4. AGRICULTURAL DEVELOPMENT PLAN

4.1 Development Policy

There are three of on-going development projects in the Region; the development project planned by KEJORA, development projects planned by FELDA and the Western Johor Agricultural Development Project.

According to the information, KEJORA will reclaim about 11.8 x 10^3 ha land in the eastern part of Kota Tinggi District by 1987. FELDA will develop about 3.3 x 10^3 ha in the north-eastern part of Kota Tinggi District until 1987. These areas will be developed mostly for oil palm. While the Western Johor Agricultural Development Project covers the development of whole Pontian District, western part of Johor Bahru District and small parts of Kluang and Batu Pahat Districts. According to this project, rubber planting area will decrease from 22.5 x 10^3 ha in 1983 to 4 x 10^3 ha in 2003, mostly replanting with oil palm. Areas will expand from 10 x 10^3 ha in 1983 to 24.3 x 10^3 ha in 2003 for oil palm and from 8.1 x 10^3 to 18.3 x 10^3 ha during the same period for pineapple.

4.2 Projection of Tree Crops Area

Encompassing above-mentioned development projects, future cultivated area of rubber, oil palm and pineapple in the Region are estimated as shown in Tables 13 to 15.

Rubber planting area will decrease from 123 x 10^3 ha in 1983 to 104 x 10^3 ha in 2003. Oil palm area will increase from 175 x 10^3 ha in 1983 to 211 x 10^3 ha in 2003. While pineapple area will increase from 8.1 x 10^3 ha in 1983 to 18.3 x 10^3 ha in 2003. No increase nor decrease is contemplated in this assumption during the period from 2003, the target year of the Western Johor Agricultural Development Project, to 2005, the target year of the Study.

4.3 Anticipated Tree Crops Production

Rubber and oil plan productions are estimated using the anticipated annual yield for FELDA and anticipated annual average yield for estates and smallholders as shown in Table 8 and Table 9. Pineapple production is estimated using the data in the Western Johor Agricultural Development Project.

Rubber production will decrease from 117 x 10^3 tons of DRC in 1983 to 100 x 10^3 tons in 2005. Oil palm production will increase from 3,345 x 10^3 tons FFB in 1983 to 4,280 x 10^3 tons in 2005. Likewise pineapple production will increase from 177 x 10^3 tons of fresh fruit in 1983 to 491 x 10^3 tons in 2005.

4.4 Processing Facilities

To cope with the increase of productions, the requisite capacity of processing facilities are to be extended. Three of palm oil mills with total processing capacity of 500 x 10^3 tons of FFB per year will be constructed under FELDA by 1990. Moreover three of palm oil mills with total capacity of 440 x 10^3 tons and two of pineapple cannery factories with total capacity of 150 x 10^3 tons of fresh fruit per year will be constructed under the Western Johor Agricultural Development Project by 2000. The locations of these proposed palm oil mills and pineapple cannery factories are not designed yet. They were, however, assumed for this water demand study taken into account their proposed land use and the geography as shown in Fig. 2. Pineapple cannery factories will be allocated adjacent to the existing facilities.

Assumed processing capacities of each facility for rubber, oil palm and pineapple are shown in Tables 16 to 18. In this assumption, daily operation hour of 16 hours and annual operation period of 250 days were applied to each facility.

4.5 Projection of Processing Water Requirement

Water demands by processing facilities are estimated as shown in Tables 19 to 21.

An unit yield of 16.6 m^3 of water per 1 ton of DRC for SMR (Standard Malaysian Rubber) factories and 10m^3 of crepe or latex factories are adopted to estimate the water demand, rubber factory. While 1.45 m^3 of water per 1 ton of FFB is adopted for palm oil mills and 2.7 m^3 of water per 1 ton of fresh fruit for pineapple cannery factories.

Projection of total water demand in rubber factories will decrease from 1,650 x 10^3 m^3 in 1983 to 1,400 x 10^3 m^3 in 2005. In palm oil mills total water demand will increase from 4,850 x 10^3 m^3 in 1983 to 6,210 x 10^3 m^3 in 2005. As for pineapple cannery factories, total water demand will increase from 477 x 10^3 m^3 in 1983 to 1,330 x 10^3 m^3 in 2005.

Projected total water demand in the agro-industrial sector in the Study Area will increase from 6,980 x 10^3 m^3 in 1983 to 8,940 x 10^3 m^3 in 2005.

According to the interview to factories and information from RRIM, many of the processing facilities depend entirely on river as water source at present. Although one palm oil mill, eight rubber factories and four pineapple cannery factories use JKR supply water besides own water source facilities, the share of JKR supply water in these facilities varies from 1.1% to 31% of total water demand in each of them, and covers only as low as 2% of total water demand.

4.6 Irrigation Development for Paddy

4.6.1 Irrigation area

In the Region, irrigation development has been considered by the State DID of Johor by means of an extension of existing paddy schemes.

Future development plan of existing irrigation schemes are described hereunder.

The Lukut scheme

This scheme is composed of 3 blocks, i.e. 51.4 ha of Block A, 26.3 ha of Block B, and 26.7 ha of Block C. At present Blocks A and C have been irrigated after rehabilitation of irrigation facilities from 1980 to 1983. Implementation of Block B is expected to be completed by 1987 under 5MP. Net irrigation area is, therefore, expected to be increased to 104 ha by 1990.

The Ulu Benut scheme

This scheme was rehabilitated during 1978-1983 and net irrigation area became 177 ha. Southward extension of the scheme of 50 ha seems to be possible owing to topography and sufficient water source for double cropping of rice in the Benut river. Net irrigation area of this scheme is expected to be increased to 227 ha in the near future.

4.6.2 Estimation of irrigation water demand

The present and future irrigation water demand by paddy in the Lukut and Ulu Benut schemes are estimated by 10-day basis based on projected irrigation area, assumed cropping pattern (see Fig. 4) and methodology described hereunder.

(1) Methodology of calculation

The irrigation water demand for paddy is calculated by the following equation.

$$IDR = FIR/Ec \qquad (1)$$

where, IDR: Irrigation diversion requirement
FIR: Field irrigation requirement
Ec : Conveyance efficiency

In this study, a computer simulation model of the plot-to-plot irrigation model which was developed in the previous study (Ref. 3) is applied in the estimation of FIR based on the following basic water balance equation (see Fig. 5).

$$R + Ii = Oi + ET + P + h \qquad (2)$$

where, R : Rainfall
Ii: Irrigation supply to i-plot (= Outflow from (i-1) plot)
Oi: Outflow from i-plot (= Inflow to (i+1) plot)
ET: Crop evapotranspiration
P : Percolation rate
h : Water level change in i-plot

Calculation is made from the first plot up to the terminal plot. If the number of the continuous plot is "n", outflow from n-plot is regarded as the total loss from the series of plots. In the above equation, irrigation supply to the first plot is equivalent to the field irrigation requirement in Eq. (1).

(2) Rainfall data

The Kota Tinggi rainfall station (No. 1738129), 7 km southwest of Lukut, was selected as a representative station of the Lukut scheme and the Ladang Wessyington rainfall station (No. 1833092), 5 km east of Ulu Benut, was selected as a representative station of the Ulu Benut scheme. Both stations have long-term records over 50 years with good data quality.

(3) Evapotranspiration

The evapotranspiration (ET) was calculated by the following equation.

$$ET = ETo \times kc \qquad (3)$$

where, ET : Evapotranspiration by crop
ETo: Open water evaporation
kc : Crop coefficient

Crop coefficient curve which was prepared by using data obtained in MADA area as shown in Fig. 6 is adopted in the above calculation. The open water evaporation at 10-day basis at Kota Tinggi station is shown in Table 23.

(4) Percolation rate

As an average figure, 2 mm/d is applied in the estimation.

(5) Conveyance efficiency

The conveyance efficiency in the both schemes is assumed to be 70% for both present and future conditions. No improvement on efficiency is assumed for conservative estimation.

(6) Assumptions in calculation by using plot-to-plot irrigation model

a) Water depth in the field is assumed to be 90 mm for soil saturation depth and 100 mm for standing water depth.
b) Average size and number of continuous plot are assumed to be 0.4 ha and 3 respectively.
c) Allowable drought level is assumed that 10-day continuous dry spell on the field causes no drought damage to paddy.

(7) Irrigation method

The scheduled irrigation method is adopted, which is a method to simplify the water management by fixing the supply amount for each 10-day period during growing season based on computer simulation using previous rainfall records.

(8) Result of calculation

Following the calculation method and assumptions mentioned above, 10-day irrigation water demand for both schemes are obtained as shown in Table 24 and Table 25. The summarized figure is shown in Table 26. The irrigation water demand by paddy in the Region is estimated to be 5.0 x 10^6 m^3/y in the year 1983 and 6.5 x 10^6 m^3/y in the year 1990 onward.

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TABLES

Table 1 AREAL EXTENT OF SOILS IN THE REGION

Unit: km^2

Soils	Area
A. Alluvial Soils	
Alluvial soils on coastal plains	720
Alluvial soils on coastal and/or riverine	1,212
Alluvial soils on riverine flood plains and/or riverine terraces	400
Alluvial soils on intermediate and higher terraces	482
Sub-total	2,814
B. Sedentary Soils	
Sedentary soils on undulating plains to rolling land	3,330
Sedentary soils on rolling and low hilly land	594
Sedentary soils on hills and mountains	560
Sub-total	4,484
C. Urban and Mined Land	
Soils on urban and mined land	52
Total	7,350

Source: Ref. 1

Table 2 ESTIMATED RUBBER AREA IN 1983

Unit : 10^3ha

District	Small-holder	Estate	FELDA	Total
Mersing	0.9	1.2	-	2.1
Kluang	8.4	5.7	-	14.1
Pontian	22.5	0.4	-	22.9
Johor Bahru	12.1	13.1	7.4	32.6
Kota Tinggi	11.6	36.4	3.3	51.3
Total	55.5	56.8	10.7	123.0

Table 3 ESTIMATED OIL PALM AREA IN 1983

Unit : 10^3ha

District	Small-holder	Estate	FELDA	Total
Mersing	1.8	1.4	11.0	14.2
Kluang	2.1	13.8	5.0	20.9
Pontian	5.5	1.3	-	6.8
Johor Bahru	1.5	30.3	5.2	37.0
Kota Tinggi	4.1	30.7	61.5	96.3
Total	15.0	77.5	82.7	175.2

Table 4 ESTIMATED PINEAPPLE AREA IN 1983

Unit : 10^3ha

District	Small-holder	Estate	FELDA	Total
Kluang	0.5	3.0	-	3.5
Pontian	2.6	1.9	-	4.5
Batu Pahat	0.1	-	-	0.1
Total	3.2	4.9	-	8.1

Table 5 ESTIMATED COCONUT AREA IN 1983

Unit: 10^3 ha

District	Smallholder	Estate	Total
Kluang	-	0.1	0.1
Pontian	16.9	0.1	17.0
Johr Bahru	0.8	0.4	1.2
Kota Tinggi	1.7	1.6	3.3
Total	19.4	2.2	21.6

Source: Ref. 2

Table 6 ESTIMATED COCOA AREA IN 1983

Unit: 10^3 ha

District	Smallholder	Estate	FELDA	Total
Mersing	0.1	-	0.6	0.7
Pontian	2.2	-	-	2.2
Johr Bahru	0.1	0.9	1.2	2.2
Kota Tinggi	0.2	0.2	0.1	0.5
Total	2.6	1.1	1.9	5.6

Source: Ref. 2

Table 7 ESTIMATED COFFEE AREA IN 1983

Unit: 10^3 ha

District	Smallholder	Total
Pontian	1.6	1.6
Johor Bahru	0.3	0.3
Kota Tinggi	0.1	0.1
Total	2.0	2.0

Source: Ref. 2

Table 8 OIL PALM YIELD ESTIMATED FOR PRESENT CONDITION AND ANTICIPATED FOR FUTURE CONDITION

Unit : FFB/1 ton/ha

Year	Present Yield			Future Yield		
	Small Holder	FELDA	Estate	Small Holder	FELDA	Estate
1	15.1	18.1	22.0	15.1	18.1	22.0
2	15.1	18.1	22.0	15.1	18.1	22.0
3	15.1	18.1	22.0	15.1	18.1	22.0
4	15.1	18.1	22.0	15.1	18.1	22.0
5	15.1	18.1	22.0	15.1	18.1	22.0
6	15.1	18.1	22.0	15.1	18.1	22.0
7	15.1	18.1	22.0	15.8	18.7	22.5
8	15.4	18.5	22.4	16.5	19.2	23.1
9	15.9	19.1	23.1	17.5	20.4	24.5
10	16.4	19.7	23.9	18.5	21.6	25.5
11	16.4	19.7	23.9	18.5	21.6	25.5
12	16.1	19.3	23.4	18.5	21.6	25.5
13	16.1	19.3	23.4	18.3	21.3	25.2
14	15.9	19.1	23.1	18.3	21.3	25.2
15	15.6	18.7	22.7	18.0	21.0	24.9
16	15.6	18.7	22.7	18.0	21.0	24.9
17	15.6	18.7	22.7	17.5	20.4	24.5
18	15.4	18.5	22.4	17.3	20.2	24.2
19	15.4	18.5	22.4	17.0	19.8	23.8
20	15.1	18.1	22.0	16.8	19.8	23.5
21	14.9	17.9	21.7	16.8	19.6	23.5
22	14.9	17.9	21.7	16.8	19.6	23.5
23	14.6	17.5	21.2	16.5	19.2	23.1
24	14.6	17.5	21.2	16.5	19.2	23.1
25	14.6	17.5	21.2	16.5	19.2	23.1
Annual average yield	15.4	18.4	22.4	16.8	19.7	23.6

/1 : Fresh Fruit Bunch

Table 9 RUBBER YIELD ESTIMATED FOR PRESENT CONDITION AND ANTICIPATED FOR FUTURE CONDITION

Unit : DRC /1 kg/ha

Harvest year	Present Yield			Future Yield		
	Small Holder	FELDA	Estate	Small Holder	FELDA	Estate
1	570	790	990	570	790	990
2	570	790	990	570	790	990
3	570	790	990	570	790	990
4	570	790	990	570	790	990
5	570	790	990	570	790	990
6	570	790	990	570	790	990
7	610	830	1,045	620	880	1,080
8	650	880	1,110	670	960	1,160
9	695	930	1,180	730	1,030	1,230
10	740	980	1,250	790	1,090	1,290
11	740	980	1,250	790	1,090	1,290
12	730	975	1,240	780	1,080	1,280
13	720	970	1,230	770	1,070	1,270
14	710	965	1,220	765	1,060	1,260
15	700	960	1,210	760	1,050	1,250
16	690	955	1,200	755	1,040	1,240
17	680	950	1,190	750	1,030	1,230
18	670	945	1,185	745	1,020	1,225
19	660	940	1,180	740	1,010	1,220
20	650	935	1,175	735	1,005	1,215
21	640	930	1,170	730	1,000	1,210
22	630	925	1,165	725	995	1,205
23	620	920	1,160	720	990	1,200
24	610	915	1,155	715	985	1,195
25	600	910	1,150	710	980	1,190
26	590	905	1,145	705	975	1,185
27	580	900	1,140	700	970	1,180
28	570	900	1,135	695	965	1,175
29	570	900	1,130	690	960	1,170
30	570	900	1,130	690	960	1,170
Annual average yield	635	901	1,136	672	965	1,169

/1 Dry Rubber Content

Table 10 AVERAGE COCONUT YIELD IN 1983

Unit: ton/ha

District	Smallholder	Estate
Kluang	-	1.3
Pontian	1.3	1.1
John Bahru	1.2	1.3
Kota Tinggi	1.2	1.2

Source: Ref. 2

Table 11 AVERAGE COCOA YIELD IN 1983

Unit: ton/ha

District	Smallholder	Estate
Mersing	0.6	1.6
Pontian	0.9	-
Johor Bahru	0.7	1.5
Kota Tinggi	0.7	1.4

Source: Ref. 2

Table 12 AVERAGE COFFEE YIELD IN 1983

Unit: ton/ha

District	Smallholder
Pontian	4.0
Johor Bahru	3.7
Kota Tinggi	3.4

Source: Ref. 2

Table 13 PROJECTED PLANTING AREA OF RUBBER BY DISTRICT

Unit : 10^3ha

District	1983	1985	1990	1995	2000	2005
Mersing	2.1	2.1	2.1	2.1	2.1	2.1
Kluang	14.1	14.1	14.1	14.1	14.1	14.1
Pontian	22.9	22.1	17.6	12.5	8.8	6.6
Johor Bahru	51.3	51.2	50.2	49.2	48.6	48.6
Kota Tinggi	32.6	32.6	32.6	32.6	32.6	32.6
Total	123.0	122.1	116.6	110.5	106.2	104.0

Table 14 PROJECTED PLANTING AREA OF OIL PALM BY DISTRICT

Unit : 10^3ha

District	1983	1985	1990	1995	2000	2005
Mersing	14.2	14.2	14.2	14.2	14.2	14.2
Kluang	20.9	20.9	20.9	20.9	20.9	20.9
Pontian	6.8	7.9	13.2	15.5	17.3	18.3
Johor Bahru	37.0	38.3	39.5	40.4	40.6	40.8
Kota Tinggi	96.3	97.1	116.8	116.8	116.8	116.8
Total	175.2	178.4	204.6	207.8	209.8	211.0

Table 15 PROJECTED PLANTING AREA OF PINEAPPLE BY DISTRICT

Unit : 10^3ha

District	1983	1985	1990	1995	2000	2005
Kluang	3.5	3.5	3.7	4.0	4.0	4.0
Pontian	4.5	5.5	7.6	9.6	11.9	14.2
Batu Pahat	0.1	0.1	0.1	0.1	0.1	0.1
Total	8.1	9.1	11.4	13.7	16.0	18.3

Table 16 ESTIMATED PROCESSING REQUIREMENT OF RUBBER BY RUBBER FACTORIES IN THE REGION

Unit : DRC/1 10^3 ton

No.	Rubber Factory	1983	1985	1990	1995	2000	2005
1.	Tropical Product	9.9	9.1	6.9	4.9	3.2	2.2
2.	Sykt. Lai Hup Seng	2.0	1.5	1.1	0.8	0.5	0.4
3.	Lam Leong	2.7	2.5	1.9	1.3	0.9	0.6
4.	Hiap Heng Trading	2.1	1.9	1.4	1.0	0.7	0.5
5.	Lee Rubber	3.8	3.5	2.7	1.9	1.2	0.8
6.	Mardec Kulai	9.7	9.7	9.7	9.6	9.6	9.7
7.	Chip Heng	3.8	3.8	3.8	3.8	3.8	3.8
8.	Seng Cheong	4.2	4.2	4.2	4.2	4.2	4.2
9.	Foh Chong	1.2	1.2	1.2	1.2	1.2	1.2
10.	Ladang Kulai	1.2	1.2	1.2	1.2	1.2	1.2
11.	Lee Plantation	9.4	9.4	9.4	9.4	9.4	9.4
12.	Lee Rubber	8.8	8.8	8.8	8.8	8.8	8.8
13.	lee Latex	10.7	10.7	10.7	10.7	10.7	10.7
14.	Ladang Tebrau	7.7	7.7	7.6	7.5	7.7	7.9
15.	Tropical Produce	9.8	9.8	9.8	9.8	9.8	9.8
16.	Ulu Tiram	7.5	7.5	7.5	7.5	7.5	7.5
17.	Tai Tak	0.7	0.7	0.7	0.7	0.7	0.7
18.	Kilang Getah	8.1	8.1	8.0	7.8	7.9	7.6
19.	Keck Seng	10.5	10.5	10.4	10.3	10.7	10.7
20.	Telok Sengat	3.1	3.1	3.1	3.0	2.9	2.7
	Total	116.9	114.9	110.1	105.4	102.6	100.4

/1 Dry Rubber Content

Table 17 ESTIMATED PROCESSING REQUIREMENT OF OIL PALM BY PALM OIL MILLS IN THE REGION

Unit : FFB/1 10^3 ton

No.	Palm Oil Mill	1983	1985	1990	1995	2000	2005
1.	Southern	115.4	115.4	115.4	115.4	115.4	115.4
2.	Kulai	95.7	95.7	95.7	95.7	95.7	95.7
3.	Yule Catto	118.0	118.0	118.0	118.0	118.0	118.0
4.	Fraser	118.0	118.0	118.0	118.0	118.0	118.0
5.	Kulai	96.0	96.0	96.0	96.0	96.0	96.0
6.	South Johor	47.5	47.5	47.5	47.5	47.5	47.5
7.	Kim Long	136.5	136.5	136.5	136.5	136.5	136.5
8.	Ulu Remis	223.5	223.5	223.5	223.5	223.5	223.5
9.	FELDA Belitong (proposed)	-	133.1	148.0	147.7	139.1	136.7
10.	Ulu Sebol	113.8	113.8	113.8	113.8	113.8	113.8
11.	Eng Wei	82.6	82.6	82.6	82.6	82.6	82.6
12.	FELDA Penggeli	138.6	138.9	134.1	129.9	134.9	139.3
13.	FELDA Taib Andak	133.4	132.1	130.4	133.4	140.9	146.6
14.	FELDA Bukit Besar	86.9	84.8	84.0	85.8	98.8	98.5
15.	Kulim Malaysia	151.4	151.4	151.4	151.4	151.4	151.4
16.	Tai Tak	192.1	192.1	192.1	192.1	192.1	192.1
17.	Masai	83.2	83.2	83.2	83.2	83.2	83.2
18.	FELDA Air Tower	158.1	154.5	149.1	147.8	149.4	176.8
19.	FELDA Semencu	218.3	217.2	213.7	207.5	209.5	219.8
20.	FELDA Adela	241.4	240.8	238.3	232.8	234.2	237.4
21.	FELDA Sening	127.6	130.9	196.4	199.3	201.7	197.8
22.	FELDA Lok Heng	228.2	232.1	222.7	224.4	223.2	219.4
23.	Semperna	78.4	78.4	78.4	78.4	78.4	78.4
24.	Sungai Ambat	93.3	93.3	93.3	93.3	93.3	93.3
25.	FELDA Tenggaroh	198.4	282.4	174.8	145.6	164.6	163.1
26.	FELDA Wa Ha (proposed)	-	-	182.1	187.3	190.3	185.3
27.	FELDA Tenggaroh B (proposed)	-	-	211.8	238.2	229.5	216.1
28.	Proposed	68.8	125.0	130.0	120.0	120.0	120.0
29.	Proposed	-	-	126.0	120.0	120.0	120.0
30.	Proposed	-	-	-	111.0	151.0	158.0
	Total	3,345.1	3,617.2	4,086.8	4,176.1	4,252.5	4,280.2

/1 : Fresh Fruit Bunch

Table 18 ESTIMATED PROCESSING REQUIREMENT OF PINEAPPLE BY PINEAPPLE FACTORIES IN THE REGION

Unit : 10^3 tons

No.	Pineapple Factory	1983	1985	1990	1995	2000	2005
1.	Peninsular Plantation Simpamg Renggam	77.4	78.4	88.4	101.6	105.6	108.0
2.	Peninsular Plantation Sicon	-	22.4	23.2	35.6	37.0	40.5
3.	Lee Pineapple	42.0	47.0	55.0	66.0	73.9	83.7
4.	United Malaysian Pineapple Growers	30.9	38.1	43.0	53.3	58.1	67.5
5.	Pineapple Cannery of Malaysia	26.5	33.6	40.6	50.8	55.4	72.9
6.	Proposed	-	-	19.1	38.1	52.8	64.8
7.	Proposed	-	-	-	-	37.0	54.0
	Total	176.8	219.5	269.3	345.4	419.8	491.4

Table 19 PROJECTED PROCESSING WATER DEMAND BY RUBBER FACTORIES IN THE REGION

Unit : 10^3 m^3/y

No.	Rubber Factory (Type of Product)	1983	1985	1990	1995	2000	2005
1.	Tropical Product (SMR)	164	151	114	82	53	36
2.	Sykt. Lai Hup Seng (Crepe)	20	15	11	8	5	4
3.	Lam Leong (SMR)	44	41	31	22	14	10
4.	Hiap Heng Trading (Crepe)	21	19	14	10	7	5
5.	Lee Rubber (SMR)	64	58	44	32	20	14
6.	Mardec Kulai (Latex)	97	97	97	96	96	97
7.	Chip Heng (SMR)	63	63	63	63	63	63
8.	Seng Cheong (SMR)	69	69	69	69	69	69
9.	Foh Chong (SMR)	20	20	20	20	20	20
10.	Ladang Kulai (SMR, Latex)	20	20	20	20	20	20
11.	Lee Plantation (Latex)	94	94	94	94	94	94
12.	Lee Rubber (SMR)	147	147	147	147	147	147
13.	Lee Latex (Latex)	107	107	107	107	107	107
14.	Ladang Tebran (SMR)	127	127	126	124	128	131
15.	Tropical Produce (Latex)	98	98	98	98	98	98
16.	Ulu Tiram (SMR)	125	125	125	125	125	125
17.	Tai Tak (SMR)	11	11	11	11	11	11
18.	Kilang Getah (SMR)	135	135	133	130	130	127
19.	Keck Seng (SMR)	174	174	173	171	178	178
20.	Telok Sengat (SMR)	52	51	51	50	50	44
	Total	1,652	1,622	1,548	1,480	1,435	1,400

Table 20 PROJECTED PROCESSING WATER DEMAND BY PALM OIL MILLS IN THE REGION

Unit : 10^3 m^3/y

No.	Palm Oil Mill	1983	1985	1990	1995	2000	2005
1.	Southern	167	167	167	167	167	167
2.	Kulai	139	139	139	139	139	139
3.	Yule Catto	171	171	171	171	171	171
4.	Fraser	171	171	171	171	171	171
5.	Kulai	139	139	139	139	139	139
6.	South Johor	69	69	69	69	69	69
7.	Kum Long	198	198	198	198	198	198
8.	Ulu Remis	324	324	324	324	324	324
9.	FELDA Belitong (proposed)	-	193	215	214	202	198
10.	Ulu Sebol	165	165	165	165	165	165
11.	Eng Wei	120	120	120	120	120	120
12.	FELDA Penggeli	201	201	194	188	196	202
13.	FELDA Taib Andak	193	192	189	193	204	213
14.	FELDA Bukit Besar	126	123	122	124	143	143
15.	Kulim Malaysia	220	220	220	220	220	220
16.	Tai Tak	279	279	279	279	279	279
17.	Masai	121	121	121	121	121	121
18.	FELDA Air Tower	229	224	216	214	217	256
19.	FELDA Semencu	317	315	310	301	304	319
20.	FELDA Adela	350	349	346	338	340	344
21.	FELDA Sening	185	190	285	289	293	287
22.	FELDA Lok Heng	331	337	323	325	324	318
23.	Semperna	114	114	114	114	114	114
24.	Sungai Ambat	135	135	135	135	135	135
25.	FELDA Tenggaroh	288	410	254	211	239	237
26.	FELDA Wa Ha (proposed)	-	-	264	272	276	269
27.	FELDA Tenggaroh B (proposed)	-	-	307	345	333	313
28.	Proposed	100	181	188	174	174	174
29.	Proposed	-	-	183	174	174	174
30.	Proposed	-	-	-	161	219	229
	Total	4,852	5,247	5,928	6,055	6,170	6,208

Table 21 PROJECTED PROCESSING WATER DEMAND BY PINEAPPLE FACTORIES IN THE REGION

Unit : 10^3 m^3/y

No.	Pineapple Factory	1983	1985	1990	1995	2000	2005
1.	Peninsular Plantation Simpang Renggam	209	212	239	274	285	292
2.	Peninsular Plantation Sicon	-	60	63	96	100	109
3.	Lee Plantation	113	127	149	178	200	226
4.	United Malaysian Pineapple Growers	83	103	116	144	157	182
5.	Pineapple Cannery of Malaysia	72	91	110	137	150	197
6.	Proposed	-	-	52	103	143	175
7.	Proposed	-	-	-	-	100	146
	Total	477	593	729	932	1,135	1,327

Table 22 FEATURE OF IRRIGATED PADDY SCHEMES IN THE REGION

Description		Scheme: Lukut	Scheme: Ulu Benut
1. Location			
District		Kota Tinggi	Kluang
River Basin		R. Johor	R. Benut
2. History			
Year of Initial Completion		1940	1969
Year of Rehabilitation		1980-87	1978-83
3. Irrigation Area			
Main Season Paddy (ha)		78	177
Off Season Paddy (ha)		-	177
4. Water Source & Type of Scheme			
Water Source		R. Lalang	R. Benut
Type of Scheme		Gravity	Gravity
Catchment Area at Intake (km^2)		4.6	26.9
5. Feature of Existing Facilities			
Diversion Weir:	Gate size (m)	1.5 x 2.0	6.0 x 1.5
	Gate nos.	3	2
Main Canal:	Type	Earth	Concrete
	Length (km)	1.31	1.65
Field Canal:	Type	Concrete	Concrete
	Length (km)	1.18	5.14
Field Drain:	Length (km)	1.48	4.49
River Band:	Length (km)	-	1.97
6. Extension Plan			
Irrigation Area (ha)		26	50
Main Canal (km)		0.24	-
Field Canal (km)		2.55	1.09
Main Drain (km)		0.66	-
Field Drain (km)		1.22	
7. Canal Density in Future			
Field Canal (km/ha)		35.9	35.2
Field Drain (km/ha)		26.0	25.4

Table 23 10-DAY OPEN WATER EVAPORATION AT KOTA TINGGI

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily Evaporation (mm/d)												
1 - 10	4.7	5.2	5.4	5.2	5.0	4.8	4.6	4.7	5.0	5.1	4.9	4.6
11 - 20	4.8	5.3	5.4	5.1	5.0	4.7	4.6	4.8	5.1	5.1	4.8	4.5
21 - End	5.0	5.4	5.3	5.0	4.9	4.6	4.6	4.9	5.1	5.0	4.7	4.5
Average	4.8	5.3	5.4	5.1	5.0	4.7	4.6	4.8	5.1	5.1	4.8	4.5
10-day Evaporation (mm)												
1 - 10	47	52	54	52	50	48	46	47	50	51	49	46
11 - 20	48	53	54	51	50	47	46	48	51	50	48	45
21 - End	54	42	58	51	55	47	52	54	51	56	47	50
Total	149	147	166	154	155	142	144	149	152	157	144	141

Annual Total 1,800 mm

Table 24 10-DAY IRRIGATION WATER DEMAND FOR THE LUKUT IRRIGATION SCHEME

Unit : m^3/s

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1983 (78 ha)												
1 - 10	0.08	0.11	0.12	0.07	0.01	0	0	0	0	0	0	0.07
11 - 20	0.09	0.11	0.10	0.04	0.01	0	0	0	0	0	0	0.07
21 - End	0.11	0.11	0.08	0.02	0	0	0	0	0	0	0	0.07
Average	0.10	0.11	0.10	0.04	0.01	0	0	0	0	0	0	0.07
1990 onward (104 ha)												
1 - 10	0.11	0.16	0.16	0.09	0.03	0	0	0	0	0	0	0.09
11 - 20	0.13	0.16	0.13	0.06	0.03	0	0	0	0	0	0	0.09
21 - End	0.15	0.16	0.11	0.03	0	0	0	0	0	0	0	0.09
Average	0.13	0.16	0.13	0.06	0.02	0	0	0	0	0	0	0.09

Table 25 10-DAY IRRIGATION WATER DEMAND FOR THE ULU BENUT IRRIGATION SCHEME

Unit : m^3/s

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1983 (177 ha)												
1 - 10	0.20	0.21	0.19	0.03	0.16	0.16	0.18	0.15	0.06	0	0	0.16
11 - 20	0.21	0.21	0.15	0	0.19	0.15	0.18	0.11	0.03	0	0.06	0.16
21 - End	0.21	0.19	0.11	0.11	0.19	0.16	0.18	0.09	0	0	0.11	0.16
Average	0.21	0.20	0.15	0.05	0.18	0.16	0.18	0.12	0.03	0	0.06	0.16
1990 onward (227 ha)												
1 - 10	0.26	0.28	0.24	0.03	0.21	0.21	0.23	0.19	0.07	0	0	0.21
11 - 20	0.28	0.28	0.19	0	0.24	0.19	0.23	0.15	0.04	0	0.07	0.21
21 - End	0.28	0.24	0.15	0.15	0.24	0.21	0.23	0.11	0	0	0.15	0.21
Average	0.27	0.27	0.19	0.06	0.23	0.20	0.23	0.15	0.04	0	0.07	0.21

Table 26 IRRIGATION AREA AND WATER DEMAND IN THE REGION

Item		Scheme		
		Lukut	Ulu Benut	Total
Irrigation Area (ha)				
1983	Main	78	177	255
	Off	0	177	177
1990 onward	Main	104	227	331
	Off	0	227	227
Irrigation Water Demand (10^6 m^3/year)				
1983		1.09	3.90	4.99
1990 onward		1.45	5.01	6.46

FIGURES

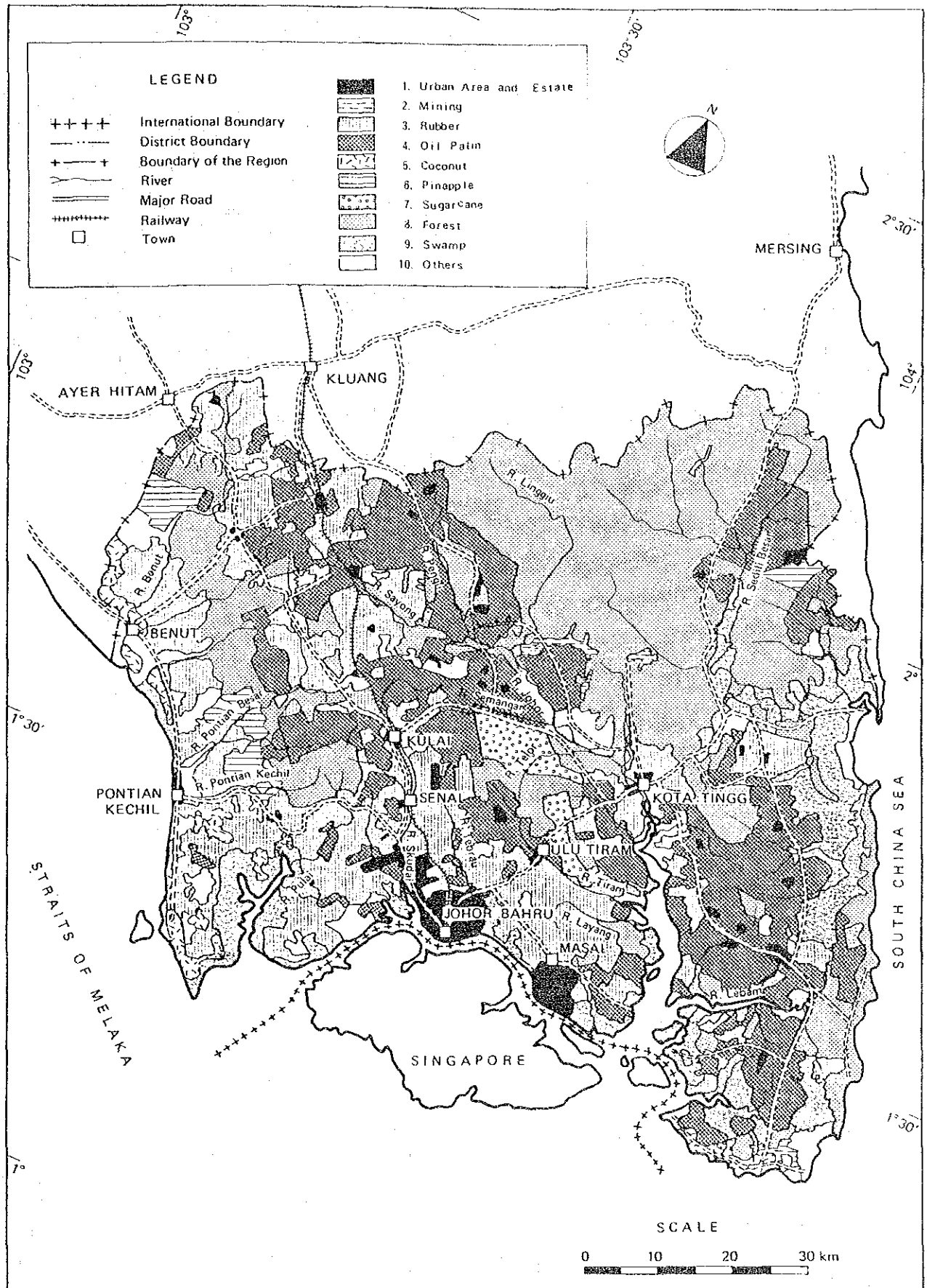

Fig. 1 General Land Use Map

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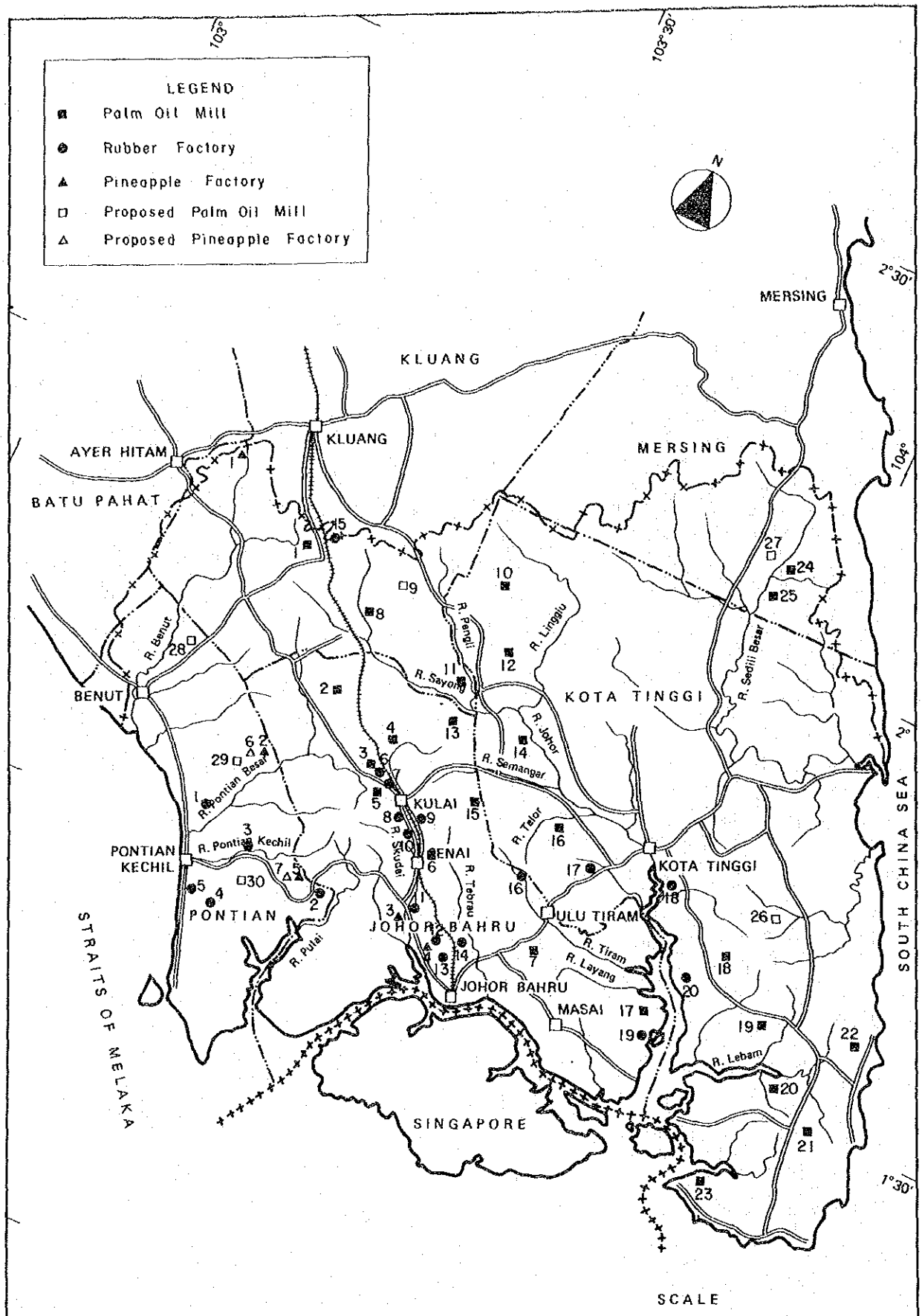

Fig.2 Location of the Existing and Proposed Processing Facilities in the Region

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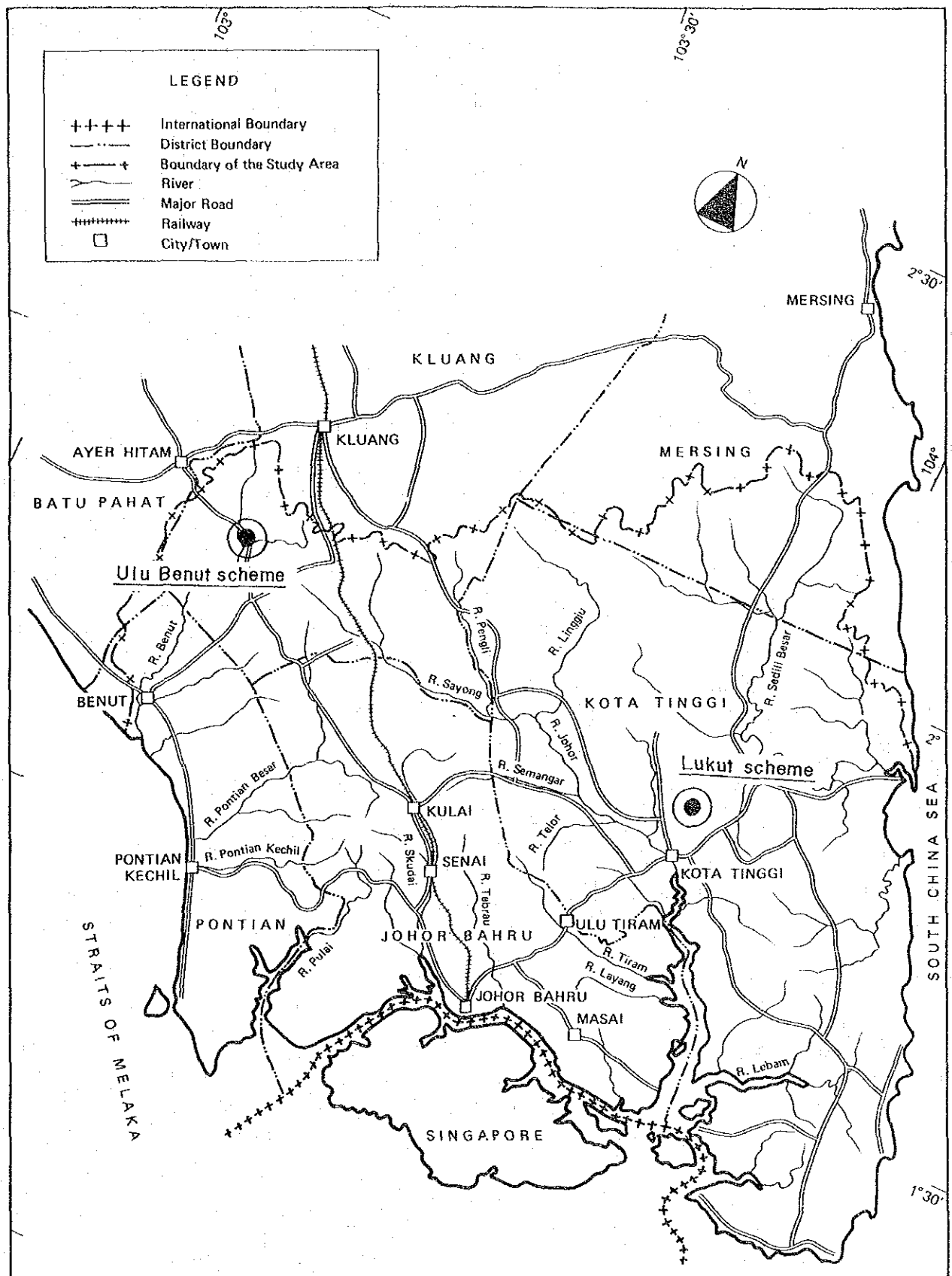

Fig. 3 Location of Irrigation Schemes

SCALE
0 10 20 30 km

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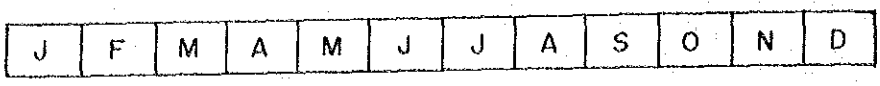
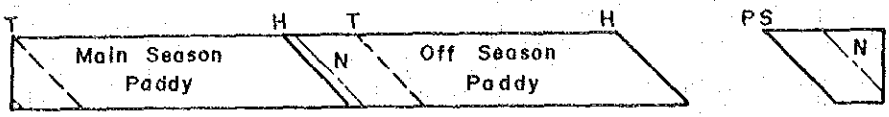


Cropping Pattern

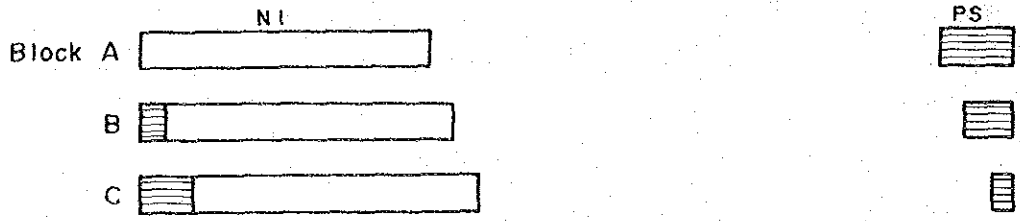
1. Lukut Scheme

2. Ulu Benut Scheme

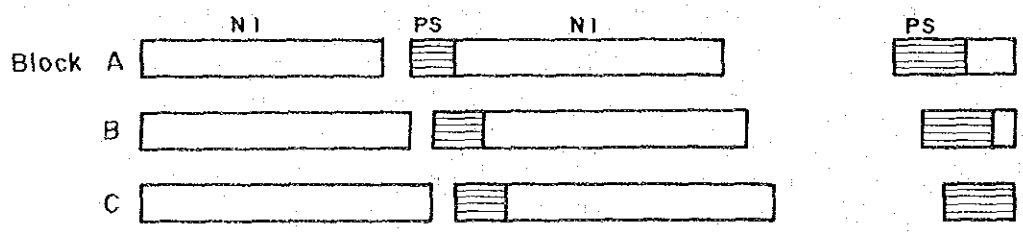


Irrigation Schedule

1. Lukut Scheme



2. Ulu Benut



Remarks , PH : Presaturation, N : Nursery , T : Transplanting
H : Harvest , NI : Normal irrigation period

Fig . 4 Proposed Cropping Pattern and Irrigation Schedule

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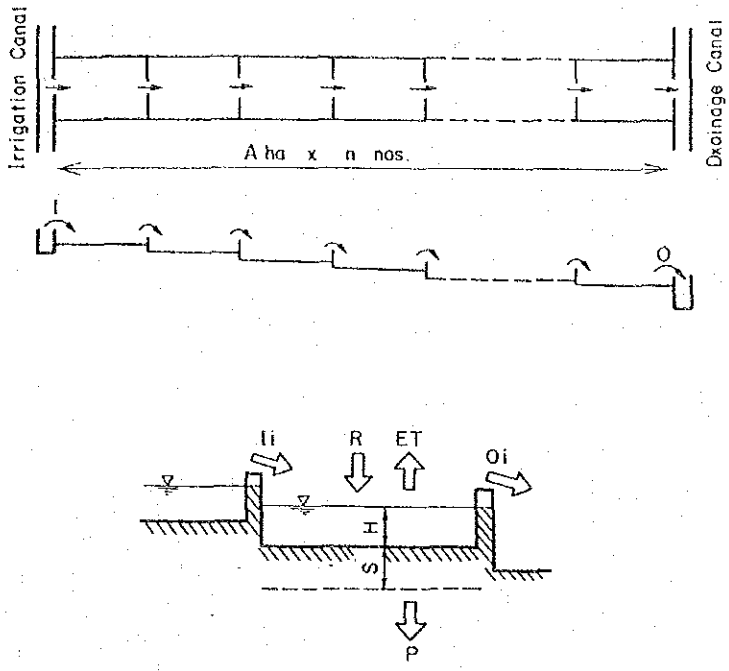


Remarks;

Input data and output of the computer model for the plot-to-plot irrigation are as follows:

Input data

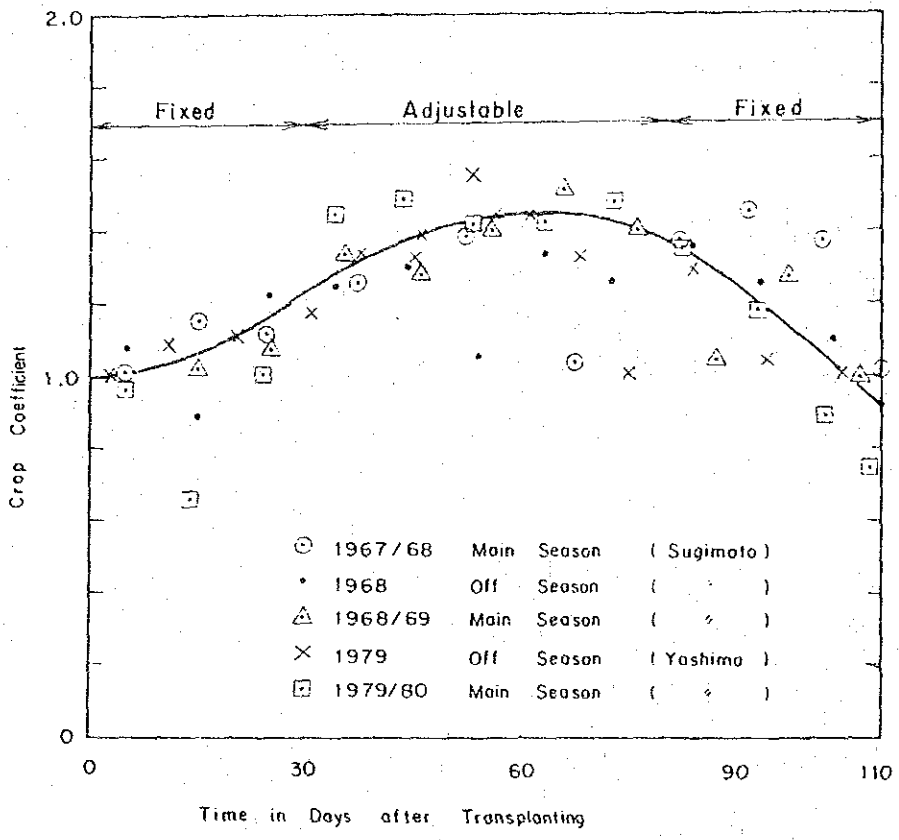
R : Daily rainfall in mm (saved in file in the computer system)
Io : Irrigation supply in m^3/s (10-day mean discharge)
ET : Crop evapotranspirating in mm/d
P : Percolation rate in mm/d
A : Average size of paddy plot in ha
n : Number of continuous plot
S : Water depth for soil saturation in mm
H : Height of spillway of each plot in mm
Hmax: Maximum water depth on the terminal plot in mm
Hmin: Minimum water depth on the terminal plot in mm

Output

Daily water depth on the terminal plot in mm
Daily irrigation supply in m^3/s
Daily outflow from the terminal plot in mm
Monthly rainfall in m^3/month
Monthly irrigation supply in m^3/month
Monthly outflow from the terminal plot in m^3/month
Monthly water loss in m^3/month (ET + P)

Source ; Ref. 3

Fig. 5 Plot-to-Plot Irrigation Model



Remarks. This figure is for 135-day variety.
In case of variety with deferent growing period, proportional adjustment of the cuve is necessary in the above "Adjustable" portion.

Fig. 6 Variation of Crop Coefficient with Growing Stage

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