Unit: Person (%)

Education Level	Scheme			State of P. Pinang*
	Sg. Kulim I	Sg. Kulim II	Total	
a. No schooling	6 (10)	9 (6)	15 (7)	16 (16)
b. Primary	38 (60)	112 (77)	150 (72)	77 (77)
c. Form 1-3	8 (13)	13 (9)	21 (10)	6 (6)
d. Form 4-5	8 (13)	11 (7)	19 (9)	1 (1)
e. Form 6	1 (2)	1 (1)	2 (1)	0 (0)
f. College level	1 (2)	0 (0)	1 (1)	0 (0)
Total Respondents	63 (100)	146 (100)	209 (100)	100 (100)

*Remarks: *; Results of JICA Sample Survey 1989*

2.2 Economic and Living Conditions

(1) Annual revenue

The annual average gross income of the sample farm households was estimated to be M$9,750 as shown below. The annual average farm income amounted to M$8,000, accounting for 82% of the annual average gross income. The subsidiary businesses in the two scheme areas comprise the rubber tapping, blue color works, part-time jobs and other activities which come under odd jobs (Kerja Kampung).

Unit: Household (%)

Annual Revenue (M$)	Scheme			State of P. Pinang*
	Sg. Kulim I	Sg. Kulim II	Total	
a. 1 - 1,000	0 (0)	2 (1)	2 (1)	5 (5)
b. 1,001 - 2,000	0 (0)	4 (3)	4 (2)	4 (4)
c. 2,001 - 3,000	2 (3)	3 (2)	5 (2)	21 (21)
d. 3,001 - 4,000	3 (5)	8 (6)	11 (5)	9 (9)
e. 4,001 - 5,000	3 (5)	15 (9)	18 (8)	6 (6)
f. 5,001 - 6,000	7 (11)	8 (6)	15 (7)	9 (9)
g. 6,001 - 7,000	8 (13)	10 (7)	18 (9)	4 (4)
h. 7,001 - 8,000	6 (10)	8 (5)	14 (7)	6 (6)
i. 8,001 - 9,000	6 (10)	4 (3)	10 (5)	4 (4)
j. 9,001 - 10,000	4 (6)	7 (5)	11 (5)	3 (3)
k. 10,000 - 11,000	5 (8)	7 (5)	12 (6)	6 (6)
l. 11,001 - 12,)00	2 (3)	8 (6)	10 (5)	1 (1)
m. 12,001 - 13,000	2 (3)	5 (3)	7 (3)	1 (1)
n. 13,001 - 14,000	2 (3)	6 (4)	8 (4)	1 (1)
o. 14,001 - 15,000	1 (2)	11 (8)	12 (6)	3 (3)
p. Above 15,000	12 (19)	40 (27)	52 (25)	9 (9)
q. No income/no answer	0 (0)	0 (0)	0 (0)	8 (8)
Total Respondents	63 (100)	146 (100)	209 (100)	100 (100)

(2) Important or remunerative activity

For the question "what is the most important or remunerative activity", 88% of the respondents indicated "paddy cultivation" as shown below. Other activities are "part-time job" selected by 16% of the respondents, "upland cash crops" by 15%, "government service" by 14%, and "blue collar work" by 10%.

Unit: Nos. of responses (%)

Activities	Scheme		
	Sg. Kulim I	Sg. Kulim II	Total
a. Paddy cultivation	51 (81)	133 (91)	184 (88)
b. Upland cash crop	15 (24)	15 (10)	30 (15)
c. Tree crop cultivation	1 (2)	4 (3)	5 (2)
d. Fruit crop cultivation	0 (0)	0 (0)	0 (0)
e. Animal breeding	0 (0)	3 (2)	3 (1)
f. Business	2 (3)	9 (6)	11 (5)
g. Part-time job	16 (25)	18 (12)	34 (16)
h. Government service	4 (6)	26 (18)	30 (15)
i. Skilled work	4 (6)	7 (5)	11 (5)
j. Blue collar work	6 (10)	14 (10)	20 (10)
k. Others	2 (3)	15 (10)	17 (8)
Total Respondents	63	146	209
No. of Responses*	101 (160)	244 (167)	345 (165)

*Remarks: *; Selecting multiple answers.*

The electrification rate runs up to 94% in the two scheme areas. Due to such higher rate, the electric appliances are well diffused: TV set owned by 92% of the respondents, radio/cassette by 89%, electric fan by 69%, sewing machine by 56% and refrigerator by 50%. The piped water is already installed in 92% of the respondent farm households. As for the cooking fuel, 64% of farmers use gas followed by oil of 29%, firewood of 28% and electricity of 1%.

To look into the community relationship, the existence of and participation in farmers' organizations are shown below. The participation rate of 89% in the Sungai Kulim I and II scheme areas is very high compared to 58% at the State level.

Unit: Person (%)

Status	Scheme		
	Sg. Kulim I	Sg. Kulim II	Total
a. Participated	51 (81)	135 (93)	186 (89)
b. Available, but not participated	8 (13)	9 (6)	17 (8)
c. No farmers' association	4 (6)	2 (1)	6 (3)
Total Respondents	63 (100)	146 (100)	209 (100)

The participation rate of farmers in rural communities, accounts for only 18% in the two selected scheme areas. Such features seem to be due to the promotion of agricultural development projects and impending urbanization pressure in the Kulim I and II scheme areas.

Unit: Person (%)

Status	Scheme		
	Sg. Kulim I	Sg. Kulim II	Total
a. Participated	17 (27)	21 (14)	38 (18)
b. Available, but not participated	18 (29)	23 (16)	41 (20)
c. No farmers' association	28 (44)	102 (70)	130 (62)
Total Respondents	63 (100)	146 (100)	209 (100)

2.3 Farming Conditions

In the two scheme areas, 69% of the respondent farmers are "pure-tenants" as shown below. While, 24% of the respondents are "owner-operators" and 7% are the mixed tenure category of "owner-tenant" consisting of farmers who operated their own land but augmented their holdings with some rented land. Of tenants, 93% paid their rent on a fixed cash basis.

Unit: Person (%)

Tenure Status	Scheme		
	Sg. Kulim I	Sg. Kulim II	Total
a. Owner-operator	13 (21)	38 (26)	51 (25)
b. Pure-tenant	45 (71)	99 (68)	144 (69)
c. Owner-tenant	5 (8)	9 (6)	14 (6)
Total Respondents	63 (100)	146 (100)	209 (100)

The sizes of total farm land in the Kulim I and II scheme areas shows the following distribution pattern.

Unit: Person (%)

Farm Land (ha)	Scheme		
	Sg. Kulim I	Sg. Kulim II	Total
a. None	51 (81)	123 (84)	174 (82)
b. Less than 0.4	1 (2)	3 (2)	4 (2)
c. 0.4 - 0.7	4 (6)	6 (4)	10 (5)
d. 0.8 - 1.2	4 (6)	10 (7)	14 (7)
e. 1.3 - 1.5	0 (0)	0 (0)	0 (0)
f. 1.6 - 2.0	1 (2)	0 (0)	1 (1)
g. 2.1 - 3.0	0 (0)	3 (2)	3 (1)
h. 3.1 - 4.0	2 (3)	0 (0)	2 (1)
i. 4.1 - 5.0	0 (0)	0 (0)	0 (0)
j. 5.1 - 6.0	0 (0)	0 (0)	0 (0)
k. 6.1 - 7.0	0 (0)	1 (1)	1 (1)
l. Above 7.0	0 (0)	0 (0)	0 (0)
Total Respondents	63 (100)	146 (100)	209 (100)

In the two selected scheme areas, the distribution pattern of actual paddy planting area is different from that of farm land holding size as below.

Unit: Person (%)

Paddy Planted Area (ha)	Scheme		
	Sg. Kulim I	Sg. Kulim II	Total
a. None	8 (12)	10 (6)	18 (9)
b. Less than 0.4	1 (2)	5 (4)	6 (3)
c. 0.4 - 0.7	11 (17)	34 (23)	45 (22)
d. 0.8 - 1.2	26 (41)	35 (24)	61 (29)
e. 1.3 - 1.5	1 (2)	2 (1)	3 (1)
f. 1.6 - 2.0	5 (8)	25 (17)	30 (15)
g. 2.1 - 3.0	8 (12)	15 (10)	23 (11)
h. 3.1 - 4.0	1 (2)	6 (5)	7 (3)
i. 4.1 - 5.0	1 (2)	2 (1)	3 (1)
j. 5.1 - 6.0	0 (0)	3 (2)	3 (1)
k. 6.1 - 7.0	0 (0)	4 (3)	4 (2)
l. Above 7.0	1 (2)	5 (4)	6 (3)
Total Respondents	63 (100)	146 (100)	209 (100)

Of the active farmers, 63% are cultivating no more than 1.2 ha, showing the preponderance of small uneconomic farm holdings. This suggests a strong dependence on off-farm jobs for a large proportion of

the households. The small farm size seems to arise from the interplay of two factors: scarcity of land due to urbanization pressure and inheritance custom among the Malays. Of the respondents, 39% own only one paddy field lot, while 54% have two or more parcels. As regards the progressive fragmentation of lands, 96% answer "no effective/good measure" to prevent it and 3% of the respondents express the plan to lease/rent their land.

For the question "do you have irrigation facilities in your paddy fields", 67% of the respondents answer "yes - whole field", while 31% reply "yes - partly".

Of the respondent farmers, 77% consider that water is sufficient for the main season, while 19% reply "not sufficient". The situation is more severe in the off season with the proportion of 52% for "sufficient" and 48% for "not sufficient". The present condition of irrigation facilities is clarified by sample farmers' replies indicating that water supply conditions are much better in the Sungai Kulim I than those in the Sungai Kulim II scheme area throughout the year. Among others, the pollution of irrigation water is aggravating due to the increase of pollutant sources including sewage/rubbish, industrial waste and piggery.

Unit: Person (%)

Quantity of Water Supply	Scheme		
	Sg. Kulim I	Sg. Kulim II	Total
Main Season			
a. Sufficient	45 (82)	101 (75)	146 (77)
b. Not sufficient	10 (18)	33 (25)	43 (23)
Total Respondents	55 (100)	134 (100)	189 (100)
Off-Season			
a. Sufficient	39 (71)	60 (45)	99 (52)
b. Not sufficient	16 (29)	74 (55)	90 (48)
Total Respondents	55 (100)	134 (100)	189 (100)

For the question on the present conditions of irrigation and drainage facilities in the Sungai Kulim I and II scheme areas, 23% of the farmers interviewed express "not good".

Unit: Person (%)

Rate	Scheme		
	Sg. Kulim I	Sg. Kulim II	Total
a. Very good	5 (8)	4 (3)	9 (4)
b. Good	32 (51)	48 (33)	80 (38)
c. Fairly good	17 (27)	53 (36)	70 (34)
d. Not good	8 (13)	40 (27)	48 (23)
e. No answer	1 (1)	1 (1)	2 (1)
Total Respondents	63 (100)	146 (100)	209 (100)

Mechanization has proceeded swiftly since adoption of double-cropping, especially in land preparation and harvesting.

To the question "whether farmers fully utilize their paddy field currently", 94% of the respondents answer "yes". The survey results reveal that the idle paddy fields occur by such reasons as lack of drainage facilities, insufficient water supply and ravage of rats, birds and/or insects. The idle paddy fields in the two selected scheme areas occurred in the beginning of 1980's.

3 FARMERS' INTENTIONS ON CROP DIVERSIFICATION

3.1 Intention towards Continuation of Paddy Cultivation

To the question "do you have the intention to convert presently paddy planted area into other crop fields", 90% of the respondents answer "no" in the negative as shown below. This result suggests the difficulty to realize the agricultural innovation within a short period. Those who answered in the negative indicate such reasons as unsuitability of land for other crops than paddy, need of much cares, attachment to paddy cultivation and tenancy of land. Although the preponderance of negative responses are not encouraging, their attitudes are understandable and would be changed by demonstrating that crop diversification is technically and financially feasible.

Unit: Person (%)

Intention	Scheme		
	Sg. Kulim I	Sg. Kulim II	Total
a. Yes - actively	3 (5)	5 (4)	8 (4)
b. Yes - to some extent	3 (5)	7 (5)	10 (5)
c. No	49 (90)	125 (90)	174 (90)
d. Don't know/no plan	0 (0)	1 (1)	1 (1)
Total Respondents	55 (100)	138 (100)	193 (100)

Regarding their intentions and expectations on the future farming operations, 80% of the respondents say "expecting to continue paddy cultivation", followed by 16% for "expecting to introduce crop diversification" and 4% for "expecting to convert" to tree planting.

3.2 Problems and Difficulties towards Crop Diversification

To the question "what type of problems and/or difficulties they encountered in their farming operation towards crop diversification?", the interviewed farmers' replies are summarized below.

Unit: nos of responses %

Problems & constraints	Study Area in P. Pinang		
	S. Kulim I	S. Kulim II	Total
a. Inefficient irrigation/ insufficient water supply	31 (49)	84 (57)	115 (55)
b. Poor drainage	17 (27)	50 (34)	67 (32)
c. Lack of fund/machinery	47 (74)	93 (63)	140 (67)
d. Labour shortage	25 (39)	47 (32)	72 (34)
e. Marketing difficulty	39 (62)	51 (35)	90 (43)
f. Frequent pest and diseases	46 (73)	124 (85)	170 (81)
g. Natural disaster	9 (14)	25 (17)	34 (16)
h. Poor access road	6 (10)	12 (8)	18 (8)
i. Ravage by wild animals due to no fencing	1 (2)	0 (0)	1 (1)
j. No cooperation among farmers	1 (2)	1 (1)	2 (1)
k. Unsuitable land	0 (0)	1 (1)	1 (1)
l. No land to expand	1 (2)	1 (1)	2 (1)
m. Others	0 (0)	2 (2)	2 (1)
n. No problem/difficulty	1 (2)	2 (2)	3 (2)
No. of Respondents [*]	63	146	209
Total No. of Responses	224 (356)	493 (338)	717 (343)

Note: [*] Multiple answers are given.

Major problems are frequent pest and diseases selected by 81% of the respondents, lack of fund/machinery by 67%, inefficient irrigation/insufficient water supply by 55%, and marketing difficulty by 43%.

3.3 Main Concerns to Introduce Crop Diversification

To the another question "what are your concerns to introduce crop diversification in the paddy fields", 63% of the respondent farmers indicated "finance", followed by "marketing" pointed out by 45% of the respondents, "technique" by 41%, "labour" by 29% and others by 14%, as summarized below.

Unit: Nos. of responses (%)

Main Concerns	Scheme		
	Sg. Kulim I	Sg. Kulim II	Total
a. Finance	51 (81)	81 (55)	132 (63)
b. Technique	28 (44)	57 (39)	85 (41)
c. Marketing	34 (54)	61 (42)	95 (46)
d. Labour	21 (33)	40 (27)	61 (29)
e. Others	11 (18)	19 (13)	30 (14)
f. None	2 (3)	30 (21)	32 (15)
Total Respondents	63	146	209
No. of Responses*	147 (233)	288 (197)	435 (208)

*Remarks: *; Selecting multiple answer.*

For the smooth and effective implementation of crop diversification, 40% of the respondents express the hope to get principal assistance components such as finance, technology and marketing as a package. About the necessary funds for introduction or expansion of crop diversification, 66% answer that they have an idea to raise them.

3.4 Preferred Organizations

The organizations that farmers prefer to have recourse to in financing, extension service and marketing are as follows. The respondents give their replies in a multiple answering manner.

Unit: Person (%)

Preferred Organization	Scheme		
	Sg. Kulim I	Sg. Kulim II	Total
Financing			
a. BPM	33 (52)	56 (38)	89 (43)
b. Farmers' organization	10 (16)	20 (14)	30 (14)
c. DOA	5 (8)	7 (5)	12 (6)
d. Own fund	43 (5)	7 (5)	10 (5)
e. RISDA	2 (3)	0 (0)	2 (1)
f. No idea	21 (33)	67 (46)	88 (42)
Extension Service			
a. MARDI	26 (41)	41 (28)	67 (32)
b. State DOA	10 (16)	38 (26)	48 (23)
c. Farmers' organization	19 (30)	28 (19)	47 (22)
d. No idea	17 (27)	61 (42)	78 (37)
Marketing			
a. FAMA	37 (59)	77 (53)	114 (55)
b. Own connection	14 (22)	20 (14)	34 (16)
c. Farmers' organization	6 (10)	8 (5)	14 (7)
d. No idea	14 (22)	58 (40)	72 (34)

3.5 Diversified Crops and Marketing

As for most promising and profitable crops, 47% of the interviewed farmers cite maize followed by 35% for okra, 26% for cucumber and 23% for chilli. About marketing these diversified crops, 47% of the respondent farmers say "a little bit worried". Those who answer "very promising" account for only 17% of the total respondents, while 27% answer "no perspective" on the marketing of diversified crops.

To the question "where do you aim to deliver your diversified crops in the future", 53% of the respondents cite "local market", followed by 30% for "neighboring urban center".

As preferred farming system, 49% of the respondents indicate "individual operation" whereas another 49% are in favour of "group farming". About the existence of candidate leading farmer in the neighborhood, 90% reply "yes".

3.6 Requirements for Crop Diversification

Farmers' requirements for implementation of crop diversification program are summarized below. The respondents give their replies in a multiple answering manner.

Unit: No. of responses (%)

Requirements for Crop Diversification	Scheme		
	Sg. Kulim I	Sg. Kulim II	Total
Irrigation Facilities			
a. Rehabilitation/upgrading of the existing irrigation system	36 (57)	95 (65)	131 (63
b. Introduction of sprinkler irrigation facility	35 (56)	60 (41)	95 (45)
c. Construction of the irrigation facility	5 (8)	36 (25)	41 (20)
Drainage Facilities			
a. Rehabilitation/upgrading of the existing drainage facility	47 (75)	107 (73)	154 (74
b. Construction of new drainage facilities	10 (16)	32 (22)	42 (20)
c. Construction or improvement of flood protection structure	5 (8)	12 (8)	17 (8)
Farm Roads			
a. Rehabilitation/upgrading of existing roads	29 (46)	59 (40)	88 (42)
b. Construction of new farm road	12 (19)	24 (16)	36 (17)

3.7 Utilization of Idle Paddy Fields

To the question "what do you think about the idea that your area is to be converted to high value crop cultivation area", 55% of the interviewed farmers are in favour of the conversion to high value crop cultivation including 30% of the respondents saying "good idea" and 16% of the interviewed farmers are "welcomed with certain conditions" as below. However, 41% of the sample farmers answer in the negative comprising 21% for "difficult" and 20% for "impossible".

Unit: Person (%)

Opinions	Scheme		
	Sg. Kulim I	Sg. Kulim II	Total
a. Good idea	30 (48)	52 (36)	82 (39)
b. Welcomed with certain conditions	9 (14)	25 (17)	34 (16)
c. Difficult	12 (19)	32 (22)	44 (21)
d. Impossible	12 (19)	29 (20)	41 (20)
e. No answer/don't know	0 (0)	8 (5)	8 (4)
Total Respondents	63 (100)	146 (100)	209 (100)

Those who say "difficult" and "impossible" to introduce the high value crop cultivation give the following reasons. They give their replies in a multiple answering manner.

Unit: No. of responses (%)

Reasons for Difficulty	Scheme		
	Sg. Kulim I	Sg. Kulim II	Total
Saying "Difficult"			
a. Land is not suitable for other crops than paddy	8 (67)	20 (63)	28 (64)
b. Paddy cultivation is more profitable and needs less labours	2 (17)	7 (22)	9 (20)
c. Existence of land use problem between tenant farmers and landlord	1 (8)	4 (13)	5 (11)
d. More time needed to produce other crops	1 (8)	2 (6)	3 (7)
e. No experience	0 (0)	2 (6)	2 (5)

Unit: No. of responses (%)

Reasons for Difficulty	Scheme		
	Sg. Kulim I	Sg. Kulim II	Total
Saying "Impossible"			
a. Land is not suitable for other crops than paddy	6 (50)	18 (62)	24 (59)
b. Rented land/not own land	3 (25)	8 (28)	11 (17)
c. Lack of experience	1 (8)	4 (14)	5 (12)
d. Need of too much care	1 (8)	2 (7)	3 (7)
e. Drainage problem	1 (8)	2 (7)	3 (7)
f. Natural disaster like drought & pest	0 (0)	2 (7)	2 (5)
g. Can not expect big profit from crop diversification	2 (17)	0 (0)	2 (5)
h. No more intention to continue to work on farm	0 (0)	1 (3)	1 (2)
i. Others	0 (0)	1 (3)	1 (2)

3.8 Perspective and Prospect on High Value Crops

About the perspective/prospect on the introduction of high value crops, 38% of the respondents manifest the optimistic views including 10% of the respondents saying "very promising" and 28% answering "promising in general trend".

Unit: Person (%)

Perspective and Prospect	Scheme		
	Sg. Kulim I	Sg. Kulim II	Total
a. Very promising	7 (11)	15 (10)	22 (10)
b. Promising in general trend	23 (37)	35 (24)	58 (28)
c. Risky	25 (40)	56 (38)	81 (39)
d. Don't know/no answer	8 (12)	40 (28)	48 (23)
Total Responses	63 (100)	146 (100)	209 (100)

Those who answer "risky" point out the reasons as low yield and small profit by 25% of them, not interested/prefer to plant paddy by 25%, land is only suitable for paddy planting by 17%, no experience by 16%, unstable market by 12% and no cooperation among farmers and/or limited participation of farmers by 12% in a multiple answering manner.

3.9 Government Involvement

To the final question "what kind of assistance or support do you expect from the Government agencies for conversion of your land to the high value crop cultivation of your land to the high value crop cultivation area", they express the following expectations and requirements in a multiple answering manner.

Unit: No. of responses (%)

Expectations/ Requirements	Scheme		
	Sg. Kulim I	Sg. Kulim II	Total
a. finance (Land & Credit)	59 (93)	119 (81)	178 (85)
b. Agronomic technology (extension services & training)	53 (84)	114 (78)	167 (80)
c. Marketing development	51 (81)	106 (73)	157 (75)
d. Mechanization support (rental & credit)	52 (83)	103 (71)	155 (74)
e. Improvement of irrigation facility	37 (59)	100 (68)	137 (66)
f. Improvement of drainage facility	36 (57)	82 (56)	118 (56)
g. Institutional arrangements (irrigation of idle lands & group farming, etc.)	19 (30)	40 (27)	59 (28)
h. Input support (insecticide, fertilizer, seeds)	7 (12)	23 (16)	30 (15)
i. Others	0 (0)	1 (1)	1 (0)
j. None	2 (3)	14 (10)	16 (8)
Total Respondents	63	146	209
No. of Responses	316 (502)	702 (481)	1,018 (487)

4. IMPLICATIONS OF ANALYSIS ON DETAILED SAMPLE SURVEY RESULTS

The Detailed Sample Survey was conducted with the following aims:

- to grasp the present conditions of the selected scheme areas,
- to ascertain the nature of the problems faced by farmers,
- to determine the farmers' preference or intention towards the crop diversification, and
- to present the future desirable direction for each area based on the survey results.

To promote the crop diversification in the Sungai Kulim I and II scheme areas, it is essential to take into account and incorporate the above survey results as much as possible in the promotion of crop diversification in rational manner so as to make the strategic promotion plan to be "of the people, by the people and for the people".

The general socio-economic characteristics and major problems awaiting solutions in each scheme area can be summarized as follows:

(a) Advancing urbanization around the Kulim area and availability of non-farm job opportunities;

(b) Abandonment of paddy lands mainly due to problems of insufficient irrigation water supply and acute labour shortage;

(c) Existence of uneconomically subdivided lands and uncertainty of steady income;

(d) Ineffective irrigation and drainage facilities and frequent ravages by rats, birds and insects;

(e) Existence of many pure-tenants and presumable obstacles to the agricultural innovation or promotion of farmers' grouping; and

(f) Relatively strong attachment to the paddy cultivation among the old farmers and conservation of farmers and their reluctancy to try new crops.

Since the above problems are not independent of each other and have the cause-and-effect relationship, it is necessary to prepare a comprehensive counter-measure programme, to present the required positive research results and to prove how crop diversification is supported by the Government agencies and is also profitable.

Part - II

Crop Diversification Study on Selected Schemes in N. Sembilan

Feasibility Study on Rationalization and Crop Diversification in Non-granary Irrigated Areas in Malaysia

Volume 3

Part-II

Crop Diversification Study on Selected Schemes in Negeri Sembilan

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FIGURES

1. INTRODUCTION

1.1 General

This Part-II summarizes the result of the feasibility study on crop diversification for the selected non-granary irrigation schemes in the State of Negeri Sembilan (the Study).

The aim of the Study is to present a possible direction to promote crop diversification by converting idle paddy fields to long-term tree crops such as oil palm and cocoa. Requirement for upgrading agricultural infrastructure and the justification of proposed plans have been examined.

1.2 Background

The State of Negeri Sembilan is located in the southern part of the west coast of Malaysia, bounded on the north by Selangor, on the east by Pahang, and on the south by Melaka and Johor. Central portion of the State is mountainous. The west is low hills and plains. The population is 658,000 in 1988. Rural population ratio declined from 63% in 1985 to 60% in 1988.

In Negeri Sembilan, the total area under crops is about 330,000 ha or 49% of the whole territory of the State. Some 12,300 ha are paddy fields. A total of 296,800 ha is covered with tree crops. Productive planted areas of tree crops include oil palm of 77,660 ha, rubber of 65,030 ha, coconut of 1,120 ha and cocoa of 260 ha.

There are 156 non-granary irrigation schemes in the State. The total area of irrigable paddy fields is 10,934 ha for the main season and 5,285 ha for the off season. For the past three years (1985-1987) the average cropped area of paddy is 2,309 ha in the main season and 859 ha in the off season, while the non-paddy crop growing area is 1,105

ha. Thus overall scheme utilization ratio is 31% for the main season and 18% for the off season.

At present 43 schemes are fully idle, while 6 schemes have already been fully converted to permanent tree cropping area.

1.3 Selection of the Study Area

For undertaking a feasibility study on conversion of paddy to perennial crops, 7 schemes located along the Mampong river and its small tributaries were selected taking into account the farming operation situation in the State as well as through discussions with the Steering and Technical Committees. The study area covers the whole irrigable areas of 517 ha in these 7 non-granary irrigation schemes as listed below.

Scheme	Irrigable Area (ha)
Ulu Sepri	72
Mampong	64
Ampang Limau	131
Chembong	173
Ulu Chembong	24
Anak Air Tontong	33
Kampung Chuai	20
Total	517

2. PRESENT SITUATION OF SELECTED SCHEMES

2.1 Physical Conditions

(1) Location and topography

The Selected schemes are located in a valley bottom along the Mampong river which flows 20 km southeast of the State capital, Seremban as shown in Fig. II-1. Topography in the scheme is flat to gently sloping surrounded by hilly topography. The gradient of the Mampong river is in a range of 1/500 to 1/1,000.

(2) Climate

The climate is characterized by two rainy seasons. The wet months are September to November influenced by the northeast monsoon and March to May affected by the southwest monsoon. The average annual rainfall is 2,450 mm and 1 in 5 year low rainfall is 1,400 mm (see Fig. II-2) according to the data for 59 years from 1930 to 1988 at the Ladang Perentian Tinggi station.

Data on monthly distribution of rainfall, average air temperature, relative humidity and wind speed in the study area are presented below.

Month	Monthly Rainfall (mm)	Relative Temperature (°C)	Wind Humidity (%)	Speed (m)
Jan.	116	27.2	78.8	3.0
Feb.	127	28.0	80.0	2.8
Mar.	226	28.2	82.0	2.1
Apr.	269	28.0	85.2	1.4
May	230	27.8	86.0	1.3
June	164	27.6	85.2	1.4
July	163	27.1	85.1	1.4
Aug.	185	27.0	85.2	1.4
Sept.	208	27.1	85.5	1.6
Oct.	275	27.2	85.5	1.5
Nov.	288	27.1	87.0	1.7
Dec.	195	27.0	83.0	2.6

(3) Rivers

The Water source for the selected schemes in the Mampong river basin and their catchment area are listed below.

Name of Scheme	Name of River	Catchment Area at Intake (km^2)
Ulu Sepri	Batu Hampar	18.1
Anak Air Tontong	Tontong	5.4
Ampang Limau	Chembong	29.0
Ulu Chembong	Chembong	5.5
Chuai	Chuai	2.3
Chembong	Chembong	41.0
Mampong	Chembong	51.8

There is no stream gauging station on these rivers.

(4) Soils

Soils in the selected schemes are formed of Telemong soil series with such characteristics as well to excessively drained condition, variable soil texture and weak soil structure. In the downstream scheme, Mampong, soils along the main river course are of Akob soil series covering about 15% of the irrigable area. It is featured by imperfect drainage condition.

2.2 Socio-economic Status

(1) General

The State of Negeri Sembilan is administratively divided into 7 districts. The selected schemes in the Mampong river basin is situated in the Rembau District of 414 km^2, the smallest district in the State.

According to the mid-year estimated population made by DOS, the population of the Rembau District is 42,400 in 1986, accounting for 6.4% of the State's population of 663,400. The average annual

population growth was 3.2% in the Rembau District between 1980 and 1986 which is slightly higher than the State average of 3.0% per annum.

(2) Socio-economic status in the Mampong area
- results of the Sample Survey -

According to the Sample Survey for 20 non-granary irrigation schemes in the Rembau District (91 farm household in total), heads of farm households are mostly aged: 46 to 55 years old for 26 sample farmers, and above 55 years old for 61 sample farmers.

With regard to the future farm operation, 42 respondents except that one or two household members will succeed their paddy cultivation. At the same time they recognize their successors' intention towards involvement in the future farming activities, i.e. 9 successors as full-time farmers, 29 as part-time farmers and 4 as land owner with full-time job other than agriculture. In reality, those who strongly adhere to continuation of paddy cultivation in the future amount to 20 farm households.

On the other hand, 49 respondent farmers consider different ways to utilize their paddy fields. Of these, 17 sample farmers intend to convert their paddy fields to permanent tree crop cultivation areas, while 24 consider to stop their farm operation in their lifetimes and 8 pay their attention to other use than paddy planting.

2.3 Present Land Use

In the Rembau District, rubber is the most popular crop, although it has recently been replaced by oil palm and cocoa. The paddy cultivation area has fluctuated during the main season but continuously decreased for the off season between 1980 and 1986. Planted areas of major crops according to the State DOA are summarized below.

Unit: ha

Crop	1980	1981	1982	1983	1984	1985	1986
Paddy							
Main	431	763	725	330	469	508	390
Off	320	209	180	45	64	36	–
Rubber	27,313	27,246	27,222	27,786	16,004	17,358	17,392
Oil palm	751	814	826	1,045	1,922	2,093	2,489
Cocoa	–	–	1	1	3	125	230
Coconut	384	384	337	332	185	185	185

Some of the selected schemes have already been converted to non-paddy crop cultivation areas including oil palm and cocoa to a certain extent, while incidence of idle paddy fields is common in all the schemes with the total area of 280 ha at present. The present condition of scheme utilization is summarized below by referring to the result of the Inventory Survey.

Unit: ha

Scheme	Irrigable Area	Main Season Paddy	Upland Crop	Perennial Crop	Idle Area
Ulu Sepri	72	18	2	22	30
Anak Air Tontong	33	20	–	–	13
Ampang Limau	131	22	2	36	71
Ulu Chembong	24	7	–	–	17
Chuai	20	3	–	–	17
Chembong	173	54	2	–	117
Mampong	64	49	–	–	15
Total	517	173	6	58	280

2.4 Irrigation and Drainage Conditions

2.4.1 Irrigation system

All the selected schemes are served by gravity irrigation with headworks or small diversion structures on rivers and distribution networks. The largest intake discharge is 0.4 m^3/sec among the 7 schemes. Most part of main canals lined by concrete with trapezoidal or block section.

The irrigable area of each schemes confirmed in the State DID is as follows.

		Irrigable Area (ha)	
Code No.	Scheme	Main Season	Off Season
NS102	Ulu Sepri	72	17
NS125	Anak Air Tontong	33	5
NS111	Ampang Limau	131	5
NS118	Ulu Chembong	24	4
NS132	Chuai	20	–
NS112	Chembong	173	12
NS106	Mampong	64	6
	Total	517	49

As the command area is small, neither secondary canals nor tertiary canals is provided to the respective schemes. Thus irrigation water is directly distributed to farm lots from the main canal.

2.4.2 Operation and maintenance of irrigation schemes

The seven selected non-granary irrigation schemes are operated and maintained by DID Tampin/Rembau District Office together with other 45 schemes. For this, a total of 144 staff including 19 senior to junior class management staff is appointed in the said Office. Annual operation and maintenance costs spent for the last four years in the respective schemes are shown below.

Scheme	Irrigable Area (ha)	Annual Operation and Maintenance Costs (M$) 1984	1985	1986	1987
Ulu Sepri	72	7,299	6,112	30,216	14,696
Anak Air Tontong	33	4,350	7,246	5,160	6,070
Ampang Limau	131	19,772	9,652	8,764	36,107
Ulu Chembong	24	4,601	477	10,452	5,340
Chuai	20	–	–	–	–
Chembong	173	13,268	24,094	30,646	52,323
Mampong	64	690	750	900	896
Total	517	49,980	48,331	86,138	115,432

2.4.3 Drainage conditions

The bed slope of rivers in the Mampong area is steep, 1/500 to 1/1,000. The duration of flood or inundation is short. The estimated 1 in 5 year flood discharge at the Mampong headworks is about 60 m^3/sec which almost coincides with the draining capacity of the Mampong river at Mampong headworks.

There are some portions of poor drainage because of lack of proper field drains. The gradient of farm field is also from 1/500 to 1/1,000, however, excessive water can be eliminated through field drain with ease.

2.5 Present Agriculture

2.5.1 Present farming practice

In 1987, the Socio-economic and Poverty Study was carried out by the Project Management Unit of the Negeri Sembilan Timur Integrated Agricultural Development Project (IADP) to monitor the impact of the implementation of this project. This IADP covers 5 districts including the Rembau District in the eastern part of the State.

According to the above-mentioned Socio-economic Study, there are no less than 28 crop combinations reported in this area. The most

prevailing cropping pattern is rubber/paddy, involving about 13% of the farmers in the IADP area. Since 1985 the entry of cocoa as a major crop has enhanced numbers of cropping pattern resulting from a better use of idle paddy fields with introduction of cocoa and increase in cropping intensity in orchard fields with mixed cropping of cocoa.

Usually farmers carry out land preparation works using tractor services. Although farm mechanization services provided by FOA and also farm road networks have been improved through implementation of the Negeri Sembilan Timur IADP, participation of the private sector in this sector is very slow due mainly to economic reasons. The shortage of tractors is experienced mostly during the peak requirement period of July to September resulting in unstable cropping schedule of paddy within the same scheme area. Harvesting works are manually done because the private sector has no interest in extending its service because of access and communication problems as well as different harvesting periods in a small scale scheme area.

The Inventory Survey indicates that the total cropping intensity of irrigated paddy fields covering 517 ha in the 7 schemes is only 46%. As the cropped areas include non-matured cocoa and oil palm growing fields, the annual crop production outputs are 620 tons of the main season paddy and 30 tons of fresh corn at present.

2.5.2 Agricultural supporting services

In respect to paddy cultivation under irrigated condition, DID is responsible for provision of irrigation water as well as operation and maintenance of irrigation facilities. Extension and technical support services are provided by DOA. Farm input supply including distribution of subsidized fertilizers is done by FOA. Paddy price support scheme through implementation of the coupon subsidy is one of LPN's duties to cover downstream activities from purchasing to wholesaling.

The establishment of oil palm and cocoa schemes on idle paddy fields is the responsibility of FELCRA, while DID has to provide

necessary drainage facilities. To replant old rubber areas, RISDA is responsible for provision of inputs and technical assistance. Formulation and implementation of a comprehensive program of adaptive research is made by MARDI and provision of marketing services to farmers is done by FAMA.

3. CROP DIVERSIFICATION PLAN

3.1 Background

Due to insufficient return from uneconomical size of paddy farming, paddy farmers usually earn supplemental income from temporary rubber tapping works and also depend cash incomes for their living expenses on remittance from their children working in urban areas. The Socio-economic and Poverty Study in 1987 clearly reveals that the average annual income per farmer was M$5,752 in the Negeri Sembilan Timur IADP area and it comprised farm income of M$1,563 or 27% and non-farm income of M$4,189 or 33%.

Resulting from the nationwide Sample Survey, it can be said that young farm household members who even feel their interests in succession of farm operation intend to carry out farming activities as part-time job in the Rembau District. Under such background, many paddy farmers intend to convert their farming pattern from labor intensive paddy cultivation to labor force saving crops.

3.2 Crop Diversification Plan

(1) Development area

Proposed land use plan with project condition in the Mampong area is as follows:

(Unit: ha)

Land Use Pattern	Present Condition	Without Project	With Project
Main season paddy	173	173	0
Upland crops	6	6	0
Perennial crops	58	58	517
Idle land	280	280	0
Total	517	517	517

As an area of 58 ha has already been converted to tree crops, the project area to be covered by the proposed development plan would be 459 ha.

(2) Selection of crops

Taking into account farmers' intention towards crop diversification, oil palm and cocoa are selected as target crops. Thus the technical and financial feasibility on crop diversification plan under the Category 2 is studied to conform the possibility of converting paddy fields to permanent crop fields.

(3) Requirements for crop growth

All the selected scheme areas are included into the agro-ecological region 10 based on the MARDI's classification. Main climatic characteristics of this agro-ecological region are frequent moisture stress days with probability of over 40% in January, February and July as well as flash floods possible with probability of 80% in March and April. The former is derived from irregular rainfall causing short-term droughts. Even during months with a reasonable total rainfall, much of it may have been received during only a few days. This concentration in time may cause moisture stress in plants with shallow root systems. In the latter case, flash floods occur most frequently when the monthly total rainfall exceeds about 200 mm. Such climatic condition is suitable for planting tree crops such as oil palm.

As for soil and land suitabilities, there are moderate limitations to growth of oil palm and cocoa such as somewhat excessive drainage and weak soil structure. In case of cocoa, shading crops to protect young cocoa are required to maintain better crop growth circumstance due to moderately coarse textured paddy soils.

(4) Cropping system

It is assumed that crop diversification is done on a smallholder basis. In case of diversion to cocoa, the average farm size assumed is 3.0 ha with mixed cropped banana. While, such assumption is made that farm land is accumulated to one operator up to 6 ha including leasehold for growing oil palm as mono crop. In the Study, both oil palm and cocoa is examined as an alternative tree crops.

(5) Production output

According to data from FELCRA, the yield of tree crops increases year by year as follows:

(Unit: tons/ha)

	Period in year after planting							
Crops	1st-3rd	4th	5th	6th	7th	8th	9th	10th
Oil Palm	0	1.2	9.0	15.8	21.3	23.1	24.9	24.6
Cocoa	0	0.4	1.2	2.5	3.7	4.1	4.3	4.1

	Period in year after planting						
Crops	11th	12th	13-14	15-18	19-20	21-22	23-25
Oil Palm	24.3	23.8	22.8	22.1	20.6	20.1	19.6
Cocoa	4.1	4.1	4.1	4.1	4.1	4.1	4.1

The yield of both oil palm and cocoa would reach their maximum in 9th year after planting.

At the full production stage, the annual outputs from the 7 selected schemes of 459 ha are estimated to be 11,400 tons of fresh oil palm or 1,970 tons of dry beans of cocoa.

(6) Possibility of freshwater fish pond culture

The technical possibility to introduce the freshwater fish pond culture under the Category 5 is examined in this Section, though it is not included into the proposed plan because farmers have less intention to introduce it.

In the Negeri Sembilan Timur IADP area, it is estimated that there are about 1,550 fish ponds with a total pond area of around 200 ha. The size of pond ranges from 0.05 ha to 1.25 ha with the average size of about 0.125 ha. In total, 1,160 farmers earn monthly gross income of M$400/ha of pond area on an average. Under the Negeri Sembilan Timur IADP, 695 units of fish and prawn culture ponds covering 116 ha were newly developed by the end of 1988.

The inland freshwater fish pond culture requires constant supply of fresh water at the rate of 0.5 lit/sec/ha in net. Considering the effective rainfall and water use efficiency, the maximum gross water demand is estimated to be 0.8 lit/sec/ha, which is equivalent to one-third of water demand for paddy cultivation. If the whole area of each scheme is fully converted to a freshwater fish culture pond, the gross water demand is below the minimum available low flow in January at the headworks of the respective schemes as shown below.

Scheme	Available Low Flow (m^3/s)	Gross Water Demand (m^3/s)
Anak Air Tontong	0.04	0.03
Ulu Sepri	0.14	0.06
Ulu Chembong	0.04	0.02
Chuai	0.02	0.02
Ampang Limau	0.22	0.10
Chembong	0.32	0.14
Mampong	0.40	0.05

Judging from this result, there is no natural limitation in implementing freshwater fish pond culture.

4. UPGRADING PLAN OF INFRASTRUCTURES

4.1 Development Concept

The fundamental requirements for development of long-term tree crop cultivation under Category 2 is to provide efficient drainage system and access facilities in the scheme areas.

The drainage system will have dual function of passing surface run-off during the wet season and maintaining and controlling water tables higher during the off season. Provision of effective access road network to connect farms with the nearest main road is also required to transport agricultural products.

4.2 Upgrading Plan

(1) Drainage facilities

The main component is a feeder drain to collect run-off from the smallholdings and convey it to the nearest main drain. The feeder drain is preferably to be shared between two smallholders and hence, in a rectangular grid system of lots, there will be a feeder drain to every alternate lot boundaries. Field drains to feed back to the feeder drain will be constructed by the smallholders themselves. The feeder drain will also act as part of a water table control system.

A feeder drain with field drains to control on-farm drainage condition is indispensable for planting oil palm and cocoa in paddy fields. Low yields of oil palm from poor drainage arise from such factors as poor plant nutrient uptake, proliferation of weeds and loss of harvest, while cocoa cannot stand under water logging. According to the DID's design criteria, field drain is to be designed to drain 72 hour rainfall within 72 hours for growing tree crops such as oil palm and rubber. Based on 72 hour rainstorm data of 1 in 5 year, the drainage

requirement in the selected scheme areas is estimated to be 0.67 $m^3/sec/km^2$.

A drainage control structure will be constructed at where the feeder drain meets the main drain. The structure will have provision for drop-boards to be inserted to keep the water table high during the dry months. These structure will be operated once every off season.

The land for constructing the feeder drains is to be contributed by the smallholders themselves, but the cost of construction will be born by the public expenditure. To cut down DID's maintenance costs, the smallholders will have to maintain and clear the feeder drains.

(2) Access road

Access road will be provided along the main drain fronting the smallholders. These access roads will be paved with laterite and constructed at higher elevation so as to be usable even during the wet months. It is the smallholders' responsibility to link their access to these roads.

(3) Drainage requirement

Based on DID's design criteria, the drainage requirement for growing oil palm is determined to be 0.67 $m^3/sec/km^2$ in order to drain 72-hour rainfall within 72 hours

(4) Work quantity

The density of facilities provided to the scheme area is proposed to be 25 m/ha for the feeder drain with a drainage control structure at every 10 ha, and 10 m/ha for the access road. The total quantity of on-farm structures in the 7 selected schemes is estimated as follows:

Item	Quantity
Site clearance	459 ha
Feeder drain	11,500 m
Drainage control structure	46 nos.
Farm road (4 m)	4,600 m

4.3 Implementation Plan

It is proposed that the construction of proposed drainage and farm road networks be completed within one year due to small quantity of work volume.

4.4 Cost Estimate

(1) Investment cost

The project cost is estimated based on the following assumptions:

(i) Direct construction cost is estimated following the current unit construction cost provided by the State DID.

(ii) Engineering cost including survey and design is assumed to be 10% of the direct construction cost.

(iii) Physical contingency is assumed to be 15% of the direct construction cost and engineering cost.

(iv) Administration cost is 2% of the direct construction cost and engineering cost.

Detail of cost estimate is shown in Table II-1. The direct construction cost is estimated at M$333,340 for the selected area of 459 ha. The total project cost is estimated at M$430,000; equivalent to M$937/ha.

(2) Operation and maintenance (O&M) cost

The annual O&M costs increased by implementation of the proposed works is assumed to be 0.5% of the direct construction cost

reflecting the past performance of O&M by State DID office. The annual O&M cost to be increased by the proposed works is estimated at M$2,200 per annum.

5. EVALUATION OF CROP DIVERSIFICATION PLAN

5.1 General

The feasibility of the proposed crop diversification plan is assessed in this Chapter. The feasibility is analyzed by calculating the financial internal rate of return (FIRR).

Project benefit and cost with project condition are estimated for 459 ha excluding the existing tree crops area of 58 ha. Investment performance is examined for two alternative crops, oil palm and cocoa. In case of cocoa, mixed planting with banana for the first 6 years is to be done to protect young cocoa and to secure income source during unmatured period of cocoa.

5.2 Benefits

It is expected that benefits accrued from the project will be solely the benefit by increase in crop production. The net benefit is defined as the difference of net benefit between future with project and without project conditions. The gross benefit, production costs, and net benefit per ha for each crop is estimated referring to the *Guideline on Economic Viability of Selected Crops* prepared by MOA in 1989 (see Appendix E, Volume 2). For conservative evaluation, unit yield of banana is assumed to be 80% of the figure in the above reference.

The annual net benefit without project condition is estimated at M$358/ha as shown in Table I-2. In this calculation, the unit yield of crops is assumed to be 2.25 tons/ha for main season paddy and 53,000 cobs/ha for maize (fresh).

Annual net benefit is estimated in Tables I-3. The incremental benefit for oil palm will be realized from the sixth year of the project implementation and will reach its maximum at the 10th year, while for

cocoa it will be born from the third year and will reach its maximum at the 12th year. It is obvious that cultivation of banana contributes large to secure the net income during unmatured period of cocoa.

5.3 Financial Evaluation

The financial evaluation is made assuming a project economic life of 25 years. The flow of financial cost and benefit is shown in Table II-4 for oil palm and in Table II-5 for cocoa . The financial internal rate of return (FIRR) is estimated by crop as follows:

Type of crop	FIRR (%)
Oil palm	12.5%
Cocoa	23.0%

The proposed plan to convert paddy field to both oil palm and cocoa fields is justifiable.

5.4 Selection of Crops

The cumulative labor requirements of both crops are 272 man-day/ha for cocoa and 25 man-day/ha for oil palm as shown in Appendix E of Volume 2. Cultivation of cocoa is beneficial but labor intensive.

The selection of type of crops to the selected schemes should be considered not only from the viewpoint of expected net benefit but also from labor requirement as well as preference by farmers.

6. ROLE OF AGENCIES CONCERNED IN PROMOTING CROP DIVERSIFICATION

For effective implementation of crop diversification program under the Category 2, it is proposed to set up a separate organization within the framework of State Government along the same lines as FELCRA.

This organization will comprise a group of management and agricultural experts responsible for the financial and marketing aspects of the tree crop conversion project. They should have the necessary manpower to manage and liaise with the farmers and various Departments in order to ensure the success of the project. This organization needs to have its own financial resources for the implementation of the projects. The technical and agricultural inputs can be provided by DID, DOA and other various Departments, with the organization providing the managers and personnel for liaising with the Departments. This organization will be responsible for identifying the best crop for each project and working out the economic viability as well as the financial arrangement between the farmers and the organization for the implementation of the project.

7. CONCLUSIONS AND RECOMMENDATIONS

7.1 Conclusions

(1) To introduce crop diversification under Category 2 into paddy fields, it is prerequisite to provide efficient drainage and access facilities.

(2) The proposed plan to convert paddy fields to both oil palm and cocoa fields can financially be justified with FIRR of 12.5% and 23.0%, respectively. The investment cost for required facilities is estimated at about M$940/ha.

(3) The selection of type of crops (either oil palm or cocoa) to the selected schemes should be considered not only from the viewpoint of expected net benefit but also from labor requirement as well as preference by farmers.

7.2 Recommendations

(1) For effective implementation of crop diversification program under Category 2, it is recommended to set up a separate organization within the framework of State Government along the same lines as FELCRA.

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Crop Diversification Study on Selected Schemes

Part - II

Tables

Table II-1 Summary of Construction Cost for Mampong Area

	Work Item		Unit	Quantity	Unit Price	Amount
1	Direct Construction Cost					
	Site Clearance		ha	459	100	45,900
	Farm Road	4 m wide, 10 m/ha	m	4,600	20	92,000
	Field Drain	20 m/ha	m	9,200	15	138,000
	Drainage end control		nos.	9	200	1,800
	Miscellaneous					55,540
	Sub-total					333,240
2	Engineering cost (10% of Item 1)					33,324
3	Physical contingency (15% of Items I & 2)					54,985
4	Administration Cost (2% of Items 1 to 3)					8,451
	Total					430,000
						(M$937/ha)

Table II-2 Net Benefit per Ha without Project Condition in the Mampong Area

	Planted Area (ha)	Profitability (M$/ha) Gross Benefit	Production Cost	Net Benefit	Estimated Net Benefit (M$)
Ulu Sepri					
Main season paddy	18	2,250	1,350	900	16,200
Maize (fresh)	2	2,650	1,700	950	1,900
Anak Air Tontong					
Main season paddy	20	2,250	1,350	900	18,000
Ulu Chembong					
Main season paddy	7	2,250	1,350	900	6,300
Ampang Limau					
Main season paddy	22	2,250	1,350	900	19,800
Maize (fresh)	2	2,650	1,700	950	1,900
Chembong					
Main season paddy	54	2,250	1,350	900	48,600
Maize (fresh)	2	2,650	1,700	950	1,900
Kampong Chuai					
Main season paddy	3	2,250	1,290	960	2,880
Mampong					
Main season paddy	49	2,250	1,290	960	47,040
Total	(459 ha)				164,520 (M$358 / ha)

Remarks: Breakdown of gross benefit and production cost is shown in Appendix E of Volume 2.

Table II-3 Net Benefit per Ha with Project Condition in the Mampong Area

(Unit: M$/ha)

Year	Case-1	Case-2		
	Oil Palm	Cocoa	Banana*	Total
1	-1,411	-1,152	-890	-2,042
2	-644	-1,926	1,066	-860
3	-1,012	-1,110	1,045	-65
4	-1,010	-1,027	-890	-1,917
5	202	-94	1,066	972
6	387	1,115	1,045	2,160
7	912	2,075		2,075
8	1,092	2,433		2,433
9	1,192	2,433		2,433
10	1,252	2,515		2,515
11	1,222	2,515		2,515
12	1,172	2,330		2,330
13	1,072	2,330		2,330
14	1,072	2,330		2,330
15	1,002	2,330		2,330
16	1,098	2,330		2,330
17	1,098	2,330		2,330
18	1,098	2,330		2,330
19	948	2,330		2,330
20	948	2,330		2,330
21	968	2,330		2,330
22	968	2,330		2,330
23	918	2,330		2,330
24	918	2,330		2,330
25	918	2,330		2,330

Remarks: * = Shade tree for young cocoa for 6 years

Table II-4 Financial Cost and Benefit Flow for Oil Palm for the Mampong Area

(Unit : M$'000)

Year	Cost		(1.0)	Incremental
	Capital	O&M	Total	Benefit
1	422	0	422	0
2	0	2	2	-648
3	0	2	2	-296
4	0	2	2	-465
5	0	2	2	-464
6	0	2	2	93
7	0	2	2	178
8	0	2	2	419
9	0	2	2	501
10	0	2	2	547
11	0	2	2	575
12	0	2	2	561
13	0	2	2	538
14	0	2	2	492
15	0	2	2	492
16	0	2	2	460
17	0	2	2	504
18	0	2	2	504
19	0	2	2	504
20	0	2	2	435
21	0	2	2	435
22	0	2	2	444
23	0	2	2	444
24	0	2	2	421
25	0	2	2	421

IRR = 12.5%

Table II-5 Financial Cost and Benefit Flow for Cocoa Cultivation

(Unit : M$'000)

Year	Cost			Incremental Benefit
	Capital	O&M	Total	
1	422	0	422	0
2	0	2	2	-1,102
3	0	2	2	-559
4	0	2	2	-194
5	0	2	2	720
6	0	2	2	282
7	0	2	2	788
8	0	2	2	952
9	0	2	2	952
10	0	2	2	990
11	0	2	2	990
12	0	2	2	905
13	0	2	2	905
14	0	2	2	905
15	0	2	2	905
16	0	2	2	905
17	0	2	2	905
18	0	2	2	905
19	0	2	2	905
20	0	2	2	905
21	0	2	2	905
22	0	2	2	905
23	0	2	2	905
24	0	2	2	905
25	0	2	2	905

FIRR = 23.0%

Part - II

Figures

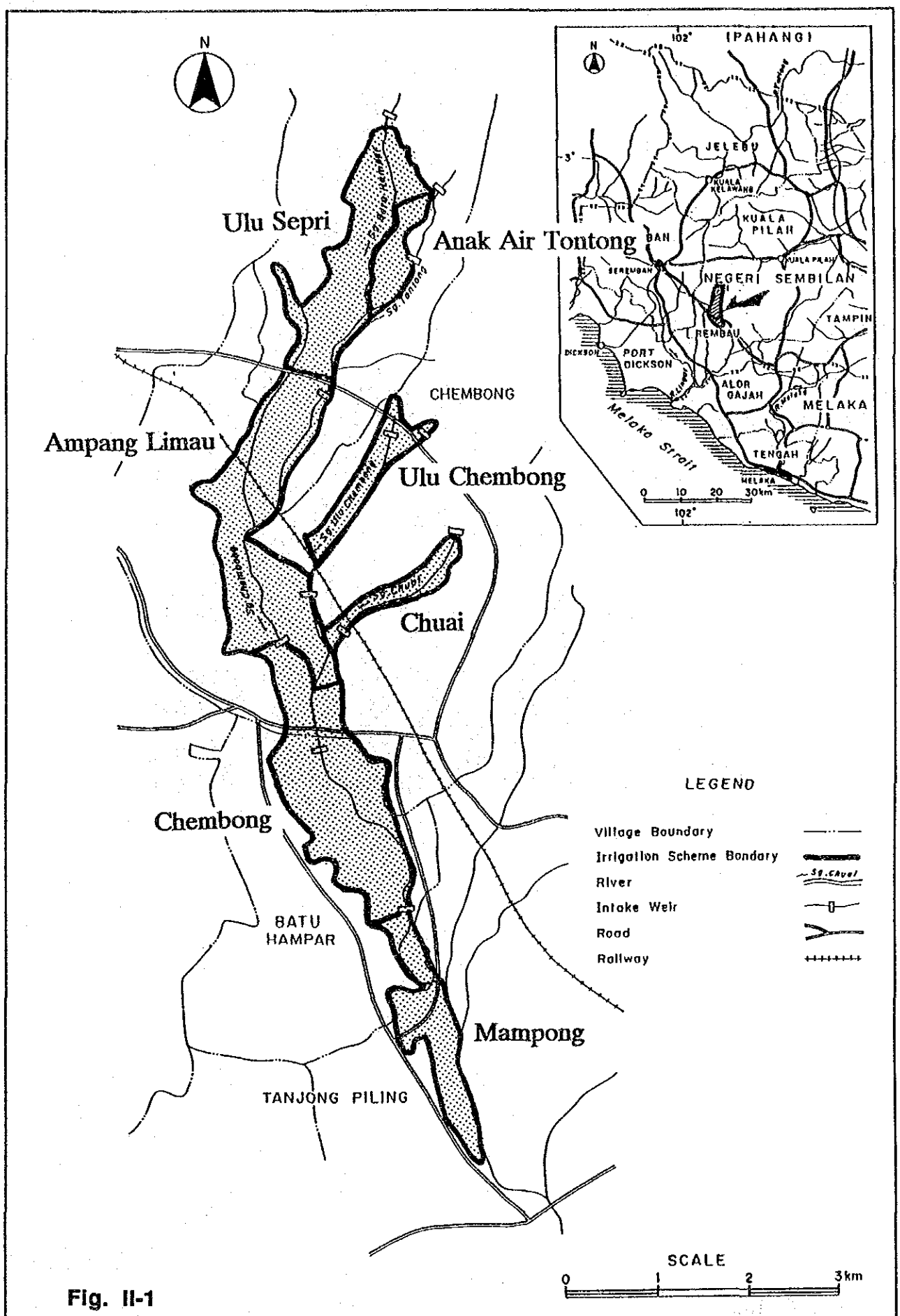


Fig. II-1

Location of Selected Schemes in Negeri Sembilan

FEASIBILITY STUDY ON RATIONALIZATION AND CROP DIVERSIFICATION IN NON-GRANARY IRRIGATED AREAS IN MALAYSIA

Japan International Cooperation Agency

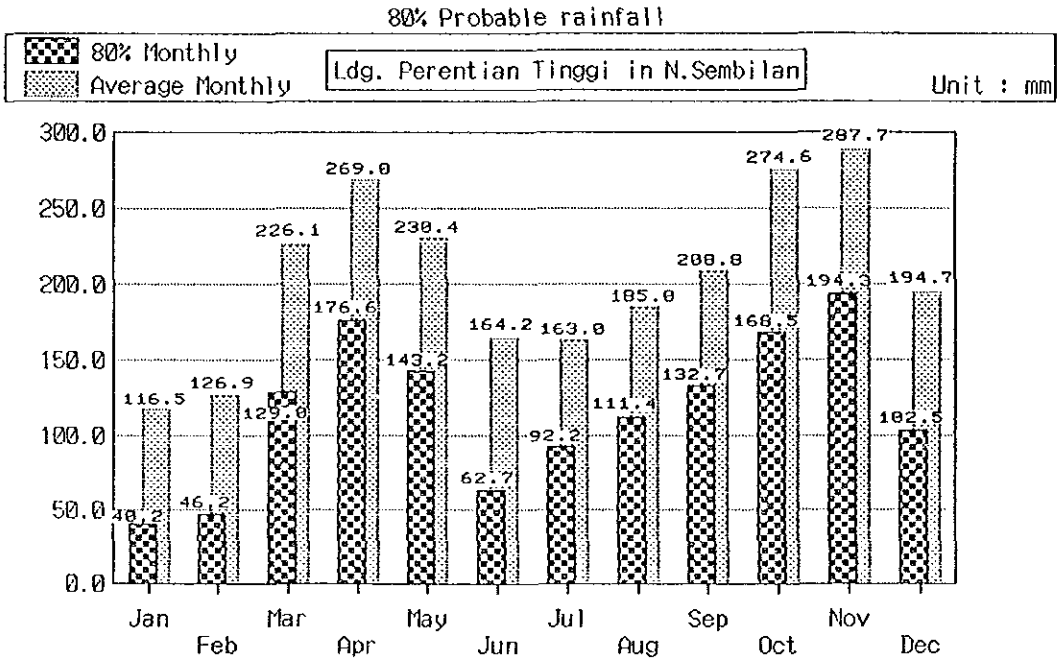


Fig. II-2

Monthly Rainfall Pattern

FEASIBILITY STUDY ON RATIONALIZATION AND CROP DIVERSIFICATION IN NON-GRANARY IRRIGATED AREAS IN MALAYSIA

Japan International Cooperation Agency

Part - III

Crop Diversification Study on Selected Schemes in Kelantan

Feasibility Study on Rationalization and Crop Diversification in Non-granary Irrigated Areas in Malaysia

Volume 3

Part-III

Crop Diversification Study on Selected Schemes in Kelantan

CONTENTS

TABLES

FIGURES

1. INTRODUCTION

1.1 General

This Part-III summarizes the result of the feasibility study on crop diversification for the selected non-granary irrigation schemes in the State of Kedah (the Study).

The aim of the Study is to present a possible direction to promote crop diversification with high value crop cultivation, to plan upgrading agricultural infrastructure and the justification of proposed plans.

1.2 Background

In the State of Kelantan, a total area of 84,426 ha is under paddy cultivation comprising 2 granary areas, KADA and Kemasin Semarak, covering 38,807 ha, and 77 non-granary irrigation schemes commanding 10,667 ha in total. The area irrigable during the off season in these non-granary irrigation schemes is limited to 3,185 ha.. The average cropped area of the past three years (1985-1987) for the main season is 6,856 ha which is formed of paddy cultivation area of 6,856 ha and non-paddy crop growing area of 379 ha. For the off season, cropped area of paddy was 1,726 ha. Thus overall scheme utilization ratio is 68% for the main season and 20% for the off season.

At present 7 schemes are fully utilized and 57 schemes are planted in more than 50% of irrigable areas for the main season. On the other hand, 5 schemes are completely idle and 8 schemes have the main season cropping intensity of less than 50%.

1.3 Selection of the Study Area

For undertaking a feasibility study on introduction of upland crops for the off season, three schemes were selected taking into account the type of irrigation water intake system, influence of annual flooding which is common in the State, and location as well as through discussions with the Steering and Technical Committees. These selected schemes are Repek, Hilir Sat I and Rawa Bechah Laut. The irrigable area of these schemes is 930 ha in total.

2. PRESENT SITUATION OF SELECTED SCHEMES

2.1 Physical Conditions

(1) Location and topography

The Repek scheme lies in the southwest of Pasir Mas town. The right bank of the Lemal river forms the southwest boundary and the railway runs along the northern boundary of the scheme. The land is gently flat with a gentle slope to the northward as shown in Fig. III-1.

The Hilir Sat I scheme is situated adjacent to the southwest corner of Machang town. It extends over the both banks of the Sat river, a tributary of the Kelantan river. The land has a slope of 1/100 to the southwest direction as illustrated in Fig. III-2.

The Rawa Bechah Laut scheme is located about 5 km west of Tanah Merah town and in the right bank area of the Manal river. The northern part of 23 ha is located along the right bank of the Manal river with fairy flat topography, while the southern part of 57 ha is slightly undulating with a ground slope of 1/200 to 1/350 as shown in Fig. III-3.

(2) Climate

The climate of the selected schemes are caracterized by a typical east coast type with a long and regular dry season from February to April, a steady increase of rainfall from May to October and high rainfall in November and December.

Average annual rainfall is 2,774 mm (1947-1988 average) in Repek and 2,523 mm (1952-1988 average) in Machang as shown in Fig. III-4. The 1 in 5 year probable rainfall is estimated to be 1,477 mm in Repek and 1,263 mm in Machang. Distribution of monthly

rainfall, average temperature, relative humidity and wind speed in and around the Study area are summarized below.

Month	Rainfall (mm) Repek	Rainfall (mm) Machang	Temperature (°C)	Relative Humidity (%)	Wind Speed (m)
Jan.	172	204	25.7	81.1	2.7
Feb.	86	79	26.2	81.2	2.7
Mar.	89	79	27.1	80.8	2.1
Apr.	75	79	27.8	81.0	1.7
May	182	151	28.1	81.4	1.6
June	198	155	27.7	82.1	1.4
July	192	149	27.1	82.6	1.5
Aug.	240	197	27.0	82.8	1.4
Sept.	258	258	26.7	83.9	1.5
Oct.	284	264	26.5	85.1	1.8
Nov.	500	410	26.1	86.9	2.7
Dec.	499	498	25.7	84.3	1.7

(3) Rivers and flood problems

Repek scheme

The Lemal river is a water source of the Repek scheme with the catchment area of 260 km^2 at the Repek intake site. At 15 km upstream of the Repek intake site, the KADA granary irrigation scheme extracts all available discharge during off season at the Tok Ubang headworks. The Repek scheme can take water from the residual catchment of 55 km^2 during the off season.

Floods occur annually in the Lemal river. Inundation depth in the scheme area is generally from 0.15 to 0.50 m being continued for 4 to 5 days except for the large floods. A highway embankment crossing the Repek scheme functions as flood protection bund. Owing to this embankment, the northeastern part of the scheme is flood free.

Hilir Sat I scheme

The Sat river, a water source for the Hilir Sat I scheme, is meandering and shallow. It has a catchment area of 56 km^2 at the intake site of the scheme. At the upstream of the Sat river, another non-granary irrigation scheme, Ulu Sat, diverts irrigation water. According to DID's procedure of flood estimation, mean annual flood is 52 m^3/sec at the intake site, while flood discharge 1 in 5 year is 81 m^3/sec.

Floods are caused by overflowing the channel of the Sat river and its tributaries after heavy and continuous rainfalls. The high water level of the Kelantan river also causes backwater effect on the Sat river resulting in overspills. In addition, land development in the catchment area has brought on siltation and rapid runoff problems.

Rawa Bechah Laut scheme

The Manal river is a water source of the Rawa Bechah Laut scheme and has a catchment area of 6.8 km^2 at the scheme's intake site. The Rawa Bechah Laut scheme is usually free from long-duration-flood caused by the Kelantan river and its tributaries. However, there exists an inundation problem during months with high rainfall.

(4) Soils

The prevailing soils are represented by Lubok Sendong soil series in the Repek scheme area, Holyrood and Lunas soil series in the Hilir Sat I scheme area and Lunas soil series in the Rawa Bechah Laut scheme area. Of these, Lunas soil series has no limitation to grow upland crops in paddy fields. Other two soil series have moderate limitations, but these are also suitable for upland crop cultivation if excessively drained condition is improved for Holyrood soil series and poorly drained condition is upgraded for Lubok Sendong soil series.

2.2 Socio-economic Status

The State of Kelantan is administratively divided into 10 districts with a total coverage of 14,943 km^2. The districts where the three selected schemes are located are the Pasir Mas District for the Repek scheme, the Machang District for the Hilir Sat I scheme and the Tanah Merah District for the Rawa Bechah Laut scheme. These three districts cover 2,610 km^2.

The mid-term estimated population made by DOS reveals that the district population in 1986 amounted to 148,970 in Pasir Mas, 72,638 in Machang and 99,508 in Tanah Merah. These three districts with a total population of 321,116 shared 30% of the State's population. Population in the three districts increased by 56,232 in number between 1980 and 1986. The average annual population growth rate during this period was 2.8% in the above districts, while it was 3.1% in the State.

The Detailed Sample Survey under the present Study was done in the three selected scheme areas to grasp farmers' intentions and requirements towards promotion of crop diversification. Among about 1,300 beneficial farm households actually conducting farm operation, a total of 105 respondents were sampled. The results of the Detailed Sample Survey is compiled in the Annex III-1. The profile of respondent farmers are highlighted as follows:

(a) In the three schemes, 59% of the respondent farmers are more than 45 years old. Advanced aging of farmers is not yet serious in these areas compared with 72% at the State level. The mean household size is 5.9 persons with working force of 2.7 persons. The educational level in these areas is 68%, while that in the State is 55% as a whole.

(b) The annual average gross income of the farm households is estimated to be M$4,550, 84% of which is derived from agriculture. Availability of off-farm job opportunities is subjected to some variations according to the location of

each scheme: 91% in Rawa Bechah Laut, 73% in Hilir Sat I and 57% in Repek.

(c) The participation rate of farmers to farmers' organization is 78% and slightly low compared to 83% at the State level. Variations in participation rate can be seen among the three schemes: 96% in Repek, 82% in Rawa Bechah Laut and 70% in Hilir Sat I.

(d) Of the respondent farmers, 62% are "owner-operators", while 19% are "pure tenants". Another 19% rent land from the others apart from their own land. This fact shows the preponderance of small uneconomic farm holdings, with 33% of the active farmers cultivating no more than 1.2 ha.

(e) In the selected scheme areas, 50% say that irrigation facilities are not fully installed. Those who complain about "not sufficient water" accounted for 20% in the main season, while 95% in the off-season. In the Repek scheme area which has been suffered from water intake problem so far, 35% respond "not sufficient" in the main season and much worse throughout the off-season.

(f) Of the sample farmer, 88% utilize their paddy fields. The remaining paddy fields are left idle for the reasons of inefficient water supply, low profitability of paddy cultivation, shortage of capital/lack of machine and ravage of rats, birds and/or insects. In the Rawa Bechah Laut where control drainage system is practiced, the rate reduces to 55% compared with 91% to 93% in other two scheme areas.

(g) Major problems and/or constraints in farming practices are marketing difficulty pointed out by 92% of the respondents, inefficient irrigation/insufficient water supply by 83%, lack of fund/machinery by 76%, labour shortage by 30% and frequent pest and diseases by 21%.

(h) Of the respondents, 66% have no intention to convert their paddy planted area into other crop field at present. Those who answer in the negative indicate such reasons as unsuitability of land, attachment to paddy cultivation and tenancy of land.

(i) The farmers' concerns about the introduction of crop diversification in the paddy fields are "marketing" selected by 94% of the respondents, "finance" by 84%, "technique" by 78%, "labour" by 37% and others by 15%. The results showed that the farmers in these three scheme areas are much concerned with the introduction of crop diversification.

(j) On the question of preferred organizations to have recourse to in financing, 95% of the respondents indicate "BPM". For extension service, 63% of the sample farmers favour "farmers' organization", while 23% select the State DOA. As to the marketing of crops, 80% cite "FAMA".

(k) As most promising and profitable crops, 86% of the respondent farmers cite maize followed by groundnuts, tobacco, chilli and cabbage.

(l) On the marketing prospect of diversified crops, 47% of the respondents say "a little bit worried". Those who answer "very promising (not worried at all)" account for 37% of the total. It is supposed that, in the three scheme areas, there are a sizable number of farmers who have a clear perspective on the marketing of the diversified crops.

(m) As future destinations of diversified crops, 77% cite "local markets", while 11% consider "neighboring urban center".

(n) As preferred farming system, 51% of the respondents favour "group farming", while 45% are in favour of "individual operation".

(o) For practicing crop diversification, 90% of the respondent farmers request to rehabilitate/upgrade the existing infrastructures or to construct new ones.

(p) For the idea that the areas are categorized as scheme to be maintained as paddy cultivation area during a definite period, 93% of the respondent farmers answer "reasonable" idea, whereas only 4% reply "not reasonable". About the intended duration to maintain the present land use, 68% of the respondents answer "no intention to change the present land use for more than 20 years".

(q) For the question of "possible category to be applied in the future", the sample farmers indicate, in order of frequency, two cropping system, animal feeding crop cultivation on cattle raising field, high value crop cultivation, and maintained as paddy cultivation area.

2.3 Present Land Use

Rubber planting area predominates throughout the 3 districts, followed by paddy cultivation area in the Pasir Mas and Machang Districts and oil palm planting area in the Tanah Merah Districts. The paddy cultivation area in each district has continuously reduced between 1980 and 1986. Planted areas of major crops according to the State DOA's statistics are shown below.

(Unit: ha)

Crop	1980	1981	1982	1983	1984	1985	1986
Paddy							
Main	23,626*	22,848*	13,432*	18,575*	9,919	5,507	3,309
Off	3,050*	6,621*	4,760*	4,524*	2,376	2,076	510
Rubber	48,196	47,115	48,109	54,690	54,625	54,267	54,718
Oil palm	5,736	7,991	8,581	9,343	9,630	9,760	9,732
Cocoa	–	107	106	47	81	267	705
Coconut	1,785	1,803	1,717	1,736	1,723	1,719	1,717

*Remarks: *; Including KADA area*

The current situation of paddy cultivation in the three schemes is summarized below based on the result of the Inventory Survey. In the Repek scheme, tobacco is cultivated in the small area.

(Unit: ha)

Scheme	Irrigable Area	Main Season Paddy	Upland Crop	Idle Area
Repek	454	146	7	301
Hilir Sat I	396	396	–	–
Rawa Bechah Laut	80	50	–	30
Total	930	592	7	331

2.4 Present Condition of Irrigation and Drainage

2.4.1 Repek scheme

The beneficial area of the Repek irrigation scheme is 454 ha consisting of 3 irrigation blocks, i.e. Block No. 1 for 106 ha, Block No. 2 for 202 ha and Block No. 3 for 146 ha. This scheme takes irrigation water by pumping system.

Salient features of the existing irrigation system is summarized below.

Pump:

There is only one pump of 20 cusec or 0.565 m^3/sec installed in a pumphouse, in spite of the original design proposing installation of three pumps including one stand-by. Since the last overhaul in 1978, the efficiency of pump has been deteriorated with the years and a major overhaul is further required. To cope with such situation, a new pumphouse with three units of pump is under construction adjacent to the existing pumphouse. The maximum supply capacity will increase to 1.13 m^3/sec.

Irrigation canal:

Irrigation canals are concrete lined with a total length of 12,875 m and density of 28.4 m/ha. Many irrigation structures have been left abandoned without proper maintenance due to water shortage.

On-farm facilities:

At present, 301 ha or 65% of irrigable paddy fields are idle due to insufficient water supply caused by poor operation condition of the existing pumphouse.

2.4.2 Hilir Sat I scheme

The command area of the Hilir Sat I scheme has an irrigable area of 396 ha in total, which is divided into six portions, i.e. Block No. 1 for 110 ha, Block No. 2 for 40 ha, Block No. 3 for 58 ha, Block No. 4 for 88 ha, Block No. 5 for 87 ha and Block No. 6 for 13 ha. Because of topography, the Block 6 is provided with irrigation water through a booster pump.

The Hilir Sat I scheme is supplied irrigation water by gravity system. Salient features of the existing irrigation system is summarized below.

Headworks:

The maximum intake discharge is about 1.0 m^3/sec through four gates. The headworks are operated under good maintenance condition.

Irrigation canal:

Main canal has trapezoidal section with concrete lining, while secondary canals have trapezoidal section and block section. The total length of irrigation canal is 11,400 m with canal density of 29 m/ha. The whole irrigation system functions well to distribute water to paddy fields. The number of structures are as follows:

Structures	Numbers
Road culvert	1
Syphon	9
U/D culvert	4
Check	53
Slot	5
Drop	4
CHO offtake	5
Field offtake	120
Booster pump	1

On-farm facilities:

Since each irrigation block is small, irrigation water is extracted directly from secondary canal. Some part of farmfield is eroded by flood, which makes equal water distribution difficult. Paddy fields are adversely affected by high groundwater level.

2.4.3 Rawa Bechah Laut scheme

The Rawa Bechah Laut scheme is a combination type of gravity irrigation and control drainage systems, even though its irrigable area covers only 80 ha. The main characteristics are summarized below.

Gravity system:

Single gated headworks on the Manal river commands 23 ha. Main irrigation canal has trapezoidal concrete section which supplies water directly to paddy field. The headworks and the main canal are maintained well except some offtake structures which have been left without maintenance.

Controlled drainage system:

This system covering 57 ha aims to improve drainage condition and control rain water for the use of irrigation. The system comprises of six series of bunds; three feet height with top width two feet; side slope 1:1.5 across the valleys at specified location incorporated with a drainage control gate with grass spillways. The water is conveyed by field earth

channels and tap off through field offtakes into the field. As on-farm facilities, seven drainage control gates, six siphons, two road culverts, two drainage control gates and five field offtakes are arranged.

2.4.4 Present drainage conditions

In the Repek scheme, the proper drainage control is subject to the improvement of existing drains to the Lemal river. Some drainage channels have been developed to alleviate flood risk for the wet season crop. But no significant flood protection has been implemented despite the regular annual risk of inundation.

In the Hilir Sat I scheme, excess water is drained to the Sat river. The typical section of the Sat river at present discharges 84 m^3/sec of flood which is equivalent to 1 in 5 year flood.

In the Rawa Bechah Laut scheme, the controlled drainage system is adopted for paddy cultivation in 57 ha. In the remaining portion, the Manal river drains excess water from paddy fields. Its drainage capacity is estimated to be about 27 m^3/sec which is equivalent to 1 in 10 year flood discharge.

2.4.5 Operation and maintenance of irrigation schemes

The Repek and Rawa Bechah Laut schemes are operated and maintained by DID Kelantan Barat District Office, while the Hilir Sat I scheme is under the management of DID Kelantan Timur Office. These two Offices share operation and maintenance works of 77 non-granary irrigation schemes in the State. For this, a total of 299 staff including 93 senior to junior class management staff is assigned in the said two Offices. Annual operation and maintenance costs spent for the four years in the three schemes are shown below.

Code No.	Scheme	Irrigable Area (ha)	Annual Operation and Maintenance Cost (M$) 1984	1985	1986	1987
KN009	Hilir Sat I	396	30,913	38,085	36,648	28,538
KN019	Repek	454	60,400	71,000	69,000	71,700
KN052	Rawa Bechah Laut	80	3,432	3,432	3,432	3,432

2.5 Present Agriculture

2.5.1 Crop production

The Inventory Survey reveals that the single cropping of paddy has continuously been conducted fully in the Hilir Sat I scheme and partly in the Rawa Bechah Laut scheme where irrigation water supply is secured during the main season. On the other hand, the paddy planted area is limited to about 30% of the whole irrigable area in the Repek scheme by the main reason of insufficient pumping capacity at the intake site. In the control drainage portion of the Rawa Bechah Laut scheme, the cropping intensity is about 50% due to unstable rainfall pattern. In the Repek scheme, some beneficial farmers grow tobacco instead of paddy.

Average paddy yields vary from 2.5 ton/ha in the Repek scheme to 3.0 ton/ha in the Hilir Sat I scheme and 3.4 ton/ha in the Rawa Bechah Laut scheme. The estimated crop production at present is 1,720 tons of paddy and 5 tons of tobacco as a whole.

2.5.2 Agricultural supporting services

The main farming activity in the three schemes is paddy cultivation. Agencies concerned with responsibility of providing paddy farmers with supporting services are: DID to distribute irrigation water and manage irrigation facilities; DOA to conduct extension and technical support services; FOA to supply farm inputs including fertilizer subsidy; and LPN to purchase paddy under the price support scheme.

As for vegetable cultivation both in paddy and non-paddy fields, DOA is responsible for provision of extension services and technical guidance, while FAMA provides various marketing services. The National Tobacco Board juridically controls tobacco cultivation through its quota system. To revitalize idle paddy fields, FOA is directly involved in undertaking and promotion of government-supported programs.

Regarding group farming activities, DOA has promoted to encourage farmers so far and at present 299 groups are active and participating in 168 projects in three Districts, Machang, Pasir Mas and Tanah Merah as shown below.

	District			State
	Machang	Pasir Mas	Tanah Merah	Total
Total No. of Farming Groups	85	120	94	1,208
Total No. of Group Farming Project	53	39	76	527
No. of Participating Farmers	7,453	13,396	7,147	81,570

3. CROP DIVERSIFICATION PLAN

3.1 Background

Paddy farming in non-granary irrigation scheme areas of Kelantan has close relation to flood circumstance in terms of cropping pattern and calender. In low-lying areas which are annually affected by floods, farmers start their paddy planting either in August to finish harvesting works before flooding or in February and onward after flooding caused by heavy rainfall in November and December. Even though irrigation water source is available for the dry months, thus, this topographical limitation enables farmers to grow paddy once a year. On the contrary, the main season single cropping of paddy can been normally performed in flood-free areas, but the off season paddy is hardly planted due to less run-off from small catchments of non-granary irrigation schemes, being located along upstream reaches of minor tributaries of the Kelantan river. These physical constraints are not easy to be improved scheme by scheme with provision of economical structural measures.

Farmers have optimistically contented themselves with the above situation. Through the Detailed Sample Survey, such farmers' attitude is clearly indicated by the fact that beneficial farmers earn 84% of their annual income from agricultural activities and 88% of the respondents utilize their irrigated farm land to grow paddy. The State of Kelantan is the main producing center of tobacco and also the third largest vegetable cultivation area in Malaysia. Nevertheless, 66% of the sample farmers in the three selected scheme areas have no intention to convert their paddy fields to other crop cultivation areas and further 93% hope to maintain paddy fields to a certain period.

In introducing non-paddy crops to their paddy fields even as the second crop, their main concern among others is marketing. To encourage farmers to enhance farm income sources through crop diversification, therefore, it is indispensable for provision of downstream services after harvesting. In fact, FAMA guarantees to

purchase the whole produce and provide transportation means resulting in that paddy farmers in the Bdg. Pauh non-granary irrigation scheme organize a farming group and now grow lowland cabbage twice during the off season in addition to the main paddy.

3.2 Crop Diversification Plan

(1) Selection of crop

The Detailed Sample Survey reveals that the respondents consider fresh sweat corn, groundnuts, tobacco, chilli and lowland cabbage as most promising and profitable crops when they grow non-paddy crops in their paddy fields. Of these crops, new extension of tobacco planting area is strictly controlled under the National Tobacco Board's quota system. Thus, the technical and economic feasibility on crop diversification plan under the Category 3 is studied to confirm the possibility of introducing the above short-term upland crops except tobacco as the off season cash crops.

(2) Requirements for crop growth

The three selected scheme areas are classified into the agro-climatic region 25 according to the MARDI's agro-ecological study results. Main climatic features in this region are of dry months defined by the Agricultural Rainfall Index being below 40 with probability of 80% in February to April, frequent moisture stress days with probability of over 40% in May and June, flash floods possible with probability of 80% in October and November as well as flash floods likely with probability of 90%. Both flash floods occur when the monthly total rainfall exceeds about 200 mm. There is no shortage of sunshine and strong wind gusts are rare in this region. Such climatic characteristics have no limitations to grow upland crops mentioned in the above and promise high yields with provision of proper crop management.

With regard to soil and land suitabilities for growing vegetables, soils have one serious limitation caused by very poor drainage in the Repek scheme area and one moderate limitation derived from imperfect drainage in the Rawa Bechah Laut scheme, while those in the Hilir Sat I scheme area have two limitations that are somewhat excessively drained in higher part and imperfect drainage in low-lying part.

In order to introduce the off season vegetables, the cropping schedule of the main season paddy is required to be fixed within a certain period. The required conditions are: to finish harvesting works of the main season paddy after the two wet months, November and December; to improve on-farming drainage facilities to control surface water table on paddy fields after heavy rainfalls; and to start vegetable cropping within a period that soils are still moist. Based on the DID's design criteria, the drainage requirement for the main season paddy is estimated to be 8.5 lit/sec/ha.

(3) Cropping system

The off season vegetable cropping is assumed to be performed on a group farming basis. The average size of farm operation is estimated to be 1.5 ha.

To secure enough time for practicing farm management, it is desirable for growing mid-term rice variety of 135 days for the main season. Thus, the presaturation work for the main season paddy starts from the beginning of November with a staggering period of 45 days and the harvesting work is completed by April 20 in case of the Repek scheme. Taking into account the water availability in water source rivers in the Hilir Sat I and Rawa Bechah Laut schemes, the cropping schedule starts one month earlier compared with that of the Repek scheme. As for the control drainage portion of the Rawa Bechah Laut scheme, no structural measurements are provided to improve the current cropping system and it is recommended to maintain paddy

fields as they are for a certain period unless beneficial farmers stop their paddy cultivation.

As for the off season upland crops, sweet corn, lowland cabbage and groundnuts are selected from viewpoint of short-term growing period and farmers' willingness as well. Due to the existing quota system, no attention is paid to select tobacco.

To minimize adverse effects of price fluctuation in markets, the proposed cropping pattern for the off season comprises the above three crops each covering one-third of the respective scheme areas as illustrated in Fig. III-5. The planting works start one month after harvesting of the main season paddy.

For the purpose of comparing farm income situation, the existing single cropping of paddy under the Category 7 is to be examined in term of farm budget.

4. UPGRADING PLAN OF INFRASTRUCTURES

4.1 Approach to the Development

For successful introduction of crop diversification program, the following approach and measures are considered to develop / improve infrastructures in the selected schemes in Kelantan.

(a) to assure irrigation supply for upland crops;

- increase tertiary canal density to achieve equitable and effective water management,
- rehabilitate the deteriorated irrigation facilities

(b) to improve drainage condition during main season;

- provide field drains to avoid inundation on upland field during storm rainfall

(c) to augment farm road density to improve transportation.

- provide farm road network

4.2 Irrigation Water Demand

Water requirement for the proposed cropping pattern under the Category 7 is examined based on daily rainfall data of two stations, i.e. Rumah Pum Repek between 1947 and 1988 for the Repek scheme and Kg. Machang between 1952 and 1988 for the Rawa Bechah Laut and Hilir Sat I schemes. Overall irrigation efficiency for paddy cultivation is assumed to be 0.60 under the condition to be upgraded.

As for upland crops, furrow irrigation should be proposed because of its low initial investment and easiness of maintenance, however, its application loss is bigger than that of other irrigation method. Through discussion with the State DID officials concerned, overall irrigation efficiency for upland crop cultivation is assumed to be 0.45 under the condition with upgrading works. Effective rainfall is

computed by a procedure introduced in "National Water Resources Study, Malaysia" by JICA. In this study, 1 to 5 year probable rainfall is adopted because of low tolerance of upland crops against water stress. Percolation rate is assumed to be 1 mm/day for paddy field.

To estimate peak water demands of paddy, the existing different types of cropping schedule is taken into account. For the comparison, peak water demands of the off season upland crops are also estimated. The results are summarized below.

(Unit: lit/sec/ha)

Crop	Repek	Hilir Sat I / Rawa B.L.
Main season paddy		
- Earliest case (Aug./Jan.)	1.8 (Sept.)	1.8 (Sept.)
- Normal case (Nov./Apr.)	1.8 (Feb.)	1.8 (Feb.)
- Latest case (Jan./June)	2.1 (Feb.)	2.1 (Feb.)
Off season paddy		
- Earliest case (Feb./July)	2.3 (Mar.)	2.3 (march)
- Normal case (June/Nov.)	1.9 (June)	1.9 (June)
- Latest case (Aug./Jan.)	1.8 (Sept.)	1.8 (Sept.)
Off season upland crops		
- Sweet corn	1.3 (June)	1.3 (June)
- Lowland cabbage	1.4 (May)	1.4 (May)
- Groundnut	1.1 (May, June)	1.1 (June)
- Chilli	1.3 (Apr.)	1.3 (Apr.)
- Tobacco	1.4 (July)	1.2 (June)

4.3 Water Balance

4.3.1 Water balance for the Repek scheme

(1) Available water

In the Repek scheme, daily discharge is measured at a stream gauging station located beside the Repek pumphouse from 1981 to 1986. Using these data, 1 in 5 year probable discharge is calculated based on 5-day average discharge. The calculated discharge are shown below and in Fig. III-6. The maximum capacity of two pumps is 1.13

m^3/sec, which is almost equivalent to the 1 in 5 year low flow of the Lemal river at the Repek pumphouse.

(Unit: m^3/sec)

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
2.46	1.12	1.08	1.06	1.09	1.82	1.91	1.92	4.79	5.11	4.06	4.07

(2) Water balance

The water balance for the Repek scheme is examined for each of three blocks based on irrigation water demands for paddy cultivation under the normal, earliest and latest cases of the main and off seasons, respectively as well as five combinations of the main season paddy and the off season upland crops as shown in Table III-1.

The peak irrigation water requirement is estimated at 2.8 lit/sec/ha, which occurs during the presaturation period in November. As the maximum pump capacity of the Repek pumphouse is 1.13 m^3/sec, a total of 404 ha or 85% of the irrigable area can be provided with the presaturation water. In this regard, priority in allocating water is given to flood-free part of the scheme. During the off season, there is no limitation on irrigation water supply to upland crops. The results of water balance examination is shown in Table III-2.

4.3.2 Water balance for the Hilir Sat I scheme

(1) Available water

In the Hilir Sat I scheme, the Sat river is irrigation water source with a catchment area of 56 km^2 at headworks. There is no stream gauging station along the Sat river, quantity of available water is estimated according to the DID procedure. The estimated 1 in 5 year probable surface water at the Hilir Sat I headworks is tabulated below.

(Unit: m^3/sec)

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
0.75	0.20	0.26	0.27	1.38	1.31	1.50	1.90	2.29	2.60	3.72	5.15

(2) Water balance

In the Hilir Sat I scheme, the peak irrigation water demand is 3.0 lit/sec/ha occurring in November and the gross irrigation water requirement is 3.36 m^3/sec as shown in Table III-3. The available discharge in the Sat river during the same month is estimated to be 3.72 m^3/sec and can fully meet this water requirement as shown in Table III-4. The available water sources during the off season can meet irrigation water demands of all upland crops. The only one exceptional case is that, if chilli is planted in the whole area of the scheme, the available discharge is insufficient during April.

4.3.3 Water balance for for the Rawa Bechah Laut scheme

(1) Available water

In the Rawa Bechah Laut scheme, the total irrigable area of 80 ha comprises gravity irrigation area covering 23 ha and controlled drainage area of 57 ha. The gravity irrigation area is commanded by headworks on the Manal river with a catchment area of 6.8 km^2. There is no stream gauging data on this river, available water of 1 in 5 year probability is estimated according to the DID's procedure. Surface water resources estimated are tabulated below:

(Unit: m^3/sec)

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
0.09	0.02	0.03	0.03	0.17	0.16	0.19	0.24	0.29	0.33	0.47	0.65

(2) Water balance

In the Rawa Bechah Laut scheme except control drainage portion, the peak demand and gross requirement of irrigation water are equivalent to those of the Hilir Sat I scheme. As shown in Table III-5, the available water of the Manal river can cover the gross

irrigation water demand for the two cropping systems throughout the year.

4.4 Upgrading Plan

(1) Planning criteria

The basic criteria for upgrading facilities to secure successful crop diversification are:

(a) to design irrigation canal with a flow capacity of 2.0 lit/sec/ha to meet the peak requirement;

(b) to design drainage network so as to drain 1 in 5 year 1-day storm rainfall within 24 hours; and

(c) to provide farm road network with a road density of 100 m/ha, which is equivalent to the double of the IADP standard.

Other design parameters used for the Study are the same as that of the DID and IADP standards.

The upgrading plan is formulated for all related facilities which need to meet the requirements in the final stage of crop diversification plan in the Kulim area. The proposed plan is explained hereunder.

(2) On-farm development

On-farm works are to be designed basically following the DID criteria. Drains are designed to eliminate 1 in 5 year rainfall within 24 hours which is equivalent to 1.5 $m^3/sec/km^2$ for the Repek scheme and 1.6 $m^3/sec/km^2$ for the both Hilir Sat I and Rawa Bechah Laut schemes. Considering the proposed cropping pattern and rainfall characteristics in the these scheme areas, it is recommended to upgrade on-farm service facilities. Based on a typical layout on 105 ha farm, requirements of on-farm service facilities are estimated as follows:

Work Item	Work Quantity
Site clearance	105 ha
Land leveling	105 ha
Farm road (4 m)	2,050 m
Farm road (3 m)	10,200 m
Tertiary irrigation canal	5,250 m
Tertiary drain canal	5,250 m
Field offtakes	70 nos.
Irrigation end	5 nos.
Constant head orifice	5 nos.
Drain end control	5 nos.
AC pipe	10,500 m

(3) Upgrading for the Repek scheme

In the Repek scheme, the new pumphouse is under construction and the existing intake and main canal structures are well maintained. However, downstream portion of the scheme has been left idle because of insufficient capacity of the existing pumphouse resulting in deterioration of the canal system. The following section is needed to be rehabilitated and concrete-lined, while no major canal structures are required to be replaced.

Canal System	Length (m)
No.1 (Block 3)	1,000
No.7 (Block 2)	1,300
No.17 (Block 1)	500

The southern part of the Repek scheme is subject to regular flooding of the Lemal river. Construction of flood dikes to protect this area is a part of the overall flood control plan proposed by the "Gorok River Basin Development Study". Drainage conditions in the scheme can be solved when this project will be realized.

(4) Upgrading for the Hilir Sat I scheme

For this scheme, major improvements of irrigation facilities are not necessary. Required improvement works are to replace the existing field offtakes which are provided for every 100 to 200 m on the main and secondary canals by constant head orifices.

Drainage conditions in this scheme is poor during the wet season mainly due to flooding of the Sat river caused by backwater of the Kelantan river. Flood mitigation works proposed in the "Feasibility Study on the Flood Mitigation Project in Machang, Kelantan" comprise channel widening and replacement of 9 structures of the Sat river and desilting of its tributaries. The drainage conditions in this scheme will be improved when this flood mitigation project is realized.

(5) Upgrading for the Rawa Bechah Laut scheme

For the portion served by gravity irrigation system, the existing irrigation facilities are maintenance properly. Requirements are the minor upgrading works such as replacement of field offtakes by constant head orifices.

There is no possibility of conveying water resource of the Manal river to the control drainage portion due to topography and insufficient available water due to small catchment area of the Manal river. No improvement of the controlled drainage system is proposed.

4.5 Construction Plan

As paddy fields in the selected schemes are usually inundated during the wet season, main construction works, especially earth works, should be completed during dry months.

The period required to complete the whole construction works is estimated to be approximately 12 months for the Repek and Hilir Sat I schemes, while 6 months for the Rawa Bechah Laut scheme.

4.6 Construction Cost

(1) Investment costs

The project cost is estimated based on the following assumptions:

(i) Direct construction cost is estimated following the current unit construction cost provided by the State DID.

(ii) Engineering costs including survey and design are assumed to be 10% of the direct construction cost.

(iii) Physical contingency is assumed to be 15% of the direct construction cost and engineering cost.

The unit construction cost for each work item is shown in Table III-6. In line with the proposed implementation schedule, the total project cost including survey and design and physical contingency is estimated at M$10.4 million as shown in Table III-7 in detail and is summarized below.

Stage	Main Work Items	Construction Cost (M$'000) Direct Cost	Total Cost
Repek	On-farm development 454 ha	4,337	5,486
Hilir Sat I	On-farm development 396 ha	3,685	4,662
Rawa Bechah Laut	On-farm development 23 ha	214	271
Total		8,236	10,419

(2) Operation and maintenance (O&M) costs

The annual O&M costs increased by implementation of the Project is assumed to be 0.5% of the direct construction cost reflecting the past performance of O&M by DID District office. The annual

incremental O&M cost is estimated at M$27,400 for the Repek scheme, M$23,300 for the Hilir Sat I scheme, and M$1,350 for the Rawa Bechah Laut scheme.

5. EVALUATION OF CROP DIVERSIFICATION PLAN

5.1 General

The feasibility of the proposed crop diversification plan is assessed in this Chapter. The financial feasibility is analyzed by calculating the financial internal rate of return (FIRR). Sensitivity analysis is also made in order to evaluate the financial viability of the project against the changes in the cost and benefit and delay in schedule of crop diversification.

5.2 Benefits

It is expected that benefits accrued from the project will be solely irrigation benefit. The net irrigation benefit is defined as the difference of net income by cropping schedule between future with project and without project conditions. The gross benefit, production costs, and net benefit per ha for each crop is estimated referring to the *Guideline on Economic Viability of Selected Crops* prepared by MOA in 1989 (see Appendix E, Volume 2).

The annual net benefit without project condition is estimated at M$900/ha for the Hilir Sat I and Rawa Bechah Laut schemes, and M$947/ha for the Repek scheme as shown in Table III-8. In this calculation, the unit yield of paddy is assumed to be the same as the present level of 2.25 tons/ha.

The incremental benefit will be realized from the third year of the commencement of the project and will reach its maximum at the 5th year of the project implementation, Annual net benefit with project condition at the full development stage is shown in Table III-9. The incremental net benefit is estiamated below.

Item		Repek	Hilir Sat I	Rawa B. Laut
Cropping area (ha)				
Present	main	153	396	23*
	Off	7	0	0
Without Project	main	454	396	23
	Off	7	0	0
With Project	main	454	396	23
	Off	454	396	23
Incremental benefit at full development stage (M$'000)		2,146	1,901	110

Note; * = *excluding controlled drainage area of 57 ha*

Negative benefits are not considered in the evaluation because the proposed works are of a small-scale and can be implemented without disturbance of crop cultivation.

5.3 Financial Evaluation

The financial evaluation is made assuming a project economic life of 30 years. The flow of financial cost and benefit for selected schemes are shown in Tables III-10 to III-12. The financial internal rate of return (FIRR) is estimated by schemet as follows:

Selected scheme	FIRR (%)
Repek	22.5
Hilir Sat I	23.3
Rawa Bechah Laut	23.3
Overall	22.9

A sensitivity analysis is made to evaluate the soundness of the project against possible adverse change in the future in the following factors; (1) cost overrun, (2) reduction of net benefit due to drop of market price of products and/or reduced crop yield, and (4) combination of the above. The results are presented below.

Alternative case		FIRR (%) Repek	FIRR (%) Hilir S.I & Rawa B.L.
Base		22.5	23.3
Case 1-1	cost overrun by 10%	20.9	21.6
Case 1-2	cost overrun by 20%	19.5	20.1
Case 1-3	cost overrun by 30%	18.3	18.9
Case 2-1	reduction of benefit by 10%	19.0	19.7
Case 2-2	reduction of benefit by 20%	15.7	16.3
Case 2-3	reduction of benefit by 30%	12.5	13.0
Case 3-1	combination of Case 1-1 and 2-1	17.6	18.2
Case 3-2	combination of Case 1-2 and 2-2	13.5	14.0

The proposed crop diversification program can be justified with FIRR of about 23% for all selected schemes. The sensitivity analysis indicates that viability of the project is rather insensitive to the increase in construction costs, but rather sensitive to the reduction of benefits by falling of market prices of products and/or reduced crop yields.

6. ROLE OF AGENCIES CONCERNED IN PROMOTING CROP DIVERSIFICATION

In non-granary irrigation scheme areas with the possibility of promoting crop diversification through practicing two cropping system, it is recommended that the existing coordinating committees such as Stage Agricultural Action Committee, State Planning Coordination Committee and District Agricultural Planning Coordinate Committee need to have the initiative to increase the coordination of their departments and of the agencies concerned and their interlinkages with DID, DOA, FOA, LPN, FAMA and BPM.

The State DID is responsible for design and construction of irrigation, drainage and farm access roads in each scheme area up to on-farm level. The role of the State DOA is to set up the cropping schedule, to provide extension and technical services, to supply farm inputs and to promote grouping of farmers participating in crop diversification. The responsibility of FOA is timely provision of farm machinery services for land preparation and harvesting works. As for marketing services, LPN purchases paddy on a subsidy basis, while FAMA makes the necessary arrangement for marketing upland crops. Provision of short-term credit to cover annual farm operation costs is handled by BPM.

7. CONCLUSIONS AND RECOMMENDATIONS

7.1 Conclusions

(1) Kelantan has a large market potential for upland crops: 17,000 tons of leafy vegetables, 28,000 tons of fruit vegetables, and 67,000 tons of fruits.

(2) Many schemes in Kelantan are affected by inundation often due to heavy rainfalls during wet season from October to January. These inundations are caused by direct or indirect (back water) effect of flooding in the main rivers such as the Kelantan and Golok rivers. During the wet season, there is little chance to introduce upland crops into non-granary irrigated areas in Kelantan.

(3) Upland crops can be cultivated only in the limited period in the dry months. Such conditions will cause a marketing problem by concentrating the harvesting season within a limited period. Diversification of kind of crops and staggering of planting schedule is highly important.

(4) To introduce upland cropping culture in the flood affected areas, there is a risk of inundation in the harvesting period for the second crops. It is, therefore, important to fix the cropping schedule of main season paddy. From this viewpoint, not only provision of adequate drainage systems by also upgrading of irrigation facilities is necessary.

(4) Investment of proposed upgrading works for selected schemes can financially be justified with FIRR of about 23%.

(5) Coordination among organizations and agencies related to crop diversification program is quite important. The existing coordination committees can fully be used for this purpose.

7.2 Recommendations

(1) Operation of a demonstration plot

In the initial stage for promoting crop diversification a description of support services, both technical and non-technical, should be prepared in a package form and given and explained to the intended paddy farmers. To enable conservative paddy farmers to participate in crop diversification, it is recommend that a pilot demonstration scheme be operated in a part of schemes with good access in which diversified cropping is carried out incorporating all the necessary support services.

Part - III

Tables

Table III-1 Irrigation Water Demand for Repek Scheme (1/4)

(1) Normal case of main and off season paddy

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Pattern I Area(ha) = 1.0													
Pattern II Area(ha) = 1.0													
Pattern III Area(ha) = 1.0													
ETO (mm)	144.0	148.2	177.0	184.8	166.8	154.8	154.8	157.2	157.8	142.8	121.8	118.8	1,829
ETcrop (I) (mm)	201.6	207.5	41.3		99.5	308.5	201.2	220.1	220.9		342.9	148.5	1,992
ETcrop (II) (mm)	201.6	207.5	165.2			320.8	178.0	220.1	220.9	100.0	275.9	130.7	2,021
ETcrop (III) (mm)	180.0	207.5	247.8	43.1		97.5	308.5	204.4	220.9	199.9		339.7	2,049
ETcrop (I-III) (mm)	194.4	207.5	151.4	14.4	33.2	242.2	229.2	214.8	220.9	100.0	206.3	206.3	2,021
Percolation (mm)	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	360
80% Rainfall (mm)	42.3	16.8	17.6	21.7	91.9	132.2	112.5	142.6	153.5	177.4	225.1	285.1	1,419
Effective Rainfall (mm)	22.0	10.1	10.6	13.0	39.6	42.9	41.4	52.8	58.0	65.2	79.5	97.5	533
Net Water Requirement (mm)	202.4	227.4	170.8	31.4	23.6	229.3	217.8	192.0	192.9	64.8	156.8	138.8	1,848
Overall Efficiency	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Gross Water Requirement (mm)	337.3	379.0	284.7	52.3	39.3	382.2	363.0	320.0	321.5	108.0	261.3	231.3	3,080
- do - (l/sec)	3.9	4.4	3.3	0.6	0.5	4.4	4.2	3.7	3.7	1.3	3.0	2.7	3.0
- do - (l/sec/ha)	1.3	1.5	1.1	0.2	0.2	1.5	1.4	1.2	1.2	0.4	1.0	0.9	1.0

Peak 1.9 l/sec/ha (June)

(2) Earliest case of main season paddy

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Pattern I Area(ha) = 1.0													
Pattern II Area(ha) = 1.0													
Pattern III Area(ha) = 1.0													
ETO (mm)	144.0	148.2	177.0	184.8	166.8	154.8	154.8	157.2	157.8	142.8	121.8	118.8	1,829
ETcrop (I) (mm)								293.6	173.6	199.9	170.5	110.9	949
ETcrop (II) (mm)	33.6								380.7	178.5	170.5	166.3	930
ETcrop (III) (mm)	134.4								293.9	157.1	170.5	166.3	922
ETcrop (I-III) (mm)	56.0							97.9	282.7	178.5	170.5	147.8	933
Percolation (mm)	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	360
80% Rainfall (mm)	42.3	16.8	17.6	21.7	91.9	132.2	112.5	142.6	153.5	177.4	225.1	285.1	1,419
Effective Rainfall (mm)	22.0	10.1	10.6	13.0	39.6	42.9	41.4	52.8	58.0	65.2	79.5	97.5	533
Net Water Requirement (mm)	58.6							86.3	254.7	143.3	121.0	80.3	744
Overall Efficiency	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Gross Water Requirement (mm)	97.7							143.8	424.5	238.8	201.7	133.8	1,240
- do - (l/sec)	1.1							1.7	4.9	2.8	2.3	1.5	1.2
- do - (l/sec/ha)	0.4							0.6	1.6	0.9	0.8	0.5	0.4

Peak 1.8 l/sec/ha (September)

(3) Latest case of main season paddy

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Pattern I Area(ha) = 1.0													
Pattern II Area(ha) = 1.0													
Pattern III Area(ha) = 1.0													
ETO (mm)	144.0	148.2	177.0	184.8	166.8	154.8	154.8	157.2	157.8	142.8	121.8	118.8	1,829
ETcrop (I) (mm)	313.4	170.4	247.8	215.6	116.8								1,064
ETcrop (II) (mm)	95.7	301.4	230.1	258.7	233.5								1,119
ETcrop (III) (mm)		316.3	203.6	258.7	233.5	108.4							1,121
ETcrop (I-III) (mm)	136.4	262.7	227.2	258.7	194.6	36.1							1,116
Percolation (mm)	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	360
80% Rainfall (mm)	42.3	16.8	17.6	21.7	91.9	132.2	112.5	142.6	153.5	177.4	225.1	285.1	1,419
Effective Rainfall (mm)	22.0	10.1	10.6	13.0	39.6	42.9	41.4	52.8	58.0	65.2	79.5	97.5	533
Net Water Requirement (mm)	145.7	282.7	246.6	275.7	185.0	29.7							1,165
Overall Efficiency	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Gross Water Requirement (mm)	242.8	471.2	411.0	459.5	308.3	49.5							1,942
- do - (l/sec)	2.8	5.5	4.8	5.3	3.6	0.6							1.9
- do - (l/sec/ha)	0.9	1.8	1.6	1.8	1.2	0.2							0.6

Peak 2.1 l/sec/ha (February)

Table III-1 Irrigation Water Demand for Repek Scheme (2/4)

(4) Earliest case of off-season paddy

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Pattern I Area(ha) = 1.0		===-	------	------	------	---.....							
Pattern II Area(ha) = 1.0			===---	------	------	------	.....						
Pattern III Area(ha) = 1.0				===-	------	------	---.....						
ETO (mm)	144.0	148.2	177.0	184.8	166.8	154.8	154.8	157.2	157.8	142.8	121.8	118.8	1,829
ETcrop (I) (mm)		316.3	203.6	215.6	233.5	108.4							1,077
ETcrop (II) (mm)		96.4	332.1	240.2	233.5	216.7							1,119
ETcrop (III) (mm)			336.0	212.5	233.5	216.7	108.4						1,107
ETcrop (I-III) (mm)		137.5	290.5	237.2	233.5	180.6	36.1						1,115
Percolation (mm)	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	360
80% Rainfall (mm)	42.3	16.8	17.6	21.7	91.9	132.2	112.5	142.6	153.5	177.4	225.1	285.1	1,419
Effective Rainfall (mm)	22.0	10.1	10.6	13.0	39.6	42.9	41.4	52.8	58.0	65.2	79.5	97.5	533
Net Water Requirement (mm)		150.3	310.0	254.2	224.0	167.7	31.3						1,138
Overall Efficiency	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Gross Water Requirement (mm)		250.5	516.7	423.7	373.3	279.5	52.2						1,896
- do - (l/sec)		2.9	6.0	4.9	4.3	3.2	0.6						1.8
- do - (l/sec/ha)		1.0	2.0	1.6	1.4	1.1	0.2						0.6

Peak 2.3 l/sec/ha (March)

(5) Latest case of off-season paddy

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Pattern I Area(ha) = 1.0								===-	------	------	------	---.....	
Pattern II Area(ha) = 1.0	.....								===---	------	------	------	
Pattern III Area(ha) = 1.0	---.....								===-	------	------	------	
ETO (mm)	144.0	148.2	177.0	184.8	166.8	154.8	154.8	157.2	157.8	142.8	121.8	118.8	1,829
ETcrop (I) (mm)								322.4	181.5	199.9	170.5	83.2	958
ETcrop (II) (mm)								97.9	311.7	185.6	170.5	166.3	932
ETcrop (III) (mm)	100.8								322.8	164.2	170.5	166.3	925
ETcrop (I-III) (mm)	33.6							140.1	272.0	183.3	170.5	138.6	938
Percolation (mm)	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	360
80% Rainfall (mm)	42.3	16.8	17.6	21.7	91.9	132.2	112.5	142.6	153.5	177.4	225.1	285.1	1,419
Effective Rainfall (mm)	22.0	10.1	10.6	13.0	39.6	42.9	41.4	52.8	58.0	65.2	79.5	97.5	533
Net Water Requirement (mm)	34.2							124.4	243.9	148.0	121.0	71.1	743
Overall Efficiency	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Gross Water Requirement (mm)	57.0							207.3	406.5	246.7	201.7	118.5	1,238
- do - (l/sec)	0.7							2.4	4.7	2.9	2.3	1.4	1.2
- do - (l/sec/ha)	0.2							0.8	1.6	1.0	0.8	0.5	0.4

Peak 1.8 l/sec/ha (September)

(6) Main season paddy + off-season cabbage

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Pattern I Area(ha) = 1.0	------	---.....			------	---.....				===**	**----	------	
Pattern II Area(ha) = 1.0	------	------..	....			------	.....			===	****--	------	
Pattern III Area(ha) = 1.0	------	------	---.....			------	---.....				===	** **---	
ETO (mm)	144.0	148.2	177.0	184.8	166.8	154.8	154.8	157.2	157.8	142.8	121.8	118.8	1,829
ETcrop (I) (mm)	201.6	69.2		73.9	146.0	71.0				419.0	252.1	166.3	1,399
ETcrop (II) (mm)	201.6	172.9			133.4	144.5				261.4	323.5	160.4	1,398
ETcrop (III) (mm)	201.6	207.5	82.6		66.7	135.5	71.0				401.5	248.6	1,415
ETcrop (I-III) (mm)	201.6	149.8	27.5	24.6	115.4	117.0	23.7			226.8	325.7	191.8	1,404
Percolation (mm)	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	360
80% Rainfall (mm)	42.3	16.8	17.6	21.7	91.9	132.2	112.5	142.6	153.5	177.4	225.1	285.1	1,419
Effective Rainfall (mm)	22.0	10.1	10.6	13.0	39.6	42.9	41.4	52.8	58.0	65.2	79.5	97.5	533
Net Water Requirement (mm)	209.6	169.8	33.7	32.7	105.8	104.1	18.8			191.6	276.2	124.3	1,267
Overall Efficiency	0.60	0.60	0.60	0.45	0.45	0.45	0.45			0.60	0.60	0.60	0.54
Gross Water Requirement (mm)	349.3	283.0	56.2	72.7	235.1	231.3	41.8			319.3	460.3	207.2	2,256
- do - (l/sec)	4.0	3.3	0.7	0.8	2.7	2.7	0.5			3.7	5.3	2.4	2.2
- do - (l/sec/ha)	1.3	1.1	0.2	0.3	0.9	0.9	0.2			1.2	1.8	0.8	0.7

Peak 2.8 l/sec/ha (November)

Table III-1 Irrigation Water Demand for Repek Scheme (3/4)

(7) Main season paddy + off-season chilli

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Pattern I Area(ha) = 1.0													
Pattern II Area(ha) = 1.0													
Pattern III Area(ha) = 1.0													
ET0 (mm)	144.0	148.2	177.0	184.8	166.8	154.8	154.8	157.2	157.8	142.8	121.8	118.8	1,829
ETcrop (I) (mm)	201.6	69.2	94.4	147.8	150.1	143.4	45.4			419.0	252.1	166.3	1,689
ETcrop (II) (mm)	201.6	172.9	23.6	147.8	137.6	147.1	115.3			261.4	323.5	160.4	1,691
ETcrop (III) (mm)	201.6	207.5	82.6	98.6	133.4	139.3	143.4	46.1			401.5	248.6	1,703
ETcrop (I-III) (mm)	201.6	149.8	66.9	131.4	140.4	143.3	101.4	15.4		226.8	325.7	191.8	1,695
Percolation (mm)	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	360
80% Rainfall (mm)	42.3	16.8	17.6	21.7	91.9	132.2	112.5	142.6	153.5	177.4	225.1	285.1	1,419
Effective Rainfall (mm)	22.0	10.1	10.6	13.0	39.6	42.9	41.4	52.8	58.0	65.2	79.5	97.5	533
Net Water Requirement (mm)	209.6	169.8	86.3	148.4	130.8	130.4	90.0	8.2		191.6	276.2	124.3	1,566
Overall Efficiency	0.60	0.60	0.6/0.45	0.45	0.45	0.45	0.45	0.45		0.60	0.60	0.60	0.54
Gross Water Requirement (mm)	349.3	283.0	173.1	329.8	290.7	289.8	200.0	18.2		319.3	460.3	207.2	2,921
- do - (l/sec)	4.0	3.3	2.0	3.8	3.4	3.4	2.3	0.2		3.7	5.3	2.4	2.8
- do - (l/sec/ha)	1.3	1.1	0.7	1.3	1.1	1.1	0.8	0.1		1.2	1.8	0.8	0.9

Peak 2.8 l/sec/ha (November)

(8) Main season paddy + off-season groundnuts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Pattern I Area(ha) = 1.0													
Pattern II Area(ha) = 1.0													
Pattern III Area(ha) = 1.0													
ET0 (mm)	144.0	148.2	177.0	184.8	166.8	154.8	154.8	157.2	157.8	142.8	121.8	118.8	1,829
ETcrop (I) (mm)	201.6	69.2		73.9	137.6	141.9	58.1			419.0	252.1	166.3	1,520
ETcrop (II) (mm)	201.6	172.9			133.4	139.3	126.4			261.4	323.5	160.4	1,519
ETcrop (III) (mm)	201.6	207.5	82.6		66.7	127.7	141.9	59.0			401.5	248.6	1,537
ETcrop (I-III) (mm)	201.6	149.8	27.5	24.6	112.6	136.3	108.8	19.7		226.8	325.7	191.8	1,525
Percolation (mm)	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	360
80% Rainfall (mm)	42.3	16.8	17.6	21.7	91.9	132.2	112.5	142.6	153.5	177.4	225.1	285.1	1,419
Effective Rainfall (mm)	22.0	10.1	10.6	13.0	39.6	42.9	41.4	52.8	58.0	65.2	79.5	97.5	533
Net Water Requirement (mm)	209.6	169.8	33.7	32.7	103.0	123.5	97.4	8.4		191.6	276.2	124.3	1,370
Overall Efficiency	0.60	0.60	0.60	0.45	0.45	0.45	0.45	0.45		0.60	0.60	0.60	0.55
Gross Water Requirement (mm)	349.3	283.0	56.2	72.7	228.9	274.4	216.4	18.7		319.3	460.3	207.2	2,486
- do - (l/sec)	4.0	3.3	0.7	0.8	2.6	3.2	2.5	0.2		3.7	5.3	2.4	2.4
- do - (l/sec/ha)	1.3	1.1	0.2	0.3	0.9	1.1	0.8	0.1		1.2	1.8	0.8	0.8

Peak 2.8 l/sec/ha (November)

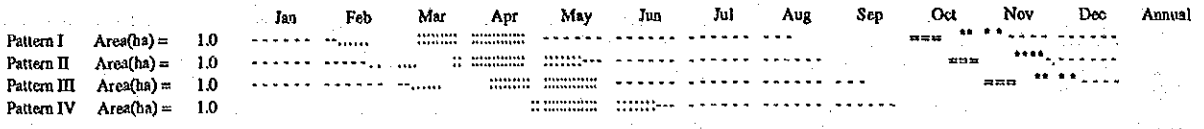
(9) Main season paddy + off-season sweet corn

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Pattern I Area(ha) = 1.0													
Pattern II Area(ha) = 1.0													
Pattern III Area(ha) = 1.0													
ET0 (mm)	144.0	148.2	177.0	184.8	166.8	154.8	154.8	157.2	157.8	142.8	121.8	118.8	1,829
ETcrop (I) (mm)	201.6	69.2		78.5	169.6	158.7				419.0	252.1	166.3	1,515
ETcrop (II) (mm)	201.6	172.9			152.9	162.5	77.4			261.4	323.5	160.4	1,513
ETcrop (III) (mm)	201.6	207.5	82.6		70.9	157.4	158.7				401.5	248.6	1,529
ETcrop (I-III) (mm)	201.6	149.8	27.5	26.2	131.1	159.5	78.7			226.8	325.7	191.8	1,519
Percolation (mm)	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	360
80% Rainfall (mm)	42.3	16.8	17.6	21.7	91.9	132.2	112.5	142.6	153.5	177.4	225.1	285.1	1,419
Effective Rainfall (mm)	22.0	10.1	10.6	13.0	39.6	42.9	41.4	52.8	58.0	65.2	79.5	97.5	533
Net Water Requirement (mm)	209.6	169.8	33.7	34.3	121.6	146.7	67.3			191.6	276.2	124.3	1,375
Overall Efficiency	*0.60*	*0.60*	*0.60*	*0.45*	*0.45*	*0.45*	*0.45*			*0.60*	*0.60*	*0.60*	*0.56*
Gross Water Requirement (mm)	349.3	283.0	56.2	76.2	270.2	326.0	149.6			319.3	460.3	207.2	2,497
- do - (l/sec)	4.0	3.3	0.7	0.9	3.1	3.8	1.7			3.7	5.3	2.4	2.4
- do - (l/sec/ha)	1.3	1.1	0.2	0.3	1.0	1.3	0.6			1.2	1.8	0.8	0.8

Peak 2.8 l/sec/ha (November)

Table III-1 Irrigation Water Demand for Repek Scheme (4/4)

(10) Main season paddy + off-season tabacco



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
ET0 (mm)	144.0	148.2	177.0	184.8	166.8	154.8	154.8	157.2	157.8	142.8	121.8	118.8	1,829
ETcrop (I) (mm)	201.6	69.2			111.2	185.8	154.8	66.8		419.0	252.1	166.3	1,627
ETcrop (II) (mm)	201.6	172.9			44.5	154.8	170.3	145.4		261.4	323.5	160.4	1,635
ETcrop (III) (mm)	201.6	207.5	82.6			103.2	185.8	157.2	67.1		401.5	248.6	1,655
ETcrop (IV) (mm)						41.3	154.8	172.9	146.0				515
ETcrop (I-IV) (mm)	201.6	149.8	27.5		51.9	147.9	170.3	123.1	22.4	226.8	325.7	191.8	1,639
Percolation (mm)	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	360
80% Rainfall (mm)	42.3	16.8	17.6	21.7	91.9	132.2	112.5	142.6	153.5	177.4	225.1	285.1	1,419
Effective Rainfall (mm)	22.0	10.1	10.6	13.0	39.6	42.9	41.4	52.8	58.0	65.2	79.5	97.5	533
Net Water Requirement (mm)	209.6	169.8	33.7		42.3	135.1	158.9	100.3	8.8	191.6	276.2	124.3	1,451
Overall Efficiency	0.60	0.60	0.60		0.45	0.45	0.45	0.45	0.45	0.60	0.60	0.60	0.54
Gross Water Requirement (mm)	349.3	283.0	56.2		94.0	300.2	353.1	222.9	19.6	319.3	460.3	207.2	2,665
- do - (l/sec)	4.0	3.3	0.7		1.5	4.6	5.4	3.4	0.3	3.7	5.3	2.4	2.9
- do - (l/sec/ha)	1.3	1.1	0.2		0.4	1.2	1.4	0.9	0.1	1.2	1.8	0.8	0.9

Peak 2.8 l/sec/ha (November)

Table III-2 Water Balance in Repek Scheme (1/2)

(1) Water requirement by crop

(Unit : m3/sec)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Peak
Sg.Lemal (1 to 5 year)	2.46	1.12	1.08	1.06	1.09	1.82	1.91	1.92	4.79	5.11	4.06	4.07	
Pump up (max. 1.13m3/s)	1.13	1.12	1.08	1.06	1.09	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13

(Unit : l/sec/ha)

Category 3 cabbage	1.3	1.1	0.2	0.3	0.9	0.9	0.2			1.2	1.8	0.8	2.8 (Nov)
Category 3 chilli	1.3	1.1	0.7	1.3	1.1	1.1	0.8	0.1		1.2	1.8	0.8	2.8 (Nov)
Category 3 groundnuts	1.3	1.1	0.2	0.3	0.9	1.1	0.8	0.1		1.2	1.8	0.8	2.8 (Nov)
Category 3 sweet corn	1.3	1.1	0.2	0.3	1.0	1.3	0.6			1.2	1.8	0.8	2.8 (Nov)
Category 3 tobacco	1.3	1.1	0.2		0.4	1.2	1.4	0.9	0.1	1.2	1.8	0.8	2.8 (Nov)
Category 7 normal	1.3	1.5	1.1	0.2	0.2	1.5	1.4	1.2	1.2	0.4	1.0	0.9	1.9 (Jun)
Category 7 main earliest	0.4							0.6	1.6	0.9	0.8	0.5	1.8 (Sep)
Category 7 main latest	0.9	1.8	1.6	1.8	1.2	0.2							2.1 (Feb)
Category 7 off earliest		1.0	2.0	1.6	1.4	1.1	0.2						2.3 (Mar)
Category 7 off latest	0.2							0.8	1.6	1.0	0.8	0.5	1.8 (Sep)

(2) Water balance

(Unit : m3/sec)

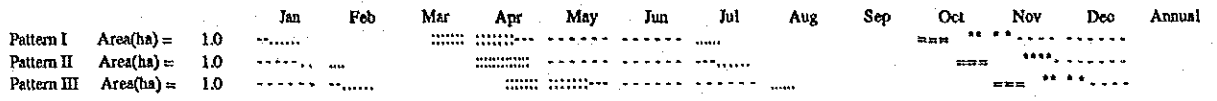
	Area(ha)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Peak
1. Paddy + cabbage														(Nov)
Block 1(No.8&17)	106	0.14	0.12	0.02	0.03	0.10	0.10	0.02			0.13	0.19	0.08	0.30
Block 2(No.5&6)	202	0.26	0.22	0.04	0.06	0.18	0.18	0.04			0.24	0.36	0.16	0.57
block 3(No.1)	146	0.19	0.16	0.03	0.04	0.13	0.13	0.03			0.18	0.26	0.12	0.41
Total	454	0.59	0.50	0.09	0.14	0.41	0.41	0.09			0.54	0.82	0.36	1.27
+/-		0.54	0.62	0.99	0.92	0.68	0.72	1.04	1.13	1.13	0.59	0.31	0.77	-0.14
2. Paddy + chilli														(Nov)
Block 1(No.8&17)	106	0.14	0.12	0.07	0.14	0.12	0.12	0.08	0.01		0.13	0.19	0.08	0.30
Block 2(No.5&6)	202	0.26	0.22	0.14	0.26	0.22	0.22	0.16	0.02		0.24	0.36	0.16	0.57
block 3(No.1)	146	0.19	0.16	0.10	0.19	0.16	0.16	0.12	0.01		0.18	0.26	0.12	0.41
Total	454	0.59	0.50	0.32	0.59	0.50	0.50	0.36	0.05		0.54	0.82	0.36	1.27
+/-		0.54	0.62	0.76	0.47	0.59	0.63	0.77	1.08	1.13	0.59	0.31	0.77	-0.14
3. Paddy + gruondnuts														(Nov)
Block 1(No.8&17)	106	0.14	0.12	0.02	0.03	0.10	0.12	0.08	0.01		0.13	0.19	0.08	0.30
Block 2(No.5&6)	202	0.26	0.22	0.04	0.06	0.18	0.22	0.16	0.02		0.24	0.36	0.16	0.57
block 3(No.1)	146	0.19	0.16	0.03	0.04	0.13	0.16	0.12	0.01		0.18	0.26	0.12	0.41
Total	454	0.59	0.50	0.09	0.14	0.41	0.50	0.36	0.05		0.54	0.82	0.36	1.27
+/-		0.54	0.62	0.99	0.92	0.68	0.63	0.77	1.08	1.13	0.59	0.31	0.77	-0.14
4. Paddy + sweet corn														(Nov)
Block 1(No.8&17)	106	0.14	0.12	0.02	0.03	0.11	0.14	0.06			0.13	0.19	0.08	0.30
Block 2(No.5&6)	202	0.26	0.22	0.04	0.06	0.20	0.26	0.12			0.24	0.36	0.16	0.57
block 3(No.1)	146	0.19	0.16	0.03	0.04	0.15	0.19	0.09			0.18	0.26	0.12	0.41
Total	454	0.59	0.50	0.09	0.14	0.45	0.59	0.27			0.54	0.82	0.36	1.27
+/-		0.54	0.62	0.99	0.92	0.64	0.54	0.86	1.13	1.13	0.59	0.31	0.77	-0.14
5. Paddy + tobacco														(Nov)
Block 1(No.8&17)	106	0.14	0.12	0.02	0.00	0.04	0.13	0.15	0.10	0.01	0.13	0.19	0.08	0.30
Block 2(No.5&6)	202	0.26	0.22	0.04	0.00	0.08	0.24	0.28	0.18	0.02	0.24	0.36	0.16	0.57
block 3(No.1)	146	0.19	0.16	0.03	0.00	0.06	0.18	0.20	0.13	0.01	0.18	0.26	0.12	0.41
Total	454	0.59	0.50	0.09	0.00	0.18	0.54	0.64	0.41	0.05	0.54	0.82	0.36	1.27
+/-		0.54	0.62	0.99	1.06	0.91	0.59	0.49	0.72	1.08	0.59	0.31	0.77	-0.14
6. Normal case of main and off season paddy														(Jun)
Block 1(No.8&17)	106	0.14	0.16	0.12	0.02	0.02	0.16	0.15	0.13	0.13	0.04	0.11	0.10	0.20
Block 2(No.5&6)	202	0.26	0.30	0.22	0.04	0.04	0.30	0.28	0.24	0.24	0.08	0.20	0.18	0.38
block 3(No.1)	146	0.19	0.22	0.16	0.03	0.03	0.22	0.20	0.18	0.18	0.06	0.15	0.13	0.28
Total	454	0.59	0.68	0.50	0.09	0.09	0.68	0.64	0.54	0.54	0.18	0.45	0.41	0.86
+/-		0.54	0.44	0.58	0.97	1.00	0.45	0.49	0.59	0.59	0.95	0.68	0.72	0.27
7. Earliest case of main season paddy														(Sep)
Block 1(No.8&17)	106	0.04							0.06	0.17	0.10	0.08	0.05	0.19
Block 2(No.5&6)	202	0.08							0.12	0.32	0.18	0.16	0.10	0.36
block 3(No.1)	146	0.06							0.09	0.23	0.13	0.12	0.07	0.26
Total	454	0.18							0.27	0.73	0.41	0.36	0.23	0.82
+/-		0.95	1.12	1.08	1.06	1.09	1.13	1.13	0.86	0.40	0.72	0.77	0.90	0.31

Table III-2 Water Balance in Repek Scheme (2/2)

	Area(ha)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Peak
8. Latest case of main season paddy														(Feb)
Block 1(No.8&17)	106	0.10	0.19	0.17	0.19	0.13	0.02							0.22
Block 2(No.5&6)	202	0.18	0.36	0.32	0.36	0.24	0.04							0.42
block 3(No.1)	146	0.13	0.26	0.23	0.26	0.18	0.03							0.31
Total	454	0.41	0.82	0.73	0.82	0.54	0.09							0.95
+/-		0.72	0.30	0.35	0.24	0.55	1.04	1.13	1.13	1.13	1.13	1.13	1.13	0.18
9. Earliest case of off season paddy														(Mar)
Block 1(No.8&17)	106		0.11	0.21	0.17	0.15	0.12	0.02						0.24
Block 2(No.5&6)	202		0.20	0.40	0.32	0.28	0.22	0.04						0.46
block 3(No.1)	146		0.15	0.29	0.23	0.20	0.16	0.03						0.34
Total	454		0.45	0.91	0.73	0.64	0.50	0.09						1.04
+/-		1.13	0.67	0.17	0.33	0.45	0.63	1.04	1.13	1.13	1.13	1.13	1.13	0.09
10. Latest case of off season paddy														(Sep)
Block 1(No.8&17)	106	0.02							0.08	0.17	0.11	0.08	0.05	0.19
Block 2(No.5&6)	202	0.04							0.16	0.32	0.20	0.16	0.10	0.36
block 3(No.1)	146	0.03							0.12	0.23	0.15	0.12	0.07	0.26
Total	454	0.09							0.36	0.73	0.45	0.36	0.23	0.82
+/-		1.04							0.77	0.40	0.68	0.77	0.90	0.31

Table III-3 Irrigation Water Demand for Hilir Sat I and Rawa Bechah Laut Scheme (1/2)

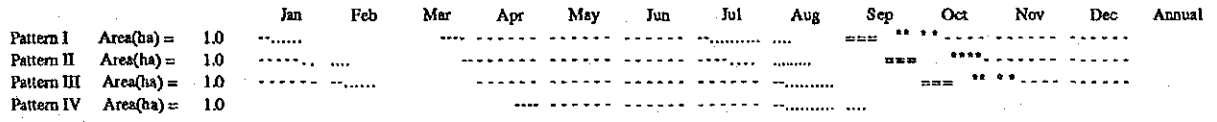
(1) Main season paddy + off-season cabbage



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Pattern I Area(ha) = 1.0													
Pattern II Area(ha) = 1.0													
Pattern III Area(ha) = 1.0													
ET0 (mm)	144.0	148.2	177.0	184.8	166.8	154.8	154.8	157.2	157.8	142.8	121.8	118.8	1,829
ETcrop (I) (mm)	67.2			73.9	146.0	71.0			431.5	276.6	170.5	166.3	1,403
ETcrop (II) (mm)	168.0				133.4	144.5			268.9	341.4	164.4	166.3	1,387
ETcrop (III) (mm)	201.6	69.2			66.7	135.5	71.0			419.0	252.1	166.3	1,381
ETcrop (I-III) (mm)	145.6	23.1		24.6	115.4	117.0	23.7		233.5	345.7	195.7	166.3	1,391
Percolation (mm)	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	360
80% Rainfall (mm)	42.3	16.8	17.6	21.7	91.9	132.2	112.5	142.6	153.5	177.4	225.1	285.1	1,419
Effective Rainfall (mm)	22.0	10.1	10.6	13.0	39.6	42.9	41.4	52.8	58.0	65.2	79.5	97.5	533
Net Water Requirement (mm)	153.6	30.2		32.7	105.8	104.1	18.8		205.4	310.4	146.2	98.8	1,206
Overall Efficiency	0.60	0.60		0.45	0.45	0.45	0.45		0.60	0.60	0.60	0.60	0.56
Gross Water Requirement (mm)	256.0	50.3		72.7	235.1	231.3	41.8		342.3	517.3	243.7	164.7	2,155
- do - (l/sec)	3.0	0.6		0.8	2.7	2.7	0.5		4.0	6.0	2.8	1.9	2.1
- do - (l/sec/ha)	1.0	0.2		0.3	0.9	0.9	0.2		1.3	2.0	0.9	0.6	0.7

Peak 3.0 l/sec/ha (November)

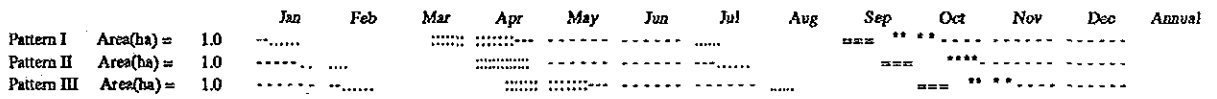
(2) Main season paddy + off-season chilli



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Pattern I Area(ha) = 1.0													
Pattern II Area(ha) = 1.0													
Pattern III Area(ha) = 1.0													
Pattern IV Area(ha) = 1.0													
ET0 (mm)	144.0	148.2	177.0	184.8	166.8	154.8	154.8	157.2	157.8	142.8	121.8	118.8	1,829
ETcrop (I) (mm)	67.2		94.4	147.8	150.1	143.4	45.4		431.5	276.6	170.5	166.3	1,693
ETcrop (II) (mm)	168.0		47.2	147.8	141.8	147.1	90.8		268.9	341.4	164.4	166.3	1,684
ETcrop (III) (mm)	201.6	69.2		147.8	133.4	147.1	139.8			419.0	252.1	166.3	1,676
ETcrop (I-III) (mm)				98.6	133.4	139.3	143.4	46.1					561
ETcrop (I-IV) (mm)	145.6	23.1	35.4	135.5	139.7	144.2	104.9	11.5	233.5	345.7	195.7	166.4	1,681
Percolation (mm)	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	360
80% Rainfall (mm)	42.3	16.8	17.6	21.7	91.9	132.2	112.5	142.6	153.5	177.4	225.1	285.1	1,419
Effective Rainfall (mm)	22.0	10.1	10.6	13.0	39.6	42.9	41.4	52.8	58.0	65.2	79.5	97.5	533
Net Water Requirement (mm)	153.6	30.2	48.7	152.5	130.1	131.4	93.5	4.4	205.4	310.4	146.2	98.9	1,505
Overall Efficiency	0.60	0.60	0.60	0.45	0.45	0.45	0.45	0.45	0.60	0.60	0.60	0.60	0.54
Gross Water Requirement (mm)	256.0	50.3	81.2	338.9	289.1	292.0	207.8	9.8	342.3	517.3	243.7	164.8	2,793
- do - (l/sec)	3.0	0.6	1.3	5.2	4.5	4.5	3.2	0.2	4.0	6.0	2.8	1.9	3.1
- do - (l/sec/ha)	1.0	0.2	0.3	1.3	1.1	1.1	0.8	0.0	1.3	2.0	0.9	0.6	0.9

Peak 3.0 l/sec/ha (November)

(3) Main season paddy + off-season groundnuts

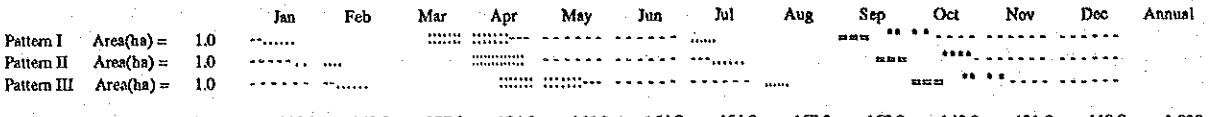


	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Pattern I Area(ha) = 1.0													
Pattern II Area(ha) = 1.0													
Pattern III Area(ha) = 1.0													
ET0 (mm)	144.0	148.2	177.0	184.8	166.8	154.8	154.8	157.2	157.8	142.8	121.8	118.8	1,829
ETcrop (I) (mm)	67.2			73.9	137.6	141.9	58.1		431.5	276.6	170.5	166.3	1,524
ETcrop (II) (mm)	168.0				133.4	139.3	126.4		268.9	341.4	164.4	166.3	1,508
ETcrop (III) (mm)	201.6	69.2			66.7	127.7	141.9	59.0		419.0	252.1	166.3	1,504
ETcrop (I-III) (mm)	145.6	23.1		24.6	112.6	136.3	108.8	19.7	233.5	345.7	195.7	166.3	1,512
Percolation (mm)	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	360
80% Rainfall (mm)	42.3	16.8	17.6	21.7	91.9	132.2	112.5	142.6	153.5	177.4	225.1	285.1	1,419
Effective Rainfall (mm)	22.0	10.1	10.6	13.0	39.6	42.9	41.4	52.8	58.0	65.2	79.5	97.5	533
Net Water Requirement (mm)	153.6	30.2		32.7	103.0	123.5	97.4	8.4	205.4	310.4	146.2	98.8	1,310
Overall Efficiency	0.60	0.60		0.45	0.45	0.45	0.45	0.45	0.60	0.60	0.60	0.60	0.55
Gross Water Requirement (mm)	256.0	50.3		72.7	228.9	274.4	216.4	18.7	342.3	517.3	243.7	164.7	2,385
- do - (l/sec)	3.0	0.6		0.8	2.6	3.2	2.5	0.2	4.0	6.0	2.8	1.9	2.3
- do - (l/sec/ha)	1.0	0.2		0.3	0.9	1.1	0.8	0.1	1.3	2.0	0.9	0.6	0.8

Peak 3.0 l/sec/ha (November)

Table III-3 Irrigation Water Demand for Hilir Sat I and Rawa Bechah Laut Scheme (2/2)

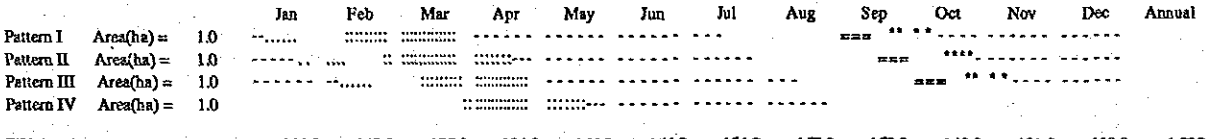
(4) Main season paddy + off-season sweet corn



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Pattern I Area(ha) = 1.0													
Pattern II Area(ha) = 1.0													
Pattern III Area(ha) = 1.0													
ET0 (mm)	144.0	148.2	177.0	184.8	166.8	154.8	154.8	157.2	157.8	142.8	121.8	118.8	1,829
ETcrop (I) (mm)	67.2			78.5	169.6	158.7			431.5	276.6	170.5	166.3	1,519
ETcrop (II) (mm)	168.0				152.9	162.5	77.4		268.9	341.4	164.4	166.3	1,502
ETcrop (III) (mm)	201.6	69.2			70.9	157.4	158.7			419.0	252.1	166.3	1,495
ETcrop (I-III) (mm)	145.6	23.1		26.2	131.1	159.5	78.7		233.5	345.7	195.7	166.3	1,505
Percolation (mm)	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	360
80% Rainfall (mm)	42.3	16.8	17.6	21.7	91.9	132.2	112.5	142.6	153.5	177.4	225.1	285.1	1,419
Effective Rainfall (mm)	22.0	10.1	10.6	13.0	39.6	42.9	41.4	52.8	58.0	65.2	79.5	97.5	533
Net Water Requirement (mm)	153.6	30.2		34.3	121.6	146.7	67.3		205.4	310.4	146.2	98.8	1,315
Overall Efficiency	0.60	0.60		0.45	0.45	0.45	0.45		0.60	0.60	0.60	0.60	0.54
Gross Water Requirement (mm)	256.0	50.3		76.2	270.2	326.0	149.6		342.3	517.3	243.7	164.7	2,396
- do - (l/sec)	3.0	0.6		0.9	3.1	3.8	1.7		4.0	6.0	2.8	1.9	2.3
- do - (l/sec/ha)	1.0	0.2		0.3	1.0	1.3	0.6		1.3	2.0	0.9	0.6	0.8

Peak 3.0 l/sec/ha (November)

(5) Main season paddy + off-season tabacco



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Pattern I Area(ha) = 1.0													
Pattern II Area(ha) = 1.0													
Pattern III Area(ha) = 1.0													
Pattern IV Area(ha) = 1.0													
ET0 (mm)	144.0	148.2	177.0	184.8	166.8	154.8	154.8	157.2	157.8	142.8	121.8	118.8	1,829
ETcrop (I) (mm)	67.2			151.5	166.8	153.8	75.9		431.5	276.6	170.5	166.3	1,660
ETcrop (II) (mm)	168.0			75.8	151.8	154.8	152.2		268.9	341.4	164.4	166.3	1,644
ETcrop (III) (mm)	201.6	69.2			136.8	154.8	153.8	77.0		419.0	252.1	166.3	1,631
ETcrop (IV) (mm)					63.5	140.9	157.2	155.2	155.2				672
ETcrop (I-IV) (mm)	145.6	23.1		56.8	129.7	151.1	134.8	58.0	233.5	345.7	195.7	166.3	1,640
Percolation (mm)	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	360
80% Rainfall (mm)	42.3	16.8	17.6	21.7	91.9	132.2	112.5	142.6	153.5	177.4	225.1	285.1	1,419
Effective Rainfall (mm)	22.0	10.1	10.6	13.0	39.6	42.9	41.4	52.8	58.0	65.2	79.5	97.5	533
Net Water Requirement (mm)	153.6	30.2		73.8	120.2	138.2	123.3	35.2	205.4	310.4	146.2	98.8	1,435
Overall Efficiency	0.60	0.60		0.45	0.45	0.45	0.45	0.45	0.60	0.60	0.60	0.60	0.56
Gross Water Requirement (mm)	256.0	50.3		164.0	267.1	307.1	274.0	78.2	342.3	517.3	243.7	164.7	2,665
- do - (l/sec)	3.0	0.6		2.5	4.1	4.7	4.2	1.2	5.3	6.0	2.8	1.9	3.0
- do - (l/sec/ha)	1.0	0.2		0.6	1.0	1.2	1.1	0.3	1.3	2.0	0.9	0.6	0.9

Peak 3.0 l/sec/ha (November)

Table III-4 Water Balance in Hilir Sat I Scheme

(1) Water requirement by crop

(Unit : m3/sec)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Peak
Sg.Lemal (1 to 5 year)	0.75	0.20	0.26	0.27	1.38	1.31	1.50	1.90	2.29	2.60	3.72	5.15	
													(Unit : l/sec/ha)
Category 3 cabbage	1.0	0.2		0.3	0.9	0.9	0.2		1.3	2.0	0.9	0.6	3.0 (Nov)
Category 3 chilli	1.0	0.2	0.3	1.3	1.1	1.1	0.8	0.0	1.3	2.0	0.9	0.6	3.0 (Nov)
Category 3 groundnuts	1.0	0.2		0.3	0.9	1.1	0.8	0.1	1.3	2.0	0.9	0.6	3.0 (Nov)
Category 3 sweet corn	1.0	0.2		0.3	1.0	1.3	0.6		1.3	2.0	0.9	0.6	3.0 (Nov)
Category 3 tobacco	1.0	0.2		0.6	1.0	1.2	1.1	0.3	1.3	2.0	0.9	0.6	3.0 (Nov)

(2) Water balance

(Unit : m3/sec)

	Area(ha)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Peak
1. Paddy + cabbage														(Nov)
Block 1(No.1)	110	0.11	0.02	0.00	0.03	0.10	0.10	0.02	0.00	0.14	0.22	0.10	0.07	0.33
Block 2(No.2)	40	0.04	0.01	0.00	0.01	0.04	0.04	0.01	0.00	0.05	0.08	0.04	0.02	0.12
Block 3(No.3)	58	0.06	0.01	0.00	0.02	0.05	0.05	0.01	0.00	0.08	0.12	0.05	0.03	0.17
Block 4(No.4)	88	0.09	0.02	0.00	0.03	0.08	0.08	0.02	0.00	0.11	0.18	0.08	0.05	0.26
Block 5(No.5)	87	0.09	0.02	0.00	0.03	0.08	0.08	0.02	0.00	0.11	0.17	0.08	0.05	0.26
Block 6(B.Pump)	13	0.01	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.02	0.03	0.01	0.01	0.04
Total	396	0.40	0.08	0.00	0.12	0.36	0.36	0.08	0.00	0.51	0.79	0.36	0.24	1.19
+/-		0.35	0.12	0.26	0.15	1.02	0.95	1.42	1.90	1.78	1.81	3.36	4.91	2.53
2. Paddy + chilli														(Nov)
Block 1(No.1)	110	0.11	0.02	0.03	0.14	0.12	0.12	0.09	0.00	0.14	0.22	0.10	0.07	0.33
Block 2(No.2)	40	0.04	0.01	0.01	0.05	0.04	0.04	0.03	0.00	0.05	0.08	0.04	0.02	0.12
Block 3(No.3)	58	0.06	0.01	0.02	0.08	0.06	0.06	0.05	0.00	0.08	0.12	0.05	0.03	0.17
Block 4(No.4)	88	0.09	0.02	0.03	0.11	0.10	0.10	0.07	0.00	0.11	0.18	0.08	0.05	0.26
Block 5(No.5)	87	0.09	0.02	0.03	0.11	0.10	0.10	0.07	0.00	0.11	0.17	0.08	0.05	0.26
Block 6(B.Pump)	13	0.01	0.00	0.00	0.02	0.01	0.01	0.01	0.00	0.02	0.03	0.01	0.01	0.04
Total	396	0.40	0.08	0.12	0.51	0.44	0.44	0.32	0.00	0.51	0.79	0.36	0.24	1.19
+/-		0.35	0.12	0.14	-0.24	0.94	0.87	1.18	1.90	1.78	1.81	3.36	4.91	2.53
3. Paddy + gruondnuts														(Nov)
Block 1(No.1)	110	0.11	0.02	0.00	0.03	0.10	0.12	0.09	0.01	0.14	0.22	0.10	0.07	0.33
Block 2(No.2)	40	0.04	0.01	0.00	0.01	0.04	0.04	0.03	0.00	0.05	0.08	0.04	0.02	0.12
Block 3(No.3)	58	0.06	0.01	0.00	0.02	0.05	0.06	0.05	0.01	0.08	0.12	0.05	0.03	0.17
Block 4(No.4)	88	0.09	0.02	0.00	0.03	0.08	0.10	0.07	0.01	0.11	0.18	0.08	0.05	0.26
Block 5(No.5)	87	0.09	0.02	0.00	0.03	0.08	0.10	0.07	0.01	0.11	0.17	0.08	0.05	0.26
Block 6(B.Pump)	13	0.01	0.00	0.00	0.00	0.01	0.01	0.01	0.00	0.02	0.03	0.01	0.01	0.04
Total	396	0.40	0.08	0.00	0.12	0.36	0.44	0.32	0.04	0.51	0.79	0.36	0.24	1.19
+/-		0.35	0.12	0.26	0.15	1.02	0.87	1.18	1.86	1.78	1.81	3.36	4.91	2.53
4. Paddy + sweet corn														(Nov)
Block 1(No.1)	110	0.11	0.02	0.00	0.03	0.11	0.14	0.07	0.00	0.14	0.22	0.10	0.07	0.33
Block 2(No.2)	40	0.04	0.01	0.00	0.01	0.04	0.05	0.02	0.00	0.05	0.08	0.04	0.02	0.12
Block 3(No.3)	58	0.06	0.01	0.00	0.02	0.06	0.08	0.03	0.00	0.08	0.12	0.05	0.03	0.17
Block 4(No.4)	88	0.09	0.02	0.00	0.03	0.09	0.11	0.05	0.00	0.11	0.18	0.08	0.05	0.26
Block 5(No.5)	87	0.09	0.02	0.00	0.03	0.09	0.11	0.05	0.00	0.11	0.17	0.08	0.05	0.26
Block 6(B.Pump)	13	0.01	0.00	0.00	0.00	0.01	0.02	0.01	0.00	0.02	0.03	0.01	0.01	0.04
Total	396	0.40	0.08	0.00	0.12	0.40	0.51	0.24	0.00	0.51	0.79	0.36	0.24	1.19
+/-		0.35	0.12	0.26	0.15	0.98	0.80	1.26	1.90	1.78	1.81	3.36	4.91	2.53
5. Paddy + tobacco														(Nov)
Block 1(No.1)	110	0.11	0.02	0.00	0.07	0.11	0.13	0.12	0.03	0.14	0.22	0.10	0.07	0.33
Block 2(No.2)	40	0.04	0.01	0.00	0.02	0.04	0.05	0.04	0.01	0.05	0.08	0.04	0.02	0.12
Block 3(No.3)	58	0.06	0.01	0.00	0.03	0.06	0.07	0.06	0.02	0.08	0.12	0.05	0.03	0.17
Block 4(No.4)	88	0.09	0.02	0.00	0.05	0.09	0.11	0.10	0.03	0.11	0.18	0.08	0.05	0.26
Block 5(No.5)	87	0.09	0.02	0.00	0.05	0.09	0.10	0.10	0.03	0.11	0.17	0.08	0.05	0.26
Block 6(B.Pump)	13	0.01	0.00	0.00	0.01	0.01	0.02	0.01	0.00	0.02	0.03	0.01	0.01	0.04
Total	396	0.40	0.08	0.00	0.24	0.40	0.48	0.44	0.12	0.51	0.79	0.36	0.24	1.19
+/-		0.35	0.12	0.26	0.03	0.98	0.83	1.06	1.78	1.78	1.81	3.36	4.91	2.53

Table III-5 Water Balance in Rawa Bechah Laut Scheme

(1) Water requirement by crop

(Unit : m3/sec)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Peak
Sg.Lemal (1 to 5 year)	0.09	0.02	0.03	0.03	0.17	0.16	0.19	0.24	0.29	0.33	0.47	0.65	

(Unit : l/sec/ha)

Category 3 cabbage	1.0	0.2		0.3	0.9	0.9	0.2		1.3	2.0	0.9	0.6	3.0 (Oct)
Category 3 chilli	1.0	0.2	0.3	1.3	1.1	1.1	0.8	0.0	1.3	2.0	0.9	0.6	3.0 (Oct)
Category 3 groundnuts	1.0	0.2		0.3	0.9	1.1	0.8	0.1	1.3	2.0	0.9	0.6	3.0 (Oct)
Category 3 sweet corn	1.0	0.2		0.3	1.0	1.3	0.6		1.3	2.0	0.9	0.6	3.0 (Oct)
Category 3 tobacco	1.0	0.2		0.6	1.0	1.2	1.1	0.3	1.3	2.0	0.9	0.6	3.0 (Oct)

(2) Water balance

(Unit : m3/sec)

	Area(ha)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Peak
1. Paddy + cabbage														(Oct)
Block 1(Headworks)	23	0.02	0.00	0.00	0.01	0.02	0.02	0.00	0.00	0.03	0.05	0.02	0.01	0.07
+/-		0.07	0.02	0.03	0.02	0.15	0.14	0.19	0.24	0.26	0.28	0.45	0.64	0.26
2. Paddy + chilli														(Oct)
Block 1(Headworks)	23	0.02	0.00	0.01	0.03	0.03	0.03	0.02	0.00	0.03	0.05	0.02	0.01	0.07
+/-		0.07	0.02	0.02	0.00	0.14	0.13	0.17	0.24	0.26	0.28	0.45	0.64	0.26
3. Paddy + gruondnuts														(Oct)
Block 1(Headworks)	23	0.02	0.00	0.00	0.01	0.02	0.03	0.02	0.00	0.03	0.05	0.02	0.01	0.07
+/-		0.07	0.02	0.03	0.02	0.15	0.13	0.17	0.24	0.26	0.28	0.45	0.64	0.26
4. Paddy + sweet corn														(Oct)
Block 1(Headworks)	23	0.02	0.00	0.00	0.01	0.02	0.03	0.01	0.00	0.03	0.05	0.02	0.01	0.07
+/-		0.07	0.02	0.03	0.02	0.15	0.13	0.18	0.24	0.26	0.28	0.45	0.64	0.26
5. Paddy + tobacco														(Oct)
Block 1(Headworks)	23	0.02	0.00	0.00	0.01	0.02	0.03	0.03	0.01	0.03	0.05	0.02	0.01	0.07
+/-		0.07	0.02	0.03	0.02	0.15	0.13	0.16	0.23	0.26	0.28	0.45	0.64	0.26

Table III-6 Breakdown of On-farm Development Cost in Kelantan

Work Item	Unit	Quantity	Unit Price (M$)	Amount (M$)
On-farm Development with High Canal Density (105 ha)				
Clearing/Leveling	m	105	90	9,450
On-farm Field Canal System				
Tertiary irrigation canal	m	5,250	35	183,750
Constant head orifice (CHO)	m	5	1,650	8,250
Field offtake	no.	70	550	38,500
Field pipe (AC)	m	10,500	25	262,500
Irrigation end control	no.	5	550	2,750
On-farm Drainage Canal System				
Field Drain	m	5,250	15	78,750
Drainage end control	no.	5	220	1,100
Farm road				
Road of 4 m wide	m	2,050	22	45,100
Road of 3 m wide	m	10,200	18	183,600
Miscellaneous				163,410
Total (for 105 ha)				977,160
				(M$9,306/ha)

Table III-7 Summary of Construction Cost for Selected Schemes in Kelantan

Work Item	Unit	Quantity	Unit Price	Amount
Repek Scheme				
1 Direct Construction Cost				
Canal improvement	m	2,800	40	112,000
On-farm development	ha	454	9,306	4,224,924
Sub-total				4,336,924
2 Engineering cost (10% of Item 1)				433,692
3 Physical contingency (15% of Items I & 2)				715,592
Total				5,486,209
				(M$12,084/ha)
Hilir Sat I				
1 Direct Construction Cost				
On-farm development	ha	396	9,306	3,685,176
2 Engineering cost (10% of Item 1)				368,518
3 Physical contingency (15% of Items I & 2)				608,054
Total				4,661,748
				(M$11,772/ha)
Rawa Bechah Laut				
1 Direct Construction Cost				
On-farm development	ha	23	9,306	214,038
2 Engineering cost (10% of Item 1)				21,404
3 Physical contingency (15% of Items I & 2)				35,316
Total				271,323
				(M$11,797/ha)
Grand Total				10,419,280

Table III-8 Net Benefit per Ha without Project Condition for Selected Schemes in Kelantan

	Planted Area (ha)	Profitability (M$/ha) Gross Benefit	Production Cost	Net Benefit	Estimated Net Benefit (M$)
Repek					
Main season paddy	146	2,250	1,350	900	131,400
Tobacco	7	6,365	4,430	1,935	13,545
Sub-total					144,945 (M$947 /ha)
Hilir Satu I					
Main season paddy	396	2,250	1,350	900	356,400 (M$900 /ha)
Rawa Bechah Laut					
Main season paddy	23	2,250	1,350	900	20,700 (M$900 /ha)
Total	(572)				522,045 (M$913 / ha)

Remarks: Breakdown of gross income and production cost is shown in Appendix E of Volume 2.

Table III-9 Annual Net Benefit per Ha with Project Condition in Kelantan

Unit: M$/ha

	Planted Area (%)	Gross Income	Production cost	Average Annual Net Income** Year 1	Year 2	Year 3	Year 4	Year 5
Paddy (Type-1)*	100	3,200	1,350					
Sweet corn	30	2,120	1,700					
Lowland cabbage	30	15,200	5,670					
Chilli	20	18,000	7,470					
Groundnut	20	2,871	2,420					
Total	200	12,570	5,539	685	1,942	3,199	4,456	5,713

Remarks:

* : Detail of estimated of gross income and production cost is shown in Appendix E of Volume 2.

** : Increasing rate of unit yield is as follows:
1st year=60%, 2nd year=70%, 3rd year=80%, 4th year=90%, 5th year=100%

Table III-10 Financial Cost and Benefit Flow for the Repek Scheme in Kelantan

(Unit : M$'000)

Year	Cost		(1.0)	Incremental
	Capital	O&M	Total	Benefit
1	5,486	0	5,486	0
2	0	27	27	-102
3	0	27	27	460
4	0	27	27	1,022
5	0	27	27	1,584
6	0	27	27	2,146
7 - 30	0	27	27	2,146

IRR = 22.5%

Table III-11 Financial Cost and Benefit Flow for the Hilir Sat I Scheme in Kelantan

(Unit : M$'000)

Year	Cost		(1.0)	Incremental
	Capital	O&M	Total	Benefit
1	4,662	0	4,662	0
2	0	23	23	-90
3	0	23	23	407
4	0	23	23	905
5	0	23	23	1,403
6	0	23	23	1,901
7 - 30	0	23	23	1,901

IRR = 23.3%

Table III-12 Financial Cost and Benefit Flow for the Rawa Becha Laut Scheme in Kelantan

(Unit : M$'000)

Year	Cost		(1.0)	Incremental
	Capital	O&M	Total	Benefit
1	271	0	271	0
2	0	1	1	-5
3	0	1	1	24
4	0	1	1	53
5	0	1	1	81
6	0	1	1	110
7 - 30	0	1	1	110

IRR = 23.3%

Table III-13 Financial Cost and Benefit Flow for Selected Schemes in Kelantan

(Unit : M$'000)

Year	Cost		(1.0)	Incremental
	Capital	O&M	Total	Benefit
1	10,419	0	10,419	0
2	0	52	52	-197
3	0	52	52	891
4	0	52	52	1,980
5	0	52	52	3,068
6	0	52	52	4,157
7 - 30	0	52	52	4,157

IRR = 22.9%

Part - III

Figures

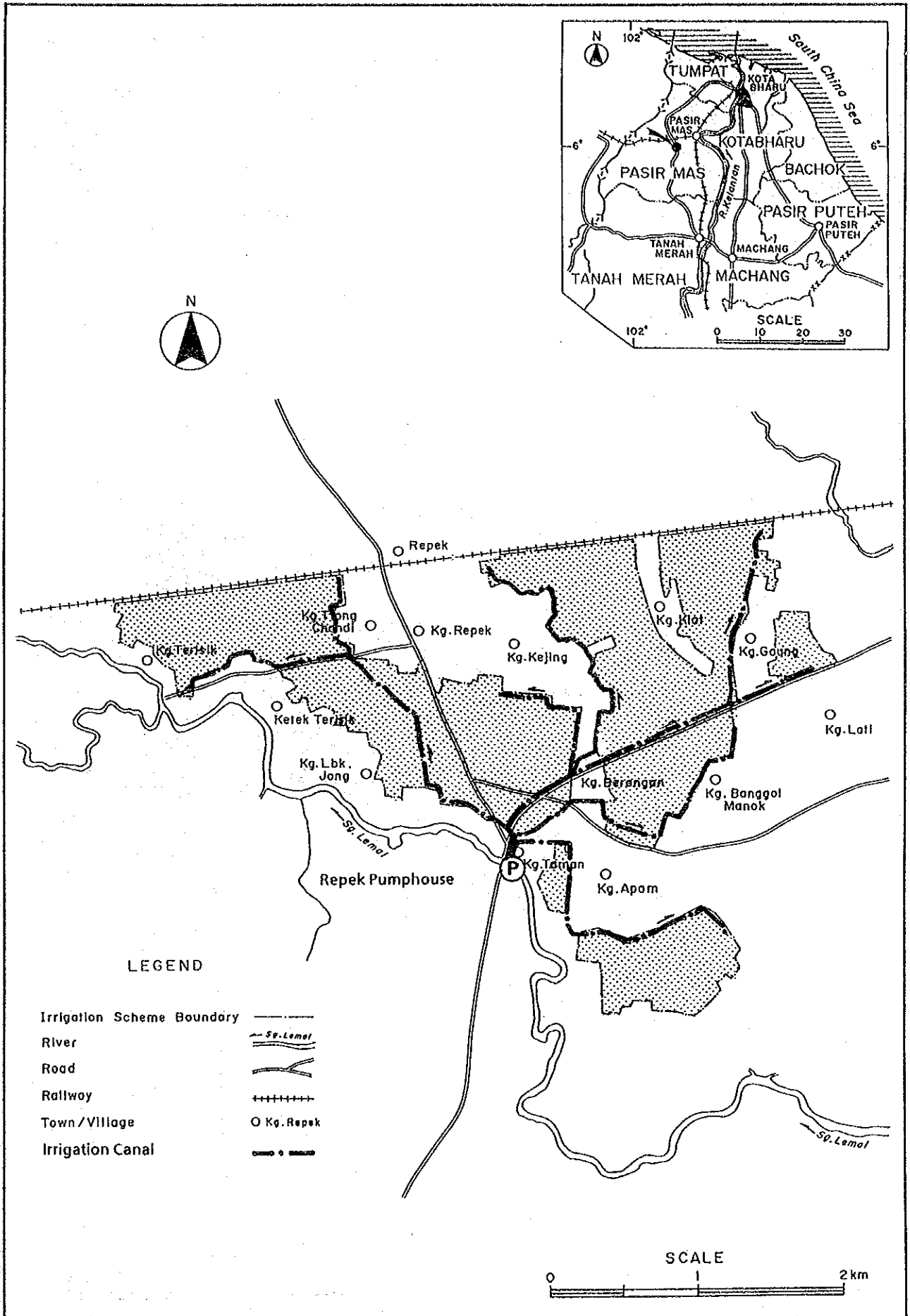


Fig. III-1
General Plan of the Repek Scheme

FEASIBILITY STUDY ON RATIONALIZATION AND CROP DIVERSIFICATION IN NON-GRANARY IRRIGATED AREAS IN MALAYSIA

Japan International Cooperation Agency

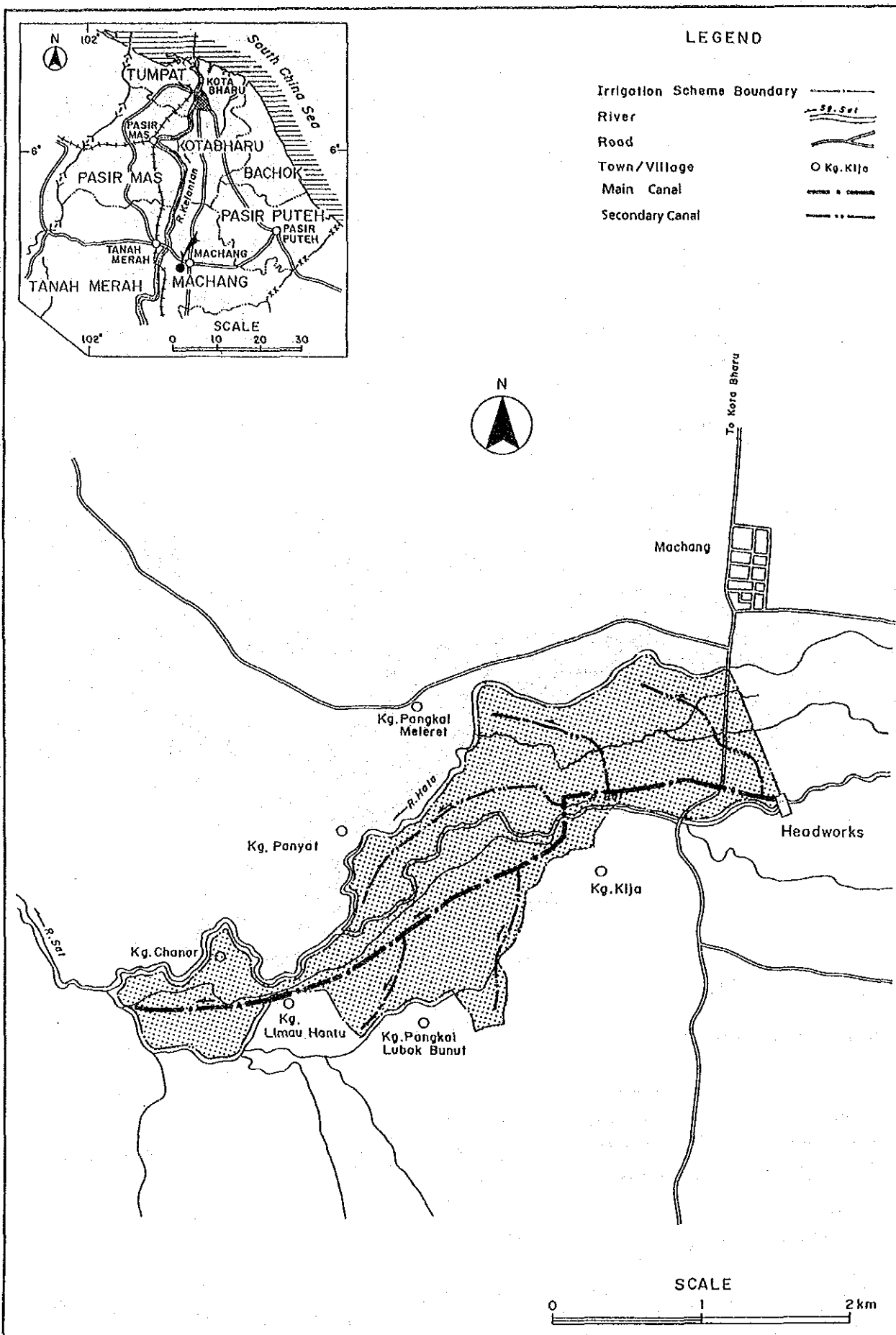


Fig. III-2

Genera Plan of the Hilir Sat I Scheme

FEASIBILITY STUDY ON RATIONALIZATION AND CROP DIVERSIFICATION IN NON-GRANARY IRRIGATED AREAS IN MALAYSIA

Japan International Cooperation Agency

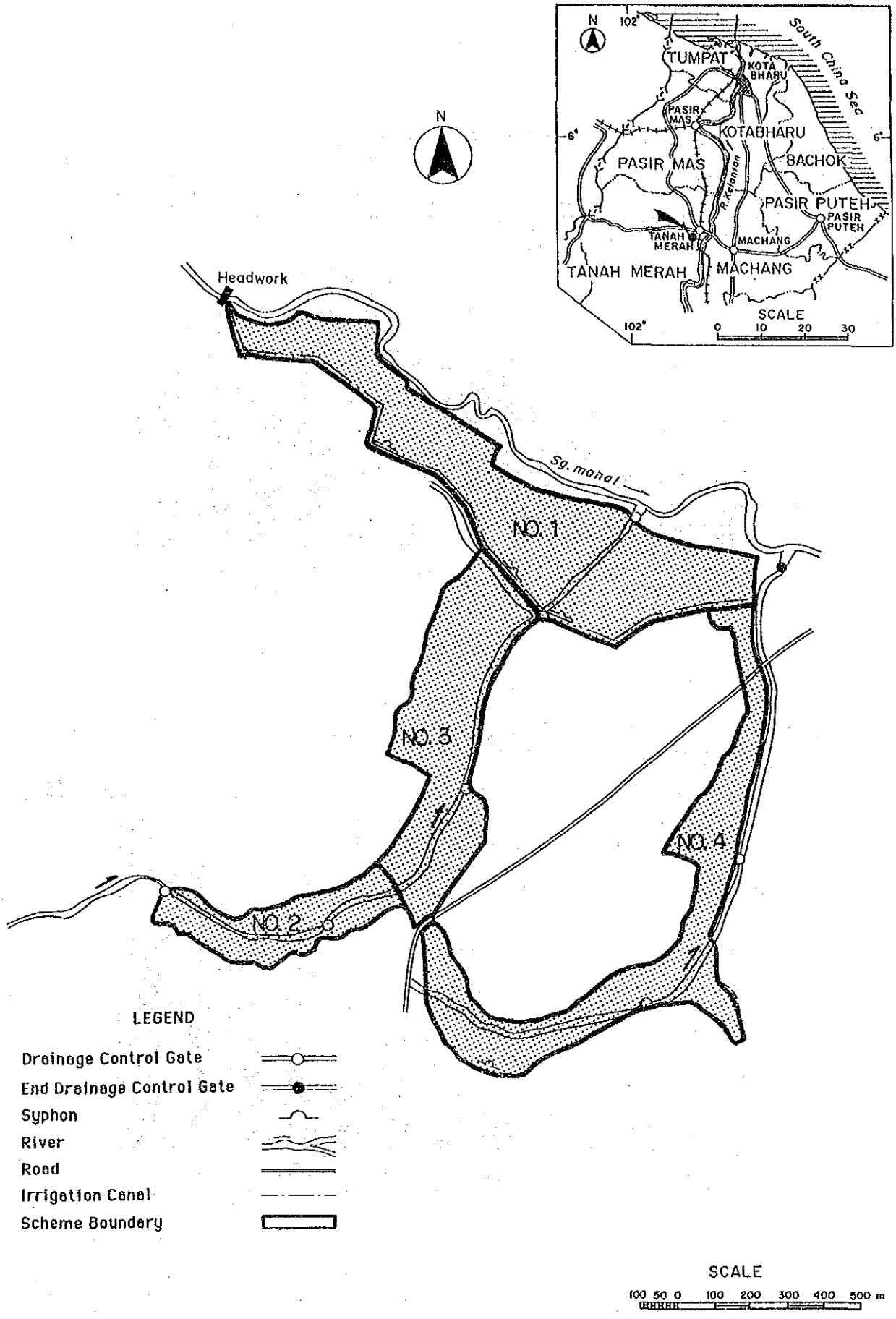


Fig. III-3

General Plan of the Rawa Bechah Laut Scheme

FEASIBILITY STUDY ON RATIONALIZATION AND CROP DIVERSIFICATION IN NON-GRANARY IRRIGATED AREAS IN MALAYSIA

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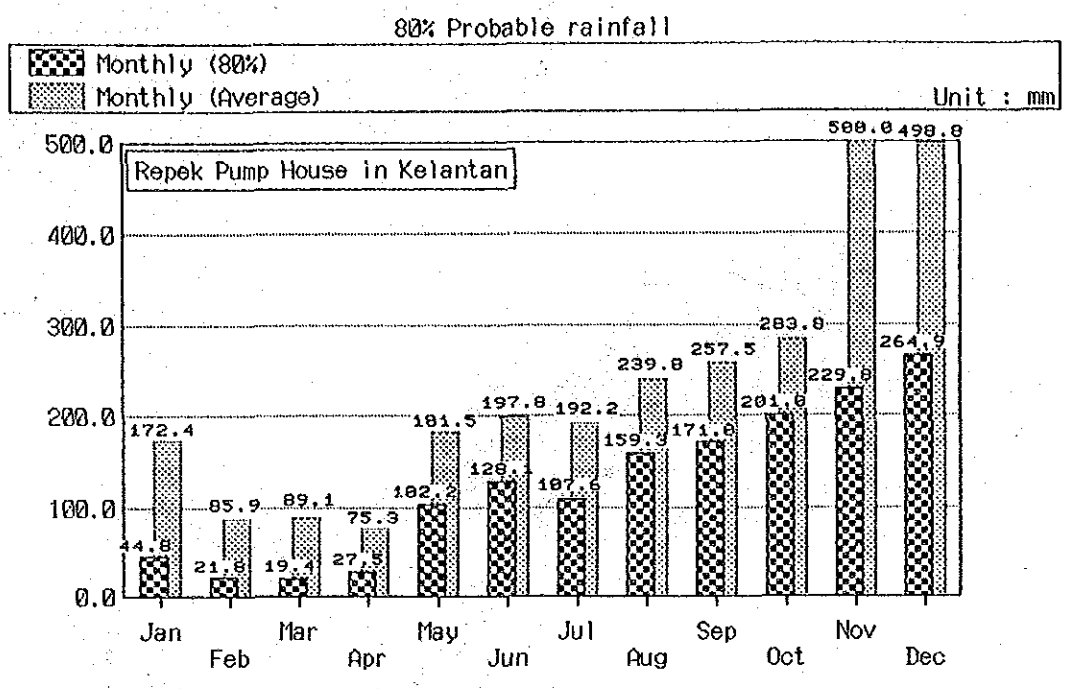

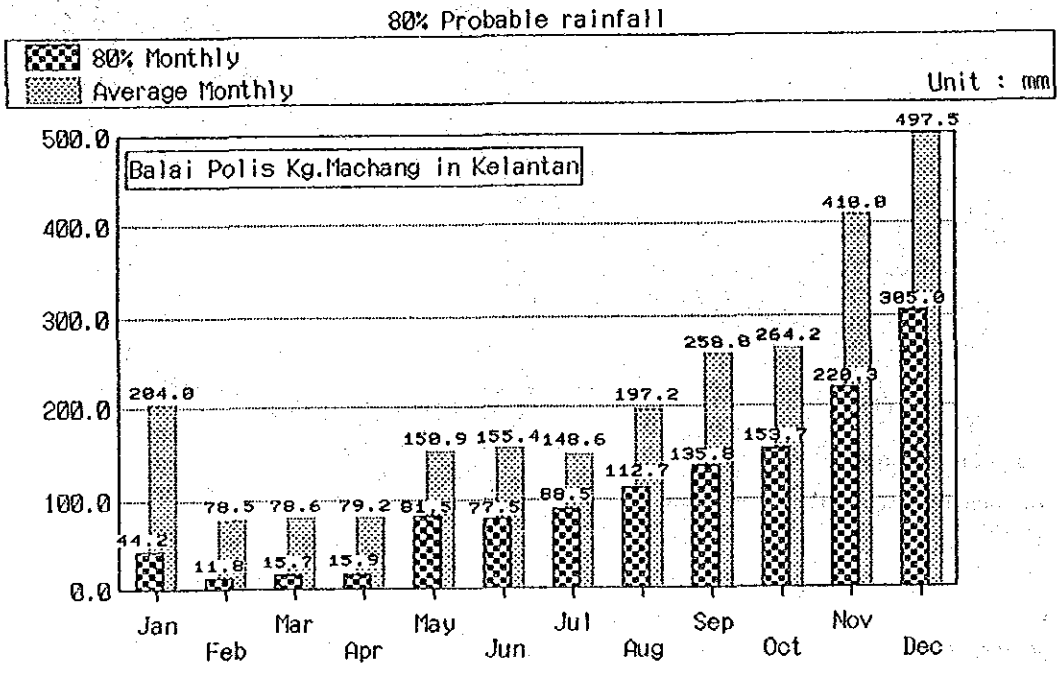

Fig. III-4
Monthly Rainfall Pattern in Kelantan

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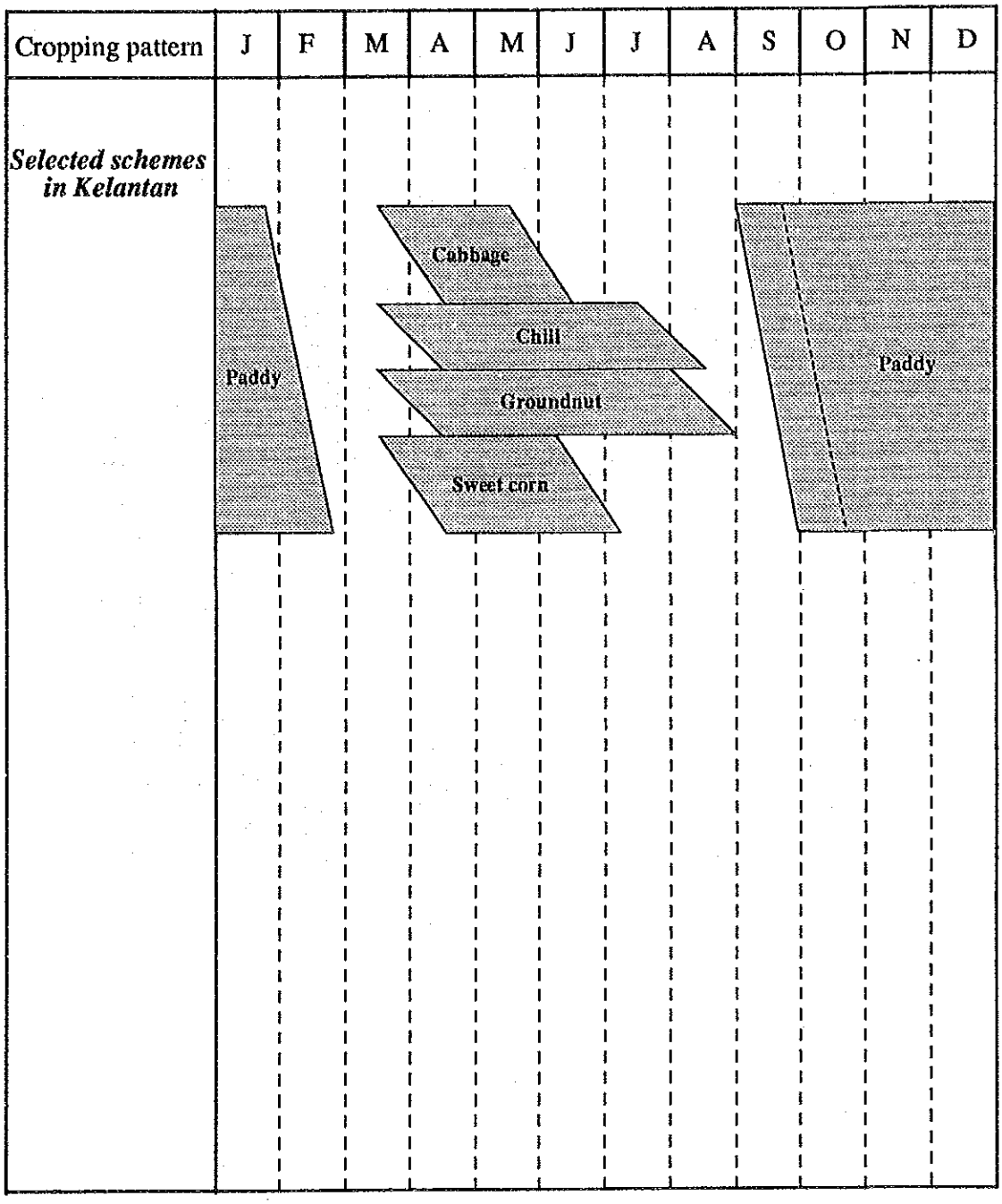

Fig. III-5

Proposed Cropping Calendar for Selected Schemes

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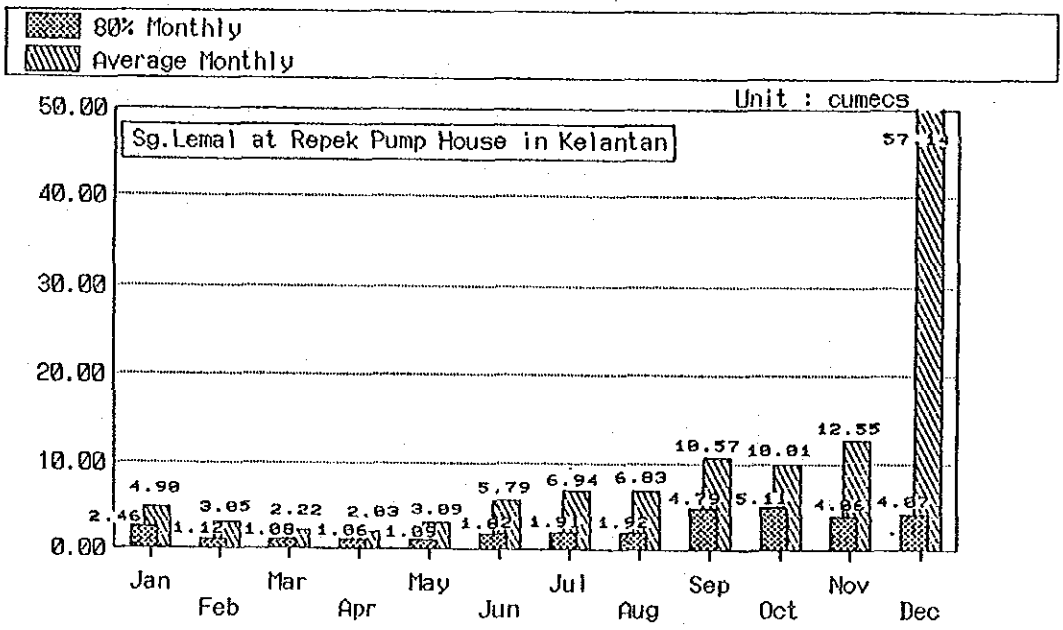

Fig. III-6

Available Discharge of the Lemal River at the Repek Pumphouse

FEASIBILITY STUDY ON RATIONALIZATION AND CROP DIVERSIFICATION IN NON-GRANARY IRRIGATED AREAS IN MALAYSIA

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Annex III-1

Detailed Sample Survey on Farmers' Intentions towards Crop Diversification Plan in Selected Schemes in Kelantan

Feasibility Study on Rationalization and Crop Diversification in Non-granary Irrigated Areas in Malaysia

Volume 3

Annex III-1

Detailed Sample Survey on Farmers' Intentions towards Crop Diversification Plan in Selected Schemes in Kelantan

CONTENTS

1. INTRODUCTION

The objective of the Detailed Sample Survey for the representative schemes in the State of Kelantan is to collect benchmark data to be used for evaluating the socio-economic impact of crop diversification on the intended beneficiary households which presently grow paddy under irrigated condition.

The total sampling numbers are allocated according to the planted area and the number of farm households estimated on such assumption that the average farm holding size is 1.25 ha in each scheme as shown below. The target sampling rate is 20% of the estimated farm households. To carry out interviews to respondent farmers, the local Consultant, Frank Small & Associates, was appointed on the sub-contract basis.

Code No.	Schemes	Irrigable Area (ha)	Planted Area (ha)	Estimated Nos. of Farm Households	Allocated No. of Sample Farmers
KN009	Hilir Sat I	396	396	317	66
KN019	Repek	454	146	117	28
KN052	Rawa Bechah Laut	80	50	56	11
	Total	930	612	490	105

2. SOCIO-ECONOMIC AND FARMING CONDITIONS

2.1 Household Characteristics

(1) Age distribution

Farmers over 55 years old occupied 28%, followed by 31% of 46 to 55 years and 28% of 36 to 45 years as shown below. Young farmers of 18 to 25 years and 26 to 35 years accounted for only 1% and 12% of the respondents, respectively. The farmers of the representative scheme areas are generally younger than those of the State. In the Rawa Bechah Laut scheme, the situation is better with 55% of the farmers no more than 45 years.

Unit; person (%)

Age Group	Scheme				State of Kelantan*
	Hilir Sat I	Repek	Rawa B. Laut	Total	
a. 18 - 25	1 (2)	0 (0)	0 (0)	1 (1)	3 (1)
b. 26 - 35	9 (14)	2 (7)	2 (18)	13 (12)	37 (6)
c. 36 - 45	16 (24)	9 (32)	4 (37)	29 (28)	127 (21)
d. 46 - 55	19 (29)	11 (39)	3 (27)	33 (31)	258 (43)
e. Over 55	21 (32)	6 (22)	2 (18)	29 (28)	172 (29)
Total Respondents	66 (100)	28 (100)	11 (100)	105 (100)	597 (100)

*Remarks: *; Results of JICA Sample Survey in 1989*

(2) Household size and working force

The mean household size is 5.9 persons in the three scheme areas and 2.7 persons or 45% are considered as working force aged 15 to 55 years old.

Number of Household Member

Unit; household (%)

Number of Household Member	Scheme				State of Kelantan*
	Hilir Sat I	Repek	Rawa B. Laut	Total	
a. 1 - 2	8 (12)	1 (3)	2 (18)	11 (11)	24 (4)
b. 3 - 4	14 (21)	7 (25)	1 (9)	22 (21)	157 (27)
c. 5 - 6	22 (33)	4 (14)	4 (37)	30 (29)	178 (30)
d. 7 - 8	15 (23)	6 (22)	3 (27)	24 (22)	149 (25)
e. 9 - 10	5 (8)	5 (18)	1 (9)	11 (10)	71 (12)
f. >10	2 (3)	5 (18)	0 (0)	7 (7)	18 (3)
Total Respondents	66 (100)	28 (100)	11 (100)	105 (100)	597 (100)

*Remarks: *; Results of JICA Sample Survey in 1989*

Number of Working Force

Unit: household (%)

No. of Working Force	Scheme				State of Kelantan*
	Hilir Sat I	Repek	Rawa B. Laut	Total	
a. 1 - 2	41 (62)	13 (46)	8 (73)	62 (59)	102 (17)
b. 3 - 4	18 (27)	11 (39)	2 (18)	31 (29)	417 (70)
c. 5 - 6	6 (9)	2 (7)	1 (9)	9 (9)	70 (12)
d. 7 - 8	0 (0)	1 (4)	0 (0)	1 (1)	7 (1)
e. 9 - 10	1 (2)	1 (4)	0 (0)	2 (2)	0 (0)
f. >10	0 (0)	0 (0)	0 (0)	0 (0)	1 (0)
Total Respondents	66 (100)	28 (100)	11 (100)	105 (100)	597 (100)

*Remarks: *; Results of JICA Sample Survey in 1989*

(3) Education level

In total, 68% of the sample farmers reported having attended school(s), comprising 55% having finished education at primary school level and 13% having taken education at secondary and higher level as shown below. Although 32% reported not having attended any school, it cannot be inferred that they are illiterate. This is in marked contrast with the education received by other members of the same respondent households such as their children.