perai and layout of canals and drains can sensibly provide a greater number of farms with direct access to water supply and drainage. On the other hand, the use of quaternary canals is less justifiable, the long narrow irrigation units favouring the use of direct offtakes from tertiary canals.

6.3.4 Because of the small size of the proposed 'schemes' most of the canals are of tertiary or quaternary level and in view of the shape of the irrigation units, as noted above, the former have a greater length. The tertiary canals will be lined. Furthermore many of the existing canals, particularly the 'main' and 'secondary' level ones are greatly oversized. They require relatively large amounts of water just to fill them and frequently supplies are delayed because of this. Seepage losses are said to be significant. We recommend that such canals be filled and a smaller lined channels of requisite size be constructed on the same alignments. Thus overall a large proportion of the canals will be lined but in view of the limitations on available water we consider the potential reduction of seepage losses, together with the reduction in maintenance costs with labour at an increasing premium, justifies such proposals.

6.3.5 The vehicle access requirements are still being studied as the cost of providing access suitable for large combine harvesters is a significant part of the total scheme costs. On the island, however, it is less likely the very large machines will be introduced and a lower grade of access may be acceptable. Recommendations will be made in the Final Report. It is worth noting that by filling in the existing oversized canals, as discussed in 6.3.4, a considerable part of the space required for access is provided and the additional land lost is small.

6.4 Preliminary Scheme Costs - Sg. Burong scheme areas

6.4.1 As a preliminary estimate of the capital cost of proposed works, Tables C4 and C5 in Appendix C5 present a total cost of the works in the Sg. Burong scheme. These costs must be treated as provisional only.

6.4.2

The total cost for Sg. Burong, including engineering design and supervision, but not including land acquisition is calculated as

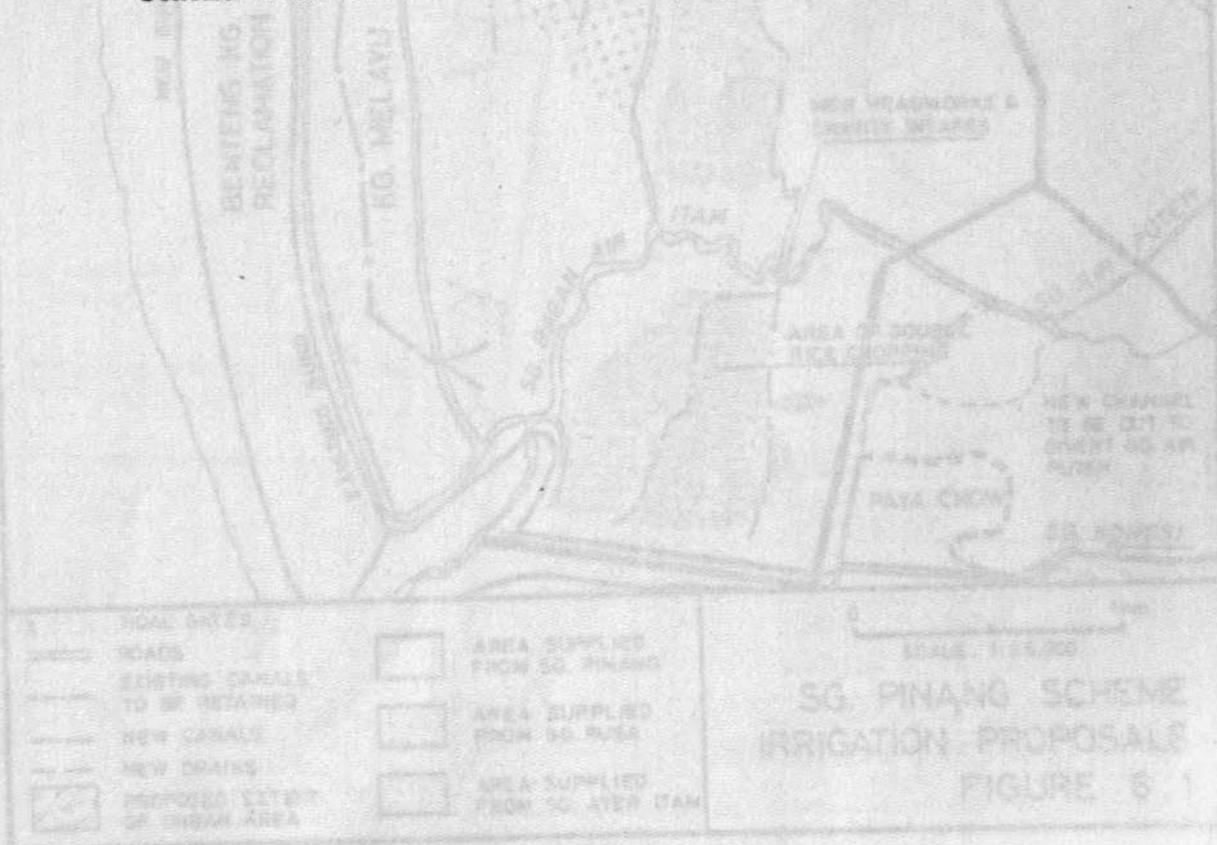
Tertiary development	\$ 2.9 x 10 ⁶
Headworks, primary and secondary development	\$ 2.3 x 10 ⁶
Total	<u>\$ 5.2 x 10⁶</u>

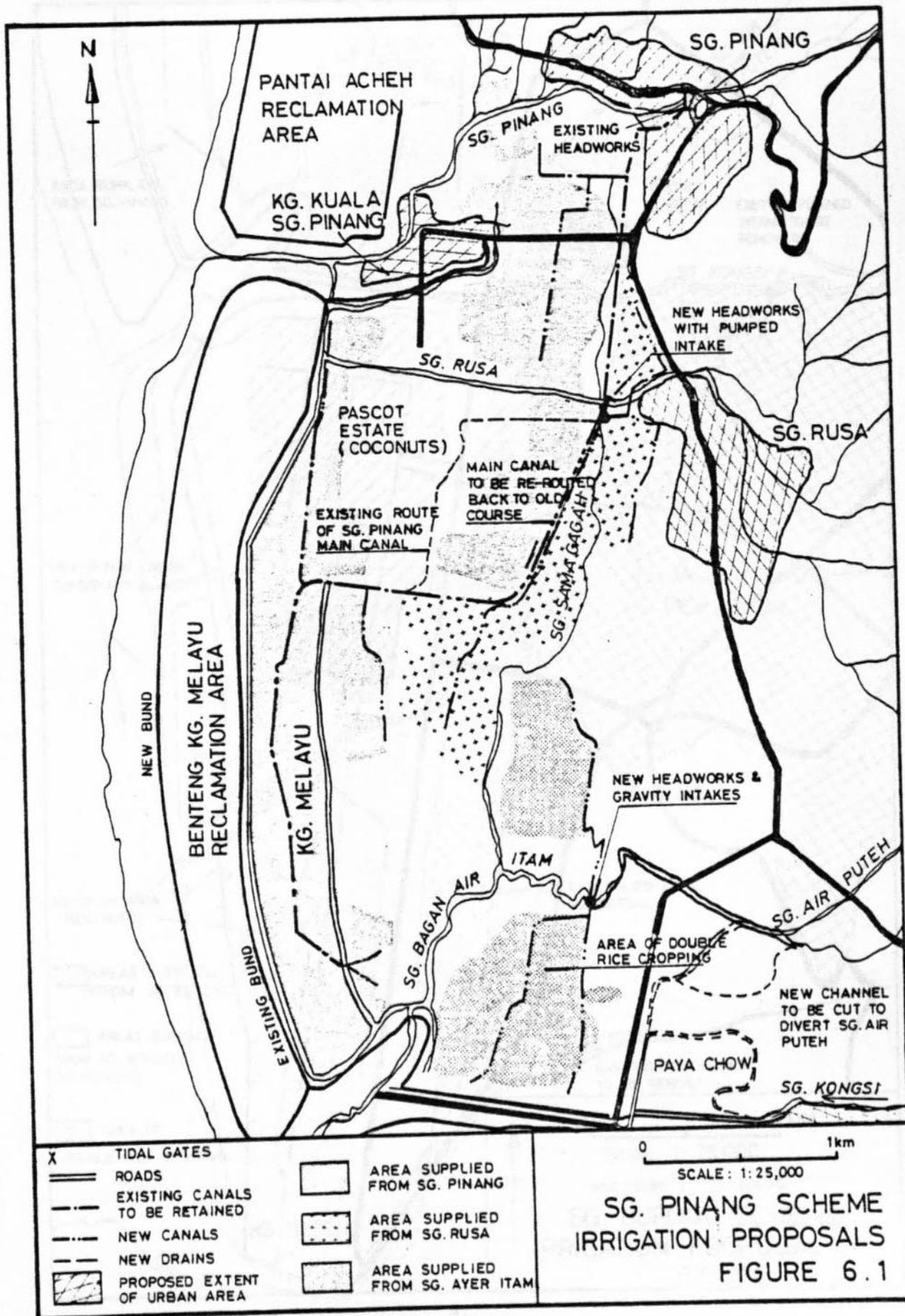
6.4.3

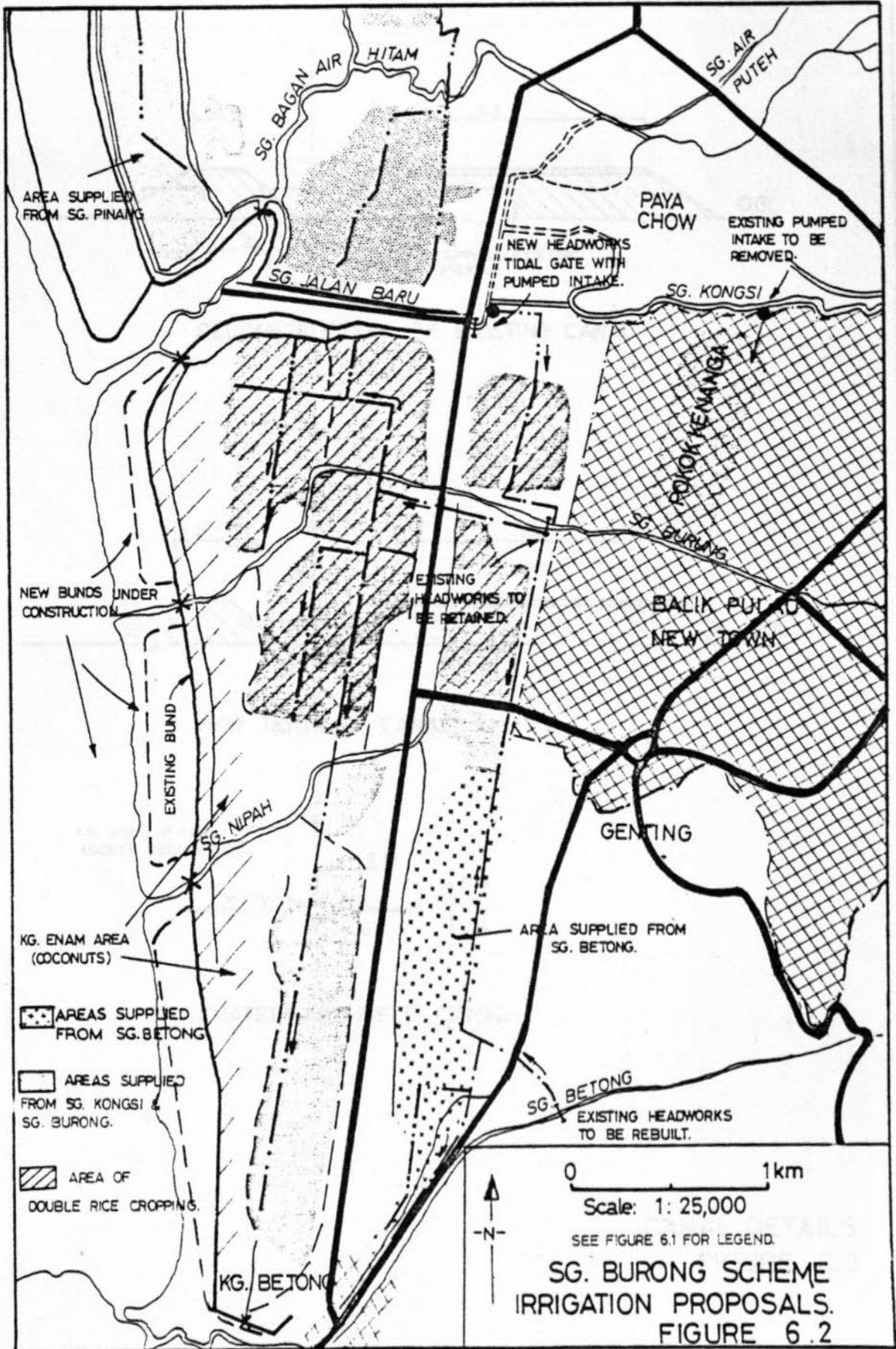
This total averages \$13,300 per hectare. Based on a similar cost per unit area, the estimated total for Sg. Pinang scheme is \$6.3 x 10⁶.

6.4.4

We have presented an estimate of land acquisition costs in Table C5. The area of land required to be purchased is estimated at 6.5% of the scheme area - i.e. 26.7 ha. This includes the cost of land along the alignment of existing canals, the reservations for which were not purchased by JPT. Estimates of land value based on information from the Federal Valuation Office suggests an average cost of about \$6,000 per hectare. At this rate, the total cost of land acquisition in the Sg. Burong scheme would amount to about \$160,000.



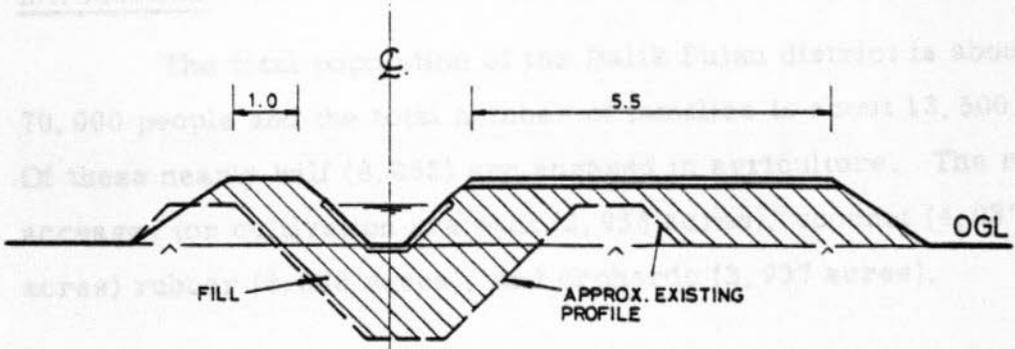




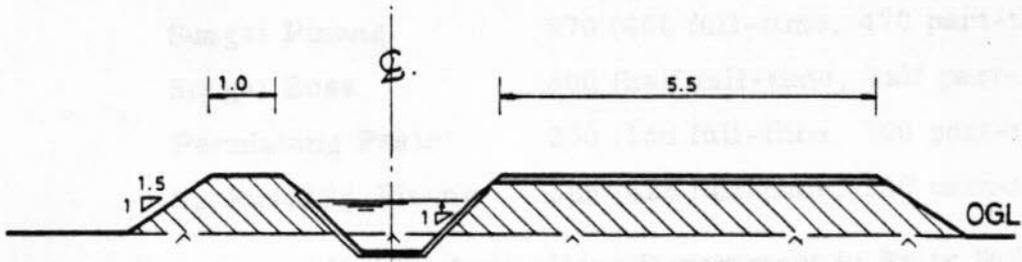
SEE FIGURE 6.1 FOR LEGEND.
SG. BURONG SCHEME
IRRIGATION PROPOSALS.
FIGURE 6.2

Introduction

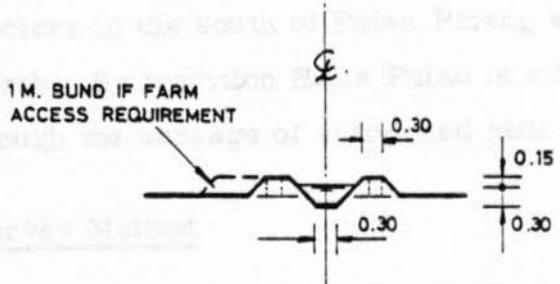
The population of the Pailan Puzon district is about 70,000 people. The total area of the district is about 13,500. Of these, 14,000 are engaged in agriculture. The reported population of the district is 13,500 (1970 census). The work force number is 21,000 people. The farming families in major areas are as follows:



RECONSTRUCTION OF EXISTING CANAL



NEW TERTIARY CANAL



QUATERNARY FIELD CANAL

CANAL DETAILS
FIGURE 6.3

7. SOCIO-ECONOMIC SURVEY

7.1 Introduction

7.1.1 The total population of the Balik Pulau district is about 70,000 people and the total number of families is about 13,500. Of these nearly half (6,055) are engaged in agriculture. The reported acreages for cultivation are padi (2,956 acres), coconut (4,937 acres) rubber (8,338 acres), and orchards (2,937 acres).

7.1.2 The total population according to the 1970 census was 48,000 people and expected to increase at 2.7% per annum. The work force number 21,000 people. The farming families in major areas are as follows:

Sungai Pinang	870 (400 full-time, 470 part-time)
Sungai Rusa	500 (half full-time, half part-time)
Permatang Pasir	250 (150 full-time, 100 part-time)
Sg. Rusa/Sg. Pinang	685 (425 full-time, 280 part-time)

(figures supplied by Agriculture Department in Balik Pulau)

Balik Pulau is situated between the expansion of very large industrial sectors in the south of Pulau Pinang and the tourist industry to the north. By tradition Balik Pulau is still under agriculture even though the acreage of abandoned padi land is still growing.

7.2 Survey Method

7.2.1 The aim of the survey was to study the socio-economic viability of the area for agriculture especially bearing in mind the fact that the area is bordered on the south side by the area of development (factories and airport) and the northern side by the development in tourist trade (hotels). The survey investigated the following:

- i. The family structure : domicile and dispersal;
- ii. Patterns of economic pursuits within the family;
- iii. Economic and educational status of members of families;
- iv. Land holding and tenancy;
- v. Present problems with regard to agriculture and land holdings.

7.2.2 Questions pertaining to alternative crops are also put to the respondents. These together with the questions on the perception of the farmers with regard to their future were also put to the respondents. The target population was limited to those still connected with padi; the surveyors were told to concentrate on the padi farming families and their problems. This has resulted in only a minority of replies from former padi farmers not now cultivating.

7.3 The Structure of the Household in Balik Pulau

7.3.1 The average family in Balik Pulau consists of 5 to 6 people with middle-aged household heads. (Table 1^{*}) The households or families interviewed have for their heads people over 40 whose education is primarily the junior school status. From Table 2, we can see clearly that nearly 94% of them received primary education (i.e. Std. 1 to Std. VI), 6% received no education at all, while only 0.4% received secondary education. We must bear in mind that Penang is the earliest area to provide education in Bahasa Malaysia, and the lack in secondary education is astonishing.

7.3.2 Table 3 shows that 34% of families have 5 to 6 members while 33% are smaller than this and 22% have 7 to 8 members. The remaining 11% have more than 8 members. We can expect a change

* All tables referred to in this Chapter will be found in Appendix D

in pattern with regard to the younger generation: we note from Table 4 that 90% of the dependents passed form V. This indicates that the majority of the dependents have gone to school, a passport to other better income jobs elsewhere. It also means a loss in the local labour force for Table 4 clearly shows that the younger generation is better equipped for better prospects elsewhere. Table 4 also shows that about 3% have reached the university level. The fact that so many have gone to school and a few have reached the university level indicates that a change not only in the family structure but also in the community as a whole is taking place. It is not surprising therefore to find the old folk tending the rice fields while the young bring in a larger income from the outside.

7.3.3 Tables 5 and 6 need some explanation: the survey was biased towards the farmers and that is why those whose main occupation was farming account for 73% of the sample. Those who are entered as not working are actually former farmers, now depending on their children for income, and the children are not farming on the land. Table 6 refers to the part-time occupation of the head of the household interviewed. It is significant that 17% in Table 6 said that their part-time occupation is farming, while half said that they had no part-time work. It is also significant to note that 10% gave fishing as part-time occupation.

7.4 Land Terms and Incomes

7.4.1 The survey also bears out the earlier reports that the majority were tenant farmers. 62% of the people interviewed were tenant farmers. Duration of tenancy arrangements is discussed in section 4.3. Those who farm on their own land are about 25%. Of those who rent land 57% pay it to persons in their kampung and most of the remainder pay to non-relatives outside the kampung (Table 12). The system of paying rent as a proportion of the crop is given in Table 13. This shows that 81%

(147 ÷ 182) pay one third of their crop to the landlords and a few even pay one half. The implications of this system for the future proposed group farms are extremely serious, since if it is not changed, a large proportion of the expected profit from group farms would go to non-participant landlords. We recommend in 8.5.3 that rental payments be changed to a fixed cash sum per year basis.

7.4.2

Incomes of the respondents personally, and of their households, are given in Tables 37 and 38. The household incomes are of course very much higher than the respondents incomes. Whereas 75% of the respondents are below the \$200 a month level, only 34% of households are below this level. Only a fraction (3%) of respondents receive more than \$400 per month, but 37% of households exceed this figure.

7.4.3

Incomes of the family dependents are given in Table 2A, and they have been discussed in section 2.6 since they are the principal source of future agricultural labour.

7.5

Agricultural Sector

7.5.1

From Table 8 we can see that single cropping accounts for 61%, double cropping covers 29%, while only 10% of the people or respondents said that they did not plant padi anymore. Taking Sg. Burung areas only we have 38% (78 ÷ 206) claiming to do double cropping. This appears to be an overstatement when compared with Table 4.2 (p 50) which indicates well below 30% double cropped in the last four years. However that table gives 44% in the off season of 1976. It is encouraging that 81% would be willing to double crop in future.

7.5.2

Table 15 gives the problems that are faced in planting padi. 56% consider that pests e.g. rats, in the abandoned rice fields are the worst problem. It is clear from the interviews

that we have had with the farmers that the pest problem would be overcome if they planted at the same time. It was pointed out that if all the farmers were to observe the timing set by the authorities pest control could be improved considerably.

7.5.3 The problem which comes second to pests is shortage of labour. 27% of the farmers give this as the main problem for their padi field. Problems of water supply into the padi fields are given by 10% only.

7.5.4 Before the survey we had interviewed the Ketua Kampung (or village elders) with regard to padi planting in the area. We had found that the padi planting had been a tradition going back to the past and that padi culture had influenced the life of the people. It must be borne in mind that padi is not the main source of income for the farmers. The padi grown is regarded more as a supplement although it plays very important part in their lives.

7.5.5 Very few farmers planted other off-season crops. On the coastal plain we find that the coconuts have been planted. There was also maize planted on the banks of the padi fields but this was seen as a half-hearted way of supplementing income. Income also came from the rubber and dusun planted on the hill sides. However commercialised planting of spices like nutmeg and cloves on the hill land is not done by Malay padi farmers.

7.6 Projection for the Future

7.6.1 Questions put to the respondents in the survey showed that the majority of the farmers were in favour of rehabilitating the land. We also put the question whether double cropping could solve the problem of livelihood and we find 72% said yes (Table 17).

7.6.2 We also put a different question to the farmers based on our recommendations with regard to future organisation. (Table 29)

Besides double cropping would they be agreeable to an arrangement based on mechanised group farming or a cooperative system? (As it is now 55% of the farmers belong to their koperasi peladang kawasan - Farmer's Organisation, as given by Table 27.) 39% would opt to be a non-working shareholder in any new cooperative, and 53% would like to work in it. Of the latter 16% wanted to be workers but not shareholders, which seems to us an unattractive option unless they envisage part time work only.

7.6.3 It appears that the concept translated as "group farming" in Questions 32 and 35 is not popular, whereas a co-operative is. This must be due to some experience or distinction in the minds of the farmers which has not been revealed. It should have no bearing on the acceptability of group farms as defined in 8.3.7 which could, as explained there, include co-operatives. Nevertheless it is clearly desirable to avoid in future use of the term "secara berkelompok" which has produced this negative reaction.

7.6.4 Table 36 gives the opinions on different crops suggested for future cultivation in co-operative units on a large scale. Replies on every category are surprisingly negative, but padi emerges with a clear lead (54%) followed by coconut (14%) and vegetables (14%). Enterprises which we have considered and rejected in our general assessment - poultry, beef, papaya and bananas - receive a negative vote of 96% or higher in each case.

7.7 Landlord/Landowner response

7.7.1 Of the landlords surveyed the majority 75% received their land by inheritance. This is not surprising since in this area land is bequeathed in ever smaller parcels according to the Islamic law of inheritance, Faraid.

7.7.2 To the question why some of the land is not worked by the landowners, it is discovered that the majority were unwilling to provide the information (65%). Of the remainder 11% each said that they are too old to work or they had other jobs to be considered.

7.7.3 As with the farmers a question was put to landowners as to whether they agree to double cropping or not. The great majority, 82% agreed to double cropping. To another question put: whether they were willing to change from padi land to other crops, only 38% agreed.

7.7.4 The question was put whether or not they were willing to surrender the land to the cooperative in order for the land to be developed. (Table 7b) 67% agreed, although they varied in number of years their land could be used by the cooperative. If there were to be a cooperative 72% agreed to be shareholders only, while 13% agreed to be shareholder as well as a worker. With regard to renting out the land 47% would restrict this to relatives or friends but 49% would rent to anyone. Only a very small number, 4%, had been approached in the past 12 months by someone wishing to buy their land.

7.8 Response of Dependents

7.8.1 It must be borne in mind that the respondents of this section are the dependents of the head of the household who were living at home and are not engaged in farm work. The majority are under 21 (63%) and 96% are under 29. Their reactions to the possibility of future work in agriculture were very encouraging - see section 2.6.4 and Table 5c etc.

7.9 Conclusion

7.9.1 From the survey and from the interviews we have had with the leaders of the padi farming community we discovered that there had been a changing pattern in the population which affected the structure of the household. Education plays a very

important role in this. While the heads of household received only primary education, the younger generation is made up of those who passed std. V, form III and form V. With this qualification they could work in the factories and this has caused the labour shortage in the padi cultivation. However we found that the younger generation, while they did not look in favour of agriculture, could provide continuity because they would return to the land if need be. The likelihood of the younger generation abandoning rice cultivation completely is small.

7.9.2 The present farmer/head of household would seem to prefer rice cultivation, especially if there is better control of the rice land. He would not mind if there was cooperative farming as most of them are tenant farmers.

7.9.3 The survey that we conducted was stratified for the different groups interviewed. The younger generation has been dealt with above. The other important group that we interviewed were the landlords, who were crucial because most of the land belong to them. They were in favour of agriculture, but they would prefer that the land they own is given better organisation and management. Therefore this group of people preferred group farming or farming in the form of a cooperative. Their preference for rice coincides with that of the farmers.

7.9.4 With regard to the cultivation of rice through cooperatives we envisage a better organisation of the farm land and mechanised farming. With regard to mechanised farming we found all the groups interviewed were agreeable as long as they could remain on the kampung land.

7.9.5 With regard to alternative farming we put the prospect to our respondents and received unfavourable answers. They were not against the idea of introducing off-season crops if double cropping of rice is not possible. However if there is a better management

the farmers still want to plant rice because it is connected with their sense of security and relationship to the earth.

7.9.6

The key to the problem is not so much the crops involved but in the management of the land. We would recommend that bodies be set up to manage the land for agricultural purposes. The most crucial group is the landowners who must agree to surrender their land. From our interviews with this group of people most would cooperate in such a body. Taking into consideration the attitudes of the present (younger) generation, if they could see that the land is better managed, there is a good prospect for a majority of them to return to the land.

This decline has been particularly marked in Sg. Puring where by the 1982/83 rain season only 19% of the cultivable area had been cropped. In the same season the area cropped in Sg. Puring had fallen to just under half (48%) of the cultivable area. Since instances of land being cultivated after a lapse of two seasons are rare, it can be expected that the majority of land left uncultivated in the rain season will almost certainly be abandoned.

8.1.2

The reasons for abandoning land are well known and are generally listed as poor drainage, lack of water, pests (particularly rodents), staggered planting, the small size of holdings and high proportion of tenant farmers (about 60%). Of these, the socio-economic survey of Rajah Muga carried out by the Consultants indicated that the farmers themselves regarded pests as the most serious problem affecting rice cultivation. Taken together these problems have resulted in low levels of income which have not been competitive with incomes offered in the rapidly expanding manufacturing and construction sectors.

8.1.3

The existence of highly competitive employment opportunities nearby has been a major (if indirect) contributor to the decline in rice cultivation, and therefore has been an important factor influencing the agricultural proposals for Rajah Muga in this chapter. It has not so much influenced the choice of crops, since this will primarily be determined by soil and agronomic considerations, but the system of

8. ENTERPRISE SELECTION AND FARM PLANNING

8.1 Introduction

8.1.1

The Balik Pulau scheme comprising the two main irrigation areas of Sg. Pinang and Sg. Burung has traditionally been devoted to the cultivation of rice. Water availability however, has limited rice cultivation to a single main season crop in Sg. Pinang and restricted double rice cropping in Sg. Burung to a maximum area of about 200 ha. No other crops are grown on the padi land. Until the 1977/78 crop year (off-season 1977 main season 1977/78) both areas were fully cultivated in the main season whilst off-season cultivation (Sg. Burung) was well below the area potentially cultivable. From the 1978/79 crop year there has been continual decline in the main season areas cultivated. This decline has been particularly marked in Sg. Burung where by the 1980/81 main season only 15% of the cultivable area had been cropped. In the same season the area cropped in Sg. Pinang had fallen to just under half (48%) of the cultivable area. Since instances of land being cultivated after a lapse of two seasons are rare, it can be expected that the majority of land left uncultivated in the main season will almost certainly be abandoned.

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8.2.3 which the crop will be grown. There has been no deliberate attempt to create rural employment through the promotion of labour intensive production systems or techniques. Instead the primary aim has been to retain those areas presently being cultivated and to bring abandoned land back into cultivation. Thus, priority has been attached to identifying systems of cultivation which are practically feasible and which will provide those participating in them with incomes and working conditions that are competitive with those offered in other industries. This has meant that the introduction of more intensively mechanised operations has received considerable attention and that economic criteria such as returns to farmers' labour have assumed greater importance as compared with returns to land.

8.2 Crop Selection

land and water

8.2.1 The main factors influencing the choice of suitable crops and ultimately cropping patterns proposed, are the quality of the soils and availability of irrigation water. The majority of soils throughout the area are deep, poorly drained, heavy clays of marine origin (Kuala Kedah and Tebangau series). Whilst their fine texture and slow drainage characteristics are ideally suited to rice cultivation, they limit their suitability for the cultivation of other annual crops. Nevertheless, the soil studies have concluded that with improved drainage it would be possible to cultivate a range of other annuals and perennial fruit crops. These included maize, soya bean, fruit bearing vegetables, bananas and papaya. The latter were included with the condition that they would require more intensive (in-field) drainage. Groundnuts and a range of root vegetables were also considered but were eventually discarded as unsuitable because of difficulties in harvesting them on the clay soils.

8.2.2 The other major soil series in Balik Pulau is the Kranji series which occupies a coastal strip extending the length of the area. Since it is outside the designated irrigation area, it does not influence the proposals in this chapter.

8.2.3 Although the availability of water will be improved with the project, through the inclusion of additional sources Sg. Rusa, Sg. Ayer Puteh, and Sg. Kongsu in the system, water availability in the off-season will continue to restrict the cropping pattern selected. There is no restriction however, in the main season, and if desirable, rice which has the highest water requirement of all the annual crops, could be cultivated throughout the entire area. In the off-season the maximum rice area possible would be 450 ha but cultivation of rice to this extent would preclude the cultivation of any other annual crop on the remainder of the area. As a general rule, rice would have to be limited to about 250 ha, for the entire area to be cultivated with annual crops in the off-season. This would remain possible even during a 1-in-5-year drought. A 1-in-10-year drought however, would cause serious water shortages in the off-season. Off-season water supplies would not restrict the areas of perennial or semi-perennial crops which could be grown.

markets

8.2.4 The availability of markets for agricultural produce is not likely to restrict the type or quantities of crops grown. Pulau Pinang is a deficit rice producing area with the balance between production and consumption being made up by transfers from the neighbouring State of Kedah. Malaysia as a whole is a net importer of rice and the Government has a stated objective (Fourth Malaysia Plan: 1981 - 1985) of attaining self-sufficiency in rice production. In terms of Government policy, increasing rice production is clearly important. Of the other grains, maize is also important with almost 300,000 tonnes being imported in 1980. There should be little difficulty in marketing maize grain in Pulau Pinang particularly as the State has a well developed feed milling industry centred on Butterworth. Maize can also be marketed as fresh cobs, although the market for this commodity is probably limited.

8.2.5 The market potential for fruit and vegetables is good. The recently completed market studies for the Balik Pulau/Seberang Perai: Integrated Agricultural Development Project (MIDF Industrial Consultants Sdn Bhd: July 1980) indicated that to satisfy the market potential in 1985 the areas of vegetables and fruits could be increased by about 1,040 and 8,360 ha respectively. The potential for bananas was parti-

cularly important (2,550 ha). The increase in area of papaya required to meet future demands was estimated at about 150 ha, and since a major proportion of this is likely to be taken up in the non-irrigated areas in the next four years, the market potential for growing papaya in Balik Pulau is limited.

selected crops and cropping pattern

8.2.6

Rice, maize (grain and cobs) and a mixture of vegetables have been selected for inclusion in the cropping pattern for Balik Pulau. Given that the land is ideally suited to rice cultivation and less well suited to the cultivation of other crops it is essential that rice should feature to the maximum extent possible within a cropping pattern that would aim at cultivating all available land in both seasons. Besides land suitability there are a number of other arguments to support a rice based cropping pattern:-

- (a) the Government's agricultural services provided through the DOA and LPP are particularly geared towards promoting rice production.
- (b) it is the Government's policy to encourage rice cultivation and to eventually achieve self-sufficiency.
- (c) the farmers themselves are familiar with its husbandry and have indicated quite clearly in the socio-economic survey that they would prefer to continue cultivating rice than change to an alternative crop.
- (d) given the present price structure, subsidies and potential yields, it is financially attractive giving high returns to both land and labour.

8.2.7

We have therefore proposed rice cultivation throughout the entire area in the main season and up to 260 ha in the off-season. The balance of the off-season area would be divided between maize (grain and cobs) 390 ha and vegetables (130 ha). Whilst bananas and papaya have received very serious consideration, they were eventually not included in the cropping proposals. The main reasons for their exclusion were the more stringent requirements for drainage than the shallower rooted annuals,

and the uncertainty over the time required to lower the water table sufficiently to allow their cultivation.

8.2.8 Crop budgets were prepared for bananas and papayas (8.4 and Table 8.1). The expected returns from bananas (which represented the greatest market potential) and papayas are not markedly higher than double rice cropping and would be unlikely to justify additional drainage costs or the risks attached to their cultivation under less than ideal conditions. Although soya beans have not been included (mainly because of the lack of agronomic data available on their cultivation in this area) they could replace some maize in the cropping pattern. The returns from soya beans however are unlikely to differ significantly from the returns from a mixture of maize grain and fresh cobs, and thus the inclusion of soya beans would have little impact on farmers' incomes or on the project economics.

8.3 Crop Production Systems

8.3.1 The current system of rice production is based on individually farmed smallholdings, the majority of which range in size between 0.2 ha and 2.5 ha with an average size of about 0.75 ha. The production system is labour intensive with land preparation, transplanting and harvesting mainly being carried out by hand methods.

8.3.2 The present system of production is clearly coming under considerable pressure as indicated by the decline in areas cultivated annually and the growing area of land abandoned. Although there are isolated examples of individuals who are expanding their area of rice and who have introduced mechanised land preparation (power tiller and medium powered tractors), an alternative crop production system has not yet evolved or been introduced. If the present trend is to be halted, and abandoned land returned to cultivation, an alternative system of production which is less dependent upon hand labour and employs higher levels of technology will have to be introduced.

8.3.3 A number of labour saving innovations have already been adopted in other rice growing areas of Malaysia. For instance, the use of combine harvesters is now widespread throughout the MADA scheme in Kedah

and is becoming more important in the Seberang Perai Utara schemes, whilst direct seeding is being carried on successfully in parts of MADA and at Tanjung Karang in Selangor. Although these innovations are probably more easily introduced into larger scale units where irrigation can be more rigidly scheduled, they are becoming more important in smallholder rice production. With the improved water control resulting from the upgrading of irrigation and drainage works, the introduction of these innovations should be relatively easy. Given this we do not believe that re-organisation of smallholders is essential to the introduction and adoption of labour saving technologies. On the other hand it is unlikely that smallholder farming could be easily re-introduced throughout those areas which have already been abandoned. A large scale mechanised system based on groups of farmers (owner-operators and tenant farmers) is therefore proposed for abandoned land or areas where the farmers themselves wish to form groups and operate on a larger scale. Experience elsewhere in Malaysia suggests that such a system would be technically possible and that it could lead to more rapid rehabilitation of abandoned land.

8.3.4 The major problem with group farming is expected to be organisational rather than technical and it is proposed that immediate priority should be given to establishing "pilot group farming areas" in order that suitable organisational forms can be developed by the time engineering works are completed and agricultural operations about to commence. The group farming and smallholder systems proposed are described in the following sections.

group farming

8.3.5 Large scale group farming would apply to those areas uncultivated or abandoned at the time when the irrigation and drainage upgrading programme was implemented, and to those areas where existing farmers were determined to form groups and to adopt a large scale farming system. As the major part of Sg. Pinang and Sg. Burung is already uncultivated, large scale group farming will be the predominant system throughout Balik Pulau extending over at least 660 ha or 85% of the entire area.

- 8.3.6 The group farm would comprise all of the holdings within a tertiary irrigation unit and thus would vary in size both in terms of number of members and overall area depending upon the size of the tertiary unit. Throughout Balik Pulau the group farms would range between 50 and 100 ha comprising 65 to 130 members. The members would include landowners, owner-operators and the tenant farmers who had most recently been farming the area.
- 8.3.7 The term "group farm" is used to describe any formal grouping of participants and may include any business form; company, partnership or co-operative. The important point is that group implies corporate action and responsibility rather than individual. The group would therefore have to have its own decision making committee or board and would have to decide on a procedure for electing them. Since the co-operative structure and procedures are already well understood, co-operatives probably represent the most suitable structure to adequately accommodate the large membership envisaged. The elected committee would be responsible for determining and implementing policies on behalf of its members and for hiring or appointing whatever managerial and supervisory staff considered necessary. As the businesses overall are not large (50 - 100 ha) and the farming systems proposed relatively simple, it is expected that a manager and two supervisors who would be responsible for organising and supervising field activities would be adequate for each group.
- 8.3.8 Should it prove impossible to interest groups of farmers in returning to cultivate abandoned land, the large scale system of cultivation proposed could equally well interest individual entrepreneurs or even small partnerships. These should not be discouraged since they will contribute to achieving the aim of returning abandoned land to cultivation. Also individual entrepreneurs can often bring a valuable innovative flair to production systems.
- 8.3.9 The system is dependent upon landowners continuing to make their land available for cultivation by the group. Under the IADP it is proposed that a new Land Lease Section is established within the Land Office. This section would be responsible for payment of rents to the

landlord and for recovery of rent from the farmer or groups of farmers. If this section is established it could well facilitate leasing arrangements between farmers and landlords. It is not, however, considered essential as already about 62% of all farmers successfully lease land from landowners.

8.3.10 Two cropping systems, double rice cropping and main season rice followed by maize and vegetables are proposed. Rice cultivation would have the following features:-

- (a) Mechanised land preparation.
- (b) Direct seeding.
- (c) Use of herbicides supplemented by hand weeding for weed control.
- (d) Mechanised harvesting (combine harvester).

Two systems of direct seeding are possible; broadcasting of pregerminated seeds into a wet seed bed, or drilling of dry seed into a dry seed bed using the technique and equipment developed at Tanjung Karang. It is likely that both would eventually be used with the choice between systems being determined mainly by weather and soil conditions from season to season. For budgeting purposes however, broadcasting of pregerminated seed has been assumed.

8.3.11 Maize production would also be based on mechanised land preparation, planting and harvesting (grain only by combine harvester) with weed control being maintained mainly by herbicides supplemented by hand methods as necessary. Maize grown for fresh cobs would be hand harvested.

8.3.12 Vegetables production would be much more dependent upon hand labour and only land preparation would be mechanised. Since there is such a high dependence upon hand labour for vegetable production, it is proposed that this enterprise could be carried out by participants on an individual basis within an area designated for vegetable production during the off-season on each farm.

8.3.13

It is proposed that a Machinery Service Centre (8.7) is established in the project area and that the majority of mechanised operations for land preparation and harvesting would be carried out by this centre. The possibility of some farms having their own tractor and cultivating equipment should not be ruled out and this decision would be dependent upon the willingness and financial resources of the group members. We have assumed however, that the Centre would service the majority of farms on the grounds that the farm group members may not have the financial resources, and that maintenance, repairs and effective operation of machinery might be more easily arranged at a service centre. Similarly whilst one farm could not justify owning a combine harvester for its own crops, it could operate as a contractor to surrounding farms. Whilst it is recognized that this should be encouraged, it is unlikely that many farms would have the financial resources, and the majority of farms would be dependent on the service centre for harvesting their crops.

smallholder farming systems

8.3.14

The socio-economic survey results indicated that (at least in the short term) a proportion of the existing smallholders would wish to maintain their individual status and to continue farming as smallholders. Providing that these farmers represented a majority within their particular tertiary irrigation unit, there is no overriding reason why they should be persuaded to participate in any formal grouping or association. It is inevitable however, that they will have to accept a degree of co-operation if innovations such as mechanization of field operations are eventually to be introduced. If the advantages of formal grouping are clearly evident, it is quite likely that farmers may voluntarily decide to join in a formal group at a later stage. If this is the case it should be encouraged. In terms of area and numbers they represent a minor sector of the overall area and farm population and since they are predominantly located in the areas of Sg. Pinang and Sg. Burung designated for future double rice cropping, it is assumed that this cropping system would be practised by the smallholders.

8.3.15 With the introduction of mechanization to the surrounding areas it is unlikely that the smallholder farming systems will remain completely unchanged and there is no doubt that there will be a gradual uptake of innovations. Of the major rice innovations, mechanized land preparation, direct seeding and mechanized harvesting, it is most likely that adoption of mechanized land preparation (using power tillers) would be most rapid, and would probably be followed by mechanized harvesting in current use, it is recommended that "intermediate" alternatives such as self-propelled binders (cutting and binding) and stationary threshers are also considered.

8.3.16 It is impossible to predict the rate at which technical innovations such as these will be taken up. Overall they are not expected to have any significant impact on crop yields but will have a more direct influence on the pattern of labour usage. Since the rate of uptake of innovations is unpredictable and will in any case be unlikely to have a major impact on the economics of rice production, the following practices have been assumed in the preparation of crop budgets and farm models (8.4 and 8.5):-

- (a) Land preparation will be completely mechanized with either power tiller or four-wheeled medium powered tractor.
- (b) Rice will be hand transplanted.
- (c) Weed control will be mainly through use of herbicides supplemented by hand weeding.
- (d) The majority of the rice will be harvested by hand methods.

Yield improvements will be largely attributable to availability of recommended seeds, fertilizers, herbicides and pesticides, improved control and availability of water, more timely planting of the rice crop and an intensified extension effort.

8.4 Enterprise Budgets

8.4.1 Enterprise budgets (at market prices) have been prepared for the cropping systems discussed in Section 8.3 and for potential livestock enterprises.

crop budgets

8.4.2

Crop budgets have been prepared for the following crops:-

- smallholder rice
- mechanized rice production (group farms)
- mechanized maize grain production (group farms)
- fresh maize cob production
- vegetables (okra, long bean, cucumber, brinjal and chilli)
- bananas
- papayas

8.4.3

The detailed costs of mechanization, materials and labour inputs are given in Appendices D and E. The crop budgets showing returns to land and labour at market prices are summarized in Table 8.1. Of the annual crops, mixed vegetables (65% okra, 10% long beans, 10% cucumber, 10% brinjals and 5% chilli) is the most attractive in terms of returns to land whilst also having a relatively high return to labour. Vegetable production however, is a technically demanding enterprise and has a high requirement for hand labour. Together these will limit the overall extent to which vegetables are grown. Fresh maize cob production also has a high revenue potential with high returns to both land and labour. Whilst the cultivation of fresh maize is much less demanding than vegetables, the extent to which it can be grown will almost certainly be limited by the volumes which can be marketed.

8.4.4

The returns to land and labour are relatively high for both systems of rice production (smallholder and group farm) and when considered along with factors such as the particular suitability of the soils for rice cultivation and the farmers' preference for rice, maximising the area of rice grown is clearly justified. Whilst returns to labour from maize grain production are similar to smallholders rice, returns to land are very low. The maize production system proposed however, is relatively simple and complementary to mechanized rice production. Given that it will be combined with the higher revenue earning fresh maize cob production, its inclusion in cropping patterns can also be justified.

8.4.5 Although bananas and papayas are not included in the proposed cropping patterns for the irrigable areas, their crop budgets are summarized in Table 8.1. They represent possible additional revenue earning enterprises which farmers could attempt on an individual basis on small areas of non-irrigated land (such as house plots). Of the two papaya is the most attractive with reasonably high returns to both land and labour. Returns from both however, would be of a similar order to those for double rice cropping.

livestock enterprises

8.4.6 Poultry broiler and layer enterprises have been examined as potential sources of additional income to farmers in the Balik Pulau area. They are considered particularly relevant since they will not take up irrigable land and the market potential study (MIDF Industrial Consultants 1981) has projected shortfalls by 1985 of 2,800 tonnes of poultry meat and 92 million eggs in the Balik Pulau and Seberang Perai areas.

8.4.7 Livestock enterprises (cattle and buffalo) would be dependent upon irrigable land for the production of fodder and thus their inclusion would have to be at the expense of irrigated cash crops. The returns from these enterprises are generally low and would not justify their inclusion in an irrigation scheme. Whilst this would also be true for imported exotic (or exotic cross) stock with higher production potential, exotic stock could not be recommended on the grounds of their high initial cost and their requirement for a very high level of husbandry and stockmanship if their production potential is to be realised.

poultry: broiler enterprise

8.4.8 The economics of poultry meat production have been examined in terms of a 500 bird unit which is considered by producers to be the ideal number of birds for one poultry house. It is not however, regarded as a minimum economic size; poultry producers who have no other occupation normally consider 10 houses or 5,000 birds to be the minimum economic unit. Since broiler production is being considered

here as supplementary activity to irrigated crop production, examination of a 500 bird unit is appropriate. Larger scale enterprises would comprise multiples of the 500 bird unit.

8.4.9 The "all in all out" system is proposed with four batches of birds produced per house per year. The cycle is thus 60 days occupation of the house by birds followed by 30 days for resting and cleaning the house. The house would comprise a concrete floor, RC walls and a corrugated aluminium roof. It would have electric lighting, self-feeding and an automatic water fountain, and depending upon the quality of materials used, would cost between M\$1,000 and M\$1,875 per house.

8.4.10 Table 8.2 presents the annual enterprise budget at 1980 market prices. Excluding labour the net revenue per year is \$203 per annum or a return to labour of M\$2.9 per man-day. If labour is charged at the going wage rate of M\$7 per man-day the enterprise makes a loss of M\$287 per annum. To produce a return to labour equivalent to rice cultivation (i.e. M\$19.3 per man-day) the price of poultry meat would have to be raised by 33 cents a kg (20 cents per kati). The profitability of broiler production is highly cyclical and the situation modelled at 1980 prices may not be sustained. However, it is clearly a high risk enterprise, extremely sensitive to small price movements in poultry meat and feedstuffs and cannot therefore, be recommended for widespread adoption by farmers in the project area.

poultry: 500 bird layer enterprise

8.4.11 A 500 bird house is again considered as the ideal size of house but not necessarily the minimum economic size of poultry enterprise. The main features of the proposed system are:-

- (a) birds will remain in the same house from day old until completion of the laying period.
- (b) the time from day old to point of lay is 140 days.
- (c) the laying period would be 420 days after which all birds are sold.

(d) egg production is expected to average 70% lay over the first 180 days of the laying period and 65% thereafter.

(e) housing would comprise a concrete floor, RC walls and a corrugated aluminium roof. Water and electricity would be laid on. Houses would be provided with laying boxes.

8.4.12 Table 8.3 presents the enterprise budget over a 590 day period from day old to completion of the laying period and clearing out and resting of the house (30 days). The net revenue after charging for labour at \$7 per man-day amounts to \$650 per 500 batch of birds. Considering the high amounts of capital and risk involved this represents a low return. The return to labour is M\$14.1 per man-day and is lower than any of the irrigated crop alternatives. Like broiler production it is highly sensitive to marginal changes in feed and output (egg) prices and cannot be recommended for widespread adoption by farmers.

8.5 Farm Models - Smallholder Farms

8.5.1 A number of farm models have been prepared to indicate the potential levels of income available to participants in an upgraded Balik Pulau scheme. Smallholder farming is expected to be limited in extent to about 120 ha and to be confined to a double rice cropping system. The model showing holding size, revenues, costs and net income is summarized in Table 8.4.

8.5.2 The farm sizes assumed, 0.75 and 0.6 ha, are the average farm size and most frequently occurring farm size group, 0.4 - 0.6 ha (1 - 1.5 ac) respectively, determined by an analysis of a sample of 271 farm sizes taken from the cadastral map of the area. Annual rice yields are expected to build up over a three-year period from 6.7 tonnes per ha (both crops) to 8.6 tonnes per ha. The first year's yield has allowed for a limited amount of disruption following completion of the engineering construction works.

8.5.3 For owner-operators net farm incomes at maturity (return to farm labour and investment) would range between M\$2,665 and M\$3,331 per

annum depending upon the size of the farm. Tenant farmers' incomes are much lower ranging from \$1,135 to \$1,419 per annum. This assumes that the current form of rental agreement i.e. 1/3 of the crop going to the landlord, continues. Since public sector investment will be used to improve the productivity of the land it would be unreasonable to allow this system to continue. It is recommended that an attempt is made to change to a "fixed" (cash) rent system similar to that prevailing in Seberang Perai. The introduction of a fixed rent of \$321 per ha of crop would raise tenant incomes to M\$2,280 and M\$2,850 for 0.6 and 0.75 ha farms respectively, and increase the return to the labour to M\$16.5 per man-day.

8.6 Farm Models - Group Farms

8.6.1 Group farming will be based on two models; double rice cropping, and main season rice followed by annual cash crops, maize (grain and cob) and mixed vegetables. Farm sizes will depend upon the size of the tertiary irrigation unit and will vary between 50 and 100 ha. The size selected for the models is 60 ha with a group membership of 80 families. Since a relatively new technology is to be introduced in both models a four-year period for yield build up in all crops is assumed.

double rice cropping

8.6.2 The expected level of income from the double rice cropping farm is indicated in Table 8.5. As group farming will apply mainly to abandoned or uncultivated land it is assumed that a reasonable level of rent i.e. \$320 per ha could be negotiated with landlords. After payment of rents to external and group member landlords, and salaries for supervisory and book-keeping staff, the margin for distribution amongst group members is expected to build up from M\$40,340 to M\$113,780 giving an average income per member of M\$1,422. In addition there would be an opportunity to share in the M\$45,360 required annually for farm labourers' wages. Although the overall labour requirement would amount to about 80 man-days per participating family, in practice it is more likely that a permanent labour force of about 15 members would be recruited from the group members and the balance of the requirement would be hired as casual labour. Permanent workers could expect to

earn M\$1,974 per annum which together with their share of net revenues would provide an annual income of M\$3,396.

8.6.3 The system would leave a major part of the family labour supply free to find permanent employment off the farm if desired. Table 8.7 shows the potential incomes for various levels of participation in the group.

<u>Table 8.7</u> Balik Pulau: Potential Incomes for Participants in Double Rice Group Farm	
Level of Participation	Potential Farm Income (M\$ per annum)
Landlord ⁽¹⁾ and permanent worker	3,877
Tenant and permanent worker	3,396
Participant non-worker	1,422
Non-participant landlord ⁽¹⁾	481

Note: (1) Assumes ownership of 0.75 ha

rice, maize and vegetable farm

8.6.4 The cropping pattern proposed for this model is 100% rice in the main season followed by 75% maize (45 ha) and 25% vegetables (15 ha) in the off-season. The maize would comprise 75% of the area grown for grain and 25% for fresh cobs. The expected level of income is indicated in Table 8.6. After payment of rent, salaries and miscellaneous expenses, the margin for distribution amongst members is expected to rise M\$27,560 to M\$115,655 giving an average income per member by the fourth year of M\$1,446 per annum which could be augmented by wages earned through participation in the farm labour force. Whilst the average earnings per family if all families provided labour would amount to about M\$694, it is more likely that the farm would establish a permanent labour force

of 15 to 20 people with the balance of labour necessary being met through hiring casual labour on a daily basis. Permanent workers could expect to earn about M\$1,974 per annum (282 days) in addition to their income as a participant. Again the system would leave a major part of the family labour supply free to find off-farm employment if desired. Table 8.8 shows the potential incomes from various levels of participation. These incomes assume that vegetable production will be a "group" activity. If however, the members decide that vegetable production should be an individual activity within an allocated 15 ha area and not all members wish to do it then clearly incomes will be redistributed towards those growing vegetables. A non-vegetable grower's income as a tenant participant would drop from M\$1,446 per annum to around \$850 per annum.

Table 8.8 Balik Pulau: Potential Incomes for Participants in Rice, Maize and Vegetable Group Farms

Level of Participation	Potential Farm Income (M\$ per annum)
Landlord ⁽¹⁾ and permanent worker	3,901
Tenant and permanent worker	3,420
Participant non-worker	1,446
Landlord ⁽¹⁾ non-participant	481

Note: (1) Assumes ownership of 0.75 ha

8.7 Agricultural Services

8.7.1 The Working Group on Farm Production Services for Padi and Other Crops (July 1981 report) have made wide ranging and comprehensive proposals to improve the existing agricultural services to farmers in the Balik Pulau/Seberang Perai areas as part of an Integrated Agricultural Development Project for that area. Those of particular importance to the irrigation farmers are:-

- (a) The strengthening of the Extension Service by increasing the number of field workers, building two Regional Offices, introduction of the T & V system of extension and by making provision for Training.
- (b) The establishment of a Crop Protection Unit within the DOA as a technical support service. It would be responsible for rat control campaigns.
- (c) The Farmers' Organization Authority (LPP) would establish two Farm Mechanization Service Centres.
- (d) Expansion of the number of Farmers' Development Centres by establishing five new Centres and four new Sub-Centres.
- (e) The setting up of an Agricultural Produce Marketing Committee and establishment by FAMA of Marketing Centres in Balik Pulau and Seberang Perai.
- (f) The establishment of a rice milling and drying complex by the LPN and general improvements for rice collection and marketing.

8.7.2 We believe that the recommendations of the Working Group are appropriate and that when implemented they will provide a sound supporting infrastructure to farmers in the area. They adequately cover the requirement for marketing, input supply, crop protection and go some way towards strengthening of the extension services. Our proposals are complementary to those of the Working Group and are concerned mainly with detail such as increasing the numbers of extension workers and setting up Mechanization Service Centres.

field extension workers

- 8.7.3 We have estimated that three field extension workers would be required to provide an adequate service to farmers in Balik Pulau after rehabilitation and implementation of a mainly Group Farming system. There are currently two officers in the area and only one additional worker will be required. However since it is understood that a worker could be transferred from N E District without reducing the ratio of extension workers to farmers below the desired minimum, it is assumed that no additional field workers will be required.

machinery service centres

- 8.7.4 Whilst two new Machinery Service Centres have been proposed by the Working Group for Seberang Perai, no provision has been made to set up a Centre in Balik Pulau. Implementation of the agricultural proposals for the area will depend upon a Centre being established to service both smallholders and Group farms. The centre would comprise a small office, store for oil, grease, tools and spare parts, a fuel tank, covered service area and hard-standing for tractors and machinery. Service facilities would include a compressor, welding equipment and range of basic tools for general maintenance and minor repairs. Overall it would comprise an area of approximately 5,000 sq. metres enclosed by a wire fence.

- 8.7.5 The centre would be staffed by a Manager, Field Supervisor, Wages and Fuel Clerk, Mechanic, Assistant Mechanic, drivers and their assistants (combine harvesters). A pick-up truck and motor cycle would be provided to facilitate transport of spare parts and supervision of drivers and machinery in the field. The capital cost of constructing the Centre is estimated at M\$521,000, whilst the recurrent costs of management and supervision (Manager, Field Supervisor and clerical staff salaries, transport and general maintenance are estimated at M\$37,900 per annum. Other operating costs such as mechanics and drivers' salaries, spare parts, oils and fuels are included in the machinery operation and maintenance budgets. Table 8.9 summarizes the complement of machinery required.

Table 8.1 Crop Budgets: Returns to Land and Labour at Market Prices

Crop	Yield (1) (tonnes/ha)	Market Price (M\$/tonne)	Gross Revenue (M\$/ha)	Direct Production Costs (2) (M\$/ha)	Net Revenue (3) (M\$/ha)	Labour (man-days)	Cost (M\$/ha)	Returns to Land (4) (M\$/ha)	Returns to Labour (5) (M\$/man-day)
Rice: Smallholder	4.3	612	2,632	411 (6)	2,221	115	805	1,416	19.3
Rice: Group farm	4.0	612	2,448	733 (6)	1,715	54	378	1,337	31.8
Maize (grain)	3.5	360	1,260	843	417	26	182	235	16.0
Maize (cobs)	30,000 (cobs)	8 ¢ per cob	2,400	698	1,702	45	315	1,387	37.8
Maize (grain 75%, cob 25%)			1,545	804	741	31	217	524	23.9
Vegetables (mixed) (7)	14.65	494	7,236	1,800	5,436	220	1,540	3,896	24.7
Bananas (year 3 onwards) (7)	13.0	414	5,382	1,842	3,540	136	952	2,588	26.0
Papayas (average annual over 3 year cycle)	21.4	330	7,062	3,230	3,832	135	945	2,887	28.4

Source: Consultants estimates detailed in Appendices

Notes: (1) Yield at project maturity achieved after 3 years smallholder rice, 4 years for group farm rice, maize grain and cob and vegetables.

(2) Excluding labour: Mechanisation costs are included at contractors rates.

(3) Gross Revenue - direct production costs

(4) Net Revenue - labour costs.

(5) Net Revenue - number of mandays.

(6) Excluding fertiliser.

(7)

	Yield (tonne/ha)	Gross Revenue	Direct Production Costs	Net Revenue	Labour		Returns to Land (M\$/ha)	Returns to Labour (M\$/man-day)
					(man-days)	Cost (\$)		
Bananas Year 1	7.4	3,064	1,827	1,237	161	1,127	110	NA
Year 2	15.4	6,375	1,545	4,830	132	959	3,872	36.5
Papayas Year 1	5.3	1,749	2,965	(1,216)	172	1,204	NA	NA
Year 2	33.0	10,890	3,388	7,502	117	819	6,683	64.1
Year 3	26.0	8,580	3,338	5,242	117	819	4,423	44.8

Table 8.2 500 Bird Broiler Enterprise Budget at Market Prices

	M\$
<u>Revenues</u>	
1,938 birds ⁽¹⁾ per year weighing 1.82 kg (3 kati) @ M\$2.40 per kg (\$1.45 per kati)	<u>8,465.00</u>
<u>Production Costs</u>	
Day old chicks @ 85¢ each	1,700.00
Feed: 4.6 kg per bird ⁽²⁾	5,980.00
Water and electricity	70.00
Veterinary and medicines	300.00
Repairs and maintenance to housing ⁽³⁾	50.00
Housing: depreciation and interest annual charge ⁽⁴⁾	162.00
	<u>8,262.00</u>
Labour: 70 man-days per year for 4 batches	<u>490.00</u>
Net Revenue excluding labour	203.00
including labour	(287.00)

Source: Consultants estimates

- Notes: (1) Assumes 2% additional birds supplied and 5% mortality.
 (2) Starter mash \$0.75 per kg and 0.7 kg per bird.
 Grower mash \$0.64 per kg and 1.6 kg per bird.
 Finisher mash \$0.66 per kg and 2.3 kg per bird.
 (3) Assumes capital cost \$1,000 per house. 5% of initial capital cost per annum.
 (4) Assumes 10 year life and 10% interest.

Table 8.4 Farm Model: Smallholder Double Rice Cropping

<u>Revenues & Gross Margins (per ha)</u>	Year		
	1	2	3
Yield per year (tonnes) ⁽¹⁾	6.7	8.0	8.6
Farm gate price (M\$/tonne)	612	612	612
Gross revenue (M\$)	<u>4,100</u>	<u>4,896</u>	<u>5,263</u>
<u>Production Costs (excluding labour and fertiliser)</u>	822	822	822
Gross Margin per ha	<u>3,278</u>	<u>4,074</u>	<u>4,441</u>
Labour requirement (man-days)	230	230	230
Direct Subsidies per ha ⁽²⁾			
Price subsidy	1,108	1,323	1,422
Fertiliser subsidy	470	470	470
	<u>1,578</u>	<u>1,793</u>	<u>1,892</u>
<u>Farm Incomes (M\$/annum)</u>			
Owner-operator			
0.75 ha farm	2,458	3,055	3,331
0.60 ha farm	1,967	2,444	2,665
Tenant farmer ⁽³⁾			
0.75 ha farm	1,434	1,831	2,016
0.60 ha farm	1,148	1,465	1,613
<u>Return to farm labour (M\$/man-day)</u>			
Owner	14.3	17.7	19.3
Tenant	8.3	10.6	11.7
<u>Direct Subsidy per Farm</u>			
0.75 ha farm	1,183	1,345	1,419
0.60 ha farm	947	1,076	1,135

- Notes: (1) Two crops
(2) Price subsidy \$165 per tonne (\$10 per picul)
Fertiliser \$235 per ha
(3) Rent is based on 1/3 of the crop paid to the landlord

Table 8.5 Balik Pulau Group Farm Model: Double Rice Cropping

<u>Revenues & Gross Margins (per ha)</u>	Year			
	1	2	3	4
Yield per year (tonnes) ⁽¹⁾	6.0	6.8	7.5	8.0
Farm gate price (M\$/tonne) ⁽²⁾	612	612	612	612
Gross revenue (M\$)	3,672	4,126	4,590	4,896
Production Costs (excluding fertiliser)	2,223	2,223	2,223	2,223
Gross Margin (excluding fertiliser)	1,449	1,903	2,367	2,673
Subsidies per ha				
Fertilisers ⁽³⁾	450	450	450	450
Price subsidy	992	1,125	1,240	1,323
	1,442	1,575	1,690	1,773
<u>Farm Income - 60 ha farm (80 members)</u>				
Farm gross margin	86,940	114,180	142,020	160,380
Rents payable to landowners	38,400	38,400	38,400	38,400
Field supervisors and book-keepers salaries	7,200	7,200	7,200	7,200
Incidental expenses	1,000	1,000	1,000	1,000
Margin available for distribution among members	40,340	67,580	95,420	113,780
Annual farm income for group members	504	845	1,193	1,422
Wage income available for group members	45,360	45,360	45,360	45,360
Potential wage income per family	567	567	567	567
Labour supply required per family (man-days)	81	81	81	81

- Notes: (1) Two crops
 (2) Includes subsidy M\$165.4 per tonne (\$10 per picul)
 (3) Fertilisers are provided free

Table 8.6 Balik Pulau Group Farm Model: Rice, Maize & Vegetable Farm

<u>Revenues & Gross Margins (per ha)</u>	Year			
	1	2	3	4
Yields:				
Rice (tonnes)	3.0	3.4	3.75	4.0
Maize Grain (tonnes)	2.7	3.0	3.3	3.5
Maize Cobs (1,000 cobs)	22,000	25,000	28,000	30,000
Vegetables (tonnes)	10.0	12.0	13.0	14.65
Gross Revenues (M\$ per ha)				
Rice (M\$612 per tonne) ⁽¹⁾	1,836	2,080	2,295	2,448
Maize: 0.75 ha grain, 0.25 ha cobs (maize grain M\$360 per tonne; cobs 8 ¢ each)	1,169	1,310	1,451	1,545
Vegetables (M\$494 per tonne)	4,940	5,928	6,422	7,237
Production Costs (M\$ per ha) ⁽²⁾				
Rice	1,111	1,111	1,111	1,111
Maize: 0.75 ha grain; 0.25 ha cobs	1,021	1,021	1,021	1,021
Vegetables	3,340	3,340	3,340	3,340
Gross Margins (M\$ per ha)				
Rice	725	696	1,184	1,337
Maize (grain and cobs)	148	289	430	524
Vegetables	1,600	2,588	3,082	3,897
Farm Income - 60 ha farm (80 members) (60 ha rice; 45 ha maize; 15 ha vegetable)				
Gross Margin: Rice	43,500	58,140	71,040	80,220
Maize	6,660	13,005	19,350	23,580
Vegetables	24,000	38,820	46,230	58,455
Total Gross Margin	74,160	109,965	136,620	162,255
Rents Payable to Landowners ⁽³⁾	38,400	38,400	38,400	38,400
Staff Salaries (supervisory + clerical)	7,200	7,200	7,200	7,200
Incidental	1,000	1,000	1,000	1,000
Margin available for distribution	27,560	63,365	90,020	115,655
Annual farm income for group members	345	792	1,125	1,446
Wage income available for group members	55,545	55,545	55,545	55,545
Potential wage income per family	694	694	694	694
Labour required per family (man-days)	99	99	99	99

- Notes:
- (1) Includes subsidy M\$165.4 per tonne (M\$10 per picul)
 - (2) Rice fertiliser costs are excluded and labour costs are included. It is assumed that members contributing to labour force will be paid wages
 - (3) Rent taken at \$320 per ha per crop

Table 8.9 Balik Pulau Machinery Service Centre: Estimated Requirement for Agricultural Machinery

Machine	Number
Tractors	12
Combine Harvesters	4
Rotavators	9
Disc-harrows	3
Maize planters	3
Fertilizer distributors	3
Trailers	3

9. PRELIMINARY DEVELOPMENT PLAN

9.1 General

- 9.1.1 Our proposals for implementation of the project have not been worked out in detail at this stage but outline proposals for discussion are given in this section; they form the basis for our economic and financial analysis.
- 9.1.2 A sample area for infrastructure improvement was selected early in the Study so as to follow up immediately with detailed topographic survey. The area covers 227 ha of padi in the Sg. Burung scheme. Its topographic survey is nearly complete. This means its rehabilitation contract could be awarded 3 - 4 months ahead of that for the rest of the area. However with a total project area of only 900 ha it does not appear justifiable to split the work into two contracts merely to complete one four months before the other. We therefore recommend all engineering work is done in one contract.
- 9.1.3 Development of the improved irrigation, drainage and farm roads system is the core of the work and it forms the project principal capital cost. However, equally important is the development of new farming units - group farms - which can make the most of the scarce labour available through the best possible use of mechanization, and thereby yield a reasonable income and standard of living to those working on them. Since we consider it essential to have feed-back into the designs and organizational matters from the farmers' practical experience, we are proposing a working prototype to be implemented before the work on the bulk of the irrigation areas is far advanced.
- 9.1.4 The measures to be considered in rehabilitating abandoned land, which we believe require the adoption of group farming methods, need to be tried out in an area where there are good chances of success, in order to act as an example. Since it is also necessary to implement the changes as soon as possible, the trial area should preferably not have too many engineering problems. The criteria are therefore to select land:-

- (a) which is at present abandoned.
- (b) where a sufficient number of farm workers can be attracted back into their traditional work quickly.
- (c) where the owners and tenants are agreeable to a group farming pilot scheme.
- (d) where the engineering infrastructure is serviceable, or can be made so with a minimum of construction work.

It is hoped that suitable areas can be identified shortly.

9.1.5

Our development programme is based on the earliest possible implementation of the agricultural pilot area of about 100 ha, after which the whole project area should receive upgrading in all senses, agricultural, management and engineering, as soon as practicable. The whole programme must be based on a sound appreciation of the people's needs and objectives and it must carry full support from the farmers and their representatives, without which the whole scheme of construction and agronomic improvements would be wasted.

9.2

Programme Detailing

9.2.1

Ground survey of the remainder of the Balik Pulau area should start as soon as possible, but preferably after receipt of aerial photo-mosaics at 1:6,336 scale or better. Assuming the survey can be completed by April 1982 the tentative programme would be as follows:-

- | | | |
|--|----------|------|
| - Start design | April | 1982 |
| - Start land acquisition | August | 1982 |
| - Complete land acquisition and award contract | July | 1983 |
| - Complete construction | December | 1984 |

This timing allows only 12 months for land acquisition, which may be on the short side for an area where speculation on urban development is affecting prices. It is emphasized that the trial area for group farming is expected to be in action, using mainly existing irrigation and drainage, well before 1984, and hopefully by the off-season 1983.

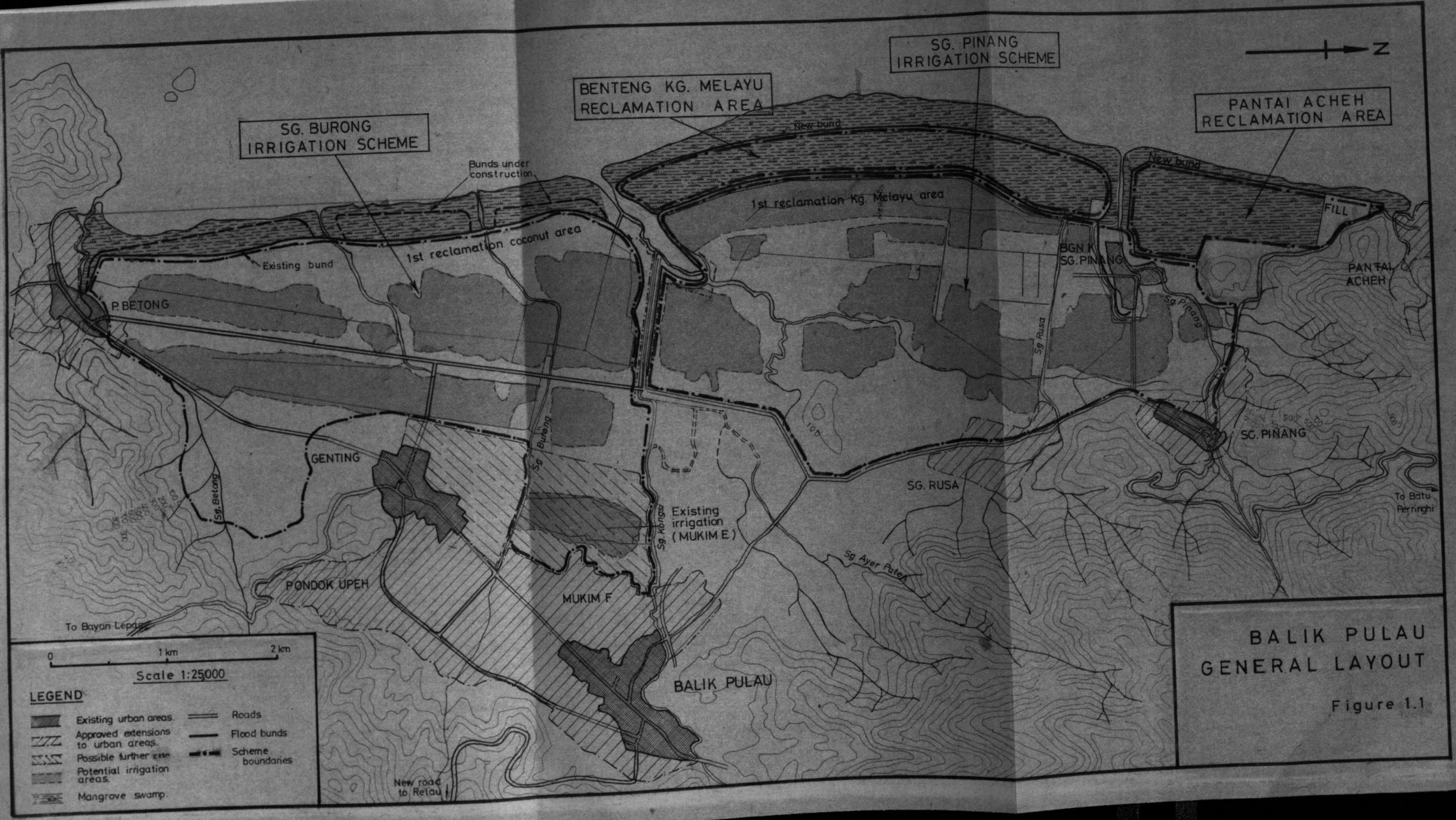
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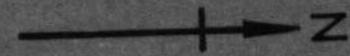


SG. BURONG IRRIGATION SCHEME

BENTENG KG. MELAYU RECLAMATION AREA

SG. PINANG IRRIGATION SCHEME

PANTAI ACHEH RECLAMATION AREA



Bunds under construction

1st reclamation Kg. Melayu area

Existing bund

1st reclamation coconut area

P. BETONG

BGN K SG. PINANG

FILL

PANTAI ACHEH

GENTING

Sg. Burong

Existing irrigation (MUKIM E)

SG. RUSA

SG. PINANG

To Batu Ferringhi

PONDOK UPEH

MUKIM F

BALIK PULAU

To Bayan Lepas

New road to Relau

BALIK PULAU GENERAL LAYOUT
Figure 1.1

0 1 km 2 km

Scale 1:25000

- LEGEND**
- Existing urban areas.
 - Approved extensions to urban areas.
 - Possible further extension.
 - Potential irrigation areas.
 - Mangrove swamp.
 - Roads
 - Flood bunds
 - Scheme boundaries

APPENDIX A
SOIL SAMPLES FROM SALEM DAM

SOIL NO.	DEPTH (ft)	WATER (%)
Series No. 1		
0 - 4	5.0	20
4 - 12	4.7	110
12 - 18	4.5	110
18 - 24	4.2	200
Series No. 2		
0 - 4	5.4	140
4 - 12	6.3	130
12 - 18	6.4	220
18 - 24	6.7	210
Series No. 3		
0 - 4	5.4	50
4 - 12	4.6	70
12 - 18	4.7	240
18 - 24	5.9	240
Series No. 4		
0 - 4	6.4	110
4 - 12	6.1	130
12 - 18	6.4	200
18 - 24	6.1	200
Series No. 5		
0 - 4	5.1	90
4 - 12	5.4	40
12 - 18	5.3	50
18 - 24	5.4	40
Series No. 6		
0 - 4	6.2	30
4 - 12	6.1	100
12 - 18	6.3	100
18 - 24	7.1	110

APPENDICES

Some data were not fully reported previously. These values, indicated by the high values of water content, indicate the absence of soil samples in the bulk of the soil walls of Salem Dam.

APPENDIX A
* SOIL SAMPLES FROM BALIK PULAU

SAMPLE NO.	pH (1:1)	$\mu\text{mho/cm.}$
Point No. 1		
0 - 6	5.0	50
6 - 12	4.7	110
12 - 18	4.5	150
18 - 24	3.9	300
Point No. 2		
0 - 6	5.8	140
6 - 12	6.3	190
12 - 18	6.4	200
18 - 24	6.2	310
Point No. 3		
0 - 6	6.8	62
6 - 12	6.8	95
12 - 18	6.7	240
18 - 24	5.9	240
Point No. 4		
0 - 6	6.6	130
6 - 12	6.5	180
12 - 18	6.8	200
18 - 24	6.7	300
Point No. 5		
0 - 6	5.1	90
6 - 12	5.4	40
12 - 18	5.0	50
18 - 24	5.4	60
Point No. 6		
0 - 6	6.2	140
6 - 12	6.7	190
12 - 18	6.8	200
18 - 24	7.1	310

* Data from Mardi Files, unreported previously. These values, (somewhat on the high side) do however clearly indicate the absence of acid problems in the bulk of the padi soils of Balik Pulau.

Point No. 7

0 - 6	4.8	62
6 - 12	4.7	95
12 - 18	4.3	240
18 - 24	4.2	240

Point No. 8

0 - 6	5.6	80
6 - 12	6.3	120
12 - 18	6.5	125
18 - 24	6.7	130

Point No. 9

0 - 6	6.3	210
6 - 12	6.7	260
12 - 18	6.7	320
18 - 24	6.9	350

Point No. 10

0 - 6	6.0	60
6 - 12	5.1	55
12 - 18	4.8	50
18 - 24	4.6	40

Point No. 11

0 - 6	6.1	150
6 - 12	6.6	140
12 - 18	6.7	150
18 - 24	6.6	155

Point No. 12

0 - 6	5.1	60
6 - 12	4.8	45
12 - 18	4.5	50
18 - 24	4.2	45

Point No. 13

0 - 6	6.3	180
6 - 12	6.7	190
12 - 18	7.1	195
18 - 24	7.1	240

Point No. 14

0 - 6	4.8	60
6 - 12	4.6	45
12 - 18	4.7	65
18 - 24	4.9	20

Point No. 15

0 - 6	5.7	110
6 - 12	6.4	280
12 - 18	6.6	290
18 - 24	6.7	350

Point No. 16

0 - 6	5.5	70
6 - 12	5.6	23
12 - 18	5.8	38
18 - 24	5.6	32

Point No. 17

0 - 6	6.6	450
6 - 12	6.8	670
12 - 18	6.9	725
18 - 24	6.9	650

Point No. 18

0 - 6	6.0	100
6 - 12	6.6	170
12 - 18	7.2	160
18 - 24	7.1	150

Point No. 19

0 - 6	6.3	2,000
6 - 12	6.6	2,350
12 - 18	6.5	3,100
18 - 24	7.2	2,750

Point No. 20

0 - 6	6.7	1,600
6 - 12	6.8	1,700
12 - 18	6.9	2,000
18 - 24	6.6	2,200

Point No. 21

0 - 6	6.2	1,900
6 - 12	6.2	1,700
12 - 18	6.4	2,300
18 - 24	6.1	2,500

Point No. 22

0 - 6	5.8	2,900
6 - 12	6.1	3,200
12 - 18	5.9	4,000
18 - 24	6.6	3,700

Point No. 23

0 - 6	5.2	130
6 - 12	5.0	160
12 - 18	5.1	170
18 - 24	5.5	170

Point No. 24

0 - 6	5.2	260
6 - 12	5.7	340
12 - 18	6.2	390
18 - 24	6.5	530

Point No. 25

0 - 6	5.5	60
6 - 12	5.6	590
12 - 18	5.3	270
18 - 24	4.6	720

Point No. 26

0 - 6	4.7	130
6 - 12	4.9	160
12 - 18	5.0	180
18 - 24	4.6	230

Point No. 27

0 - 6	5.2	140
6 - 12	5.1	140
12 - 18	5.2	230
18 - 24	5.3	360

Point No. 28

0 - 6	5.1	180
6 - 12	5.4	200
12 - 18	5.9	250
18 - 24	5.9	260

Point No. 29

0 - 6	5.1	290
6 - 12	5.5	520
12 - 18	6.1	700
18 - 24	6.3	800

Point No. 30

0 - 6	5.4	340
6 - 12	6.1	680
12 - 18	6.2	660
18 - 24	6.2	800

Point No. 31

0 - 6	5.4	320
6 - 12	6.4	450
12 - 18	6.6	530
18 - 24	6.7	680

Point No. 32

0 - 6	6.4	500
6 - 12	6.7	1,000
12 - 18	6.8	1,100
18 - 24	7.0	1,200

Point No. 33

0 - 6	6.9	730
6 - 12	6.9	750
12 - 18	7.0	780
18 - 24	7.3	940

Point No. 34

0 - 6	6.6	170
6 - 12	7.5	720
12 - 18	7.2	400
18 - 24	6.9	330

Point No. 35

0 - 6	6.8	255
6 - 12	7.0	350
12 - 18	7.1	600
18 - 24	6.9	730

Point No. 36

0 - 6	6.4	160
6 - 12	6.7	350
12 - 18	7.1	390
18 - 24	7.2	450

Point No. 37

0 - 6	7.2	200
6 - 12	7.3	300
12 - 18	7.9	520
18 - 24	8.1	530

Point No. 38

0 - 6	7.1	140
6 - 12	7.1	160
12 - 18	7.2	170
18 - 24	7.6	170

Point No. 39

0 - 6	6.2	100
6 - 12	6.6	220
12 - 18	7.0	270
18 - 24	7.1	280

Point No. 40

0 - 6	6.6	90
6 - 12	6.6	150
12 - 18	6.7	160
18 - 24	6.7	190

Point No. 41

0 - 6	7.3	180
6 - 12	7.9	230
12 - 18	7.6	475
18 - 24	7.8	510

Point No. 42

0 - 6	5.6	69
6 - 12	6.5	150
12 - 18	6.8	150
18 - 24	7.1	130

Point No. 43

0 - 6	6.6	355
6 - 12	7.3	590
12 - 18	6.9	575
18 - 24	7.1	560

Point No. 44

0 - 6	6.7	180
6 - 12	7.2	340
12 - 18	6.9	330
18 - 24	7.2	400

Point No. 45

0 - 6	6.2	210
6 - 12	6.9	370
12 - 18	7.3	410
18 - 24	7.4	420

Point No. 46

0 - 6	6.9	395
6 - 12	7.1	440
12 - 18	7.2	420
18 - 24	7.2	420

Point No. 47

0 - 6	5.9	170
6 - 12	5.9	360
12 - 18	5.9	360
18 - 24	5.9	450

Point No. 48

0 - 6	6.0	270
6 - 12	6.9	395
12 - 18	7.3	540
18 - 24	7.4	900

Soil Series

Kuala Kedah

Location

Point No. 49

Top 6 In. 0 - 6	6.9	150
Leuciform 6 - 12	7.1	180
Vegetation 12 - 18	7.4	425
Forest Gate 18 - 24	7.4	400

Drainage

Very poorly drained

Point No. 50

Top 6 In. 0 - 6	6.9	240
6 - 12	7.3	380
12 - 18	7.5	900
18 - 24	7.7	600

Point No. 51

0 - 6	7.0	430
6 - 12	7.4	670
12 - 18	7.0	750
18 - 24	6.8	1,000

Point No. 52

0 - 6	7.2	450
6 - 12	7.3	650
12 - 18	6.9	680
18 - 24	7.6	690

The soil cracks only in the Ap in extremely dry periods, 2 cm wide.

Soil Series - Kuala Kedah
 Location - -
 Map & Grid Reference - -
 Landform - Flat depression
 Vegetation - Paddy
 Parent Material - Marine alluvium
 Drainage - Very poorly drained

Profile Description

Apl 0 - 17 cm

Dark grey (10YR 4/1) clay, dark grey (10YR 3/1) when moist; abundant coarse prominent red (2.5YR 4/6) iron deposits on pad faces and root channels; massive; very hard (dry); some fine sand; many fine roots and root mat; clear and wavy boundary to.

C1G 17 - 40 cm

Greenish grey (5G 5/1) wet clay; many fine distinct strong brown (7.5YR 5/6) iron deposits on former root channels in upper part of horizon; massive; sticky and slightly plastic (wet); very few fine roots; clear boundary to.

C2G 40 - 74 cm

Greenish grey (5B 6/1) wet clay; many medium distinct olive (5Y 5/4) deposits; weakly developed coarse prismatic and angular blocky; sticky and slightly plastic (wet) diffuse boundary to.

C3G 74 - 96 cm

Greenish grey (5G 6/1) wet clay; many medium distinct olive (5Y 5/4) deposits along former root traces; massive; very sticky and plastic (wet) diffuse boundary to.

C4G 96 cm +

Greenish grey (5G 5/1) wet clay; many gritty greyish green (5G 5/2) deposits; massive; very sticky and plastic (wet).

The soil cracks only in the Ap in extremely dry periods, 2 cm wide.

Soil Series - Tebangau
Location - -
Map & Grid Reference - -
Landform - Flat Coastal plain
Vegetation - Paddy
Parent Material - Marine alluvium
Drainage - Poorly drained

Profile Description

Ap1 0 - 10 cm

Dark grey (10YR 4/1) clay, dark grey (10YR 3/1) when moist; many fine distinct reddish yellow (7.5YR 6/8) iron deposits on root traces and crack faces; massive; very hard (dry); few pores; many fine roots; gradual boundary to.

Ap2 10 - 23 cm

Black (10YR 2/1) clay, black (10YR 2/0) when moist; few fine distinct reddish yellow (7.5YR 6/8) iron deposits on root channels and crack faces; massive; extremely hard (dry); few fine roots; abrupt boundary to.

C1G 23 - 50 cm

Greenish grey (5GY 6/1) wet clay; many medium to coarse distinct strong brown (7.5YR 5/8) mottles; massive; slightly sticky and slightly plastic (wet); diffuse boundary to.

C2G 50 - 97 cm

Grey to light grey (5Y 6/1) wet clay; few medium faint pale olive (5Y 6/4) mottles; massive; sticky and slightly plastic (wet); many soft, very dark grey (5YR 3/1) manganese concretions; few old root traces; clear boundary to.

C3G 97 cm +

Greenish grey (5BG 5/1) wet clay; many gritty greyish green (5G 5/2) deposits; massive; sticky and plastic (wet).

The soil cracks in the Ap1 and Ap2 in dry periods (1-2cm wide).

The Mangrove Ecosystem

KRANJI SERIES

This is located as a narrow fringe along the west coasts on the marine clays under swamp conditions. The profile consists of, a thin topsoil of dark greyish brown organic clay, with friable weak structures overlying the permanently waterlogged greenish grey sticky and structureless clay (sometimes with sulphurous smell at depths and plant remains.) These are very saline soils, which with bunding and drainage have supported some coconuts and padi.

Based on the very significant contribution of the fisheries industry to the socio-economic development of the coastal communities, and on the demonstration in many countries of the vital role of mangrove forests to the sustained production of fishery resources, there is an urgent need for collaboration between the agencies responsible for the planning and implementation of all activities involving the ecosystem so that these activities will collectively produce the optimum benefits to the country.

Barbridge (1981) points out that the direct distribution of mangrove is a serious problem in South East Asia, and the main cause of these problems is the failure to appreciate the significance to society of the complex web of resource opportunities offered by mangrove systems. The creation of agencies aligned to sectoral interests such as forestry, fisheries, agriculture, etc. reinforces a compartmentalized approach to the management of resources which runs counter to ecological and economic concepts of linkage and interdependence within resource systems. Relationships within and between ecological systems are often crucial to the maintenance of economic activity, for example, the dependence of extensive fisheries upon the function of mangrove systems.

Soils of mangrove forest areas occurring along the coast in the active tidal areas are derived from marine and continental brackish water sediments and are mainly very saline soils with weak profile development. Most mangrove soils are more or less saline. The degree of salinity, however, varies enormously and is influenced by such factors as distance from the sea and the supply of fresh water by rivers.

APPENDIX B

The Mangrove Ecosystem

Mangrove areas have become one of the prime targets for development throughout South East Asia and the preservation of mangrove areas under natural conditions is becoming very difficult. There is an upward trend in exploitation of mangrove areas for other land uses without consideration of the usefulness of mangroves for coastal fisheries (Heald and Odum, 1968).

Apart from producing timber for fuel wood, poles, etc mangrove forests also play an important role in the sustained production of many types of fish, prawns, cockles, crabs etc.

Based on the very significant contribution of the fisheries industry to the socio-economic development of the coastal communities, and on the demonstration in rainy countries of the vital role of mangrove forests to the sustained production of fisheries resources, there is an urgent need for collaboration between the agencies responsible for the planning and implementation of all activities involving the ecosystem so that these activities will collectively produce the optimum benefits to the country.

Burbridge (1980) points out that the direct distribution of mangrove is a serious problem in South East Asia, and the main cause of these problems is the failure to appreciate the significance to society of the complex web of resource opportunities offered by mangrove systems. The creation of agencies aligned to sectoral interests such as forestry, fisheries, agriculture, etc: reinforces a compartmentalized approach to the management of resources which runs counter to ecological and economic concepts of linkages and interdependence within resource systems. Relationships within and between ecological systems are often crucial to the maintenance of economic activity, as, for example, the dependence of extensive fisheries upon the function of mangrove systems.

Soils of mangrove forest areas occurring along the coast in the active tidal area are derived from marine and somewhat brackish water sediments and are mainly young saline clayey soils with weak profile development. Most mangrove soils are more or less saline. The degree of salinity, however, varies enormously and is influenced by such factors as distance from the sea and the supply of fresh water by rivers.

Some mangrove soils developed from marine and/or brackish sediments contain sulfides such as pyrites (FeS_2). If the soil is drained, the sulphates are oxidised and sulphuric acid is formed. Some sampling was carried out in the Pantai Acheh area and incubation pH values were determined. About a dozen pH recordings were made. There were no indications of the presence of pyrite. However it should be pointed out that the sampling intensity was extremely low because of the difficulties in field sampling. In view of the need for systematic detailed sampling, the statement regarding the absence of the potential acid sulphate soils should be treated with caution. In any case, the author strongly believes that the mangrove areas in the Balik Pulau area should be preserved at all costs and that the conversion of these areas to padi is to be strongly resisted.

There is considerable evidence that mangrove forests are very important habitats of several commercially important species of fish, crustaceans and molluscs. They also serve as nursery areas for many of the above species. In recent year increasing areas of mangrove forests have been disturbed and areas have been totally cleared and reclaimed for various purposes such as housing, agriculture, aquaculture, industries etc. The decline of coastal fisheries in recent years would suggest that both overfishing and increased disturbance of the mangrove forest has contributed significantly to the decline of the coastal fisheries which are dependent on mangrove forests.

K.T. Joseph

References:

- 1) Heald, E.J. and Odum WE (1968)
The contribution of mangrove swamps to Florida fisheries. In Proceeding of the Gulf and Carribean Fisheries Institute San Juan, Puerto Rico.

- 2) **Burbridge, P.R (1980)**
The Management and Planning of Mangrove Resources in Asia. In Asian Symposium on Mangrove Environment - Kuala Lumpur
- 3) **Chan Sang and Smith I.R. (1980)**
Compatibility of Alternative Uses of Mangroves and Estuarine Resources.
In Asian Symposium on Mangrove Environment Kuala Lumpur

On arriving at these rates it is assumed that the work would be carried out under a single contract by national or international (Class A) contractors - not on a piecemeal basis by small local firms.

Some considered applicable allowance has been made for difficult site access and increased transport costs for imported items. For example in construction of quaternary canals where access will have to be through the fields and possibly limited to periods between crops. Similarly allowance is made in such cases for manual excavation and construction of banks.

Canal and Drain Unit Costs

Although the existing irrigation systems normally have a main and secondary canal system, in fact, as discussed in Section 6.3.4, most of these canals are little bigger than tertiary canals, and we propose to provide a concrete lining in most cases. Costs have therefore been assessed for three categories of canal without making any distinction between main, secondary and tertiary canals:-

- (I) Lining of existing canals
- (II) Construction of new lined canals
- (III) Construction of new unlined (quaternary) canals

PRELIMINARY ENGINEERING COSTSC.1 Unit Rates

Unit rates, to be used in the costing of the proposed works, are listed in Table C.1 for the major items of construction. These rates are based on their calculated for Seberang Perai (ref. 29) which were assessed as representative of rates for similar types of work in north-west Malaysia as of mid-1981. Some minor variations between these rates and those for Seberang Perai have been allowed, to take into account differences in transport costs, particularly that of imported fill.

C.1.2 In arriving at these rates it is assumed that the works would be carried out under a single contract by national or international (Class A) contractors - not on a piecemeal basis by small local firms.

C.1.3 Where considered applicable allowance has been made for difficult site access and increased transport costs for imported fill - for example in construction of quaternary canals where access would have to be through the fields and possibly limited to periods between crops. Similarly allowance is made in such cases for manual excavation and construction of bunds.

C.2 Canal and Drain Unit Costs

C.2.1 Although the existing irrigation systems nominally have a main and secondary canal system, in fact, as discussed in Section 6.3.4, most of these canals are little bigger than tertiary canals, and we propose to provide a concrete lining in most cases. Costs have therefore been assessed for three categories of canal without making any distribution between main, secondary and tertiary canals:-

- (i) Lining of existing canals
- (ii) Construction of new lined canals
- (iii) Construction of new unlined (quaternary) canals

- C.2.2 Because of the oversizing of many of the existing canals, lining will involve filling the existing section and excavation for the new canal within the fill material, (see figure 6.3). For preliminary cost estimates an average size for all the existing canals has been assumed. For detailed costing it may be necessary to consider the relative sizes of existing and proposed canals and to estimate costs accordingly.
- C.2.3 The smaller canal sections are lined with U-shaped precast concrete 'block' sections. For larger canals a trapezoidal canal section lined with precast concrete slabs, 65 mm ($2\frac{1}{2}$ ") thick, is proposed. Unit costs for the canals, both reconstruction of existing canals and construction of new canals are given in Table C.2. For preliminary cost estimates of tertiary development an average cost of tertiary canal in both cases has been assessed on the basis of the average size of canal in a typical tertiary block. For the reconstruction of an existing canal the average cost is estimate at \$180/m and for construction of new tertiary canals the average cost is estimated at \$170/m.
- C.2.4 Quaternary canals are unlined and, for costing purposes, a standard size is assumed throughout. (Figure 6.3) The cost is estimated at \$6.5/m.
- C.2.5 Tertiary drains, if constructed to the optimum hydraulic section, will vary in size depending on the accumulated area they serve. A breakdown in cost for three typical sections is given in Table C.3. For preliminary costing we have assumed the provision of a maintenance track beside the drain, although our final recommendation may be to dispense with this. The quantities assume a 25% shrinkage of the excavated material and imported fill as necessary to top up the bund. Because the quality of imported fill needed decreases as the size of the drain increases a minimum price of about \$15.5/m is found with the largest size likely to be required and therefore this section and price have been used throughout for preliminary costing.

C.2.6 Quaternary drains, like quaternary canals, have taken as a single size for costing. The excavated volume is assumed to balance the fill requirements. The unit cost is estimated at \$4.0/m.

C.3 Structure Unit Costs

C.3.1 As with the main and secondary canals, costs of structures particular to a location or scheme will be assessed individually however 4 types of structure are required for the infrastructure development in all areas, namely:-

- Offtakes (generally constant-head orifice)
- Quaternary offtake boxes
- Canal access culverts
- Tertiary drain end-control structures

C.3.2 For preliminary costing an average cost for each of these types of structure has been assessed as follows:-

CHO offtakes	\$ 8,250
Quaternary offtake boxes	\$ 3,800
Canal access culverts	\$ 3,200
Tertiary drain end-control structures	\$10,500

C.4 Total Costs

C.4.1 To the costs as estimated from the measured items are added the following percentage:-

- (i) Contractor's mobilisation preliminary and general items - 10%.
- (ii) Physical contingencies - 15% of the total including (i).
- (iii) Engineering design and supervision of construction - 8% of the accumulated total.

C.4.2 Land acquisition costs are treated separately. They are not included in the economic analysis but are required for financial planning, thus the totals calculated as indicated above do not include these costs. Moreover the percentage additions in C.4.1 are not applied to them.

C.5 Tertiary Development Costs

C.5.1 Using the unit costs for canals, drains and structures total costs have been developed for the tertiary infrastructure in the whole of Sg. Burong scheme as shown on drawing no BP.1. Details of these costs are given in Table C.4.

C.6 Scheme Costs

C.6.1 As a preliminary estimate of total scheme costs, estimates have been made of the cost of new construction and improvements to the whole of the Sg. Burong scheme area, including the new intake on Sg. Kongsu.

C.6.2 Total scheme costs for the 390 ha of irrigated area in Sg. Burong are given in Table C.5. Total cost of the scheme is estimated at about $\$5.2 \times 10^6$ excluding land acquisition. Using the same total cost per unit area, the cost of the proposed works in the Sg. Pinang area is estimated at $\$6.4 \times 10^6$

C.6.3 An estimate of the area of land to be acquired for construction of the works in the Sg. Burong scheme is given in Table C.5. It is estimated at 6.5% of the gross scheme area. This is higher than might be expected because few of the existing canals lie on reservations purchased by JPT. We would recommend that all canal and drain reservations are purchased and a preliminary estimate of these acquisition costs are indicated. These are estimated based on the information supplied by the Federal Valuation office.

Structural concrete (including shuttering and reinforcement)	m ³	135
Concrete for canal linings (including shuttering)	m ³	250
M.S. reinforcement	kg	1,700
Driven piles	no.	5

Table G.1 Unit Rates

Item	Unit	Rate
Cement (on site)	tonne	260
Fine aggregate/sand (on site)	m ³	30
Coarse aggregate (on site)	m ³	45
Canal/drain bulk excavation (machine)	m ³	2.5
Canal/drain excavation (manual)	m ³	6.5
Trimming excavation	m ²	1.0
Excavation for structures (including trimming and backfill)	m ³	25
Imported fill	m ³	15
Addition cost on imported fill for poor access	m ³	1.5
Laterite surface for access roads	m ³	16.5
Mass concrete (including shuttering)	m ³	190
Structural concrete	m ³	160
Structural concrete (including shuttering)	m ³	370
Structural concrete (including shuttering and reinforcement)	m ³	485
Concrete for canal linings (including shuttering)	m ³	280
M.S. reinforcement	kg	1.75
Bakau piles	No.	9

Table C.2 Unit Costs of Lined Canals

Canal section	'Road' bund width		
	1.0 m	2.5 m	5.5 m
<u>New canals</u>		(\$/m)	
'15 inch' block section	75	90	125
'18 inch' block section	85	105	140
'24 inch' block section	100	120	155
Trapezoidal section (0.30/0.75)	130	155	190
<u>Reconstruction of existing canals</u>			
'15 inch' block section	-	55	100
'18 inch' block section	-	70	115
'24 inch' block section	-	110	155
Trapezoidal sections:- 0.30/0.75	-	145	190
0.45/0.86	-	255	300
0.61/0.86	-	270	375
0.61/0.97	-	295	340

1. Indicates size of canal section in m
Bed width/height of concrete lining.

Table 0.3 Tertiary Drain Unit Costs

Item	Unit	Rate (\$)	D=0.7m		B=1.0m		D=0.8m		B=1.5m		D=0.9m		B=2.0m	
			Qty (m ³)	Cost/m (\$)										
Excavation	m ³	2.5	1.44	3.6	2.16	5.4	3.02	7.55						
Imported fill	m ³	15	0.75	11.25	0.21	3.15	-	-						
Laterite road surface	m ³	16.5	0.41	6.77	0.41	6.77	0.41	6.77						
Totals				21.62		15.32							15.34	

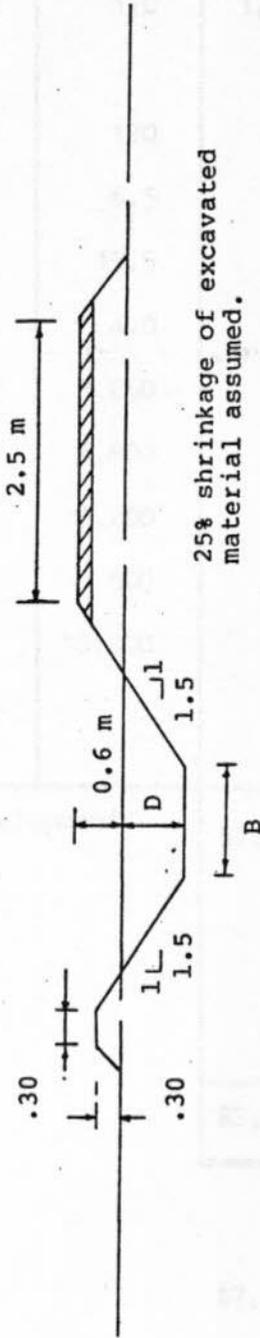


Table C.5 Sg. Burong Scheme Costs

Item	Cost (\$ x 10 ³)
Tertiary infrastructure	2,118
Main and secondary canals:	715
Main and secondary drains:	207
New Kongsì headworks (including tidal gate/control structure and pumped intake)	440
Canal and drain structures	135
Access roads	180
Total headworks, main and secondary systems	1,677
Total measured items	\$3,795 x 10 ³
Contractors preliminaries and general items	380
Physical contingencies	626
Engineering	384
Total (excluding land acquisition)	\$5,185 x 10 ³
Total cost per unit area =	\$13,300/ha
Estimated area of land acquisition =	26.7 ha
For preliminary estimate assume average cost at \$6,000/ha	
Total cost of land acquisition	\$160,000

SOCIO ECONOMIC SURVEY TABLES

Tables 1 - 40 refer to main respondent (Head of household)

- 1 - SBE = Sungai Burung East
 2 - SBW = Sungai Burung West
 3 - SP = Sungai Pinang

Table 1: Age Distribution of Household Heads by Regions in Balik Pulau.

Age Group	SBE 1	SBW 2	SP 3	Total	
				No.	%
Less 30	0	0	1	1	0.4
31 - 40	16	7	8	31	11.5
41 - 50	57	13	19	89	33.0
51 - 60	54	16	21	91	33.7
61 +	31	12	15	58	21.5
Total	158	48	64	270	100

Minimum Age 23 yrs old
 Max 81
 Average 52.8

Age of Respondent

Minimum Age of respondent is 23 yrs old, and the max. is 81 yrs. old. The average is 52.8 yrs old. Majority of the respondents: 41 yrs. above (88.2%)

Age structure of the population:

	Age	No	%
1 -	3.9 yrs	68	(4.13%) out of 1648
4 -	5.9	38	(2.30)
6 -	12.9	203	(12.32)
13 -	15.9	141	(8.56)
16 -	19.9	209	(12.68)
20 -	25.9	256	(15.53)
26 -	30.9	134	(8.13)
31 -	40.9	188	(11.41)
41 -	50.9	199	(12.08)
51 yrs. above		212	(12.86)

The labour force at the age of 26-40.9 = 322 (19.5%)

Table 2: Education of Respondent

level of education	SBE	SBW	SP.	No.	Total %
No School	11 (7.0)	3 (6.3)	2 (3.1)	16	5.9
Primary	147 (93.0)	45 (93.8)	61 (95.3)	253	93.7
Secondary	0	0	1 (0.6)	1	0.4
Total	158	48	64	270	100

Table 3: Size of Household

Member of household	SBE	SBW	SP.	No	Total %
1 - 2	12	3	3	18	6.6
3 - 4	43	12	17	72	26.6
5 - 6	53	16	22	91	33.7
7 - 8	34	14	11	59	21.9
9 - 10	15	2	9	26	9.6
11 - 12	1	1	2	4	1.4
Total	158	48	64	270	100

Min. 1 member
 Max. 12
 average 5/6 members of household.

Not working - formerly farmers, now depending on working children

Table 4: Highest Education Received by any Member of the Family

level of education received	1	2	3	Total	
				No.	%
No information	3	2	0	5	1.9
Std. 6	46	15	9	70	25.9
Form 3	48	13	10	71	26.3
Form 5	49	14	36	99	36.7
Form 6	4	0	6	10	3.7
College	4	3	1	8	3.0
University	4	1	2	7	2.6
Total	158	48	64	270	100

Table 5: Main Occupation

Occupation	1	2	3	Total	
				No	%
Not Working	3	1	1	47	1.9
Farmer	118	32	47	197	73.0
Fishermen	5	3	5	13	4.8
Business	1	1	1	3	1.1
White Collar	19	4	5	28	10.4
Others	11	7	5	23	8.5
Total	158	48	64	270	100

Not working - formerly farmers, now depending on working children

Table 6: Part - time work

Occupation	1	2	3	Total	
				No.	%
No part time work	82	16	32	130	48.1
Farmer	28	9	8	45	16.7
Fishing	10	11	8	29	10.7
Business	3	0	1	4	1.5
Others/	35	12	15	62	23.0
Total	158	48	64	270	100

Others: includes: Tukang/artisen
 buat atap
 menebas/hired labour
 jaga
 naik kelapa, cari ketam, menternak ayam/lembu.

Table 7: Tenure Status

Tenure Status	1	2	3	Total	
				No.	%
landowner/landlord	1	2	3	6	2.2
owner operator & renting owt	5	1	1	7	2.6
Owner operator	43	7	18	68	25.2
Owner operator + tenant	7	3	4	14	5.2
Tenant	97	34	37	168	62.2
Not any now	5	1	1	7	2.6
Total	158	48	64	270	100

Table 8: Cropping intensity

Cropping pattern	1	2	3	Total	
				No	%
No crop now	17	3 (6.3)	7 (10.9)	27	10.0
Single	77 (48.7)	31 (64.6)	56 (87.5)	164	60.7
double	64 (40.5)	14	1	79	29.3
Total	158	48	64	270	100

Not working now - this people formerly farmers.

Table 9: Willingness to double crop

Willingness to double crop	1	2	3	Total	
				No	%
No	21	9	22	52	19.3
Yes	137	39	42	216	80.7
Total	158	48	64	270	100

Table 10: Types of Cropping prefer most

	1	2	3	Total	
				No.	%
Not Willing	4	4	6	14	5.2
Single Cropping	43	5	15	63	23.3
Double Cropping	111	39	43	193	71.5
Total	158	48	64	270	100

Table 11: Length of time being tenants

tenancy in yrs	1	2	3	Total	
				No	%
not involved	54	11	23	88	32.6
1 - 5	19	7	7	33	12.1
6 - 10	11	6	11	28	10.4
11 - 15	16	7	2	25	9.2
16 - 20	10	3	4	17	6.4
21 - 25	8	3	3	14	5.2
26 - 30	9	5	6	20	7.4
31 - 35	7	0	3	10	3.7
36 - 40	6	1	2	9	3.4
41 - 45	1	0	2	3	1.1
46 - 60	3	0	0	3	1.7
no information	14	5	1	20	7.4
Total	158	48	64	270	± 100

Table 14: The system tenant pay the rent

Table 12: From whom do you rent land

	1	2	3	Total	
				No	%
Relative in Kampung	22	14	19	55	20.4
Relative outside Kampung	5	3	5	13	4.8
Non relative in Kampung	32	6	10	48	17.8
People outside Kampung	44	15	7	66	24.4
Not tenant	55	10	23	88	32.6
Total	158	48	64	270	100

Table 13: tenancy system

	1	2	3	Total	
				No.	%
Fixed rent (fixed)	5	2	1	8	3.0
half of crop	3	0	4	7	2.6
one third of crop	87	26	34	147	54.4
others	8	10	2	20	7.4
Not involved	55	10	23	88	32.6
Total	158	48	64	270	100

Table 14: The system tenant pay the rent

System	1	2	3	Total	
				No.	%
Cash	14	10	2	26	9.6
Kind	76	14	37	127	47.0
both cash & kind	13	14	2	29	10.7
not involved	55	10	23	88	32.6
Total	158	48	64	270	100

Table 15: Main problem in padi cultivation

Prefer most.

Problems	1	2	3	Total	
				No	%
lack of labour	42	24	7	73	27.1
Pests	94	13	43	150	55.6
soil not fertile	0	0	1	1	0.4
water	14	4	9	27	10.0
Tractor	1	0	0	1	0.4
others	7	7	4	18	6.7
Total	158	48	64	270	100

Table 16: Is it a good idea to rehabilitation land here?

	1	2	3	Total	
				No.	%
No	2	3	1	6	2.2
Yes	156	45	63	264	97.8
Total	158	48	64	270	100

Table 18: Type of off-season crop prefer

Table 17: If two padi crops can be grown, do you can depend on it for livelihood?

Type of crops	1	2	3	Total	
				No.	%
Maize	27	21	14	62	22.9
Vegetables	79	4	0	83	30.7
Other	0	1	0	1	0.4
Total	106	26	14	146	53.9

Note: Total 214 (78.3)

Two-wheel 58 (20.7%)

Table 18: Willingness to grow off-season crops.

If land here is rehabilitated, to enable single crop padi, would you be willing to grow any off-season crop after padi?

	1	2	3	Total	
				No.	%
No	42	22	21	85	31.5
Yes	116	26	43	185	68.5
Total	158	48	64	270	100.0

Table 19: Types of off-season crop prefer

Type of crops	1	2	3	Total	
				No.	%
Maize	37	21	34	92	34.1
Vegetables	79	4	9	92	34.1
Other	0	1	0	1	0.4
No crop	42	22	21	85	31.5
Total	158	48	64	270	100.0

Table 20: Do you use tractor?

	1	2	3	Total	
				No.	%
No	105	45	64	214	79.3
Yes	53	3	0	56	20.7
Total	158	48	64	270	100.0

Note: None 214 (79.3)
Two-wheel 56 (20.7%)

Table 21: Who owns the tractors?

	1	2	3	Total	
				No.	%
Not used	105	45	64	214	79.3
Self-owned	1	0	0	1	0.4
Other farmers/ Co-operative/LPP	52	3	0	55	20.4
Total	158	48	64	270	100.0

Table 22: Willingness to increase farm size

	1	2	3	Total	
				No.	%
No	96	21	37	154	57.0
Yes	62	27	27	116	43.0
Total	158	48	64	270	100.0

Table 23: Opinion about Government land rehabilitation scheme

Opinion	1	2	3	Total	
				No.	%
Very good	104	27	61	192	71.1
Good	53	19	1	73	27.0
Do not know	0	1	0	1	0.4
No answer	1	1	2	4	1.5
Total	158	48	64	270	100.0

(No one said it was a 'bad' idea).

Table 24: Willingness to be farmer even though better offer in other sector

	1	2	3	Total	
				No.	%
No	23 (14.6)	13 (27.1)	8 (12.5)	44	16.3
Yes	135 (85.4)	35 (72.9)	56 (87.5)	226	83.7
Total	158	48	270	270	100.0

Table 25: Willingness to co-operate with the Government to improve padi land

	1	2	3	Total	
				No.	%
No	3 (1.9)	6 (12.5)	6 (9.4)	15	5.6
Yes	155 (98.1)	42 (87.5)	58 (90.6)	255	94.4
Total	158	48	64	270	100.0

Table 26: Reaction to conversion of padi land to other crops
If there is an effort to convert the padi land in Balik
Pulau into a different crop, what would be your
reaction to that

	1	2	3	Total	
				No.	%
Strongly agree	18	20	15	53	19.6
Agree	35	10	6	51	18.9
Neutral	21	3	1	25	9.3
Disagree	40	5	5	50	18.5
Strongly disagree	34	5	35	74	27.4
Do not know	10	5	2	17	6.3
Total	158	48	64	270	100.0

Table 27: Participation in local co-operative movement

Participation	1	2	3	Total	
				No.	%
No	89 (56.3)	15 (31.3)	18 (28.1)	122	(45.4)
As ordinary member	66 (41.8)	31 (64.6)	43 (67.2)	140	(51.9)
As Exco	3 (1.9)	2 (4.2)	3 (4.7)	8	(3.0)
Total	158	48	64	270	(100.0)

Table 28: Opinion of the co-operative

Opinion	1	2	3	Total	
				No.	%
No answer/ No opinion	76	11	8	95	35.2
Very good	31	8	41	80	29.6
Good	33	14	4	51	18.9
Bring no change	10	5	7	22	8.1
No good	8	10	4	22	8.1
Total	158	48	64	270	100.0

Table 29: Willingness to participate in co-operative system

	1	2	3	Total	
				No.	%
As shareholder	50	18	37	105	38.9
As worker	30	13	1	44	16.3
As shareholder & worker	66	12	22	100	37.0
Do not want	6	1	1	8	3.0
No answer	6	4	3	13	4.8
Total	158	48	64	270	100.0

This is a projection for a large co-operative system in farming which is to be managed by a 'Lembaga'.

Table 30: If not willing to participate (Table 29) give reason

Reasons	1	2	3	Total	
				No.	%
Sufficient income	1	0	0	1	0.4
Owned no land	5	0	1	6	2.2
Padi as tradition	0	0	0	0	0.0
Others	0	1	0	1	0.4
Not involved	152	47	63	262	97.0
Total	158	48	64	270	100.0

} 8 (3.0%)

Table 31: Farming system - alternative prefer

Alternative	1	2	3	Total	
				No.	%
Double crop	77	21	28	126	46.6
Single crop + off-season	63	7	21	91	33.7
Change to other crop, coconut, etc.	18	20	15	53	19.6
Total	158	48	64	270	100.0

Table 32 : Farming system : alternative prefer

Alternative prefer	1	2	3	Total	
				No	%
Individual farming	45 (28.5)	10 (20.3)	36 (56.3)	91	(33.7)
Group farming	21 (13.3)	2 (4.2)	4 (6.3)	27	(10.0)
Large scale co-op system	90 (57.0)	36 (75)	22 (34.4)	148	(54.8)
No answer	2 (1.3)	0	2 (3.1)	4	1.5
Total	158	48	64	270	100

Table 33 : Alternative crops for individual farming

Alternative crop	1	2	3	Total	
				No	%
Padi	44	8	35	87	32.2
Vegetables	1	2	0	3	1.1
Banana	0	0	1	1	0.4
No answer/not involved	113	38	28	179	66.3
Total	158	48	64	270	100

Table 34: Alternative crop preferred for group farming and other activities

	No	Yes
Padi	242 (89.6)	28 (10.4)
Coconut	257 (93.0)	19 (7.0)
Banana	252 (93.3)	18 (6.7)
Papaya	254 (94.1)	16 (5.9)
Poultry	257 (93.0)	19 (7.0)
Beef	254 (94.1)	16 (5.9)
Vegetables	251 (93.0)	19 (7.0)

Table 35: Willingness to participate in group farming

	No	Yes
As ordinary worker	247 (91.5)	23 (8.5)
Shareholder	266 (98.5)	4 (1.5)

Table 36: Alternative crop preferred for large scale co-operative system

	No	Yes
Padi	124 (45.9)	146 (54.0)
Coconut	231 (85.6)	39 (14.4)
Banana	264 (97.8)	6 (2.2)
Papaya	267 (98.9)	3 (1.1)
Poultry	260 (96.3)	10 (3.7)
Beef	268 (99.3)	2 (0.7)
Vegetables	233 (86.3)	37 (13.7)
Others	255 (98.1)	5 (1.9)

Table 37: Monthly Household Income

Income (\$)	Household	%	Cumulative %
Less than 100	49	18.1	18.1
101 - 200	42	15.6	33.7
201 - 300	46	17.0	50.7
301 - 400	32	11.9	62.6
401 - 500	22	8.1	70.7
501 - 600	19	7.0	77.7
601 - 700	13	4.9	82.6
701 - 800	18	6.7	89.3
801 - 900	8	2.9	92.2
901 - 1000	8	2.9	95.1
1001 and above	13	4.9	100.0
Total	270	100	

Table 38: Monthly major income of the Respondent

Income (\$)	Respondent	%	Cumulative %
None	63	23.3	23.3
1 - 100	64	23.7	47.0
101 - 200	77	28.5	75.5
201 - 300	35	12.9	88.4
301 - 400	23	8.5	96.9
401 - 500	6	2.2	99.1
501 - 600	-	-	
601 - 700	-	-	
701 - 800	1	0.45	
801 - 900	1	0.45	100.0
Total	270	100	

Table 39: Monthly part-time Income of the Respondent

Income (\$)	Respondent	%
0	155	57.4
1 - 100	77	28.5
101 - 200	30	11.1
201 - 300	5	1.9
301 - 400	2	0.7
401 - 500	1	0.4
Total	270	100

Table 40: Best Organization of farming in Balik Pulau

	No information (%)	Individual operation (%)	Group farming (%)	Large Scale Co-ops (%)	Total
SBE	1.3	28.5	13.3	57.0	158
SBW	-	20.8	4.2	75.0	48
S.P	3.1	56.3	6.3	34.4	64
ALL	1.5	33.7	10.0	54.8	270

Crops Preferred by farmers

A.	Individually operated (33.7%)	no. reporting
	Padi	89
	Vegetables	3
	Banana	1
B.	Group farming (10%)	
	Padi	23
	Coconut	19
	Bananas	18
	Poultry	19
	Papaya	16
	Beef	16
	Vegetables	19
C.	Cooperative Farming (54.8)	
	Padi	146
	Coconut	39
	Veges	37
	Poultry	10
	Bananas	6
	Papaya	3

B. Respondent: Landowner/Landlord

Table 1B: How do you own your land?

Reasons	1	2	3	Total	
				No.	%
No information	2 (5.6)	0	1 (9.1)	3	(5.5)
Inheritance	26 (72.2)	6 (75.0)	9 (81.8)	41	(74.5)
Purchase	6 (16.7)	2 (25.0)	0	8	(14.5)
Others	2 (5.6)	0	1 (9.1)	3	(5.5)
Total	36 (65.5)	8 (14.5)	11 (20.0)	55	(100.0)

Table 2B: Reasons for not cultivating the land

Reasons	1	2	3	Total	
				No.	%
No information	26 (72.2)	6 (75.0)	4 (36.4)	36	(65.5)
Divorced/widow	1 (2.8)	0	1 (9.1)	2	(3.6)
Old age	1 (2.8)	1 (12.5)	4 (36.4)	6	(10.9)
Have no time	1 (2.8)	0	0	1	(1.8)
Have other job	4 (11.1)	0	2 (18.2)	6	(10.9)
Others	3 (8.3)	1 (12.5)	0	4	(7.3)
Total	36 (65.5)	8 (14.5)	11 (20.0)	55	(100.0)

Table 3B: Willingness to improve land for double cropping

Reasons	1	2	3	Total
Strongly agree	11 (30.6)	2 (25.0)	8 (72.7)	21 (38.2)
Agree	18 (50.0)	3 (37.5)	3 (27.3)	24 (43.6)
Do not care	1 (2.8)	1 (12.5)	0	2 (3.6)
Probably not	5 (13.9)	1 (12.5)	2	6 (10.9)
Not agree at all	0	0	0	1 (1.8)
Do not know	0	1 (12.5)	0	0
No information	1 (2.8)	0	0	1 (1.8)
Total	36 (65.5)	8 (14.5)	11 (20.0)	55 (100.0)

Table 4B: Willingness to change padi land to other crops

Reasons	1	2	3	Total
Strongly agree	2 (5.6)	0	1 (9.1)	3 (5.5)
Agree	12 (33.3)	4 (50.0)	2 (18.2)	18 (32.7)
Do not care	2 (5.6)	0	0	2 (3.6)
Probably not	10 (27.8)	2 (25.0)	6 (54.5)	18 (32.7)
Not agree at all	7 (19.4)	2 (25.0)	2 (18.2)	11 (20.0)
No information	3 (8.3)	0	0	3 (5.5)
Total	36 (65.5)	8 (14.5)	11 (20.0)	55 (100.0)

Table 5B: Willingness to cultivate your land

Willingness	1	2	3	Total	
				No.	%
Likely yes	26 (72.2)	4 (50.0)	5 (45.5)	35	(63.6)
Yes	4 (11.1)	1 (12.5)	1 (9.1)	6	(10.9)
Not sure	2 (5.6)	2 (25.0)	2 (18.2)	6	(10.9)
Not willing	2 (5.6)	1 (12.5)	0	3	(5.5)
Not willing at any cost	1 (2.8)	0	3 (27.3)	4	(7.3)
No information	1 (2.8)	0	0	1	(1.8)
Total	36 (65.5)	8 (14.5)	11 (20.0)	55	(100.0)

Table 6B: If not willing to above (Table 5B), give reasons

Reasons	1	2	3	Total	
				No.	%
Old age/divorce/ Widower	2 (5.6)	1 (12.5)	4 (36.4)	7	(12.7)
Have other per- manent occupation	2 (5.6)	0	1 (9.1)	3	(5.5)
Waiting to see the land	0	0	0	0	0
Others	1 (2.8)	0	0	1	(1.8)
No information	31 (86.1)	7 (87.5)	6 (54.5)	44	(80.0)
Total	36 (65.5)	8 (14.5)	11 (20.0)	55	(100.0)

Table 7B: Willingness to rent out padi land to large Co-operative system

Willingness	1	2	3	Total	
				No.	%
No	12 (33.3)	3 (37.5)	3 (27.3)	18	(32.7)
Yes (1 - 3 yrs)	13 (36.1)	5 (62.5)	8 (72.7)	26	(47.3)
Yes (3.1-6 yrs)	4 (11.1)	0	0	4	(7.3)
Yes (6.1 - 10 yrs)	1 (2.8)	0	0	1	(1.8)
Yes (10 yrs more)	6 (16.7)	0	0	6	(10.9)
Total	36 (65.5)	8 (14.5)	11 (20.0)	55	(100.0)

Table 8B: Willingness to participate in large co-operative system

Reasons	1	2	3	Total	
				No.	%
As shareholder only	24 (66.7)	7 (87.5)	9 (81.8)	40	(72.7)
As shareholder and worker	7 (19.4)	0	0	7	(12.7)
Not willing to participate	4 (11.1)	1 (12.5)	2 (18.2)	7	(12.7)
No information	1 (2.8)	0	0	1	(1.8)
Total	36 (65.5)	8 (14.5)	11 (20.0)	55	(100.0)

Table 9B: To whom do you prefer to rent out your land?

	1	2	3	Total	
				No.	%
Relative	18 (50.0)	4 (50.0)	3 (27.3)	25	(45.5)
Friends in the kampong	1 (2.8)	0	0	1	(1.8)
Anyone willing to rent it	15 (41.7)	4 (50.0)	8 (72.7)	27	(49.1)
No information	2 (5.6)	0	0	2	(3.6)
Total	36 (65.5)	8 (14.5)	11 (20.0)	55	(100.0)

Table 10B: Did anyone offer to buy your land for the last one year?

	1	2	3	Total
Yes, genuine buyer	1 (2.8)	0	0	1 (1.8)
Yes, broker	0	0	1 (9.1)	1 (1.8)
No	34 (94.4)	8 (100)	10 (90.9)	52 (94.5)
No information	1 (2.8)	0	0	1 (1.8)
Total	36 (65.5)	8 (14.5)	11 (20.0)	55 (100.0)

C.

Off-farm worker among the family member of farmer's household -
younger generation - particularly the children of respondent

Table 1C : Age of Respondent

	1	2	3	Total	
				No	%
Less 18	17 (16.5)	1 (2.9)	11 (21.2)	29	(15.7)
18 - 21	53 (51.5)	16 (45.7)	22 (42.3)	91	(47.9)
22 - 25	21 (20.4)	14 (40.0)	14 (26.9)	49	(25.8)
26 - 29	6 (5.8)	4 (11.4)	2 (3.8)	12	(6.2)
30 - 33	3 (2.9)	0	2 (3.8)	5	(2.6)
Above 34	3 (2.9)	0	1 (1.9)	4	(2.1)
Total	103 (54.2)	35 (18.4)	52 (27.4)	190	(100)

Table 2C : Occupation

types of Occupation	1	2	3	Total	
				No	%
Factory woker	77 (74.8)	21 (60.0)	45 (86.5)	143	(75.3)
Govt. labour	12 (11.7)	7 (20.0)	3 (5.8)	22	(11.6)
Clerical (Govt./private)	3 (2.9)	2 (5.7)	0	5	(2.6)
Police/Secu- rity Officer	3 (2.9)	2 (5.7)	0	5	(2.6)
Teacher	1 (1.0)	0	0	1	(0.5)
Officer (Govt/ Private)	1 (1.0)	1 (2.9)	0	2	(1.1)
Others	4 (3.9)	2 (5.7)	3 (5.8)	9	(4.7)
No. specific job	2 (1.9)	0	1 (1.9)	3	(3.6)
Total	103 (54.2)	35 (27.4)	52 (27.4)	190	(100)

Table 3C : Attitude towards padi/agriculture

Attitudes		2	3	Total	
				No	%
a) Low income	32 (31.1)	14 (40.0)	11 (21.2)	57	(30.0)
b) Working condition - tiring	44 (42.7)	15 (42.9)	32 (61.5)	91	(47.9)
c) No experience	26 (25.2)	3 (8.6)	6 (11.5)	35	(18.4)
d) Others	1 (1.0)	3 (8.6)	2 (3.8)	6	(3.2)
e) No information	0	0	1 (1.9)	1	(0.5)
Total	103 (54.2)	35 (18.4)	52 (27.4)	190	(100)

Table 4C : Do you help your parents working in the farm

	1	2	3	Total	
				No	%
No	13 (12.6)	11 (31.4)	12 (23.1)	36	(18.9)
When asked	25 (24.3)	13 (37.1)	27 (51.9)	65	(34.3)
When necessary	23 (22.3)	2 (5.7)	2 (3.8)	27	(14.2)
Free time	42 (40.8)	9 (25.7)	11 (21.2)	62	(32.6)
Total	103 (18.4)	35 (18.4)	52 (27.4)	199	(100)

Table 5C : Willingness to participate in agriculture when improvement was made by the Government

Willingness	1	2	3	No	Total	%
Full time	9 (8.7)	3 (8.6)	10 (19.2)	22		(11.6)
Part time	73 (70.9)	22 (62.9)	25 (48.1)	120		(63.2)
Not at all	18 (17.5)	8 (22.9)	16 (30.8)	42		(22.1)
No information	3 (2.9)	2 (5.7)	1 (1.9)	6		(3.2)
Total	103 (54.2)	35 (18.4)	52 (27.4)	190		(100)

Table 6C : What shall the respondents do to their parent's padiland

	1	2	3	No	Total	%
a) I will improve and cultivate it	47 (45.6)	10 (28.6)	12 (23.1)	69		(36.3)
b) Rent out to other people	43 (41.7)	22 (62.9)	37 (71.2)	102		(53.7)
c) Advise my parent to sell it	0	1 (2.9)	0	1		(0.5)
d) Others	4 (3.9)	1 (2.9)	3 (5.8)	8		(4.2)
e) No land	9 (8.9)	1 (2.9)	0	10		(5.3)
Total	103 (54.2)	35 (18.4)	52 (27.4)	190		(100)

Table 7C : Willingness to participate in large scale cooperative system in operating agriculture

	1	2	3	No	Total %
As shareholders only	37	3	32	72	(37.9)
As worker only	13	23	4	40	(21.1)
As shareholder & woker	40	5	12	57	(30.0)
As managerial only	0	0	0	0	-
Do not want to take part	13	4	4	21	(11.1)
Total	103	35	52	190	

Table 8C : Willingness to participate in cooperative with high pay or as much as they get in the factories

	1	2	3	No	Total %
No	32 (31.1)	6 (17.1)	27 (51.9)	65	(34.2)
Yes	71 (68.9)	29 (82.9)	25 (48.1)	125	(65.8)
Total	103	35	52	190	100

Table 9C : Sex ratio of the respondent

Age of the respondent	Male	Female	% total
- 17	19	9	14.7
18 - 21	60	31	47.9
22 - 25	18	31	25.8
26 - 29	4	8	6.3
30 - 34	3	2	2.6
35 above	0	4	2.1
	105 (55.3)	85 (44.7)	

APPENDIX E

I. MACHINERY & MECHANIZATION COSTS

disc. year

1. LAND PREPARATION

1.1 Power Tiller

(a) Base Data

Capital cost M\$5,800
 Life 5 years or 3,000 working hours (600 hours/year)
 Interest charges 10%

(b) Hourly Operating Costs:

- hourly capital charge (depreciation + interest)	2.55
- fuel 3 l.	1.35
- repairs and maintenance	1.95
- insurance	0.10

Sub-total (rounded) \$6.00 per hour 5.95

(c) Cost of Cultivation per hectare

- 1st cultivation 14 hours per ha	84.00
- 2nd cultivation 11 hours per ha	66.00

Cost per hectare (rounded) 150.00

(d) Current Contract Rates for two cultivations (per ha) 198.00

(e) Margin for labour and contractors' profit (per ha) 48.00

1.2 Four Wheeled Tractor (60-70 HP) & Rotavator

(a) Base Data: Tractor

Capital cost M\$48,420
 Life 6 years or 6,000 hours (1,000 hours/year)
 Interest charges 10%

(b) Hourly Operating Costs:

- hourly capital charge (depreciation + interest)	11.10
- fuel 10 l. at M\$0.45 per l.	4.50
- repairs and maintenance	7.30
- insurance	0.70
- driver's wages per hour	2.00

25.60

(c) Base Data: Rotavator

Capital cost M\$9,360
 Life 6 years or 4,800 hours (800 hours/year)
 Interest charges 10%

Operating costs per hour

- hourly capital charge (interest + depreciation)	2.70
- repairs and maintenance	1.80

Hourly operating cost 4.50

(d) Hourly Cost of Rotavating (b) + (c) 30.10

(e) Cost of Rotavation per hectare		
- 1st cultivation 5 hours per ha		
- 2nd cultivation 2 hours per ha		MS
7 hours @ \$30.10		210.70
Rounded cost per hectare		210.00
(f) Contract price M\$250.00 per hectare		
1.3 <u>Four Wheeled Tractor: Disc Harrowing followed by Rotavating</u>		
(a) Tractor hourly operating cost		25.60
(b) Rotavator hourly operating cost		4.50
(c) Disc harrow operating costs		
- capital cost M\$8,280		
- life 8 years @ 800 hours/year		
- hourly capital charge M\$1.90		
- repairs and maintenance M\$1.60		
Hourly operating cost		3.50
(d) Land Preparation Cost per hectare		
Disc harrowing 4 hours @ \$29.1		116.40
Rotavating 2 hours @ \$30.1		60.20
Cost per hectare		176.60
Rounded cost per hectare		177.00
(e) Contractors margin \$6.00 per tractor hour		
2. RICE HARVESTING: COMBINE HARVESTER		
(a) Basic Assumptions		
Capital cost M\$185,000 (inclusive of extras + trailer for table)		
Life 8 years or 6,000 hours (750 hours/year)		
Interest charges 10%		
(b) Hourly Operating Costs		
- hourly capital charge (depreciation + interest)		46.20
- 15 l. @ \$0.45		6.80
- repairs and maintenance		37.00
- insurance + registration		13.30
- operator + attendants M\$12 per hour		12.00
Hourly costs		115.30
(c) Cost per hectare		
- average rate of work (allowing for transporting, etc)		
0.6 ha per combine hour		
- Cost per hectare		192.00
(d) Contractors' rate		250.00

II. WITH PROJECT: CROP BUDGETS AT MARKET PRICES

1. SMALLHOLDER: RICE PRODUCTION

1.1 Direct Production Costs per hectare

		M\$
(a)	Materials	
	Seeds 25 kgs per ha transplanted	15.00
	Plastic sheeting for nursery	2.50
	Wooden posts for fencing nursery	14.00
	Fertilizers 10 kgs Ammophos for nursery	10.20
	100 kgs Urea	75.00
	200 kgs of NPK compound	150.00
	Pesticides 23 kgs Gamma BHC	32.50
	2.5 l. dieldrex	16.80
	Herbicides 4.5 kgs Rumpotox	38.00
	Miscellaneous	25.00
	Sub-total	379.00
(b)	Machinery Contractors (1)	224.00
(c)	Depreciation on tools and equipment	15.00
(d)	Labour inputs per hectare	
		<u>Mandays</u>
	Land preparation nursery	5 35.00
	Bund maintenance and irrigation	20 140.00
	Transplanting and carrying	30 210.00
	Fertilizing	6 42.00
	Application of herbicides	6 42.00
	Application of pesticides	6 42.00
	Weeding	2 14.00
	Harvesting, threshing & cleaning	40 280.00
		115 805.00
(e)	Quit Rent and Irrigation	28.1
Summary:		
	Total direct costs	1,451.00
	Direct costs excluding fertilizers	1,261.00
	Direct costs excluding fertilizers and labour	411.00

Notes:

- (1) Assumes 50% by two wheeled power tiller and 50% by four wheeled tractor.

3. Mechanized Maize Grain Production: Group Farms

(a) Materials		M\$
Seed 25 kgs		17.50
Fertilizers - rock phosphate	180 kgs	43.00
- Muriate of potash	100 kgs	50.00
- Urea	150 kgs	112.00
Lime	750 kgs	45.00
Herbicides Grammoxone	10 l.	94.00
Pesticides Gamma BHC	1.25 gals	59.00
Miscellaneous (sacking, etc)		20.00
		<hr/>
		441.00
(b) Mechanisation ⁽¹⁾		
Land preparation: disc harrowing (4 hrs)		116.40
Planting		28.00
Fertilizer application		56.00
Harvesting (combine) (1 ha per hour)		115.30
		<hr/>
Mechanisation costs at contractors' rates		387.00
(c) Depreciation on hand tools and sprayers		15.00
(d) Labour	(mandays)	
Bund maintenance and irrigation	8	56.00
Pest control	4	28.00
Weed control	6	42.00
Seed and fertilizer handling	2	14.00
Handling bagging grain at harvest	6	42.00
	<hr/>	<hr/>
	26	182.00
(e) Cost Summary		
Total costs per hectare		954.00
Costs excluding labour		772.00
(f) Total costs assuming machinery contractors' rates		1,025.00
Costs excluding labour assuming machinery contractors' rates		843.00

Note: (1) Machinery contractors' margin: \$6 per hour for tractor use and \$35 per hour for combine harvesting.

Group Farms: Mechanized Maize Production (Cobs)

		M\$
(a)	Materials	
	Seed 25 kgs	17.50
	Fertilizers	205.50
	Lime	45.00
	Herbicides Grammoxone 10 l.	94.00
	Pesticides Gamma BHC 1.25 gals	59.00
	Miscellaneous	20.00
		<hr/>
		441.00
(b)	Mechanisation	
	Land preparation: disc harrowing (4 hours)	116.40
	Planting 1 hour per ha	28.00
	Fertilizer spreading (2 hours)	56.00
		<hr/>
		200.00
	Mechanisation costs at contractors' rates ⁽¹⁾	242.00
(c)	Depreciation on hand tools and sprayer	15.00
(d)	Labour	<u>(mandays)</u>
	Bund maintenance and irrigation	8 56.00
	Pest control	4 28.00
	Weed control	6 42.00
	Seed and fertilizer handling	2 14.00
	Picking and carrying	25 175.00
		<hr/>
		45 315.00
(e)	Cost Summary	
	Total costs	971.00
	Costs excluding labour	656.00
(f)	Total costs assuming machinery contractor	1,013.00
	Costs excluding labour assuming machinery contractor	698.00

Note: (1) Contractors' margin \$6 per tractor hour.

Table Balik Pulau: Revenues and Gross Margins from Mixed Vegetables (M\$ per hectare)

Crop	Yield(1) (tonne/ha)	Price (M\$/tonne)	Revenue (M\$/ha)	Direct Production Costs(1) (M\$/ha)	Net Revenue (M\$/ha)	Proportion of mix (%)	Net Revenue (M\$)	Vegetable Mix			
								Labour (man-day)	Cost (M\$)	Return to Land(4) (M\$)	Return to Labour(5) (M\$)
Okra	15	500	7,500	1,394	6,106	65	3,969	136	952	3,017	29.1
Long bean	10	490	4,900	2,099	2,801	10	280	19	133	147	14.7
Cucumber	16	350	5,600	1,958	3,642	10	364	18	126	238	20.2
Brinjal	18	470	8,460	3,171	5,289	10	529	29	203	326	18.2
Chilli	10	930	9,300	3,420	5,880	5	294	18	126	168	16.3
						100	5,436	220	1,540	3,896	24.7

Notes: (1) Consultants' estimate assuming improved drainage.

(2) Source: FAMA records, farmer interviews and wholesale market surveys. Price per tonne for vegetable mix is M\$496 per tonne of vegetables produced.

(3) Excluding labour. Direct production costs for vegetable mix is \$1,800 per ha.

(4) Net Revenue - labour costs.

(5) Net Revenue - number of man-days.

Bananas

	Year						
	1	2	3				
(a) Material Inputs							
Planting material 1,115 suckers @ 35 cents	390						
Fertilizer:							
Year 1 250 kgs rock phosphate (0.05 lb/hole)	60						
960 kgs NPK compound (2 lb/mat)	765						
Year 2 1,440 kgs NPK compound (3 lb/mat)		1,148					
Year 3 1,920 kgs NPK compound (4 lb/mat)			1,530				
Lime:							
Year 1 2.5 tonnes; Year 2 onwards 1 tonne	150	60	60				
Herbicides:							
Year 1 10 litres paracol	140						
Year 2 5 litres paracol		70					
Year 3 2.5 litres paracol			35				
Insecticides 4.5 kgs Agrocide each year	12	12	12				
Miscellaneous packing materials	80	200	150				
	<u>1,597</u>	<u>1,490</u>	<u>1,787</u>				
(b) Land Preparation							
Ploughing and disc harrowing (6 hours)	175						
	<u>175</u>	-	-				
(c) Depreciation on hand tools	30	30	30				
	<u>30</u>	<u>30</u>	<u>30</u>				
(d) Labour							
		Year					
		1	2	3			
		(mandays)					
Digging holes and liming	50	5	5	350	35	35	
Carrying and planting	25	-	-	175			
Fertilizer application	8	10	12	56	70	84	
Pesticide application	14	14	14	98	98	98	
Desuckering	8	15	22	56	105	154	
Leaf pruning	8	15	15	56	105	105	
Harvesting	25	55	45	175	385	315	
Irrigation and drainage	8	8	8	56	56	56	
Miscellaneous	15	15	15	105	105	105	
	<u>161</u>	<u>132</u>	<u>136</u>	<u>1,127</u>	<u>959</u>	<u>952</u>	
(e) Transfer Charges							
Quit rent	25	25	25				
	<u>25</u>	<u>25</u>	<u>25</u>				
Production costs per hectare	2,954	2,504	2,794				
(f) Costs Summary							
Total costs	2,954	2,504	2,794				
Costs excluding labour	1,827	1,545	1,842				

Papayas

		Year		
		1	2	3
			(M\$)	
(a) Material Inputs				
Planting material	2,075 seedlings	622		
Fertilizer:				
Year 1	450 kgs rock phosphate	108		
	180 kgs NPK compound	1,430		
Year 2 & 3	2,700 kgs NPK compound		2,145	2,145
	900 kgs Superphosphate		752	752
Lime:				
25 tonnes in Year 1; 1 tonne from Year 2 onwards		150	60	60
Mulching straw/grass		200		
Herbicides:				
Year 1	10 litres/ha	140		
Year 2	4 litres		56	56
Insecticides (malathion)		35	35	35
Fungicide Dithane M45			35	35
Packaging materials		50	250	200
		<u>2,735</u>	<u>3,333</u>	<u>3,283</u>
(b) Land Preparation				
Ploughing and disc harrowing (6 hours)		175	-	-
(c) Depreciation on hand tools		30	30	30
(d) Labour				
		Year		
		1	2	3
		(mandays)		
Digging holes and liming		65	5	5
Carrying and planting		40	-	-
Fertilizer application		12	15	15
Pesticide application		14	14	14
Mulching and shading		8	-	-
Harvesting		10	60	60
Irrigation and drainage		8	8	8
Miscellaneous		15	15	15
		<u>172</u>	<u>117</u>	<u>117</u>
		<u>1,204</u>	<u>819</u>	<u>819</u>
(e) Transfer Charges				
Quit rent		25	25	25
(f) Cost Summary				
Total Costs		4,169	4,207	4,157
Costs excluding labour		2,965	3,388	3,338

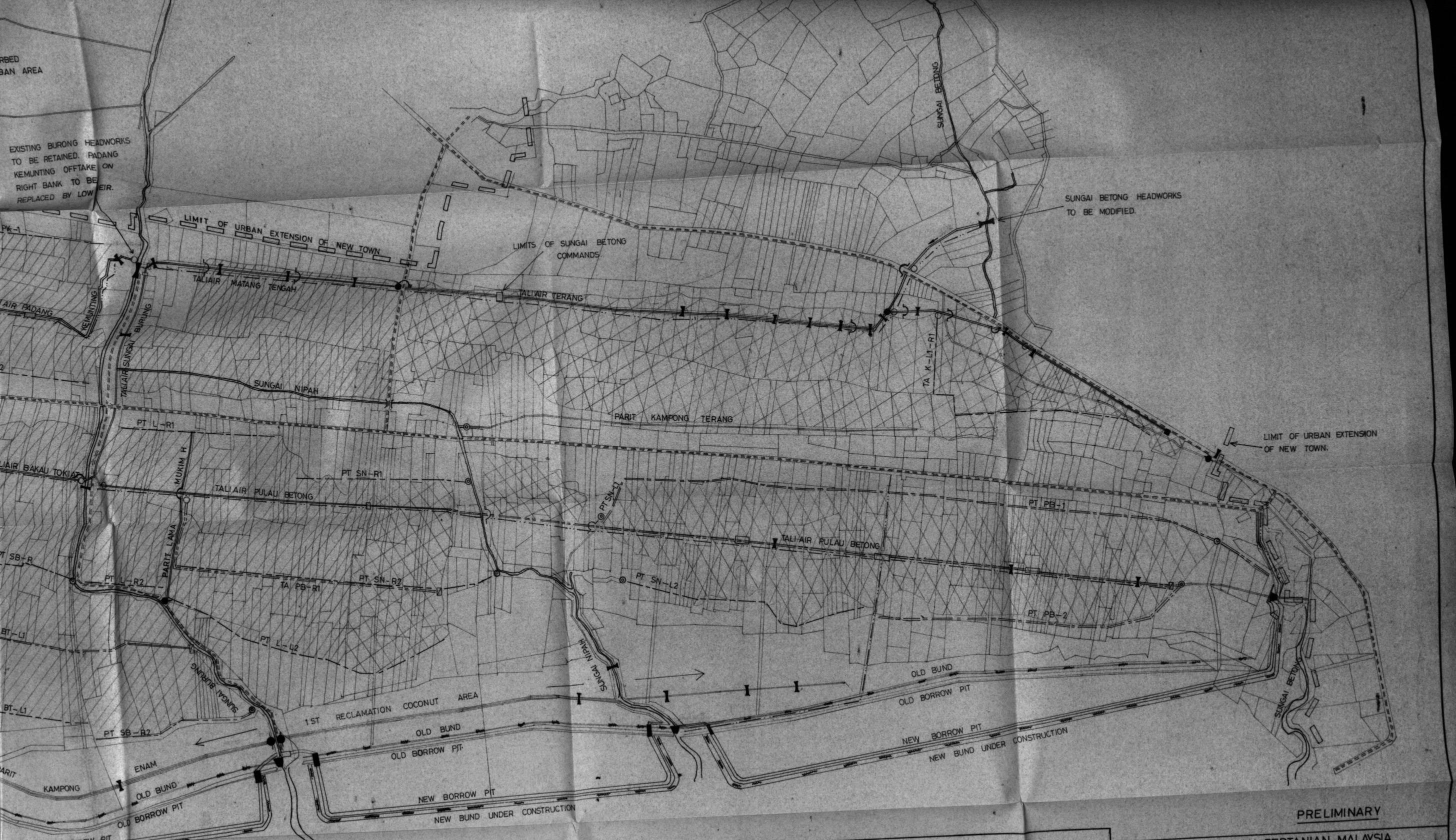
DRAWING



LEGEND

	EXISTING MAIN/SECONDARY/TERTIARY CANAL		EXISTING DRAINAGE CONTROL
	PROPOSED SECONDARY/TERTIARY CANAL		PROPOSED DRAINAGE CONTROL
	PROPOSED QUARTEINARY CANAL		EXISTING OFFTAKE
	EXISTING RIVER/MAIN/SECONDARY/TERTIARY DRAIN		PROPOSED CHO
	PROPOSED TERTIARY DRAIN		EXISTING SYPHON/UNDER DRAINAGE CULVERT
	PROPOSED FIELD DRAIN		PROPOSED SYPHON/UNDER DRAINAGE CULVERT
	EXISTING ACCESS ROAD		EXISTING IRRIGATION CONTROL
	PROPOSED ACCESS ROAD		

KEMENTERIAN
 INTEGRATED
 UPGRADEING OF
 BALIK PULAU
 SUNGAI BAYUNG



EXISTING BURONG HEADWORKS TO BE RETAINED. PADANG KEMUNTING OFFTAKE ON RIGHT BANK TO BE REPLACED BY LOW WEIR.

SUNGAI BETONG HEADWORKS TO BE MODIFIED.

LIMIT OF URBAN EXTENSION OF NEW TOWN.

LEGEND

	EXISTING MAIN/SECONDARY/TERTIARY CANAL		EXISTING DRAINAGE CONTROL
	PROPOSED SECONDARY/TERTIARY CANAL		PROPOSED DRAINAGE CONTROL
	PROPOSED QUARternary CANAL		EXISTING OFFTAKE
	EXISTING RIVER/MAIN/SECONDARY/TERTIARY DRAIN		PROPOSED CHO
	PROPOSED TERTIARY DRAIN		EXISTING SYPHON/UNDER DRAINAGE CULVERT
	PROPOSED FIELD DRAIN		PROPOSED SYPHON/UNDER DRAINAGE CULVERT
	EXISTING ACCESS ROAD		EXISTING IRRIGATION CONTROL
	PROPOSED ACCESS ROAD		PROPOSED IRRIGATION CONTROL
	AREA TO BE CULTIVATED WITH PADDY		PROPOSED IRRIGATION END CONTROL
	AREA TO BE CULTIVATED WITH VEGETABLE OR MAIZE		EXISTING TIDAL CONTROL GATE
	EXISTING HEADWORK		PROPOSED TIDAL CONTROL GATE
	EXISTING FOOTBRIDGE		

PRELIMINARY

KEMENTERIAN PERTANIAN MALAYSIA	
PULAU PINANG	
INTEGRATED AGRICULTURAL DEVELOPMENT PROJECT	
UPGRADING OF IRRIGATION AND DRAINAGE SCHEMES	
BALIK PULAU AND SEBERANG PRAI	
SUNGAI BURUNG IRRIGATION SCHEME	
CONTRACT NO:	REGISTER NO:
BINNIE DAN RAKAN (MALAYSIA)	
JURUTERA PERUNDING	
BANGUNAN BANK HONG KONG KUALA LUMPUR	
DATE	
DRG. NO: BP.1	