

TABLE F-13-4 CROPPING GUIDE (Vegetables)

Crops Name: Yard Long Bean
(Variety)

1. Sowing Time able to cultivate all year round
2. Transplanting time
3. Planting pattern row width spacing
40 cm × 80 cm = 5,000 plant/rai
4. Seed Rate 2 - 3 kg/rai 120 Baht/kg
5. Fertilizers Input (1) Before Sowing

Lime stone	-	kg/rai
N15 : P15 : K15	50	kg/rai

 (2) Flower-bud-appearing stage

Urea	-	kg/rai
------	---	--------
6. Irrigation Interval
7. Pest Control (Agricultural Chemicals name)

Disease injury	-	Metalaxyl MZ 72
Insect injury	-	Carbonfuran (Furandan 3% G)
8. Harvesting 60 - 90 days
9. Average Production 3,000 kg/rai
10. Cropping Season
 Jan. Feb. Mar. Apr. May Jun. Jul. Aug. Sep. Oct. Nov. Dec.
 ← all year →

Source : Agricultural Station

TABLE F-13-5 CROPPING GUIDE (Food Crop)

Crops Name: Mungbean
(Variety)

1. Sowing Time May - Jun.
2. Transplanting time May - Jun.
3. Planting pattern row width spacing 50 cm × 50 cm = 12,800 - 38,400 plant/rai
4. Seed Rate 4 - 5 kg/rai 13 - 18 Baht/kg · ℓ
5. Fertilizers Input
 - (1) Before Sowing
 - Lime stone kg/rai
 - N12 : P24 : K12 25 - 30 kg/rai
 - (2) Flower-bud-appearing stage
 - Urea - kg/rai
6. Irrigation Interval Flower-bud appearing stage-vegetable cutting
7. Pest Control (Agricultural Chemicals name)
 - Disease injury - Daconil
 - Insect injury - Carbaryl (Sevin 50)
8. Harvesting Jul. ~ Aug.
9. Average Production 83 kg/rai
10. Cropping Season
Jan. Feb. Mar. Apr. May Jun. Jul. Aug. Sep. Oct. Nov. Dec.

Source : Agricultural Station

TABLE F-13-6 CROPPING GUIDE (Food Crop)

Crops Name: Groundnut
(Variety)

1. Sowing Time May - Aug.
2. Transplanting time May - Aug.
3. Planting pattern row width spacing
50 cm × 25 cm = 12,800 - 38,400 plant/rai
4. Seed Rate 20 kg/rai 12 - 15 Baht/kg
5. Fertilizers Input (1) Before Sowing
 Lime stone 10 - 100 kg/rai
 N12 : P24 : K12 25 - 30 kg/rai
 (2) Flower-bud-appearing stage
 Urea - kg/rai
6. Irrigation Interval Flower → bud-appearing stage
7. Pest Control (Agricultural Chemicals name)
 Disease injury - Rust, Chlorothalonil (Daconil)
 Insect injury - Caterpillar
8. Harvesting Aug. ~ Sep.
9. Average Production 212 kg/rai
10. Cropping Season
 Jan. Feb. Mar. Apr. May Jun. Jul. Aug. Sep. Oct. Nov. Dec.

Source : Agricultural Station

TABLE F-13-7 CROPPING GUIDE (Vegetables)

Crops Name: Chillies
(Variety)

1. Sowing Time all year round
2. Transplanting time all year round
3. Planting pattern row width spacing
50 - 75 cm × 50 cm = 4,000 - 6,400 plant/rai
4. Seed Rate 0.15 ℓ/rai 100 Baht/ℓ
5. Fertilizers Input (1) Before Sowing
 Lime stone kg/rai
 N13 : P13 : K21 20 - 25 kg/rai
 (2) Flower-bud-appearing stage
 Urea 10 kg/rai
6. Irrigation Interval Flower → bud-appearing stage
7. Pest Control (Agricultural Chemicals name)
 Disease injury - Rust, Chlorothalonil (Daconil)
 Insect injury - Caterpillar
8. Harvesting 80 ~ 100 days
9. Average Production 200 ~ 400 kg/rai (dry weight)
10. Cropping Season
 Jan. Feb. Mar. Apr. May Jun. Jul. Aug. Sep. Oct. Nov. Dec.
 ← all year →

Source : Agricultural Station

TABLE F-13-8 CROPPING GUIDE (Vegetables)

Crops Name: Chinese kale
(Variety)

1. Sowing Time cultive all year round
2. Transplanting time
3. Planting pattern row width spacing
20 cm × 20 cm = 40,000 plant/rai
4. Seed Rate 2 kg/rai 250 Baht/kg
5. Fertilizers Input (1) Before Sowing
 Lime stone kg/rai
 N15 : P15 : K15 50 kg/rai
 (2) Flower-bud-appearing stage
 Urea kg/rai
6. Irrigation Interval
7. Pest Control (Agricultural Chemicals name)
 Disease injury - rotten soil disease -- used Koplarit
 Insect injury - leave eaten up by the caaterpillar -- used Malatairin
8. Harvesting 65 ~ 90 days
9. Average Production 3,200 kg/rai
10. Cropping Season
 Jan. Feb. Mar. Apr. May Jun. Jul. Aug. Sep. Oct. Nov. Dec.
 ← all year →

Source : Agricultural Station

TABLE F-13-9 CROPPING GUIDE (Vegetables)

Crops Name: Cucumber
(Variety)

1. Sowing Time able to cultivate all year round
2. Transplanting time
3. Planting pattern row width spacing
30 cm × 60 cm = 8,000 plant/rai
4. Seed Rate 2 ~ 3 kg/rai 50 Baht/ℓ
5. Fertilizers Input (1) Before Sowing
 Lime stone - kg/rai
 N15 : P15 : K15 50 kg/rai
 (2) Flower-bud-appearing stage
 Urea kg/rai
6. Irrigation Interval
7. Pest Control (Agricultural Chemicals name)
 Disease injury - --
 Insect injury - () fly destory product --- used
8. Harvesting 30 ~ 60 days start harvest when it reach 28 days
9. Average Production 4,379 kg/rai
10. Cropping Season
 Jan. Feb. Mar. Apr. May Jun. Jul. Aug. Sep. Oct. Nov. Dec.
 ← all year →

Source : Agricultural Station

TABLE F-13-10 CROPPING GUIDE (Tree)

Crops Name: Oil Palm
 (Variety) Hybrid (Dura, Pisisfera and Tenera)

1. Planting Pattern Triangle 9 × 9m = 20 plant/rai
 nursesey stock 50 Baht/plant

2. Fertilizers N15 :P15 :K15

1 year	1 kg/plant	6 year	4 kg/plant
2 "	2 "	7 "	4
3 "	2 "	8 "	4
4 "	2 "	9 "	4
5 "	2 "	10 "	4

3. Pest Control (Agricultural Chemicals name)

Disease injury - Difolatan

Insect injury - Furadan 3% G

4. Harvesting seeding 3 ~ 5 year
 budding or grafting - year

5. Flowering - Harvesting 180 days

6. Average production 1st - 2,000 kg/plant
 2 year - 2,000
 3 year - 2,000

Source : Agricultural Station

TABLE F-13-11 CROPPING GUIDE (Fruit Tree)

Crops Name: Para-rubber
(Variety) Hybrid

1. Planting Pattern Row - 7m × 3 m = 76 plant/rai
 nurse stock 5 - 8 Baht/plant

2. Fertilizers Inputs
 N18 : P10 : K6

1 year	120	g/plant	6 year	400	kg/plant
2 "	190	"	7 "	1	
3 "	190	"	8 "	1	
4 "	400	"	9 "	1	
5 "	400	"	10 "	1	

3. Pest Control (Agricultural Chemicals name)
 Disease injury -
 Insect injury -

4. Harvesting seeding - year
 budding or grafting 5.5 ~ 7 months

5. Flowering - Harvesting days

6. Average production = 20 plant/Latex 1 kg (dry weight)

1 year	fruit or kg/plant
2 "	fruit or kg/plant
3 "	fruit or kg/plant
4 "	fruit or kg/plant
5 "	fruit or kg/plant

Source : Agricultural Station

TABLE F-13-12 CROPPING GUIDE (Fruit)

Crops Name: Pineapple
 (Variety) Hybrid

1. Planting Pattern 50 cm × 50 cm = 6,400 plant/rai
 nurse stock 0.50 Baht/plant
 2. Fertilizers Inputs N P K
 15: 15: 15 50 - 100 kg/rai
 3. Pest Control (Agricultural Chemicals name)
 Disease injury - rotten trunk disease, undersized product
 Insect injury - mealy bugs
 4. Harvesting seeding - year
 budding or grafting 14 ~ 18 months
 5. Flowering - Harvesting 120 - 150 days
 6. Average production 6,400 - 19,200 kg/rai
- 1 st 1 - 3 kg/plant
 2 year 1 - 5 kg/plant
 3 " 2 - 3 kg/plant
 4 "
 5 "

Source : Agricultural Station

TABLE F-13-13 CROPPING GUIDE (Food Crop & Vegetables)

Crops Name: Upland Rice
(Variety)

1. Sowing Time May - June
2. Transplanting Time 1st May ~30th June
3. Planting Pattern row width spacing
25-30 cm × 25-30 cm = 17,777 - 25,600 Plant/rai
4. Seed Rate kg/rai or l/rai
5 kg/rai 4-5 Baht/kg
5. Fertilizers Input (1) Before Sowing

Lime stone	-	kg/rai
N16: P16: K8	20 - 30	kg/rai

 (2) Flower-bud-appearing stage

Urea	-	kg/rai
------	---	--------
6. Irrigation Interval -
7. Pest Control (Agricultural Chemicals name)

disease injury	Bird = Biological control
insect injury	sevin 50%
8. Harvesting Sep. ~Oct.
9. Average Production 320 kg/rai
10. Cropping Season
 Jan. Feb. Mar. Apr. May Jun. Jul. Aug. Sep. Oct. Nov. Dec.

Source : Agricultural Station

TABLE F-13-14 CROPPING GUIDE (Food Crop & Vegetables)

Crops Name: Eggplant
(Variety)

1. Sowing Time all year round
2. Transplanting Time all year round
3. Planting Pattern row width spacing
50 cm × 80 cm = 4000 ~ 4266 plant/rai
75 50
4. Seed Rate 0.15 ℓ/rai 100 Baht/ℓ
5. Fertilizers Input (1) Before Sowing
 Lime stone kg/rai
 N13 :P13 : K21 20 - 25 kg/rai
 (2) Flower-bud-appearing stage
 Urea 10 kg/rai
6. Irrigation Interval all year round
7. Pest Control (Agricultural Chemicals name)
 Disease injury - Karathane LC
 Insect injury - Carbofuran (Furandan 3% G)
8. Harvesting
9. Average Production 2,000 kg/rai
10. Cropping Season every month
 Jan. Feb. Mar. Apr. May Jun. Jul. Aug. Sep. Oct. Nov. Dec.

Source : Agricultural Station

TABLE F-13-15 CROPPING GUIDE (Food Crop & Vegetables)

Crops Name: Cabbage
(Variety)

1. Sowing Time culativate all year round
2. Transplanting Time 1 month
 row width spacing
3. Planting Pattern .50 cm × .50 cm = 6,400 plant/rai
4. Seed Rate 1 ℓ/rai =1,000 Baht/ℓ
5. Fertilizers Input (1) Before Sowing
 Lime stone kg/rai
 N15 : P15 : K15 50 kg/rai
 (2) Flower-bud-appearing stage
 Urea kg/rai
6. Irrigation Interval
7. Pest Control (Agricultural Chemicals name)
 Disease injury - - -
 Insect injury - Caterpillar - - - used Malataion to spray
8. Harvesting 50 - 120 days
9. Average Production 4,500 kg/rai
10. Cropping Season
 Jan., Feb. Mar. Apr. May Jun. Jul. Aug. Sep. Oct. Nov. Dec.

Source : Agricultural Station

TABLE F-13-16 CROPPING GUIDE (Food Crop & Vegetables)

Crops Name: Pumpkin
(Variety)

1. Sowing Time cultivate all year round
2. Transplanting Time cultivate all year round
3. Planting Pattern row width spacing
1 m × 1 m = 1,600 plant/rai
4. Seed Rate 2 kg/rai 120 Baht/kg
5. Fertilizers Input (1) Before Sowing
Lime stone - kg/rai
N15 : P15 : K15 50 kg/rai
(2) Flower-bud-appearing stage
Urea - kg/rai
6. Irrigation Interval
7. Pest Control (Agricultural Chemicals name)
Disease injury - ---
Insect injury - ---
8. Harvesting 120 days
9. Average Production 8,000 kg/rai
10. Cropping Season
Jan. Feb. Mar. Apr. May Jun. Jul. Aug. Sep. Oct. Nov. Dec.

Source: Agricultural Station

TABLE F-13-17 CROPPING GUIDE (Fruit Tree)

Crops Name: Banana
(Variety)

1. Planting Pattern 4 - 5 m × 4 - 5 m = 64 - 100 plant/rai
nurse stock 50 Baht/plant
2. Fertilizers N15 :P15 :K15

1 year	1/2	kg/plant	6 year	1	kg/plant	11 year	kg/plant
2 "	1	"	7 "	1			
3 "	1	"	8 "	1			
4 "	1	"	9 "	1			
5 "	1	"	10 "	1			
3. Pest Control (Agricultural Chemicals name)
 - Disease injury -
 - Insect injury -
4. First Harvesting

seeding	1 year
budding or grafting	- year
5. Flowering - Harvesting 110 days
6. Average production

1st	1 bunch/plant
2 year	1 bunch/plant
3 year	1 bunch/plant
4 year	1 bunch/plant
5 year	1 bunch/plant

Source : Agricultural Station

TABLE F-13-20 CROPPING GUIDE (Fruit Tree)

Crops Name: Rambutan
(Variety)

1. Planting Pattern 10 m × 10 m = 16 plant/rai
 nurse stock 30 Baht/plant

2. Fertilizers Inputs

N15 : P15 : K15

1 year	0.5	kg/plant	6 year	3	kg/plant	11 year	5.5	kg/plant
2 "	1	"	7 "	3.5	"	12 "	6	"
3 "	1.5	"	8 "	4	"	13 "	6.5	"
4 "	2	"	9 "	4.5	"	14 "	7	"
5 "	2.5	"	10 "	5	"	15 "	7.5	"

3. Pest Control (Agricultural Chemicals name)

Disease injury - Rafang disease destroy young crops - - - prevent by using Caratan

Insect injury - Thrips absorbed water to feed flower - - - prevent by spraying Dimentoen or Phos.

4. First Harvesting seeding 4 year
 budding or grafting 3 year

5. Flowering - Harvesting 100 ~ 110 days

6. Average production

1 year	(4 year)	25	kg/plant
2 "	(5 ")	30	kg/plant
3 "	(6 ")	50	kg/plant
4 "	(7 ")	80	kg/plant
5 "	(8 ")	100	kg/plant

Source: Agricultural Station

TABLE F-13-23 CROPPING GUIDE (Fruit Tree)

Crops Name: Papaya
(Variety)

1. Planting Pattern	2.5 m × 2.5 m = nursesey stock	256 5	Plant/rai Baht/plant
---------------------	-----------------------------------	----------	-------------------------

2. Fertilizers Inputs

N15 : P15 : K15

1 year 500 gm/plant

2 " 1 kg/plant

3 " -

4 " -

5 " -

3. Pest Control (Agricultural Chemicals name)

Disease injury -

Insect injury -

4. First Harvesting	seeding	1/2	year
	budding or grafting	-	year

5. Flowering - Harvesting 150 ~ 160 days

6. Average production

1 year 30 fruit/plant

2 " 40 fruit/plant

3 " - fruit/plant

4 " - fruit/plant

5 " - fruit/plant

Source: Agricultural Station

TABLE F-13-24 CROPPING GUIDE (Fruit Tree)

Crops Name: Coconut
(Variety)

1. Planting Pattern 9 m × 9 m = 20 plant/rai
 nursery stock 10 Baht/plant

2. Fertilizers Inputs

N15 : P15 : K15

1 year	1	kg/plant	6 year	4	kg/plant	11 year	4	kg/plant
2 "	2	"	7 "	4	"	12 "	4	
3 "	3	"	8 "	4	"			
4 "	4	"	9 "	4	"			
5 "	4	"	10 "	4	"			

3. Pest Control (Agricultural Chemicals name)

Disease injury - -

Insect injury - grub eat up the young tip - - protect by keeping the plantatio clean to prevent the grub from laying their eggs.

4. First Harvesting seeding 5 year
 budding or grafting - year

5. Flowering - Harvesting 330 ~ 360 days

6. Average production

1 year (5 year)	20	fruit/plant/year
2 " (6 ")	20	fruit/plant/year
3 " (7 ")	25	fruit/plant/year
4 " (8 ")	25	fruit/plant/year
5 " (9 ")	25	fruit/plant/year

Source : Agricultural Station

TABLE F-13-25 CROPPING GUIDE (Fruit Tree)

Crops Name: Mulberry
(Variety)

1. Planting Pattern $0.75 \text{ m} \times 1.5 \text{ m} =$ 1,400 plant/rai
 nursery stock .50 Baht/plant

2. Fertilizers Inputs

N15 : P15 : K15

1 year	200	gm/plant	6	year	200	gm/plant
2 "	"	"	7	"	"	"
3 "	"	"	8	"	"	"
4 "	"	"				
5 "	"	"				

3. Pest Control (Agricultural Chemicals name)

Disease injury - rotten root disease - - - used Arlie to spray

Insect injury - grub make hole in the trunk - - - used Supisyon

4. First Harvesting seeding 10 months
 budding or grafting 8 year

5. Flowering - Harvesting ~ days

6. Average production

1 year	1,000	kg/rai
2 "	1,500	kg/rai
3 "	"	kg/rai
4 "	"	kg/rai
5 "	"	kg/rai

Source : Agricultural Station

APPENDIX G. IRRIGATION / DRAINAGE

APPENDIX G. IRRIGATION / DRAINAGE

<< BACHO F/S AREA >>

LIST OF FIGURES

	Page
Figure G-1-B Detail of Existing Irrigation/Drainage Systems	G-1

LIST OF TABLES

Table G-1-B Design Rainfall for Irrigation -----	G-2
Table G-2-B Unit Water Requirement for Paddy Crop -----	G-3
Table G-3-B Unit Water Requirement for Upland Crop -----	G-4
Table G-4-B Unit Water Requirement for Tree Crop -----	G-5
Table G-5-B Total Water Requirement -----	G-6
Table G-6-B(1) Water Balance of Water Retention Block -----	G-7
Table G-6-B(2) Water Balance of Water Retention Block -----	G-8

<< KAB DAENG F/S AREA >>

LIST OF FIGURES

Figure G-1-K Detail of Existing Irrigation/Drainage Systems	G-9
---	-----

LIST OF TABLES

Table G-1-K Design Rainfall for Irrigation -----	G-10
Table G-2-K Unit Water Requirement for Paddy Crop -----	G-11
Table G-3-K Unit Water Requirement for Upland Crop (Peat)---	G-12
Table G-4-K Unit Water Requirement for Upland Crop (Acid Sulfate) -----	G-13
Table G-5-K Total Water Requirement -----	G-14

<< MUNO-KOKNAI F/S AREA >>

LIST OF FIGURES

	Page
Figure G-1-M Detail of Existing Irrigation/Drainage systems	G-15

LIST OF TABLES

Table G-1-M Design Rainfall for Irrigation -----	G-16
Table G-2-M Unit Water Requirement for Paddy Crop -----	G-17
Table G-3-M Unit Water Requirement for Upland Crop -----	G-18
Table G-4-M Unit Water Requirement for Para Rubber, Pineapple etc. -----	G-19
Table G-5-M Unit Water Requirement for Pasture -----	G-20
Table G-6-M Total Water Requirement -----	G-21

<< GENERAL >>

LIST OF FIGURES

Figure G-1-G Main Water Resources Development Projects in Narathiwat -----	G-30
Figure G-2-G Beneficial Area under Sai Buri River Development Project and Development Zone Around Bacho Swamp -----	G-31
Figure G-3-G Beneficial Area under Bang Nara Project and Development Zone Around To Daeng Swamp --	G-32

LIST OF TABLES

Table G-1-G List of Existing Large and Medium Scale Irrigation Project -----	G-27
Table G-2-G Development Potential -----	G-36

G-1 Muno Project -----	G-22
G-2 Medium Scale Irrigation Project -----	G-24
G-3 Ban Nara River Basin Development Project -----	G-25
G-4 Sai Buri River Basin Development Project -----	G-25
G-5 Selection of Representative Pilot area -----	G-31

Figure G-1-B Detail of Existing Irrigation/Drainage Systems

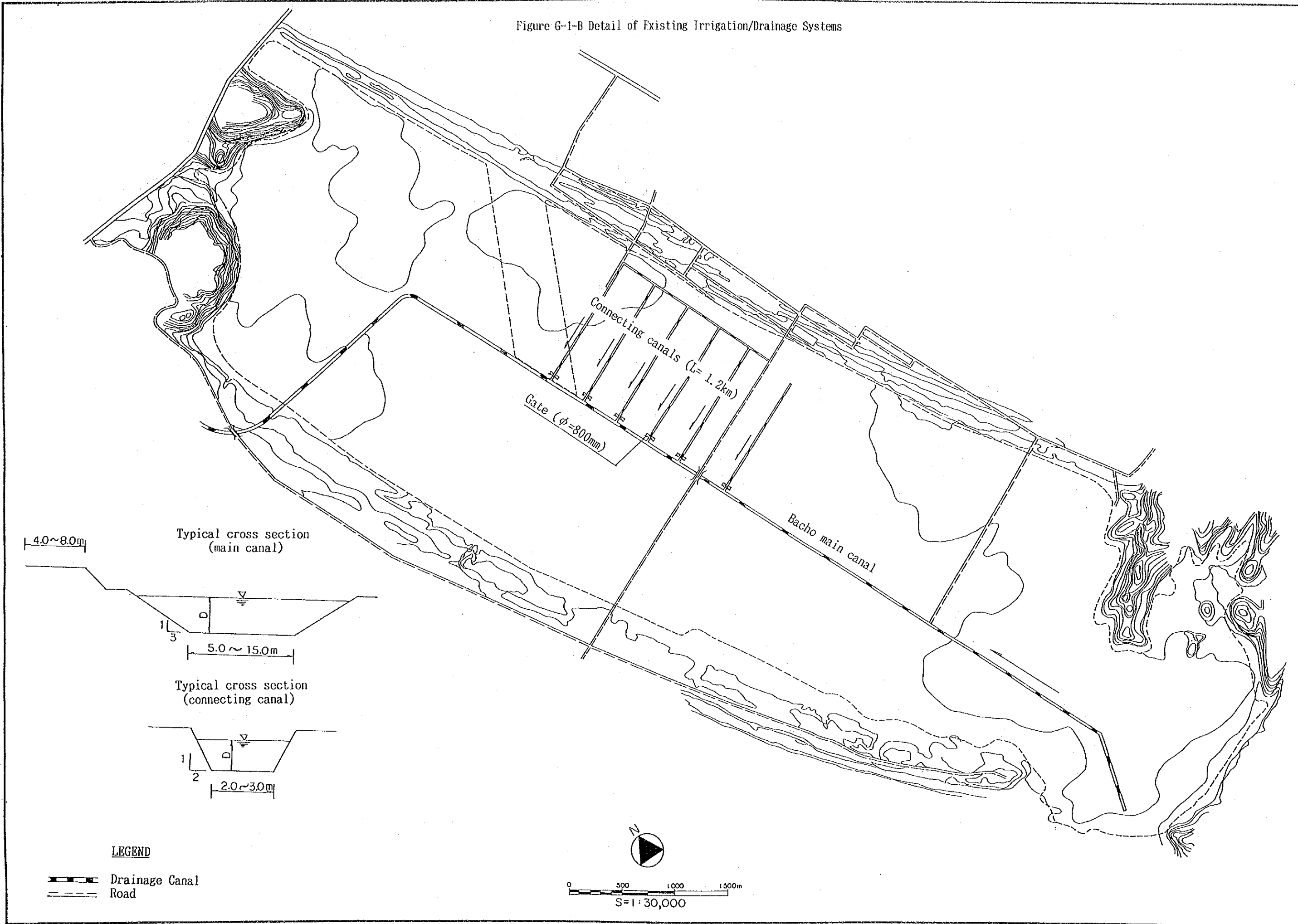


Table G-1-B Design Rainfall for Irrigation

Bacho F/S Area

Unit: mm

Month		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1977	1	0.00	0.00	0.00	0.00	0.00	48.30	14.70	39.10	18.20	155.20	115.10	121.90
	2	56.40	0.00	0.00	0.00	20.00	142.70	103.60	24.90	57.10	57.80	368.10	39.90
	3	4.70	25.50	63.10	0.00	157.20	29.80	146.80	77.00	24.70	198.40	16.60	20.90
1978	1	42.50	5.80	0.00	0.00	116.50	0.00	0.00	77.00	53.10	16.40	174.20	264.70
	2	0.00	48.10	0.00	0.00	88.10	80.90	104.40	52.20	71.40	54.70	365.40	31.90
	3	16.80	0.00	0.00	24.40	74.30	30.50	60.60	10.60	93.70	150.40	31.70	9.60
1980	1	0.00	15.90	0.00	0.00	0.00	53.00	22.60	5.80	25.80	30.50	268.00	331.70
	2	39.90	0.00	0.00	0.00	63.00	56.00	20.00	26.20	21.90	99.30	62.50	241.70
	3	8.40	34.50	14.30	0.00	10.00	57.00	0.00	0.00	12.10	30.20	218.20	128.30
1983	1	54.40	54.80	0.00	0.00	0.00	58.00	60.80	11.60	1.20	23.20	78.80	285.00
	2	6.10	34.80	64.10	0.00	15.40	10.10	121.60	0.00	163.10	63.90	122.00	488.40
	3	233.90	13.40	149.70	0.00	0.00	29.10	239.10	117.10	31.60	262.00	111.60	51.10
1984	1	0.00	7.50	100.70	0.00	0.00	159.80	37.20	22.30	63.10	68.80	20.40	220.50
	2	0.00	25.10	112.00	76.40	146.80	14.20	11.40	0.00	75.40	19.80	45.20	234.60
	3	32.80	20.20	0.00	6.40	73.80	9.70	79.50	47.40	126.10	6.60	233.30	303.20
1985	1	65.80	0.00	25.60	6.20	75.60	78.70	20.70	5.90	19.50	118.20	81.40	200.90
	2	0.00	0.00	0.00	5.30	102.20	0.00	33.70	123.70	52.30	85.10	145.10	298.70
	3	0.00	0.00	0.00	76.10	101.20	0.00	41.10	145.50	76.40	123.80	42.80	63.20
1986	1	7.90	0.00	48.60	0.00	0.00	83.90	80.00	14.10	22.10	64.10	54.50	148.40
	2	7.60	0.00	15.10	24.40	50.30	33.60	22.80	3.10	47.70	105.20	38.60	15.40
	3	18.20	0.00	0.00	0.00	67.50	4.70	54.20	2.70	97.20	136.90	567.70	25.10
1987	1	31.60	0.00	13.20	0.00	31.40	84.10	0.30	72.60	8.60	27.90	95.40	928.90
	2	5.50	0.00	0.00	0.00	6.90	13.30	49.50	87.40	101.90	57.70	47.70	175.20
	3	26.80	56.80	0.00	0.00	7.80	14.20	91.70	52.30	111.10	185.70	40.30	127.00
1988	1	13.00	0.00	19.40	64.70	119.10	0.40	128.40	47.60	63.00	6.60	304.80	193.50
	2	17.80	0.00	26.90	12.20	21.30	72.00	148.70	49.40	76.20	42.90	441.50	124.70
	3	5.00	24.40	0.00	59.50	64.90	0.90	126.60	136.60	71.40	13.70	256.40	16.90
1989	1	25.30	8.30	0.00	39.00	109.80	71.00	119.60	18.10	69.50	158.70	96.70	51.80
	2	10.10	14.10	0.00	49.40	50.90	0.10	47.30	104.30	41.90	35.10	197.90	38.90
	3	0.00	0.00	0.00	9.30	46.80	4.70	0.00	97.60	22.40	96.00	20.00	66.70
Average	1	24.1	9.2	20.8	11.0	45.2	63.7	48.4	31.4	34.4	67.0	128.9	274.7
	2	14.3	12.2	21.8	16.8	56.5	42.3	66.3	47.1	70.9	82.2	183.4	168.9
	3	34.7	17.5	22.7	17.6	60.4	18.1	84.0	68.7	66.7	120.4	153.9	81.2

Table G-2-B Unit Water Requirement for Paddy Crop

(BACHO F/S AREA)		Area = 128.6 ha										Unit: mm
Months		①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩	⑪
		ETo	Kc	ETA ①x②	Pe	③+④xDays	L. P.	Unit Requirement ⑤+⑥	Available Rainfall	Effective Rainfall ⑧-⑨.75	Shortage/ Excess ⑩-⑪	Unit Water Requirement
Jan	1	4.6	1.20	5.52	1.0	65.20		65.20	24.10	18.08	-47.13	47.13
	2	4.6	1.20	5.52	1.0	65.20		65.20	14.30	10.73	-54.48	54.48
	3	4.6	1.20	5.52	1.0	71.72		71.72	34.70	26.03	-45.70	45.70
Feb	1	5.0	1.20	6.00	1.0	70.00		70.00	9.20	5.90	-63.10	63.10
	2	5.0	0.76	3.80	1.0	48.00		48.00	12.20	9.15	-38.85	38.85
	3	5.0	0.76	3.80	1.0	25.60		25.60	17.50	13.13	-12.48	12.48
Mar	1	5.0	0.76	3.80	1.0	16.00		16.00	20.80	15.60	-0.40	0.40
	2	5.0							21.80	16.35		
	3	5.0							22.70	17.03		
Apr	1	4.9							11.00	8.25		
	2	4.9							16.80	12.60		
	3	4.9							17.60	13.20		
May	1	4.2							45.20	33.90		
	2	4.2							56.50	42.38		
	3	4.2							60.40	45.30		
Jun	1	3.7							63.70	47.78		
	2	3.7							42.30	31.72		
	3	3.7							18.10	13.58		
Jul	1	3.3							48.40	36.30		
	2	3.3							66.30	49.73		
	3	3.3							84.00	63.00		
Aug	1	4.1							31.40	23.55		
	2	4.1							47.10	35.33		
	3	4.1							68.70	51.53		
Sep	1	3.6							34.40	25.80		
	2	3.6							70.90	53.18		
	3	3.6							66.70	50.03		
Oct	1	3.6							67.00	50.25		
	2	3.6							62.20	46.65		
	3	3.6	0.90	3.24	1.0	15.55	60.00	95.55	120.40	90.30	-5.25	5.25
Nov	1	3.3	0.90	2.97	1.0	26.47	80.00	106.47	128.90	98.68	-9.79	9.79
	2	3.3	0.90	2.97	1.0	39.70	60.00	99.70	183.40	137.55	37.85	0.00
	3	3.3	1.20	3.96	1.0	49.60		49.60	153.90	115.43	65.83	0.00
Dec	1	3.4	1.20	4.08	1.0	50.80		50.80	274.70	206.03	155.23	0.00
	2	3.4	1.20	4.08	1.0	50.80		50.80	168.90	126.68	75.88	0.00
	3	3.4	1.20	4.08	1.0	55.88		55.88	81.20	60.90	5.02	0.00
Total												277.16

ETo = Potential Evapotranspiration
 Kc = Crop Coefficient
 ETA = Actual Evapotranspiration
 L.P. = Land Preparation
 Pe = Percolation

Table G-3-B Unit Water Requirement for Upland Crop

(BACHO F/S AREA)		Area = 51.2 ha						Unit: mm			
Months		①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩
		ETo	Kc	ETa	Pe	⑤+④xDays	Unit Requirement	Available Rainfall	Effective Rainfall ⑦x⑧	Shortage/Excess ⑧-⑨	Unit Water Requirement
Jan	1	4.6	0.45	2.07	1.0	20.83	20.83	24.10	18.08	-2.76	2.76
	2	4.6	0.45	2.07	1.0	41.67	41.67	14.30	10.73	-30.94	30.94
	3	4.6	0.45	2.07	1.0	68.75	68.75	34.70	26.03	-42.73	42.73
Feb	1	5.0	1.05	5.25	1.0	62.50	62.50	9.20	6.90	-55.60	55.60
	2	5.0	1.05	5.25	1.0	62.50	62.50	12.20	9.15	-53.35	53.35
	3	5.0	1.05	5.25	1.0	50.00	50.00	17.50	13.13	-36.88	36.88
Mar	1	5.0	1.05	5.25	1.0	41.85	41.85	20.80	15.60	-26.25	26.25
	2	5.0	1.05	5.25	1.0	41.85	41.85	21.80	16.35	-25.50	25.50
	3	5.0	1.05	5.25	1.0	46.04	46.04	22.70	17.03	-29.01	29.01
Apr	1	4.9	0.65	3.19	1.0	41.85	41.85	11.00	8.25	-33.60	33.60
	2	4.9	0.65	3.19	1.0	27.90	27.90	16.30	12.60	-15.30	15.30
	3	4.9	0.65	3.19	1.0	13.95	13.95	17.60	13.20	-0.75	0.75
May	1	4.2						45.20	33.90		
	2	4.2						56.50	42.38		
	3	4.2						60.40	45.30		
Jun	1	3.7						63.70	47.78		
	2	3.7						42.30	31.73		
	3	3.7						18.10	13.58		
Jul	1	3.3	0.45	1.49	1.0	8.28	8.28	48.40	36.30	28.02	0.00
	2	3.3	0.45	1.49	1.0	16.57	16.57	66.30	49.73	33.16	0.00
	3	3.3	0.45	1.49	1.0	27.34	27.34	84.00	63.00	35.67	0.00
Aug	1	4.1	1.05	4.31	1.0	53.05	53.05	31.40	23.55	-29.50	29.50
	2	4.1	1.05	4.31	1.0	53.05	53.05	47.10	35.33	-17.72	17.72
	3	4.1	1.05	4.31	1.0	58.36	58.36	68.70	51.53	-6.83	6.83
Sep	1	3.6	1.05	3.78	1.0	47.80	47.80	34.40	25.80	-22.00	22.00
	2	3.6	1.05	3.78	1.0	47.80	47.80	70.90	53.18	5.38	0.00
	3	3.6	1.05	3.78	1.0	47.80	47.80	66.70	50.03	2.23	0.00
Oct	1	3.6	0.60	2.16	1.0	31.60	31.60	67.00	50.25	18.65	0.00
	2	3.6	0.60	2.16	1.0	21.07	21.07	62.20	46.65	25.58	0.00
	3	3.6	0.60	2.16	1.0	11.59	11.59	120.40	90.30	78.71	0.00
Nov	1	3.3						128.90			
	2	3.3						183.40			
	3	3.3						153.90			
Dec	1	3.4						274.70			
	2	3.4						168.90			
	3	3.4						81.20			
Total											428.72

ETo = Potential Evapotranspiration
 Kc = Crop Coefficient
 ETa = Actual Evapotranspiration
 L.P. = Land Preparation
 Pe = Percolation

Table G-4-B Water Requirement for Tree crop

(BACHO F/S AREA)		Area = 38.4 ha						Unit: mm		
Months		①	②	③	④	⑤	⑥	⑦	⑧	⑨
		ETo	Kc	ETa	Pe	③+④xDays	Available Rainfall	Effective Rainfall ⑤x0.75	Shortage/ Excess ⑦-⑧	Unit Water Requirement
Jan	1	4.6	0.80	3.68	1.0	46.80	24.10	18.08	-28.72	28.72
	2	4.6	0.80	3.68	1.0	46.80	14.30	10.73	-36.07	36.07
	3	4.6	0.80	3.68	1.0	51.48	34.70	26.03	-25.45	25.45
Feb	1	5.0	0.80	4.00	1.0	50.00	9.20	6.90	-43.10	43.10
	2	5.0	0.80	4.00	1.0	50.00	12.20	9.15	-40.85	40.85
	3	5.0	0.80	4.00	1.0	40.00	17.50	13.13	-26.88	26.88
Mar	1	5.0	0.80	4.00	1.0	50.00	20.80	15.60	-34.40	34.40
	2	5.0	0.80	4.00	1.0	50.00	21.80	16.35	-33.65	33.65
	3	5.0	0.80	4.00	1.0	55.00	22.70	17.03	-37.98	37.98
Apr	1	4.9	0.80	3.92	1.0	49.20	11.00	8.25	-40.95	40.95
	2	4.9	0.80	3.92	1.0	49.20	16.80	12.60	-36.60	36.60
	3	4.9	0.80	3.92	1.0	49.20	17.60	13.20	-36.00	36.00
May	1	4.2	0.80	3.36	1.0	43.60	45.20	33.90	-9.70	9.70
	2	4.2	0.80	3.36	1.0	43.60	56.50	42.38	-1.23	1.23
	3	4.2	0.80	3.36	1.0	47.96	60.40	45.30	-2.66	2.66
Jun	1	3.7	0.80	2.96	1.0	39.60	63.70	47.78	8.18	0.00
	2	3.7	0.80	2.96	1.0	39.60	42.30	31.72	-7.88	7.88
	3	3.7	0.80	2.96	1.0	39.60	18.10	13.58	-26.03	26.03
Jul	1	3.3	0.80	2.64	1.0	36.40	48.40	36.30	-0.10	0.10
	2	3.3	0.80	2.64	1.0	36.40	66.30	49.73	13.33	0.00
	3	3.3	0.80	2.64	1.0	40.84	84.00	63.00	22.96	0.00
Aug	1	4.1	0.80	3.28	1.0	42.80	31.40	23.55	-19.25	19.25
	2	4.1	0.80	3.28	1.0	42.80	47.10	35.33	-7.47	7.47
	3	4.1	0.80	3.28	1.0	47.08	68.70	51.53	4.45	0.00
Sep	1	3.6	0.80	2.88	1.0	38.80	34.40	25.80	-13.00	13.00
	2	3.6	0.80	2.88	1.0	38.80	70.90	53.18	14.38	0.00
	3	3.6	0.80	2.88	1.0	38.80	66.70	50.03	11.23	0.00
Oct	1	3.6	0.80	2.88	1.0	38.80	67.00	50.25	11.45	0.00
	2	3.6	0.80	2.88	1.0	38.80	62.20	46.65	7.85	0.00
	3	3.6	0.80	2.88	1.0	42.68	120.40	90.30	47.62	0.00
Nov	1	3.3	0.80	2.64	1.0	36.40	120.90	96.68	60.28	0.00
	2	3.3	0.80	2.64	1.0	36.40	193.40	137.55	101.15	0.00
	3	3.3	0.80	2.64	1.0	36.40	153.90	115.43	79.03	0.00
Dec	1	3.4	0.80	2.72	1.0	37.20	274.70	206.03	169.33	0.00
	2	3.4	0.80	2.72	1.0	37.20	168.90	126.68	89.48	0.00
	3	3.4	0.80	2.72	1.0	40.92	81.20	68.90	19.93	0.00
Total										507.97

ETo = Potential Evapotranspiration
 Kc = Crop Coefficient
 ETa = Actual Evapotranspiration
 L.P. = Land Preparation
 Pe = Percolation

Table G-5-B Total Water Requirement

Month	Paddy (120.6 ha)			Upland (51.2 ha)			Tree crops (30.4 ha)			Total Requirement m ³ /s	Total Requirement MCM
	Unit Requirement (mm)	Unit Requirement m ³ /s	Unit Requirement (mm)	Unit Requirement m ³ /s	Unit Requirement (mm)	Unit Requirement m ³ /s	Unit Requirement (mm)	Unit Requirement m ³ /s			
Jan	1	47.13	0.066	2.76	0.002	28.72	0.01	0.078	0.067		
	2	54.48	0.076	30.94	0.018	36.06	0.01	0.107	0.089		
	3	45.70	0.058	42.73	0.023	25.45	0.01	0.089	0.085		
Feb	1	83.10	0.088	55.60	0.033	43.10	0.02	0.136	0.118		
	2	38.85	0.054	53.35	0.032	40.65	0.01	0.100	0.087		
	3	12.48	0.022	36.88	0.027	26.88	0.01	0.061	0.042		
Mar	1	0.40	0.001	26.25	0.016	34.40	0.01	0.028	0.024		
	2			25.50	0.015	32.65	0.01	0.027	0.023		
	3			28.01	0.016	37.98	0.01	0.028	0.026		
Apr	1			33.60	0.020	40.95	0.01	0.034	0.030		
	2			15.30	0.009	36.60	0.01	0.022	0.019		
	3			0.75	0.000	36.00	0.01	0.013	0.011		
May	1					0.70	0.00	0.009	0.009		
	2					1.23	0.00	0.000	0.000		
	3					2.66	0.001	0.001	0.001		
Jun	1					7.88	0.003	0.003	0.002		
	2					26.03	0.01	0.009	0.008		
	3					0.10	0.00	0.000	0.000		
Jul	1										
	2										
	3										
Aug	1			23.50	0.017	19.25	0.01	0.024	0.021		
	2			17.72	0.011	7.47	0.003	0.013	0.011		
	3			6.83	0.004						
Sep	1			22.00	0.013	13.00	0.00	0.018	0.015		
	2										
	3										
Oct	1										
	2										
	3										
Nov	1	5.250	0.007					0.007	0.006		
	2	9.790	0.014					0.014	0.012		
	3										
Dec	1										
	2										
	3										
Total		277.16	0.385	428.72	0.255	507.97	0.18	0.815	0.704		

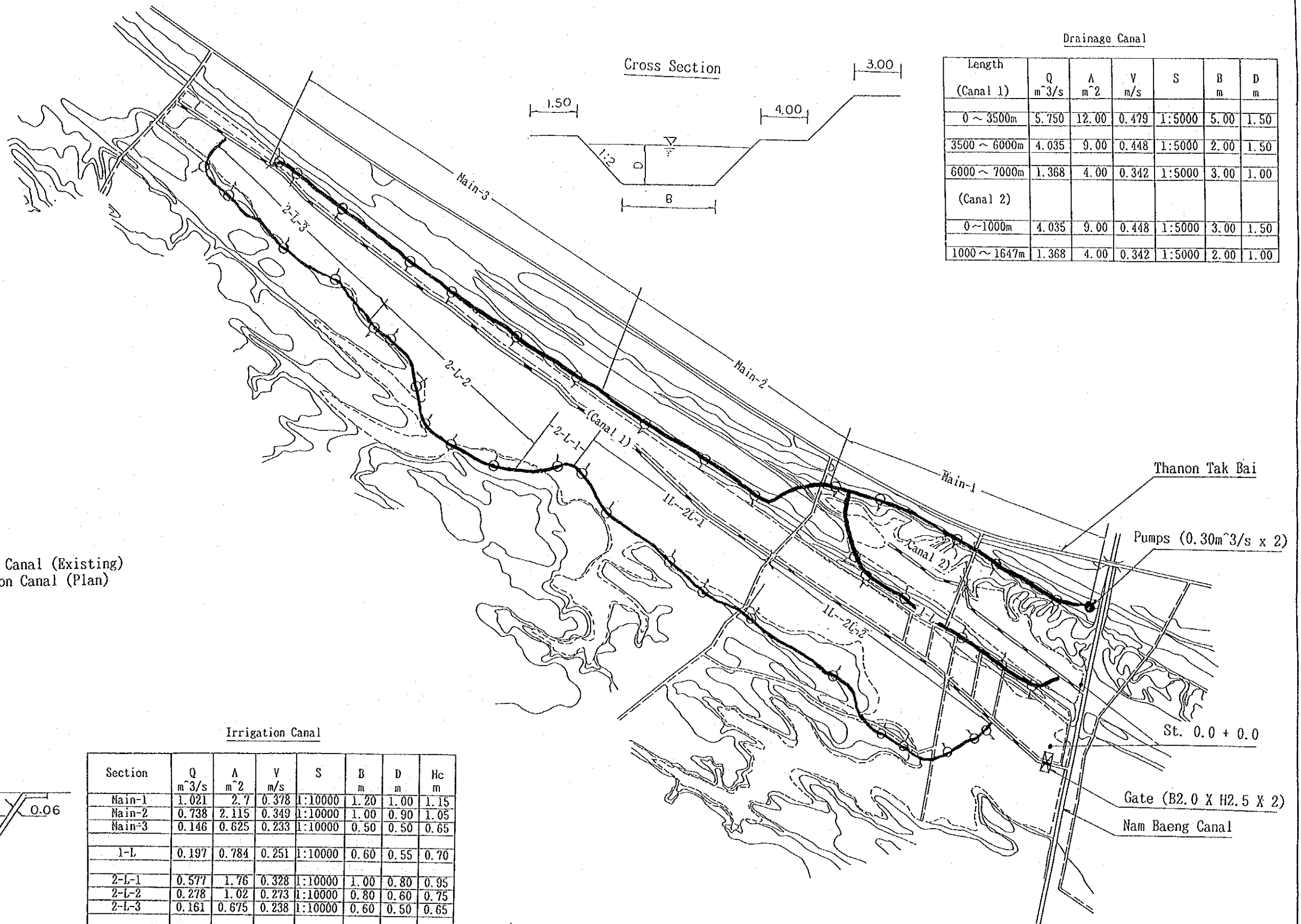
Table G-6-B(1) Water Balance of Water Retention Block

Month		Rainfall (mm)	ET _o (mm/day)	Consumptive Use (mm)	Percolation loss (mm)	Water Requirement (mm)	Excess Rainfall (mm)
Jan	1	24.1	4.6	46	10	32	-
	2	14.3	4.6	46	10	42	-
	3	34.7	4.6	51	11	27	-
Feb	1	9.2	5.0	50	10	51	-
	2	12.2	5.0	50	10	48	-
	3	17.5	5.0	45	9	37	-
Mar	1	20.8	5.0	50	10	39	-
	2	21.8	5.0	50	10	38	-
	3	22.7	5.0	55	11	43	-
Apr	1	11.0	4.9	49	10	48	-
	2	16.8	4.9	49	10	42	-
	3	17.6	4.9	49	10	41	-
May	1	45.2	4.2	42	10	7	-
	2	56.5	4.2	42	10	-	5
	3	60.4	4.2	46	11	-	3
Jun	1	63.7	3.7	37	10	-	17
	2	42.3	3.7	37	10	5	-
	3	18.1	3.7	37	10	29	-
Jul	1	48.4	3.3	33	10	-	5
	2	66.3	3.3	33	10	-	23
	3	84.0	3.3	36	11	-	37
Aug	1	31.4	4.1	41	10	20	-
	2	47.1	4.1	41	10	4	-
	3	68.7	4.1	45	11	-	13
Sep	1	34.4	3.6	36	10	13	-
	2	70.9	3.6	36	10	-	25
	3	66.7	3.6	36	10	-	21
Oct	1	67.0	3.6	36	10	-	21
	2	62.2	3.6	46	10	-	6
	3	120.4	3.6	40	11	-	69
Nov	1	128.9	3.3	33	10	-	86
	2	183.4	3.3	33	10	-	140
	3	153.9	3.3	33	10	-	111
Dec	1	274.7	3.4	34	10	-	231
	2	168.9	3.4	34	10	-	125
	3	81.2	3.4	37	11	-	33
Total						566	971

Table G-6-B(2) Water Balance of Water Retention Block

Month		Water Requirement (MCM)			Effective Storage (MCM)	Water Balance (MCM)
		Retention Block	Development Block	Total		
Jan	1	0.326	0.134	0.460	-	-0.460
	2	0.428	0.186	0.614	-	-1.074
	3	0.275	0.170	0.445	-	-1.519
Feb	1	0.520	0.236	0.756	-	-2.275
	2	0.490	0.174	0.664	-	-2.939
	3	0.377	0.084	0.461	-	-3.400
Mar	1	0.398	0.048	0.446	-	-3.846
	2	0.388	0.046	0.434	-	-4.280
	3	0.439	0.052	0.491	-	-4.771
Apr	1	0.490	0.060	0.550	-	-5.321
	2	0.428	0.038	0.466	-	-5.787
	3	0.418	0.022	0.440	-	-6.227
May	1	0.071	0.006	0.077	-	-6.304
	2	-	-	-	0.051	-6.253
	3	-	0.002	0.002	0.031	-6.224
Jun	1	-	-	-	0.173	-6.051
	2	0.051	0.002	0.053	-	-6.104
	3	0.296	0.016	0.312	-	-6.416
Jul	1	-	-	-	0.051	-6.365
	2	-	-	-	0.235	-6.130
	3	-	-	-	0.377	-5.753
Aug	1	0.204	0.042	0.246	-	-5.999
	2	0.041	0.022	0.067	-	-6.066
	3	-	-	-	0.133	-5.933
Sep	1	0.133	0.030	0.163	-	-6.096
	2	-	-	-	0.255	-5.841
	3	-	-	-	0.214	-5.627
Oct	1	-	-	-	0.214	-5.413
	2	-	-	-	0.061	-5.352
	3	-	0.012	0.012	0.704	-4.660
Nov	1	-	0.024	0.024	0.877	-3.807
	2	-	-	-	1.428	-2.379
	3	-	-	-	1.132	-1.247
Dec	1	-	-	-	2.356	1.109
	2	-	-	-	1.275	2.384
	3	-	-	-	0.337	2.721

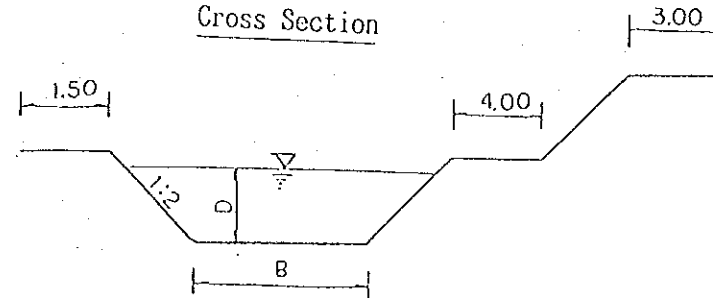
Figure G-1-K Detail of Existing Irrigation/Drainage Systems



Drainage Canal

Length (Canal 1)	Q m ³ /s	A m ²	V m/s	S	B m	D m
0 ~ 3500m	5.750	12.00	0.479	1:5000	5.00	1.50
3500 ~ 6000m	4.035	9.00	0.448	1:5000	2.00	1.50
6000 ~ 7000m	1.368	4.00	0.342	1:5000	3.00	1.00
(Canal 2)						
0 ~ 1000m	4.035	9.00	0.448	1:5000	3.00	1.50
1000 ~ 1647m	1.368	4.00	0.342	1:5000	2.00	1.00

Cross Section



LEGEND

- Drainage Canal (Existing)
- Irrigation Canal (Plan)

Irrigation Canal

Section	Q m ³ /s	A m ²	V m/s	S	B m	D m	Hc m
Main-1	1.021	2.7	0.378	1:10000	1.20	1.00	1.15
Main-2	0.738	2.115	0.349	1:10000	1.00	0.90	1.05
Main-3	0.146	0.625	0.233	1:10000	0.50	0.50	0.65
1-L	0.197	0.784	0.251	1:10000	0.60	0.55	0.70
2-L-1	0.577	1.76	0.328	1:10000	1.00	0.80	0.95
2-L-2	0.278	1.02	0.273	1:10000	0.80	0.60	0.75
2-L-3	0.161	0.675	0.238	1:10000	0.60	0.50	0.65
1L-2L-1	0.329	1.154	0.285	1:10000	0.80	0.65	0.80
1L-2L-2	0.161	0.675	0.238	1:10000	0.60	0.50	0.65

Cross Section

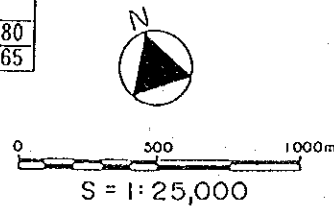
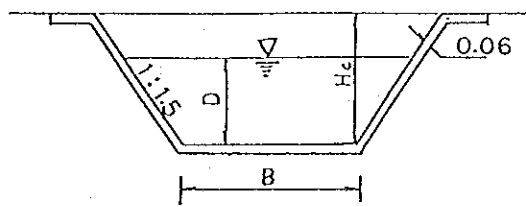


Table G-1-K Design Rainfall for Irrigation

Kab Daeng F/S Area

Unit: mm

Month		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Year													
1980	1	12.90	16.60	0.00	30.80	20.30	15.60	26.00	69.70	82.00	37.90	235.10	400.80
	2	36.80	0.00	0.00	12.80	74.60	37.10	32.70	42.30	62.80	106.50	72.60	292.40
	3	0.00	44.50	7.90	16.50	56.20	132.30	34.50	17.20	142.90	35.40	256.00	114.20
1981	1	8.90	0.00	0.00	50.20	75.30	0.00	55.40	0.00	49.30	0.00	250.00	516.40
	2	0.00	0.00	0.00	50.10	9.90	8.70	108.00	7.30	48.90	94.90	142.10	59.00
	3	0.00	16.40	5.90	10.10	76.80	0.00	45.90	80.20	18.60	191.30	248.00	5.50
1982	1	60.90	0.00	0.00	14.70	19.30	150.40	55.80	35.30	28.00	56.70	108.90	231.20
	2	5.00	0.00	216.60	17.70	9.60	15.50	28.00	22.90	31.70	73.40	45.40	298.10
	3	15.10	6.80	0.00	13.00	132.20	20.50	56.60	52.10	27.00	74.40	133.10	18.90
1983	1	47.10	35.00	0.00	0.00	10.50	72.70	28.40	127.70	83.90	17.70	114.70	328.00
	2	0.00	18.50	82.80	0.00	0.00	22.90	40.40	9.80	74.10	67.10	101.90	457.50
	3	91.60	36.60	86.90	0.00	0.00	40.60	100.90	61.20	56.70	166.10	56.20	104.50
1984	1	0.00	0.00	125.60	0.00	13.60	50.00	80.60	35.10	34.70	101.70	66.50	208.60
	2	0.00	34.10	155.00	104.50	107.80	73.40	53.80	55.70	31.20	7.00	74.80	324.60
	3	32.80	16.30	11.30	24.20	34.40	5.10	46.40	48.50	62.60	88.60	199.30	337.00
1985	1	65.50	0.00	19.40	0.00	155.30	37.30	9.30	56.20	4.80	118.70	139.40	182.30
	2	0.00	0.00	0.00	19.80	50.70	0.00	120.70	65.30	49.70	50.40	167.90	193.00
	3	0.00	0.00	0.00	88.50	56.40	0.00	50.30	126.30	73.00	79.50	76.00	50.80
1986	1	7.90	0.00	10.30	0.00	13.80	35.60	6.80	23.10	36.90	99.70	75.20	139.80
	2	7.60	0.00	28.30	10.90	46.80	27.60	11.90	0.00	54.30	36.40	46.50	32.60
	3	18.20	13.30	6.60	0.00	73.50	23.10	31.90	78.70	124.70	134.30	977.30	10.30
1987	1	31.60	31.90	35.20	0.00	80.00	66.10	20.30	53.40	9.70	50.30	116.60	657.00
	2	5.50	0.00	0.00	5.90	32.80	5.70	5.50	45.10	109.50	63.90	46.70	180.70
	3	26.50	51.00	0.00	0.00	11.80	41.10	7.80	57.60	42.90	87.10	36.80	52.70
1988	1	13.00	0.00	15.30	13.10	176.90	10.90	72.70	5.70	66.40	94.80	359.80	198.30
	2	17.80	0.00	0.00	16.40	89.80	60.90	39.80	63.90	62.10	34.20	385.80	48.20
	3	5.00	35.30	0.00	25.20	139.40	27.50	75.90	35.00	48.20	40.40	251.60	9.20
1989	1	25.30	5.00	0.00	27.70	106.60	7.40	34.80	10.80	60.50	34.90	115.50	26.10
	2	10.10	0.00	0.00	68.40	48.70	0.00	162.70	64.00	22.90	136.60	137.60	60.20
	3	0.00	0.00	0.00	0.00	33.10	14.00	0.00	66.20	49.20	78.30	71.20	67.80
Average	1	27.3	8.9	20.6	13.7	67.2	44.6	39.0	41.7	45.6	61.2	158.2	288.9
	2	8.3	5.3	48.3	30.7	47.1	25.2	60.4	37.6	54.7	67.0	122.1	194.6
	3	18.9	22.0	11.9	17.8	61.4	30.4	45.0	62.3	64.6	97.5	230.6	77.1

Table G-2-K Unit Water Requirement for Paddy Crop

(Kab Daeng F/S AREA) Area = 415.0 ha Unit: mm

Months		Paddy (90.0 ha) (Irrigable)						Paddy (300.0 ha) (Irrigable)				Paddy (25.0 ha) (Rainfed)				Total Unit Requirement	
		① ETo	② Kc	③ ETa ①xKc	④ Pe	⑤ ③+④xdays	⑥ L. P.	⑦ Unit Requirement ⑤+⑥	⑧ Kc	⑨ ETa ①xKc	⑩ ⑧+⑨xdays	⑪ L. P.	⑫ Unit Requirement ⑩+⑪	⑬ Kc	⑭ ETa ①xKc		⑮ ⑬+⑭xdays
Jan	1	4.6			1.0			1.20	5.52	65.20		65.20	0.76	3.50	44.96	44.96	110.16
	2	4.6			1.0			1.20	5.52	65.20		65.20	0.76	3.50	29.97	29.97	95.17
	3	4.6			1.0			0.76	3.50	49.46		49.46	0.76	3.50	16.49	16.49	65.94
Feb	1	5.0			1.0			0.76	3.80	32.00		32.00					32.00
	2	5.0			1.0			0.76	3.80	16.00		16.00					16.00
	3	5.0															
Mar	1	5.0															
	2	5.0															
	3	5.0															
Apr	1	4.9															
	2	4.9															
	3	4.9	0.90	4.41	1.0	18.03	80.00			111.87							111.87
May	1	4.2	0.90	3.78	1.0	31.87	80.00			107.80							107.80
	2	4.2	0.90	3.78	1.0	47.80	80.00			66.44							66.44
	3	4.2	1.20	5.04	1.0	66.44			66.44								66.44
Jun	1	3.7	1.20	4.44	1.0	54.40			54.40								54.40
	2	3.7	1.20	4.44	1.0	54.40			54.40								54.40
	3	3.7	1.20	4.44	1.0	54.40			54.40								54.40
Jul	1	3.3	1.20	3.96	1.0	49.60			49.60								49.60
	2	3.3	1.20	3.96	1.0	49.60			49.60								49.60
	3	3.3	1.20	3.96	1.0	54.56			54.56								54.56
Aug	1	4.1	1.20	4.92	1.0	59.20			59.20								59.20
	2	4.1	0.76	2.51	1.0	35.08			35.08								35.08
	3	4.1	0.76	2.51	1.0	25.73			25.73								25.73
Sep	1	3.6	0.76	3.12	1.0	13.72			13.72								13.72
	2	3.6										0.90	3.24	10.80	10.80	10.80	10.80
	3	3.6										0.90	3.24	21.60	21.60	21.60	
Oct	1	3.6			1.0			0.90	3.24	14.13	80.00	94.13	0.90	3.24	42.40	42.40	136.53
	2	3.6			1.0			0.90	3.24	28.27	80.00	108.27	1.20	4.32	53.20	53.20	161.47
	3	3.6			1.0			0.90	3.24	42.40	60.00	102.40	1.20	4.32	58.52	58.52	160.92
Nov	1	3.3			1.0			1.20	3.96	49.60		49.60	1.20	3.96	49.60	49.60	99.20
	2	3.3			1.0			1.20	3.96	49.60		49.60	1.20	3.96	49.60	49.60	99.20
	3	3.3			1.0			1.20	3.96	49.60		49.60	1.20	3.96	49.60	49.60	99.20
Dec	1	3.4			1.0			1.20	4.08	50.80		50.80	1.20	4.08	50.80	50.80	101.60
	2	3.4			1.0			1.20	4.08	50.80		50.80	1.20	4.08	50.80	50.80	101.60
	3	3.4			1.0			1.20	4.08	55.88		55.88	1.20	4.08	55.88	55.88	111.76
Total							803.23					838.94				584.22	2226.39

ETo = Potential Evapotranspiration
 Kc = Crop Coefficient
 ETa = Actual Evapotranspiration
 L.P. = Land Preparation
 Pe = Percolation

Table G-3-K Unit Water Requirement for Upland Crop

(Kab Daeng F/S AREA)

Area = 12.0 ha(Perat)

Unit: mm

Months		①	②	③	④	⑤ ③+④xDays	⑥	⑦	⑧	⑨	⑩
		ETo	Kc	ETA ①xKc	Pe		Unit Requirement	Available Rainfall	Effective Rainfall ⑦x0.75	Shortage/ Excess ⑧-⑨	Unit Water Requirement
Jan	1	4.6	1.05	4.83	1.0	58.30	58.30	27.30	20.48	-37.83	37.83
	2	4.6	1.05	4.83	1.0	58.30	58.30	8.30	6.23	-52.08	52.08
	3	4.6	1.05	4.83	1.0	64.13	64.13	18.98	14.18	-49.96	49.96
Feb	1	5.0	1.05	5.25	1.0	62.50	62.50	8.90	6.68	-55.83	55.83
	2	5.0	1.05	5.25	1.0	62.50	62.50	5.30	3.98	-58.53	58.53
	3	5.0	1.05	5.25	1.0	50.00	50.00	22.00	16.50	-33.50	33.50
Mar	1	5.0	0.65	3.25	1.0	42.50	42.50	20.60	15.45	-27.05	27.05
	2	5.0	0.65	3.25	1.0	28.33	28.33	48.30	36.23	7.89	0.00
	3	5.0	0.65	3.25	1.0	15.58	15.58	11.90	8.93	-6.66	6.66
Apr	1	4.9						13.70	10.28		
	2	4.9						30.70	23.03		
	3	4.9						17.80	13.35		
May	1	4.2	0.45	1.89	1.0	9.63	9.63	67.20	50.40	40.77	0.00
	2	4.2	0.45	1.89	1.0	19.27	19.27	47.10	35.33	16.06	0.00
	3	4.2	0.45	1.89	1.0	31.79	31.79	61.40	46.05	14.26	0.00
Jun	1	3.7	1.05	3.89	1.0	48.85	48.85	44.60	33.45	-15.40	15.40
	2	3.7	1.05	3.89	1.0	48.85	48.85	25.20	18.90	-29.95	29.95
	3	3.7	1.05	3.89	1.0	48.85	48.85	30.40	22.80	-26.05	26.05
Jul	1	3.3	1.05	3.47	1.0	44.65	44.65	39.00	29.25	-15.40	15.40
	2	3.3	1.05	3.47	1.0	44.65	44.65	60.40	45.30	0.65	0.00
	3	3.3	1.05	3.47	1.0	49.12	49.12	45.00	33.75	-15.37	15.37
Aug	1	4.1	0.60	2.46	1.0	34.60	34.60	41.70	31.28	-3.32	3.32
	2	4.1	0.60	2.46	1.0	23.07	23.07	37.60	28.20	5.13	0.00
	3	4.1	0.60	2.46	1.0	12.69	12.69	62.30	46.73	34.04	0.00
Sep	1	3.6						45.60	34.20		
	2	3.6						54.70	41.03		
	3	3.6						64.60	48.45		
Oct	1	3.6						61.20	45.90		
	2	3.6						67.00	50.25		
	3	3.6						97.50	73.13		
Nov	1	3.3						150.20	110.65		
	2	3.3						122.10	91.58		
	3	3.3						230.60	172.95		
Dec	1	3.4	0.45	1.53	1.0	8.43	8.43	288.90	216.68	208.24	0.00
	2	3.4	0.45	1.53	1.0	16.87	16.87	194.60	145.95	129.08	0.00
	3	3.4	0.45	1.53	1.0	27.83	27.83	77.10	57.83	29.99	0.00
Total											426.98

ETo = Potential Evapotranspiration
 Kc = Crop Coefficient
 ETA = Actual Evapotranspiration
 L.P. = Land Preparation
 Pe = Percolation

Table G-4-K Unit Water Requirement Upland Crop

(Kab Daeng F/S AREA)

Area = 62.0 ha (Potential Acid Sulfate)

Unit: mm

Months		① ETo	② Kc	③ ETa ①xKc	④ Pe	⑤ ③+④xDays	⑥ Unit Requirement	⑦ Available Rainfall	⑧ Effective Rainfall ⑦-⑥.75	⑨ Shortage/ Excess ⑧-⑥	⑩ Unit Water Requirement
Jan	1	4.6	1.05	4.83	1.0	58.30	58.30	27.30	20.48	-37.83	37.83
	2	4.6	1.05	4.83	1.0	58.30	58.30	8.30	6.23	-52.08	52.08
	3	4.6	1.05	4.83	1.0	64.13	64.13	18.90	14.18	-49.96	49.96
Feb	1	5.0	1.05	5.25	1.0	62.50	62.50	8.90	6.69	-55.83	55.83
	2	5.0	1.05	5.25	1.0	62.50	62.50	5.30	3.98	-58.53	58.53
	3	5.0	1.05	5.25	1.0	50.00	50.00	22.00	16.50	-33.50	33.50
Mar	1	5.0	0.65	3.25	1.0	42.50	42.50	20.60	15.45	-27.05	27.05
	2	5.0	0.65	3.25	1.0	28.33	28.33	48.30	36.23	7.89	0.00
	3	5.0	0.65	3.25	1.0	15.58	15.58	11.90	8.93	-6.66	6.66
Apr	1	4.9						13.70	10.28		
	2	4.9						30.70	23.03		
	3	4.9						17.80	13.35		
May	1	4.2	0.45	1.89	1.0	9.63	9.63	67.20	50.40	40.77	0.00
	2	4.2	0.45	1.89	1.0	19.27	19.27	47.10	35.33	16.06	0.00
	3	4.2	0.45	1.89	1.0	31.79	31.79	61.40	46.05	14.26	0.00
Jun	1	3.7	1.05	3.89	1.0	48.85	48.85	44.60	33.45	-15.40	15.40
	2	3.7	1.05	3.89	1.0	48.85	48.85	25.20	18.90	-29.95	29.95
	3	3.7	1.05	3.89	1.0	48.85	48.85	30.40	22.80	-26.05	26.05
Jul	1	3.3	1.05	3.47	1.0	44.65	44.65	39.00	29.25	-15.40	15.40
	2	3.3	1.05	3.47	1.0	44.65	44.65	60.40	45.30	0.65	0.00
	3	3.3	1.05	3.47	1.0	49.12	49.12	45.00	33.75	-15.37	15.37
Aug	1	4.1	0.60	2.46	1.0	34.60	34.60	41.70	31.28	-3.32	3.32
	2	4.1	0.60	2.46	1.0	23.07	23.07	37.60	28.20	5.13	0.00
	3	4.1	0.60	2.46	1.0	12.69	12.69	62.30	46.73	34.04	0.00
Sep	1	3.6						45.60	34.20		
	2	3.6						54.70	41.03		
	3	3.6						64.60	48.45		
Oct	1	3.6						61.20	45.90		
	2	3.6						67.00	50.25		
	3	3.6						97.50	73.13		
Nov	1	3.3						158.20	118.65		
	2	3.3						122.10	91.58		
	3	3.3						230.60	172.95		
Dec	1	3.4	0.45	1.53	1.0	8.43	8.43	288.90	216.68	208.24	0.00
	2	3.4	0.45	1.53	1.0	16.87	16.87	194.60	145.95	129.08	0.00
	3	3.4	0.45	1.53	1.0	27.83	27.83	77.10	57.83	29.99	0.00
Total											426.90

ETo = Potential Evapotranspiration
 Kc = Crop Coefficient
 ETa = Actual Evapotranspiration
 L.P. = Land Preparation
 Pe = Percolation

Table G-5-K Total Water Requirement

Area = 398.8 ha

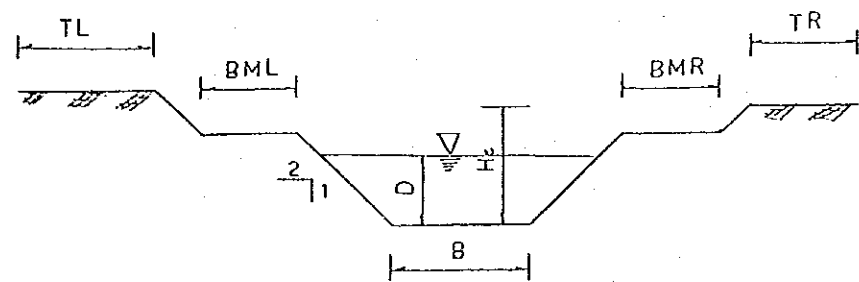
Month		Irrigable		Effective Rainfall (mm)	Shortage/ Excess (mm)	Total Unit Requirement (398.8 ha) (mm)	Total Irrigation Requirement (398.8 ha) m ³ /s	Total Irrigation Requirement (398.8 ha) HCM	Non Irrigable			Total Unit Requirement (99.0 ha) (mm)
		Paddy (98 ha)	Paddy (300.0 ha)						Paddy (25.0 ha)	Upland (62.0 ha)	Upland (12.0 ha)	
		Unit Requirement (mm)	Unit Requirement (mm)						Unit Requirement (mm)	Unit Requirement (mm)	Unit Requirement (mm)	
Jan	1		65.20	20.48	-44.72	44.72	0.16	0.13	24.48	37.83	37.83	100.14
	2		65.20	6.23	-58.97	58.97	0.20	0.18	23.74	52.08	52.08	127.90
	3		49.46	14.18	-35.28	35.28	0.11	0.11	2.31	49.96	49.96	182.23
Feb	1		32.00	6.68	-25.32	25.32	0.09	0.08		55.83	55.83	111.66
	2		16.00	3.98	-12.02	12.02	0.04	0.04		58.53	58.53	117.06
	3			16.50	16.50					33.50	33.50	67.00
Mar	1			15.45	15.45					27.05	27.05	54.10
	2			36.23	36.23							
	3			8.93	8.93					6.66	6.66	13.32
Apr	1			10.28	10.28							
	2			23.03	23.03							
	3		111.87	13.35	-98.52	98.52	0.10	0.09				
May	1		187.80	50.40	-57.40	57.40	0.06	0.05				
	2		66.44	35.33	-31.11	31.11	0.03	0.03				
	3		66.44	46.05	-20.39	20.39	0.02	0.02				
Jun	1		54.40	33.45	-20.95	20.95	0.02	0.02		15.40	15.40	30.80
	2		54.40	18.90	-35.50	35.50	0.04	0.03		29.95	29.95	59.90
	3		54.40	22.80	-31.60	31.60	0.03	0.03		26.05	26.05	52.10
Jul	1		49.60	29.25	-20.35	20.35	0.02	0.02		15.40	15.40	30.80
	2		49.60	45.30	-4.30	4.30	0.00	0.00				
	3		54.56	33.75	-20.81	20.81	0.02	0.02		15.37	15.37	30.74
Aug	1		59.20	31.28	-27.92	27.92	0.03	0.03		3.32	3.32	6.64
	2		35.08	28.20	-6.88	6.88	0.01	0.01				
	3		25.73	46.73	21.00							
Sep	1		13.72	34.20	20.48							
	2			41.03	41.03							
	3			48.45	48.45							
Oct	1		94.13	45.90	-48.23	48.23	0.17	0.14				
	2		108.27	50.25	-58.02	58.02	0.20	0.17	2.95			2.95
	3		102.40	73.13	-29.27	29.27	0.10	0.09				
Nov	1		49.60	118.65	69.05							
	2		49.60	91.58	41.98							
	3		49.60	172.95	123.35							
Dec	1		50.00	216.68	165.88							
	2		50.00	145.95	95.15							
	3		55.88	57.83	1.95							
Total		803.23	838.94			687.56	1.46	1.27	53.48	426.90	426.90	987.33

Figure G-1-M Detail of Existing Irrigation/Drainage Systems

Irrigation Facilities

Canal No.	Number of Turnouts		Standard Width m
	Left	Right	
IR-1	10	9	0.70 - 0.90
IR-2	3	2	
IR-3	7	4	

Standard Cross Section



Design Criteria of Existing Irrigation Canal

Section	Q m ³ /s	A m ²	V m/s	S	B m	D m	Hc m	BML/BMR m	TL m	TR m
Standard	0.767	4.025	0.191	1:2400	1.20	1.15	1.95	1.00	6.00	2.00

LEGEND

- Irrigation Canal
- Drainage Canal (natural)
- Drainage Canal (artificial)

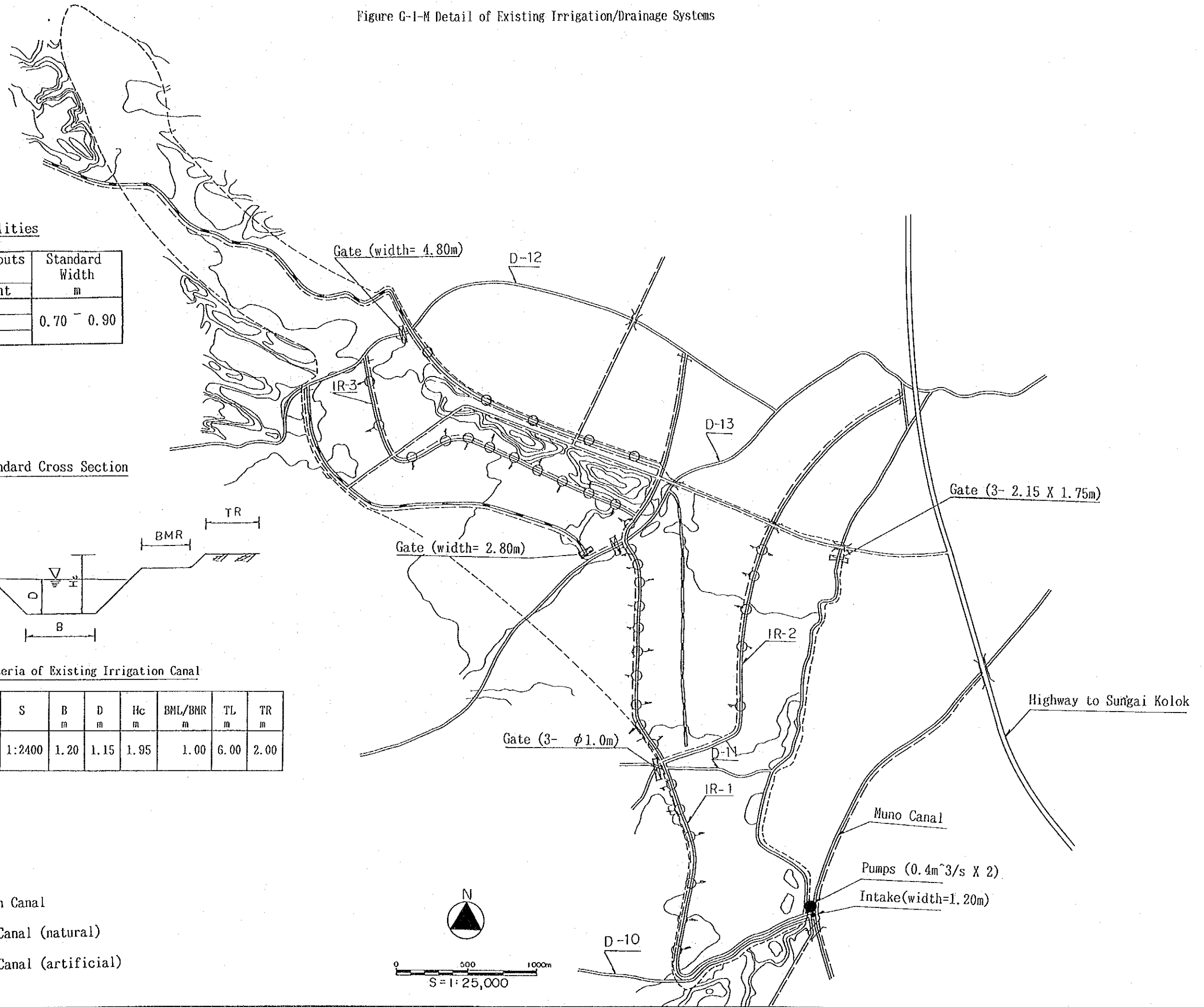
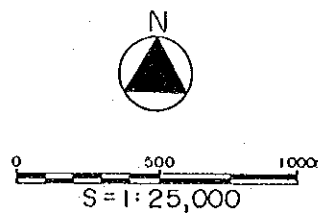


Table G-1-M Design Rainfall for Irrigation

Takbai Station

Unit: mm

Month		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Year													
1974	1	72.50	0.00	0.00	0.00	0.00	22.60	8.50	0.00	23.60	21.40	0.00	7.40
	2	11.30	0.00	65.50	8.60	27.70	8.40	21.70	19.40	36.00	0.00	354.30	0.00
	3	0.00	0.00	0.00	0.00	22.10	74.80	0.00	0.00	0.00	151.20	53.40	317.30
1975	1	0.00	0.00	0.00	32.00	0.00	12.70	27.90	41.80	14.90	0.00	81.30	25.80
	2	0.00	0.00	0.00	0.00	75.00	9.40	0.00	27.30	89.70	14.20	276.00	95.70
	3	0.00	0.00	0.00	0.00	34.50	22.80	0.00	0.00	59.60	12.40	240.50	80.60
1979	1	0.00	0.00	0.00	0.00	0.00	0.00	51.30	14.30	13.40	0.00	167.00	68.30
	2	0.00	0.00	9.30	15.30	8.50	23.70	25.00	52.30	25.50	32.00	376.30	13.90
	3	24.80	0.00	0.00	30.00	20.00	0.00	51.60	0.00	9.80	163.90	186.70	0.00
1980	1	0.00	0.00	0.00	13.60	8.50	48.30	0.00	60.80	8.40	94.30	37.00	387.50
	2	68.60	0.00	0.00	0.00	53.20	23.40	8.40	56.00	0.00	82.90	57.50	297.20
	3	0.00	37.20	0.00	7.80	41.60	140.00	33.70	0.00	226.50	13.50	254.40	18.20
1981	1	0.00	0.00	0.00	59.70	0.00	0.00	26.30	0.00	28.70	0.00	212.90	712.50
	2	54.30	0.00	0.00	0.00	8.40	16.70	56.50	0.00	48.80	18.70	79.10	53.60
	3	0.00	58.30	24.40	0.00	56.40	0.00	21.40	99.40	10.10	117.70	121.70	0.00
1982	1	7.30	0.00	0.00	0.00	0.00	59.20	99.90	32.40	42.50	34.70	168.00	342.80
	2	0.00	0.00	13.80	0.00	15.80	9.70	14.20	0.00	9.60	8.70	0.00	343.80
	3	5.80	0.00	0.00	14.30	13.40	0.00	0.00	4.70	0.00	34.00	65.40	15.20
1983	1	43.90	8.40	0.00	0.00	7.60	28.30	80.80	49.60	28.30	11.80	225.50	371.20
	2	0.00	0.00	86.40	0.00	4.80	134.20	25.70	43.80	103.80	87.20	155.30	560.60
	3	64.80	27.00	82.30	0.00	13.80	39.70	111.00	48.90	8.10	250.30	64.00	55.20
1984	1	0.00	0.00	146.90	0.00	0.00	6.10	19.10	85.10	118.40	27.80	10.80	158.00
	2	0.00	41.80	121.20	83.70	39.90	107.60	33.80	57.50	0.00	0.00	177.60	241.40
	3	5.00	0.00	0.00	0.00	89.10	28.60	18.40	29.40	57.30	83.10	270.90	333.80
1988	1	5.00	0.00	58.90	55.70	28.70	46.40	0.00	38.70	104.70	157.00	299.50	334.90
	2	23.30	0.00	0.00	0.00	6.30	163.70	84.70	89.70	120.80	35.50	414.60	39.10
	3	5.40	60.30	0.00	0.00	67.90	39.70	72.00	7.50	44.80	69.40	113.30	0.00
1989	1	43.80	0.00	0.00	0.00	45.00	12.90	51.80	17.20	67.60	28.80	83.70	0.00
	2	5.30	0.00	0.00	58.40	24.00	69.20	67.10	90.60	49.70	113.40	141.30	31.70
	3	0.00	0.00	15.40	17.60	34.00	11.60	33.50	40.10	96.30	97.20	24.90	74.90
Average	1	17.3	0.8	20.4	16.1	9.0	23.7	36.6	34.0	45.1	37.6	128.6	240.8
	2	16.3	4.2	29.6	16.6	26.4	56.6	33.7	43.7	48.4	39.3	203.2	167.7
	3	10.6	18.3	12.2	7.0	39.3	35.7	34.2	23.0	51.3	99.3	139.5	89.5

Table G-2-M Unit Water Requirement for Paddy

Months	Paddy (104.0 ha)						Paddy (345.0 ha)						Total Unit Requirement
	① ETo	② Kc	③ ETa	④ Pe	⑤ ⑤+④xdays	⑥ L.P.	⑦ Unit Requirement	⑧ Kc	⑨ ETa	⑩ ⑩+⑨xdays	⑪ L.P.	⑫ Unit Requirement	
Jan.	4.6	1.0	4.6	1.0	18.03	60.00	111.87	1.20	5.52	65.20	30.00	95.20	65.20
2	4.6	1.0	4.6	1.0	31.87	80.00	107.80	1.20	5.52	65.20	30.00	95.20	65.20
3	4.6	1.0	4.6	1.0	47.80	60.00	66.44	0.76	3.50	48.46	49.46	49.46	49.46
Feb.	5.0	1.0	5.0	1.0	66.44		66.44	0.76	3.80	32.00	32.00	32.00	32.00
1	5.0	1.0	5.0	1.0	54.40		54.40	0.76	3.80	16.00	16.00	16.00	16.00
2	5.0	1.0	5.0	1.0	54.40		54.40						
3	5.0	1.0	5.0	1.0	54.40		54.40						
Mar.	4.9	1.0	4.9	1.0	49.60		49.60						
1	4.9	1.0	4.9	1.0	49.60		49.60						
2	4.9	1.0	4.9	1.0	49.60		49.60						
3	4.9	1.0	4.9	1.0	49.60		49.60						
Apr.	4.2	1.0	4.2	1.0	59.20		59.20						
1	4.2	1.0	4.2	1.0	59.20		59.20						
2	4.2	1.0	4.2	1.0	59.20		59.20						
3	4.2	1.0	4.2	1.0	59.20		59.20						
May	3.7	1.0	3.7	1.0	44.00		44.00						
1	3.7	1.0	3.7	1.0	44.00		44.00						
2	3.7	1.0	3.7	1.0	44.00		44.00						
3	3.7	1.0	3.7	1.0	44.00		44.00						
Jun.	3.6	1.0	3.6	1.0	35.00		35.00						
1	3.6	1.0	3.6	1.0	35.00		35.00						
2	3.6	1.0	3.6	1.0	35.00		35.00						
3	3.6	1.0	3.6	1.0	35.00		35.00						
Jul.	3.6	1.0	3.6	1.0	25.73		25.73						
1	3.6	1.0	3.6	1.0	25.73		25.73						
2	3.6	1.0	3.6	1.0	25.73		25.73						
3	3.6	1.0	3.6	1.0	25.73		25.73						
Aug.	3.6	1.0	3.6	1.0	13.72		13.72						
1	3.6	1.0	3.6	1.0	13.72		13.72						
2	3.6	1.0	3.6	1.0	13.72		13.72						
3	3.6	1.0	3.6	1.0	13.72		13.72						
Sep.	3.6	1.0	3.6	1.0	14.13		14.13						
1	3.6	1.0	3.6	1.0	14.13		14.13						
2	3.6	1.0	3.6	1.0	14.13		14.13						
3	3.6	1.0	3.6	1.0	14.13		14.13						
Oct.	3.6	1.0	3.6	1.0	22.27		22.27						
1	3.6	1.0	3.6	1.0	22.27		22.27						
2	3.6	1.0	3.6	1.0	22.27		22.27						
3	3.6	1.0	3.6	1.0	22.27		22.27						
Nov.	3.3	1.0	3.3	1.0	49.60		49.60						
1	3.3	1.0	3.3	1.0	49.60		49.60						
2	3.3	1.0	3.3	1.0	49.60		49.60						
3	3.3	1.0	3.3	1.0	49.60		49.60						
Dec.	3.4	1.0	3.4	1.0	50.80		50.80						
1	3.4	1.0	3.4	1.0	50.80		50.80						
2	3.4	1.0	3.4	1.0	50.80		50.80						
3	3.4	1.0	3.4	1.0	50.80		50.80						
Total					883.23		883.23					238.94	1642.17

ETo = Potential Evapotranspiration
 Kc = Crop Coefficient
 ETa = Actual Evapotranspiration
 L.P. = Land Preparation
 Pe = Percolation

Table G-3-M Unit Water Requirement for Upland Crop

		Area = 54.0 ha				Unit: mm	
(Muno-Koknai F/S)		①	②	③	④	⑤	⑥
Months		ETo	Kc	ETa	Pe		Unit Requirement
				①xKc		③+④xDays	
Jan	1	4.6	1.05	4.83	1.0	58.30	58.30
	2	4.6	1.05	4.83	1.0	58.30	58.30
	3	4.6	1.05	4.83	1.0	64.13	64.13
Feb	1	5.0	1.05	5.25	1.0	62.50	62.50
	2	5.0	1.05	5.25	1.0	62.50	62.50
	3	5.0	1.05	5.25	1.0	50.00	50.00
Mar	1	5.0	0.65	3.25	1.0	42.50	42.50
	2	5.0	0.65	3.25	1.0	28.33	28.33
	3	5.0	0.65	3.25	1.0	15.58	15.58
Apr	1	4.9					
	2	4.9					
	3	4.9					
May	1	4.2	0.45	1.89	1.0	9.63	9.63
	2	4.2	0.45	1.89	1.0	19.27	19.27
	3	4.2	0.45	1.89	1.0	31.79	31.79
Jun	1	3.7	1.05	3.89	1.0	48.85	48.85
	2	3.7	1.05	3.89	1.0	48.85	48.85
	3	3.7	1.05	3.89	1.0	48.85	48.85
Jul	1	3.3	1.05	3.47	1.0	44.65	44.65
	2	3.3	1.05	3.47	1.0	44.65	44.65
	3	3.3	1.05	3.47	1.0	49.12	49.12
Aug	1	4.1	0.60	2.46	1.0	34.60	34.60
	2	4.1	0.60	2.46	1.0	23.07	23.07
	3	4.1	0.60	2.46	1.0	12.69	12.69
Sep	1	3.6					
	2	3.6					
	3	3.6					
Oct	1	3.6					
	2	3.6					
	3	3.6					
Nov	1	3.3					
	2	3.3					
	3	3.3					
Dec	1	3.4	0.45	1.53	1.0	8.43	8.43
	2	3.4	0.45	1.53	1.0	16.87	16.87
	3	3.4	0.45	1.53	1.0	27.83	27.83
Total							911.285

ETo = Potential Evapotranspiration
 Kc = Crop Coefficient
 ETa = Actual Evapotranspiration
 L.P. = Land Preparation
 Pe = Percolation

Table G-4-H Unit Water Requirement for Para rubber, Pine apple etc.

(Muno-Koknai F/S AREA) Area = 256.0 ha Unit: mm

Months		① ETo	② Kc	③ ETa	④ Pe	⑤	⑥ Unit Requirement	⑦ Available Rainfall	⑧ Effective Rainfall ⑦-⑧.75	⑨ Shortage/Excess ⑧-⑨	⑩ Unit Water Requirement
				①xKc		③+④xDays					
Jan	1	4.6	0.80	3.68	1.0	46.80	46.80	17.30	12.98	-33.83	33.83
	2	4.6	0.80	3.68	1.0	46.80	46.80	16.30	12.23	-34.58	34.58
	3	4.6	0.80	3.68	1.0	51.48	51.48	18.60	7.95	-43.53	43.53
Feb	1	5.0	0.80	4.00	1.0	50.00	50.00	0.00	0.00	-50.00	50.00
	2	5.0	0.80	4.00	1.0	50.00	50.00	0.00	0.00	-50.00	50.00
	3	5.0	0.80	4.00	1.0	40.00	40.00	18.30	13.73	-26.28	26.28
Mar	1	5.0	0.80	4.00	1.0	50.00	50.00	20.40	15.30	-34.70	34.70
	2	5.0	0.80	4.00	1.0	50.00	50.00	29.60	22.20	-27.80	0.00
	3	5.0	0.80	4.00	1.0	55.00	55.00	12.20	9.15	-45.85	45.85
Apr	1	4.9	0.80	3.92	1.0	49.20	49.20	16.10	12.00	-37.13	37.13
	2	4.9	0.80	3.92	1.0	49.20	49.20	16.60	12.45	-36.75	36.75
	3	4.9	0.80	3.92	1.0	49.20	49.20	7.00	5.25	-43.95	43.95
May	1	4.2	0.80	3.36	1.0	43.60	43.60	9.00	6.75	-36.85	36.85
	2	4.2	0.80	3.36	1.0	43.60	43.60	26.40	19.80	-23.80	23.80
	3	4.2	0.80	3.36	1.0	47.96	47.96	39.30	29.48	-18.49	18.49
Jun	1	3.7	0.80	2.96	1.0	39.60	39.60	23.70	17.78	-21.83	21.83
	2	3.7	0.80	2.96	1.0	39.60	39.60	56.60	42.45	2.85	0.00
	3	3.7	0.80	2.96	1.0	39.60	39.60	35.70	26.78	-12.83	12.83
Jul	1	3.3	0.80	2.64	1.0	36.40	36.40	36.60	27.45	-8.95	8.95
	2	3.3	0.80	2.64	1.0	36.40	36.40	33.70	25.28	-11.12	11.12
	3	3.3	0.80	2.64	1.0	40.04	40.04	34.20	25.65	-14.39	14.39
Aug	1	4.1	0.80	3.28	1.0	42.80	42.80	34.00	25.50	-17.30	17.30
	2	4.1	0.80	3.28	1.0	42.80	42.80	43.70	32.78	-10.02	10.02
	3	4.1	0.80	3.28	1.0	47.08	47.08	23.00	17.25	-29.83	29.83
Sep	1	3.6	0.80	2.88	1.0	38.80	38.80	45.10	33.83	-4.98	4.98
	2	3.6	0.80	2.88	1.0	38.80	38.80	48.40	36.30	-2.50	2.50
	3	3.6	0.80	2.88	1.0	38.80	38.80	51.30	38.48	-0.33	0.33
Oct	1	3.6	0.80	2.88	1.0	38.80	38.80	37.60	28.20	-10.60	10.60
	2	3.6	0.80	2.88	1.0	38.80	38.80	39.30	29.48	-9.33	9.33
	3	3.6	0.80	2.88	1.0	42.68	42.68	99.30	74.48	31.79	0.00
Nov	1	3.3	0.80	2.64	1.0	36.40	36.40	128.60	96.45	60.05	0.00
	2	3.3	0.80	2.64	1.0	36.40	36.40	203.20	152.40	116.80	0.00
	3	3.3	0.80	2.64	1.0	36.40	36.40	139.50	104.63	68.23	0.00
Dec	1	3.4	0.80	2.72	1.0	37.20	37.20	240.80	180.60	143.40	0.00
	2	3.4	0.80	2.72	1.0	37.20	37.20	167.70	125.78	88.58	0.00
	3	3.4	0.80	2.72	1.0	40.92	40.92	89.50	67.13	26.21	0.00
Total											669.71

ETo = Potential Evapotranspiration
 Kc = Crop Coefficient
 ETa = Actual Evapotranspiration
 L.P. = Land Preparation
 Pe = Percolation

Table G-5-H Unit Water Requirement for Pasture

(Muno-Koknai F/S AREA)

Area = 103.0 ha

Unit: mm

Months		①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩
		ETo	Kc	ETa	Pe	⑤+④xDays	Unit Requirement	Available Rainfall	Effective Rainfall ⑦+0.75	Shortage/ Excess ⑧-⑨	Unit Water Requirement
				①xKc							
Jan	1	4.6	0.80	3.68	1.0	46.80	46.80	17.30	12.98	-33.83	33.83
	2	4.6	0.80	3.68	1.0	46.80	46.80	16.30	12.23	-34.58	34.58
	3	4.6	0.80	3.68	1.0	51.48	51.48	10.60	7.95	-43.53	43.53
Feb	1	5.0	0.80	4.00	1.0	50.00	50.00	0.00	0.00	-50.00	50.00
	2	5.0	0.80	4.00	1.0	50.00	50.00	0.00	0.00	-50.00	50.00
	3	5.0	0.80	4.00	1.0	40.00	40.00	18.30	13.73	-26.28	26.28
Mar	1	5.0	0.80	4.00	1.0	50.00	50.00	20.40	15.30	-34.70	34.70
	2	5.0	0.80	4.00	1.0	50.00	50.00	29.60	22.20	-27.80	0.00
	3	5.0	0.80	4.00	1.0	55.00	55.00	12.20	9.15	-45.85	45.85
Apr	1	4.9	0.80	3.92	1.0	49.20	49.20	16.10	12.08	-37.13	37.13
	2	4.9	0.80	3.92	1.0	49.20	49.20	16.60	12.45	-36.75	36.75
	3	4.9	0.80	3.92	1.0	49.20	49.20	7.00	5.25	-43.95	43.95
May	1	4.2	0.80	3.36	1.0	43.60	43.60	9.00	6.75	-36.85	36.85
	2	4.2	0.80	3.36	1.0	43.60	43.60	26.40	19.80	-23.80	23.80
	3	4.2	0.80	3.36	1.0	47.96	47.96	39.30	29.48	-18.49	18.49
Jun	1	3.7	0.80	2.96	1.0	39.60	39.60	23.70	17.78	-21.83	21.83
	2	3.7	0.80	2.96	1.0	39.60	39.60	56.60	42.45	2.85	0.00
	3	3.7	0.80	2.96	1.0	39.60	39.60	35.70	26.78	-12.83	12.83
Jul	1	3.3	0.80	2.64	1.0	36.40	36.40	36.60	27.45	-8.95	8.95
	2	3.3	0.80	2.64	1.0	36.40	36.40	33.70	25.28	-11.12	11.12
	3	3.3	0.80	2.64	1.0	40.04	40.04	34.20	25.65	-14.39	14.39
Aug	1	4.1	0.80	3.28	1.0	42.80	42.80	34.00	25.50	-17.30	17.30
	2	4.1	0.80	3.28	1.0	42.80	42.80	43.70	32.78	-10.02	10.02
	3	4.1	0.80	3.28	1.0	47.08	47.08	23.00	17.25	-29.83	29.83
Sep	1	3.6	0.80	2.88	1.0	38.80	38.80	45.10	33.83	-4.98	4.98
	2	3.6	0.80	2.88	1.0	38.80	38.80	46.40	36.30	-2.50	2.50
	3	3.6	0.80	2.88	1.0	38.80	38.80	51.30	38.48	-0.33	0.33
Oct	1	3.6	0.80	2.88	1.0	38.80	38.80	37.60	28.20	-10.60	10.60
	2	3.6	0.80	2.88	1.0	38.80	38.80	39.30	29.48	-9.33	9.33
	3	3.6	0.80	2.88	1.0	42.68	42.68	99.30	74.48	31.79	0.00
Nov	1	3.3	0.80	2.64	1.0	36.40	36.40	128.60	96.45	60.05	0.00
	2	3.3	0.80	2.64	1.0	36.40	36.40	203.20	152.40	116.00	0.00
	3	3.3	0.80	2.64	1.0	36.40	36.40	139.50	104.63	66.23	0.00
Dec	1	3.4	0.80	2.72	1.0	37.20	37.20	240.80	180.60	143.40	0.00
	2	3.4	0.80	2.72	1.0	37.20	37.20	167.70	125.78	88.58	0.00
	3	3.4	0.80	2.72	1.0	40.92	40.92	89.50	67.13	26.21	0.00
Total											669.71

- ETo = Potential Evapotranspiration
- Kc = Crop Coefficient
- ETa = Actual Evapotranspiration
- L.P. = Land Preparation
- Pe = Percolation

Table G-6-N Total Water Requirement

Month		Irrigable			Effective Rainfall (mm)	Shortage/ Excess (mm)	Total Unit Requirement (503.0 ha) (mm)	Total Irrigation Requirement (503.0 ha) m ³ /s	Total Irrigation Requirement (503.0 ha) MCM	Non Irrigable			Total Unit Requirement (413.0 ha) (mm)	
		Paddy (104.0 ha)	Paddy (345.0 ha)	Upland (54.0 ha)						Upland (54.0 ha)	Para rubber/Pineapple (256.0 ha)	Pasturo (103.0 ha)		
		Unit Requirement (mm)	Unit Requirement (mm)	Unit Requirement (mm)						Unit Requirement (mm)	Unit Requirement (mm)	Unit Requirement (mm)		
Jan	1		65.20	58.3	12.98	-110.52	110.52	0.51	0.44		31.98	37.83	37.83	107.64
	2		65.20	58.3	12.23	-111.27	111.27	0.51	0.44		17.74	52.08	52.08	121.90
	3		49.46	64.13	7.95	-105.64	105.64	0.44	0.42		8.54	49.96	49.96	108.46
Feb	1		32.00	62.5	0.00	-94.50	94.50	0.44	0.30			55.83	55.83	111.66
	2		16.00	62.5	0.00	-78.50	78.50	0.36	0.31			58.53	58.53	117.06
	3			50.00	13.73	-36.27	36.27	0.03	0.02			33.50	33.50	67.00
Mar	1			42.50	15.30	-27.20	27.20	0.02	0.01			27.05	27.05	54.10
	2			20.33	22.20	-6.13	6.13	0.00	0.00					
	3			15.58	9.15	-6.43	6.43	0.00	0.00			6.66	6.66	13.32
Apr	1				12.08									
	2				12.45									
	3		111.87		5.25	-106.62	106.62	0.13	0.11					
May	1		107.80	9.63	6.75	-110.68	110.68	0.20	0.17					
	2		66.44	19.27	19.80	-65.91	65.91	0.12	0.10					
	3		66.44	31.79	29.48	-68.75	68.75	0.11	0.11					
Jun	1		54.40	48.85	17.78	-85.47	85.47	0.16	0.14			15.40	15.40	30.80
	2		54.40	48.85	42.45	-60.80	60.80	0.11	0.10			29.95	29.95	59.90
	3		54.40	48.85	26.78	-76.47	76.47	0.14	0.12			26.05	26.05	52.10
Jul	1		49.60	44.65	27.45	-66.80	66.80	0.12	0.11			15.40	15.40	30.80
	2		49.60	44.65	25.28	-68.97	68.97	0.13	0.11					
	3		54.56	49.12	25.65	-78.03	78.03	0.13	0.12			15.37	15.37	30.74
Aug	1		59.20	34.60	25.50	-68.30	68.30	0.12	0.11			3.32	3.32	6.64
	2		35.08	23.07	32.78	-25.37	25.37	0.05	0.04					
	3		25.73	12.69	17.25	-21.17	21.17	0.04	0.03					
Sep	1		13.72		33.83	20.11		0.00	0.00					
	2				36.30	36.30								
	3				38.48	38.48								
Oct	1		94.13		28.20	-65.93	65.93	0.26	0.23					
	2		108.27		29.48	-78.79	78.79	0.31	0.27		23.72			23.72
	3		102.40		74.48	-27.92	27.92	0.10	0.10					
Nov	1		49.60		96.45	46.85								
	2		49.60		152.40	102.80								
	3		49.60		104.63	55.03								
Dec	1		50.80	8.43	180.60	121.37								
	2		50.80	16.87	125.78	56.11								
	3		55.88	27.83	67.13	-16.58	16.58	0.07	0.07					
Total		803.23	838.94	911.29			1669.02	4.63	4.07		81.98	426.90	426.90	935.83

G-1. Muno Project

G-1-1. Project Description

This project is water resources development project for drainage, flood mitigation, salinity control, water storage and irrigation for agriculture and land reclamation purposes.

G-1-2. Location

This project is located in the areas in Sungai Kolok and Tak Bai District and the Head office is situated at the Muno Tail Regulator, Mu 3, Tambon Phron, Amphoe Tak Bai.

G-1-3. Project Features

(1) Drainage canal excavation

Many natural canals were redredged and many new drainage canals were excavated all over the project area for better drainage system. The project has 17 drainage canals of 87.705 km long, consisting of 2 main and 15 secondary drainage canals of 29.000 km and 58.705 km long, respectively, in order to drain part of surplus water from the Kolok river and To Daeng swamp.

(2) Drainage canal appurtenant structure

The main drainage canal appurtenant structures are as follows:

a) Muno Head Regulator

It is located at junction between Muno canal and Kolok river, with 2 radial gates with maximum discharge of 100 cu.m/s, in order to drain the required surplus water and to store the water taking from Kolok river and To Daeng for dry season agriculture.

b) To Daeng Tail Regulator

It is equipped with 4 gates of 6.0 m wide with maximum discharge of

200 cu.m/s, to drain the surplus water in the wet season and prevent brine from intruding into To Daeng canal where fresh water is retained for dry season agriculture.

c) Muno Tail Regulator

It is equipped with 4 gates of 6.0 m wide with maximum discharge of 200 cu.m/s, serving as a drainer in the wet season and sea water breaker for fresh water retainer in dry season.

(3) Salinity control

As a protective measure for sea water intrusion, sea dike of 17.290 km long with 1.5 to 2.0 m high and 6.0 m wide was constructed enclosing Amphoe Ko Sathon, running along the Kolok and Bang Nara rivers. And, other dikes for the same purpose were also constructed along the banks of To Daeng canal to prevent sea water from intruding into the farmlands.

(4) Sea dike appurtenant structures

The appurtenant structures compose of various sizes of culvert with slide gates, installed in different places to drain the surplus water from the farmlands in the wet season and to prevent sea water intrusion in the dry season.

(5) Flood protection dikes

Flood protection dikes of 11.124 km with 1.0 to 2.0 m high and 6.0 m wide, were constructed on both banks of the Muno and To Daeng main drains to protect the cropping areas from high water level.

(6) Irrigation system

For dry season cultivation, the farm area of 1,440 ha, enclosed by sea dike, receives irrigation water supplied from 4 canals of 15.124 km long. Additionally, there are 3 drain ditches of 7.807 km long, draining the excessive water out of the farmlands.

G-1-4. Project Benefits

- To mitigate flood hazards over 16,000 ha of farmland on the left bank of the Kolok river.
- To develop and increase the extensive farming area around To Daeng to 1,920 ha for farming and cattle raising.
- To encourage dry season cropping over the developing area by using water stored in the drainage canals.
- To protect the farmlands against sea water intrusion.
- To distribute perennial water to 1,440 ha of farmland in Tambon Ko Sathon.
- To supply fresh water to the water-works in Ban Taba, Tambon Tak Bai.
- To propagate fresh water fish to the project area.

G-2. Medium Scale Irrigation Project

G-2-1. Phru Bacho Mai Kaen Project

For the agricultural development, the following facilities were constructed in Bacho swamp.

- | | |
|-------------------------------|--|
| - Main drainage canal | L= 5.600 km, W=12 m |
| - Secondary drainage canal(1) | L=13.250 km, W= 6 m |
| - Secondary drainage canal(2) | L=12.000 km, W= 4 m |
| - Regulator | 3 places
(Maximum Discharge= 50 ~150 cu.m/s) |
| - Others | Bridge, Culvert, etc |

G-2-2. Nam Baeng Project

The following facilities were constructed to eliminate inundated water around To Daeng swamp.

- | | |
|------------------|-----------------------------|
| - Tail regulator | 3 gates with W=6.0m, H=3.5m |
| - Canal | L= 8.388 km, W=45 m, D=4.0m |

G-2-3. Pi Leng Project

Main facilities of this project are as follows.

- Flood protection dike L= 25.6 km
- Regulator 4 places
- Drainage canal L= 33.7 km
- Road L= 145 km

G-3. Bang Nara River Basin Development Project

Project consists of the following irrigation structures and related facilities.

(1) Tidal regulator and related facilities.

1-1. Upper

- Upper Bang Nara tidal regulator

6 slice gates of 20 m wide and 5.1 m high, $Q_{max} = 1,911 \text{ cu.m/s}$.

- Closure Dam with 220 m long and 9 m wide

1-2. Lower

- Lower Bang Nara tidal regulator

- Closure Dam with 75 m long and 8.5 m wide

1-3. Monitoring and control house

(2) Irrigation system

2-1. Pumping irrigation service area = 61,250 rai

2-2. Gravity Irrigation service area = 1,130 rai

(3) Drainage improvement and acidic water control system

3-1. Service area ; 69,000 rai

3-2. Acidic water control structures ; 8 units

Relation between the service area and the study area is shown in Figure G-3-G.

G-4. Sai Buri River Basin Development Project

This project consists of regulator with 16 gates at Raman District, Yala Province, and irrigation canal system for paddy field in the Bacho, Sai Buri Districts. The beneficial area is about 44,500 rai(7,120 ha). In connection with the study area, a part of the beneficial area is shown in Figure G-2-G.

The above relevant projects are shown in Table G-1-G and Figure G-1-G.

Table G-1-G List of Existing Large and Midium Scale Irrigation Project

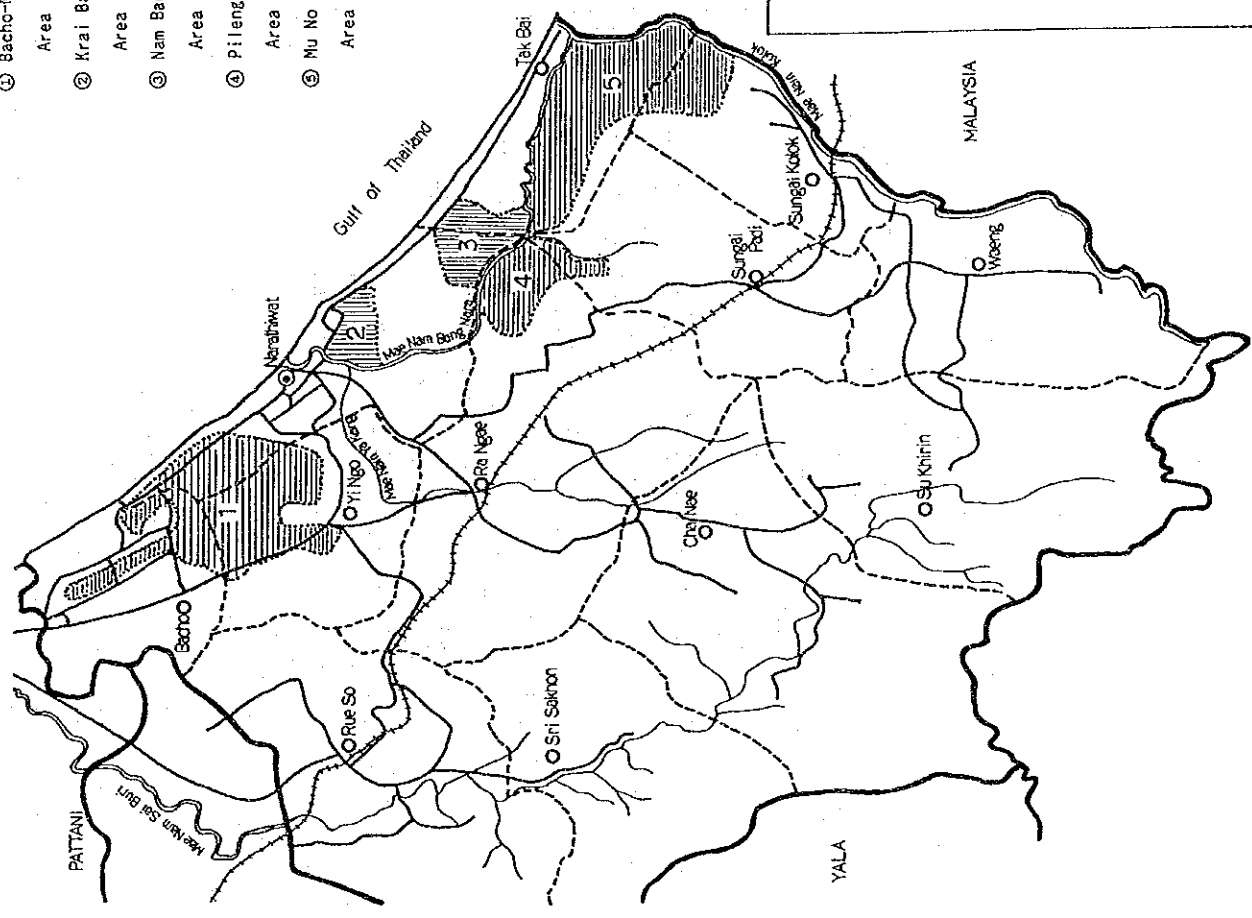
No	Description	Project						Total Area (rai)
		MU-NO ※	NAM-BAENG ※	KRAI-BAN ※	THA-PHRU ※	BA-CHO + MAI-KAEN	PI-LENG ※	
1	Size	large	medium	medium	medium	medium	medium	—
2	Types	drainage + conveyance	drainage	drainage + conveyance	drainage	drainage	drainage	—
3	Coverage	Tak-Bai Sungai-Colok	Tak-Bai	Muang	Tak-Bai	Yi Ngo Bacho Mai Kaen	Ra Ngue	—
4	Total areas (rai)	110,000	23,000	8,490	5,000	94,000	32,000	272,490
5	Flood alleviated areas (rai)	110,000	23,000	6,880	5,000	94,000	32,000	270,880
6	Conveyance areas(rai)	17,500	—	1,500	—	—	—	10,500
7	Paddy fields (rai)	49,500	6,000	4,130	2,200	18,600	9,000	89,430
8	Upland crops and Vegetables areas(rai)	2,600	—	—	—	—	1,500	4,100
9	Plantation areas(rai)	20,300	4,500	1,700	350	39,300	2,000	68,150
10	Swamp forests (rai)	20,700	11,000	380	2,000	31,400	18,300	83,780
11	Housing areas and Others (rai)	16,900	1,500	2,280	450	4,700	1,200	27,030
12	Cost (million baht)	365	50	32	—	71	138	—
13	Year of construction	1975	1977	1982	1978	1974	1982	—
14	Year of completion	1984	1983	1983	1979	1982	1987	—

Note : "※" means projects initiated by His Majesty The King

Source : ROYAL IRRIGATION DEPARTMENT MINISTRY OF AGRICULTURE AND COOPERATIVES
"REPORT" NARATHIWAT IRRIGATION PROJECT THE 12TH IRRIGATION OFFICE 1990

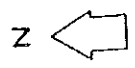
Figure G-1-G Main Water Resources Development Projects in Narathiwat

- ① Bacho-Mai Kaen Drainage Project
Area 94,000 rai
- ② Krai Ban reservoir Project
Area 8,490 rai
- ③ Nam Baeng Drainage Project
Area 23,000 rai
- ④ Pilleng Project
Area 32,000 rai
- ⑤ Mu No project
Area 110,000 rai



LEGEND

- Changwat Boundary
- - - Amphoe Boundary
- Cangwat, Amphoe
- Road
- ~ River



THE STUDY ON THE AGRICULTURAL DEVELOPMENT
FOR PEAT/ACID SULFATE SOIL AREAS IN
NARATHIWAT PROVINCE

JAPAN INTERNATIONAL COOPERATION AGENCY

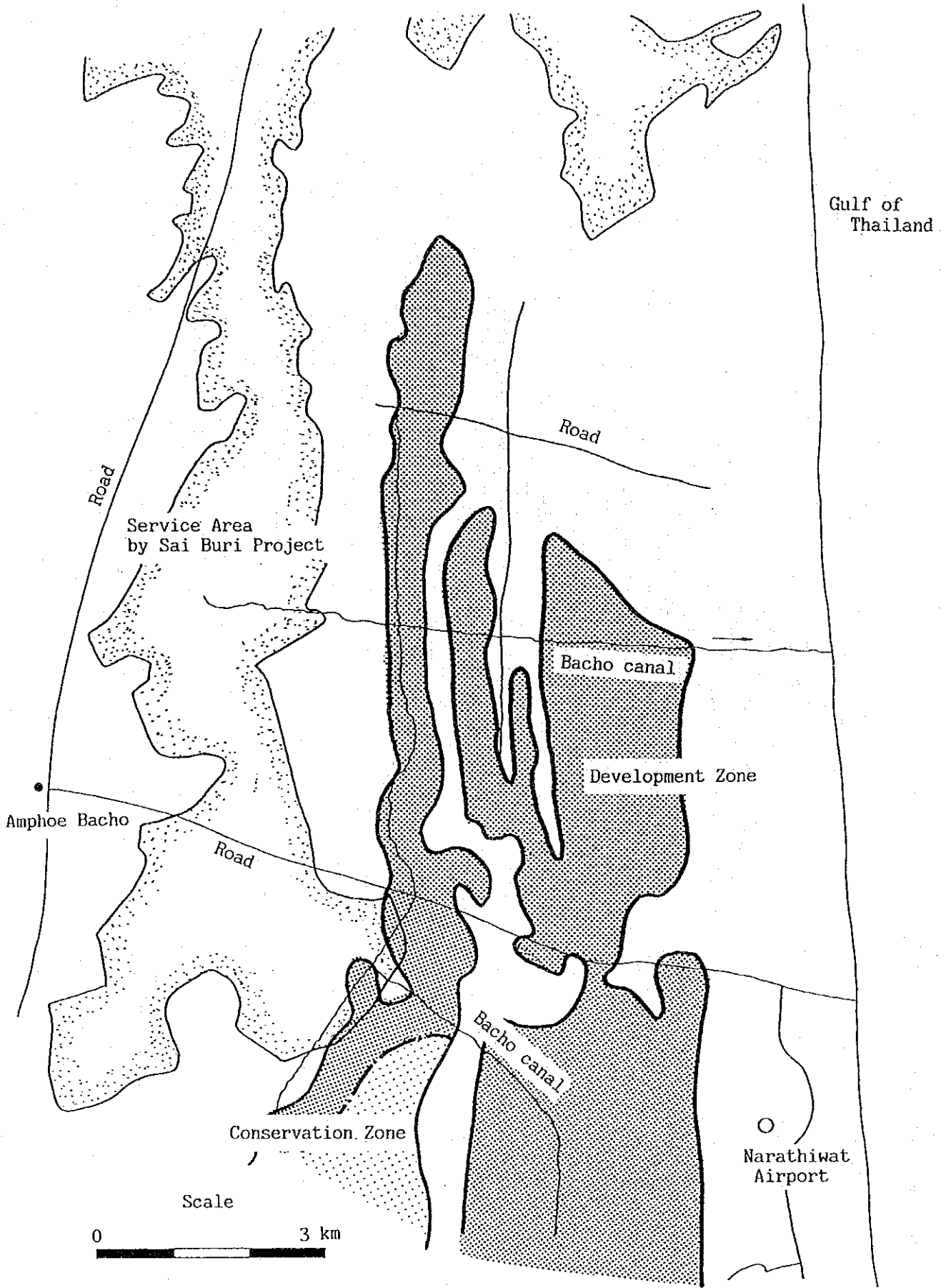


Figure G-2-G Beneficial area Under Sai Buri River Development Project and Development Zone Around Bacho Swamp



Figure G-3-G Beneficial area Under Ban Nara Project and Development Zone Around To Daeng Swamp

G-5. Selection of Representative Pilot Area

G-5-1. Subdivision of Development Zone

Development zone will be developed, finding out appropriate strategy under the above mentioned basic approach. Then, it will be operated by grouping into some areas with inherent features characterized in its extent and distribution.

As a first approach, then, zone will be subdivided based on its topographical extent, soil distribution and proper area scale of agricultural development required. And, As a result, eleven(11) of subdivided area was prepared. Topographical features of each areas are outlined as follows.

North area (Centering around Bacho swamp)

(1) N-1 area

This consists of some swamp areas with narrow band between coastal sand ridges, with elevation of 3.0 to 4.0 m, and is separated from other swamps by two hills and road at Bu Ke Chu De. Drainage canal runs toward the sea. Land is occupied by natural swamp, except for a small cultivated paddy field along the canal or road.

(2) N-2 area

In this swamp area adjacent to the airport, Bacho Land Settlement Cooperative Project is carried out. Area is enclosed by sand ridge and dune, and elevation is from 4.0 to 8.0 m. Drainage canal exists in the center of this area. Some of area looks like a certain attempt has been doned to reclaim, but remains uncultivated area at present.

(3) N-3 area

This is a area bordering conservation and preservation zones with long and narrow band. Drainage canal is not provided. Most of areas are grass or unused land. Southern area is a part of drainage area of Ya Kang river, with elevation of 3.0 to 5.0 m.

(4) N-4 area

This area is close to the city of Narathiwat. Therefore, a part of area is gradually being developed as a various land use area by governmental or private sectors.

Middle area (Centering around Kab Daeng swamp)

(5) M-1 area

This is a area centering Pikun Thong Royal Development Study Center, with low elevation of 1.0 to 3.0 m. Drainage canal runs in the center of the area to Bang Nara river. Surrounding area of the Center has been developed, but the others remains uncultivated area.

(6) M-2 area

This is in the Kab Doeng swamp and a long swamp area with narrow band in the coastal sandy dune. Elevation is from 2.0 to 5.0 m. Most of area is expected to be developed under Bang Nara Project.

(7) M-3 area

This is under the same topographical condition as the above M-2 area. But, Most of area is disconnected with service area of Bang Nara Project.

(8) M-4 area

All of this area is in relatively higher elevation of around 10.0 m. Rainfed field is to some extent distributed along the road. The others remains apparently forest area. Some part of area are expected to be supplied water by pump irrigation system under Bang Nara Project.

(9) M-5 area

This is a area centering Pi Leng Land Settlement Cooperative Project. There are some creeks originating mountainous land behind this area. And, elevation is relatively low. Most of areas, therefore, are subjected to severe flooding every year. Higher elevated land bordering this area is used as a

paddy field. But, most of area remains forest swampy area as before, especially as it is close at Bang Nara river.

South area (Centering around To Daeng swamp)

(10) S-1 area

This area is bordered on conservation area of To Daeng swamp. There are several creeks coming from To Daeng. Some paddy fields are apparently overseen along the road. But, forest is also distributed widely as it is close to conservation zone. A part of this area is included in Muno Project.

(11) S-2 area

This is a area included completely within Muno project area. In the area, settlement area exists at the almost center along the Muno canal. But, surrounding area of this settlement apparently remains uncultivated field. On the other hand, a part of southern area is relatively being developed as a paddy field.

G-5-2. Development Potential

Potentiality of agricultural development is depending on social and natural conditions of each areas. Therefore, it is preliminary evaluated by the above subdivided areas, through the following process.

- Based on the survey and data obtained in this study period, physical factors are analyzed by each areas.
- In addition, social factors given from/into the others are considered.
- Based on the above conditions, suitability for agricultural development in the subdivided areas are classified by each factors which should be considered and required for development.
- On a basis of the classification, development potential is preliminary evaluated synthetically.

In the above process, classification of suitability for development is considered as follows.

- Class I ; Having a relatively high suitability for development
- Class II ; Having a relatively middle suitability for development
- Class III ; Having a relatively low suitability for development

Factors to be examined for suitability are as follows.

(1) Soil and crop prospects

Assuming that the other conditions thinkable are under the same conditions, taking a prevailing soil in the subdivided area and its characteristics and distribution into consideration, soil improvement measures applicable to produce a certain agricultural outputs are considered on an economical basis, as follows.

- I ; Relatively low monetary inputs are required.
- II ; Between I and II .
- III ; Relatively high monetary inputs are required.

(2) Water resources prospects

As a result of survey, water resources conditions in the development zone are outlined as follows.

North area (centering around Bacho swamp)

RID is planning to convey irrigation water from Sai Buri river to the right bank of the river including west and north of Bacho. But, "development zone" is out of their service areas. Therefore, water resources development is newly required.

Middle area (centering around Bang Nara river)

Some parts of development zone are enjoyable to get irrigation water, due to in the beneficial area of Bang Nara project. Otherwise, water resources is required newly.

South area (centering around To Daeng swamp)

Some parts of development zone are enjoyable as well as Bang Nara Project. Out of irrigable area under Muno project requires new water resources.

Therefore, the following classification is considered.

- I ; Area is supposed to be supplied water under the relevant project.

II ; Water resources is required newly. But, water source available is nearby.

III ; New water resources is quite required.

(3) Drainage prospects

Taking proper measures required against flood intrusion and inflow/outflow of acid water with agricultural development into consideration, the following classification is considered.

I ; A easy method relatively is applicable, due to proper facilities nearby.

II ; Proper facilities not exist nearby. But, a countermeasure required is supposed to be small scle.

III ; Large scale countermeasures are required.

(4) Social prospects

Besides the above technical aspects, social problems such as easiness of implementation, social impact and needs, should be concerned. Then, the following classification is considered.

I ; Social needs is relatively high. easy implementation is expected.

II ; Medium between I and II.

III ; Social needs and maturity for implementaion is relatively low.

As a result of the above considerations, development potentials of each areas are preliminary evaluated. The result is shown in Table G-5-G.

Table G-5-G Development Potential

Subdivided Area	Approximate Development Area (ha)	Prevailing Soil	Suitability				Synthetical Evaluation
			Soil and Crop	Water Resources	Drainage Conditions	Social Conditions	
North Area							
N-1	1,390	c	(I) II III	I II (IV)	I (II) III	I (II) III	I (II) III
N-2	2,590	b	I II (IV)	I II (IV)	(I) II III	(I) II III	I (II) III
N-3	1,300	a	I (II) III	I (II) III	I II (IV)	I II (IV)	I II (IV)
N-4	840	c	(I) II III	I (II) III	I (II) III	I II (IV)	I (II) III
North Area							
M-1	1,040	c	(I) II III	I II (IV)	I (II) III	I (II) III	I (II) III
M-2	690	b	I (II) III	(I) II III	(I) II III	(I) II III	(I) II III
M-3	420	b	I (II) III	I (IV) III	I (II) III	(I) II III	I (II) III
M-4	1,690	c	(I) II III	I (II) III	I (II) III	I (II) III	I (II) III
M-5	3,310	b,c	I II (IV)	I II (IV)	I (II) III	I (II) III	I II (IV)
North Area							
S-1	410	d	I (II) III	(I) II III	I (II) III	(I) II III	(I) II III
S-2	1,520	c,d	I (II) III	(I) II III	I (II) III	(I) II III	(I) II III
North Area	15,200						

Note : (1) Prevailing Solid is a: Shallow to moderately thick peat

b: Thick peat

c: Potential acid sulfate soil

d: Actual acid sulfate soil

e: Alluvial soil

(2) Suitability is I:high, II:middle, III:low

APPENDIX H. ENVIRONMENT

APPENDIX H. ENVIRONMENT

LIST OF TABLES

	Page
Table H-1 Peatland Functions and Human Utilization -----	H-1
Table H-2 Plant Community in To Daeng Swamp -----	H-3
Table H-3 Species and Abundance of Wildlife in To Daeng Swamp -----	H-4
Table H-4 Comparison on the Number of Fish Species -----	H-5
Table H-5 Physio-chemical Properties of Water in Bacho Swamp -----	H-7
Table H-6 Physio-chemical Properties of Water in Bacho Swamp -----	H-8
Table H-7 Species and Abundance of Aquatic Weeds in Bacho Swamp -----	H-9
Table H-8 Groups and Abundance of Benthic Inveterate in Bacho Swamp -----	H-10
Table H-9 Number of Schools of Different Agencies, and Level of Education in Various Districts ----	H-13
Table H-10 Status of Public Health Centers (1989/90) -----	H-14

LIST OF FIGURES

	Page
Figure H-1 Observation Stations in Bacho Swamps -----	H-6
Figure H-2 Distribution of Filaria Infection Around To Daeng Swamp -----	H-11
Figure H-3 Distribution of Malaria Infection in 5 Districts Around To Daeng Swamp ----	H-12

Table H-1 Peatland Functions and Human Utilization

Role	Elements	Function	Importance to humankind	Unwise use
Store/sink	Rate, threatened or endangered plant and animal species and communities	Genetic diversity Recolonization source	Gene pool Science/ education Tourism Recreation Heritage	Excessive or uncontrolled harvest Damage removal or pollution
	Representative plant and/or animal communities	Ecological diversity Habitat maintenance	Gene pool Science/ education Torism Recreation Heritage	Excessive or uncontrolled harvest Damage removal or pollution
	Peat	Nutrient, contaminant and energy store Habitat support storage	Fuel, Palaeo-environmental data Water Horticultural use Heritage Medicinal products	Drainage Harvest faster than accumulation Destruction
	Human habitation sites	Archaeological remains	Heritage/cultural Scientific Recreation	Destruction Lowering the water-table
Pathway	Terrestrial nutrients, water and detritus	Food chain support Habitat support	Food production Water supply Wast disposal	Interruption or abnormal change of flows Pollution
	Tidal exchanges of water detritus and nutrients	Food chain support Habitat support Narsery for aquatic organisms	Fish, shellfish and other food production waste disposal	Pollution Barrier to flow Dredge and fill
	Animal Populations	Support for migratory species including fish	Harvest Recreation Science	Overexploitation Interruption of migration routes Obstruction Habitat degradation
	Lakes and rivers	Waterways	Navigation	Obstruction Reduced flows and levels
Buffer	Water bodies, vegetation, soils and depressions	Flood attenuation	Reduced damage to property and crops	Filling and reduction of storage capacity
	Water bodies, vegetation, soils and depressions	Detention and retention of nutrients	Food production Improved water quality	Removal of vegetation Drainage and flood protection
	Water bodies, vegetation, soils and depressions	Groundwater recharge and discharge	Water supply Habitat maintenance Effluent dilution River fisheries Navigation	Reduction of recharge Overpumping Pollution

Cont'd to next page

Table F-1 (cont'd)

Role	Elements	Function	Importance to humankind	Unwise use
	Water bodies and peat	Local and global climate stabilization	Equable climate for agriculture and people	Desiccation
	Water bodies	Large volume Large area	Cooling water	Drainage Filling Thermal pollution
Producer	Production of plants	Food, materials and habitat for migratory species and grazing, animals	Harvest of timber, thatch fuel and food Science Recreation	Overgrazing Overexploitation Drainage Excess change to dry land or other agricultural uses
	Animal production	Fish, shellfish, grazing and fur-bearing animals	Harvest and farming	Overexploitation Excess change Habitat degradation
	Organic matter	Methane production Nutrien cycling	Fuel Plant growth	Drainage Desiccation
Sink	Lakes, deltas floodplains	Sediment deposition and detention	Raised soil fertility Clean downstream channels Improved water quality downstream	Channelization Excess reduction of sediment throughout
	Lakes, swamps and marshes	Bio-chemical self-purification Nutrient accumulation	Natural filter for contaminants Treatment of organic wastes, partogens and effluents	Destruction of the ecosystem Over-loading of the system

Table H-2 Plant Community in To Daeng Swamp

<p>Category-1 Forest vegetation</p> <ol style="list-style-type: none"> 1. <i>Baccauria bracteata</i>-<i>Endiandra macrophylla</i> 2. <i>Macaranga prinos</i> 3. <i>Scheema wallichii</i>-<i>Fagrea fragrans</i> 4. <i>Lygidium microphyllum</i>-<i>Melabuca cajupute</i> 5. <i>Evodiaroxburghiana</i>-<i>Melaleuca cajupute</i>
<p>Category-2 Shrub vegetation</p> <ol style="list-style-type: none"> 1. <i>Eleiodoxa conferta</i>-<i>Licuala longecalycata</i> 2. <i>Eleiodoxa conferta</i>-<i>Metrozylon sazus</i> 3. <i>Lygodium microphyllum</i>-<i>Melastoma malabathricum</i> 4. <i>Rhodomyrtus tomentosa</i>
<p>Category-3 Grassland vegetation</p> <ol style="list-style-type: none"> 1. <i>Eleocharis cogesta</i> 2. <i>Echinochloa stagnina</i> 3. <i>Chrysopogon aciculatus</i>-<i>Rottboellia exaltata</i>, B. <i>Axonopus compressus</i>-<i>Mimosapudica</i> 4. <i>Isachne confusa</i> 5. <i>Axonopus compressus</i>-<i>Chrysopogon aciculatus</i> 6. <i>Eragrostis malaya</i> 7. <i>Chrysopogon orientalis</i>-<i>Massia triset</i> 8. <i>Monochoria vaginalis</i>-<i>Fuirena umbellate</i> 9. <i>Scirpodendron ghaeri</i> 10. <i>Rhynchospora corymbosa</i>-<i>Rottboellia exaltata</i> 11. <i>Chrysopogon aciculatus</i> 12. <i>Blechnum seerratum</i>-<i>Scleria sumatrensis</i>

Table H-3 Species and Abundance of Wildlife in To Daeng Swamp

	Number of species in each zone						Abundance																		
	Preservation			Development			Preservation				Conservation				Development										
	No.	X	%	No.	X	%	No.1	X	%	No.2	X	%	No.3	X	%	No.1	X	%	No.2	X	%	No.3	X	%	
Birds	46	60.5	90	80.4	28	100.0	5	10.9	21	45.7	19	43.4	40	44.4	23	25.6	27	30.0	3	10.7	9	32.1	16	57.1	/c
Mammals	10	13.2	8	7.1	-	-	4	40.0	-	-	6	60.0	3	37.5	-	-	5	62.5	-	-	-	-	-	-	-
Amphibians	8	10.5	6	5.4	-	-	4	50.0	1	12.5	3	37.5	3	33.3	2	33.3	1	16.7	-	-	-	-	-	-	-
Reptiles	12	15.8	8	7.1	-	-	2	16.7	3	25.0	7	58.2	2	25.0	2	25.0	4	50.0	-	-	-	-	-	-	-
Total	76	100.0	112	100.0	28	100.0	15	19.7	25	32.9	35	46.1	48	44.9	27	24.1	37	33.0	3	10.7	9	32.1	16	57.1	

Remark 1 = high

2 = moderate

3 = low

No. = number of animal observed

Source : Report on Environmental Impact Study of Toh Daeng Peat Swamp Development
by TEAN Consulting Engineers Co., Ltd.

Table H-4 Comparison on the Number of Fish Species

Family	No. of Species Collected	
	Toh Daeng*	Bacho
Nandidae	1	-
Cyprinidae	11	8
Notopterdae	1	1
Cobitidae	2	-
Bagridae	4	3
Siluridae	3	2
Akysidae	1	-
Hernirhamphidae	1	1
Chacidae	2	-
Synbranchidae	1	1
Pristolepidae	1	1
Anabantidae	1	1
Mastacembelidae	1	1
Luciocephalidae	1	1
Chaudhuriidae	1	-
Channidae	2	2
Anabantidae	5	5
Indostomidae	1	1
Clariidae	2	2
Chichlidae	-	2
Therapanidae	-	1

* Source : Team Consulting Engineer Co., Ltd. (1990)

Figure H-1 Observation Stations in Bacho Swamps

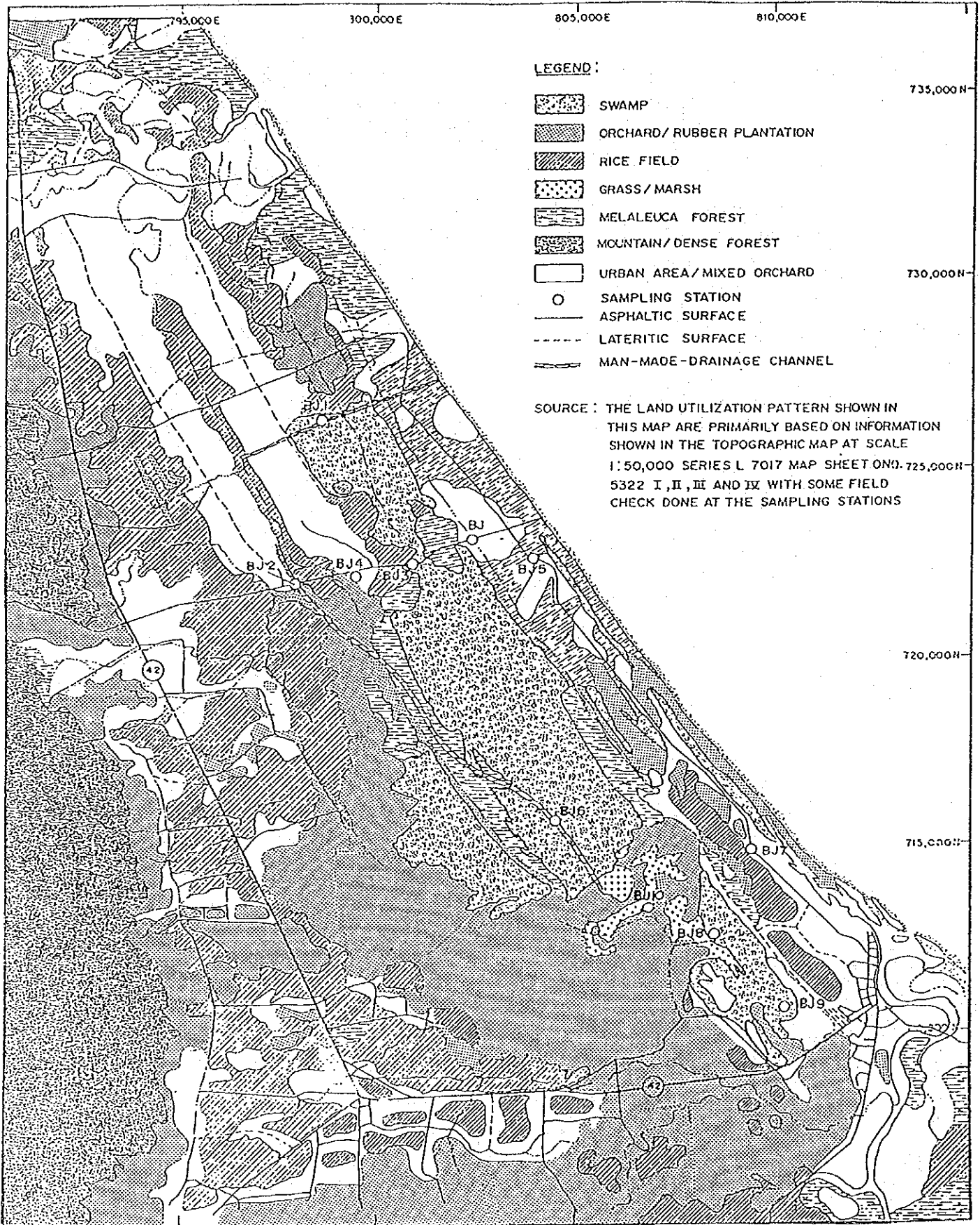


Table H-5 Physio-chemical Properties of water in Bacho Swamp
(sampled during 17 ~ 20 July '92)

Characteristics	Stations									
	BJ1	BJ2	BJ3	BJ4	BJ5	BJ6	BJ7	BJ8	BJ9	BJ10
Depth-m	0.06	0.50	0.40	Dry	Dry	1.20	1.00	0.50	0.30	Dry
Temperature- Air °C	32	32	32			30	32	31	33	
- Water °C	31	32	32			28	32	30	31	
DO-mg/l	4.1	4.0	2.8			1.8	4.4	4.6	1.8	
pH	4.2	5.2	6.4			3.9	6.6	6.2	3.0	
Conductivity-µmhos/cm	112	134	250			116	21,000	156	600	
TDS-ppm	30	90	180			70	15,120	110	370	
Salinity-ppt	N.D.	N.D.	N.D.			N.D.	25	N.D.	N.D.	
Turbidity-NTU	27	28	60			2.6	3.9	150	0.5	
Alkalinity-M.P.-mg/l	6.6	3.3	50.6			1.1	99.0	13.7	N.D.	
Acidity-mg/l	8.0	6.0	6.0			37.6	14.0	9.0	83.2	
Hardness, Total-mg/l	20.0	26.0	94.0			34.0	5,100	40.0	146	
Solid, Suspended-mg/l	12.0	32.0	18.0			12.0	10.0	68.0	2.0	
Solid, Total-mg/l	116.0	180.0	316.0			180.0	28,500	412	408	
Nitrate-mg/l	0.04	0.03	0.04			0.01	0.01	0.01	0.04	
Nitrite-mg/l	<0.01	<0.01	<0.01			N.D.	<0.01	N.D.	<0.01	
Phosphate-mg/l	0.02	N.D.	0.06			0.03	0.02	0.10	<0.01	
Sulphate-mg/l	18.5	17.0	36.0			13.8	1,800	12.0	200	
Iron-mg/l	6.1	2.3	5.0			1.1	0.2	6.5	3.1	
Manganese-mg/l	0.3	N.D.	N.D.			N.D.	N.D.	N.D.	0.7	

Note : N.D.= Not Detectable

Table H-6 Physio-chemical Properties of water in Bacho Swamp
(sampled during 17 ~ 20 Sept '92)

Characteristics	Stations										
	BJ1	BJ2	BJ3	BJ4	BJ5	BJ6	BJ7	BJ8	BJ9	BJ10	
Depth	- m	0.60	0.50	0.30	2.00	Dry	1.20	0.30	0.40	0.30	0.50
Temperature	- Air °C	38	30	28	37		31	35	36	31	33
	- Water °C	30	28	25	30		31	31	32	31	29
DO	- mg/l	3.0	4.5	3.4	2.5		3.2	5.0	2.8	4.6	0.8
pH		4.5	5.4	4.0	5.3		3.8	7.9	6.1	3.2	5.5
Conductivity	- μmhos/cm	200	290	800	280		124	1900	116	480	102
TDS	- ppm	100	110	360	100		100	1650	90	380	80
Salinity	- ppt	N.D.	N.D.	N.D.	N.D.		N.D.	30	N.D.	N.D.	N.D.
Turbidity	- NTU	25	150	17	150		2.9	3.6	115	3.1	1040
Alkalinity	- M.O.-mg/l	N.D.	8.2	N.D.	1.0		N.D.	101.0	7.2	N.D.	7.2
Acidity	- mg/l	6.9	12.9	25.7	14.9		33.7	9.9	6.9	77.2	17.8
Hardness, Total	- mg/l	26.5	28.6	230.0	29.6		44.9	6120	32.6	151.0	15.3
Solid-Suspended	- mg/l	20	375	59	126		2.8	3.2	92.6	5.6	1577*
Solid, Total	- mg/l	156	632	508	472		304	37700	432	384	2710
Nitrate	- mg/l	N.D.	0.04	N.D.	0.06		0.08	N.D.	0.07	0.07	0.36
Nitrite	- mg/l	<0.01	N.D.	<0.01	N.D.		0.001	0.002	N.D.	0.005	0.011
Phosphate	- mg/l	0.01	0.06	0.08	0.04		<0.01	0.02	0.08	<0.01	0.15
Sulphate	- mg/l	32.0	17.0	260.0	18.0		33.0	2300	12.0	212.0	14.5
Iron	- mg/l	6.4	12.5	0.08	7.5		15	0.2	5	2.3	25
Manganese	- mg/l	0.2	N.D.	N.D.	N.D.		N.D.	N.D.	N.D.	0.6	N.D.

Note : N.D. = Not Detectable
* = ss Passes Through GF/C Filter

Table H-7 Species and Abundance of Aquatic Weeds in Bacho Swamp
(as of 1992)

Family/Thai Name	Scientific Name	Abundance
Polygonaceae		
Uang Pet Mah	<u>Polygonum tomentosum</u>	+
Cyperaceae		
Kok Ka-nark	<u>Cyperus difformis</u>	+++
Haew Song Kratiem	<u>Elaeocharis plantaginea</u>	+
Lentibulariaceae		
Sarai Kao-Niew	<u>Utricularia ourea</u>	+++
Nymphaeaceae		
Bua Sai	<u>Nymphaea lotus</u>	++
Amaranthaceae		
Pak Pet Nam	<u>Alternanthera sessilis</u>	++
Pontederiaceae		
Pak Tob Thai	<u>Monochoria ellata</u>	+++
Ka Kiad	<u>Monochoria vaginalis</u>	+
Ceratophyllaceae		
Pung Chado	<u>Ceratophyllum demersum</u>	+
Salviniaceae		
Chawk Hunu	<u>Salvinia cucullata</u>	+++
Nae-daeng	<u>Azolla pinnata</u>	+

Table H-8 Groups and Abundance of Benthic Invertebrate Animals
in Bacho Swamp(as of 1992)

Organism	Stations									
	BJ1	BJ2	BJ3	BJ4	BJ6	BJ7	BJ8	BJ9	BJ10	
Class Oligochaeta										
Family Lumbricidae										
Lumbricus sp.	-	2,464	-	572	-	-	220	-	3,080	
Class Insecta										
Family Ceratopogonidae	44	-	-	-	-	-	-	-	-	
Family Chaoboridae	220	88	-	-	-	-	-	88	-	
Family Chironomidae	176	-	-	-	-	-	88	44	-	
Family Ephemeraidae	88	-	-	-	-	-	-	-	-	
Family Corixidae	308	-	44	-	-	-	-	-	-	
Family Libellulidae	44	-	-	-	-	-	44	88	-	
Class Gastropoda										
Family Ellibiidae	-	-	-	-	-	-	88	-	-	
Family Planorbidae	-	-	-	-	-	-	176	-	-	
Family Stenothyridae										
Stenothyra sp.	-	-	-	-	-	-	440	-	-	
Family Thiaridae										
Brotis sp.	-	-	-	-	-	12452	-	-	-	
Class Bivalvia										
Family Tellinidae	-	-	-	-	-	352	-	-	-	
Total	880	2,552	44	572	0	13,508	352	220	3,080	

Remark : Station BJ5 was found dried and collection of sample could not be done

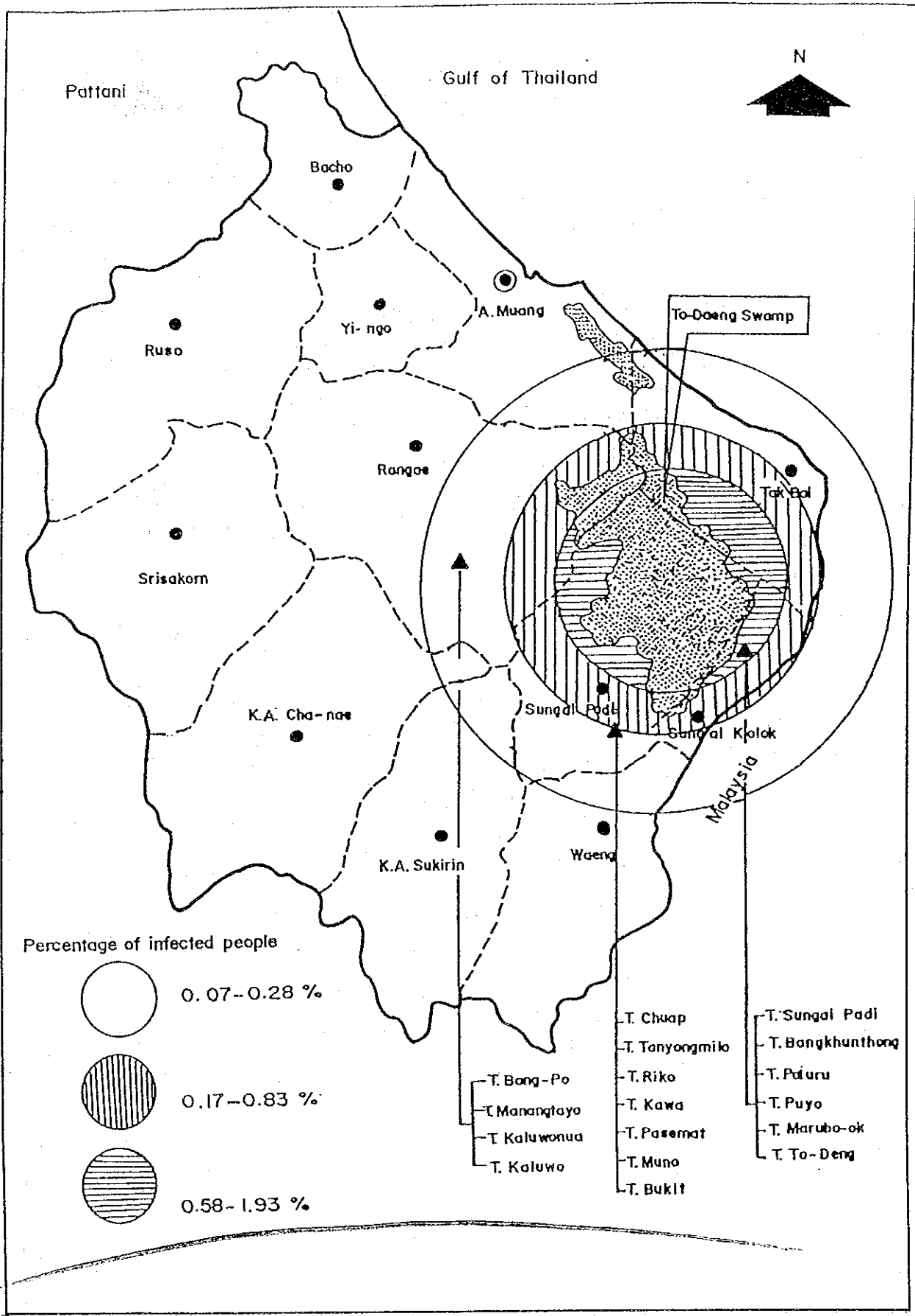


Figure H-2 Distribution of Filaria Infection around To Daeng Swamp

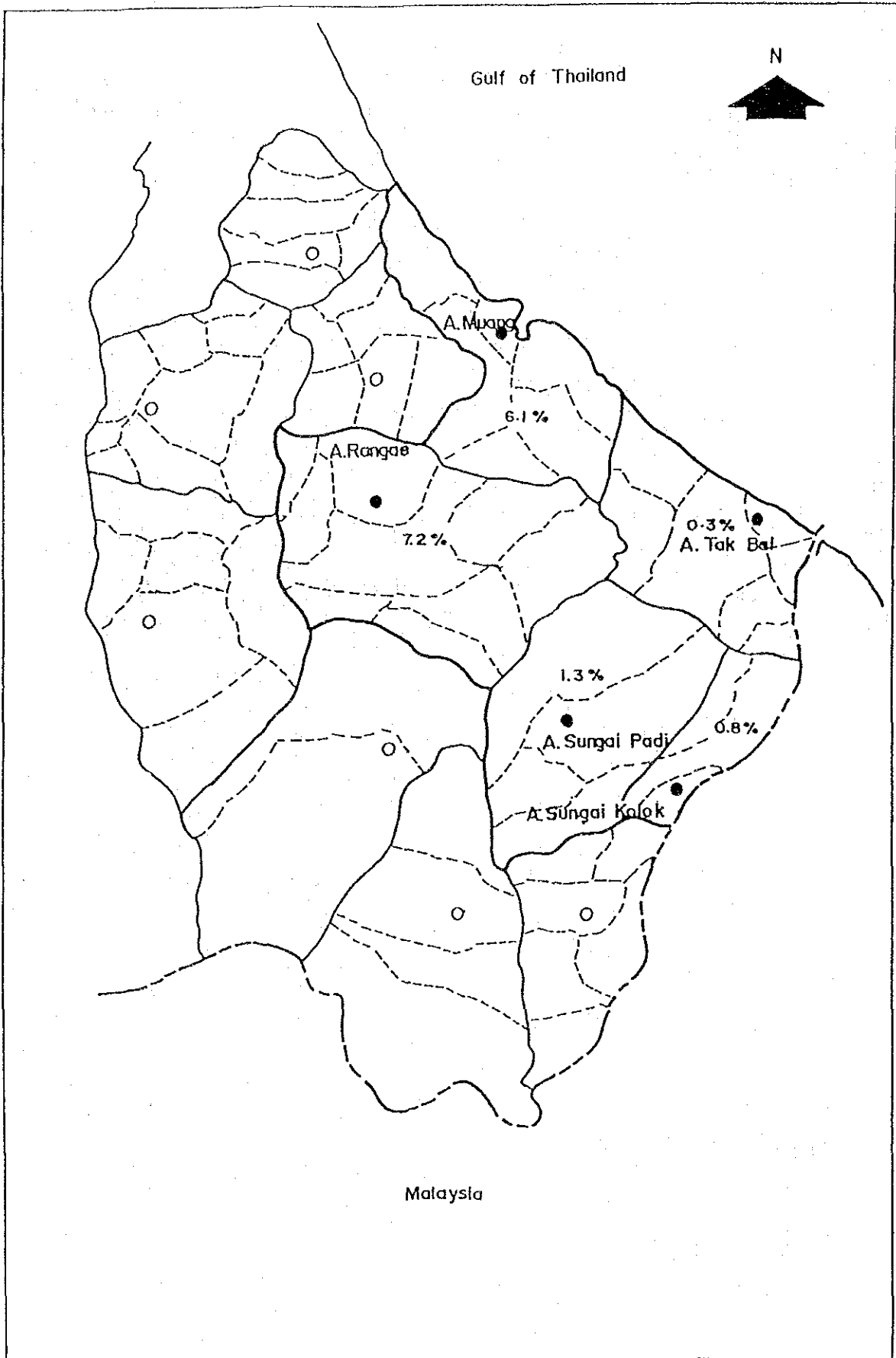


Figure H-3 Percentages of Malaria Infection in 5 Districts around To Daeng Swamp

Table H-9 Number of School of Different Agencies, and
Level of Education in Various Districts

Districts	Dept of Basic Education					Municipale					Vocational School			
	Basic to Primary		Primary to Secondary	Kindergarten	Basic small child	Basic	Primary to Primary	Kindergarten	Kindergarten Basic	Basic	Primary	Primary - Secondary		
	Primary	Primary	Secondary	garden	small child		Primary	garden	Basic		Primary	Secondary		
Muang	-	1	2	6	37	4	1	2	1	3	4	1	-	1
YiNgo	-	1	-	5	18	2	-	1	-	-	3	1	-	-
Bacho	-	1	-	2	22	1	1	-	-	-	3	2	-	-
Ruso	-	1	1	5	33	2	1	1	1	1	1	-	-	-
Srisakorn	-	1	1	2	10	4	1	-	-	-	-	-	-	-
Rangae	-	1	-	11	39	1	4	-	1	1	2	1	-	1
Takbai	-	-	1	8	22	-	3	-	-	-	-	-	-	-
Sungai Padi	-	-	1	8	19	4	1	-	1	-	1	-	-	-
Sungai Kolok	-	-	1	6	6	3	-	2	2	1	-	1	-	-
Waeng	1	1	-	6	21	1	1	-	1	-	2	-	-	-
Sukhirin	-	-	1	4	6	7	1	-	-	-	-	-	-	-
Chanae	-	1	-	4	12	1	-	-	-	-	-	-	-	-
TOTAL	1	8	8	67	245	30	14	6	7	6	16	6	0	2

Table H-10 Status of the Public Health Centers (1989-1990)

Public Health Centers	1989	1990	1991
General Hospital (number / no bed)	2/575	2/575	2/575
Community Hospital	7/90	7/90	7/90
Health Center without bed			
Branch of hospital	2	2	2
Health Center	90	92	92
Community health Services	12	13	13
Municipal health Services	2	2	2
Malaria Unit	6	6	6
Private Hospital / Clinic			
Hospital	1	1	2
Medical Clinic	16	19	23
Dental Clinic	7	4	4
Obstetrics	1	1	1

APPENDIX I. AGRO - ECONOMY

TABLE OF CONTENTS

	<i>Page</i>
1. Introduction.....	I - 1
2. Agro-Economy.....	I - 1
2-1 Socio-Economic Condition.....	I - 1
2-1-1 General.....	I - 1
2-1-2 Demography.....	I - 1
2-1-3 Labor force and employment.....	I - 2
2-1-4 Poverty.....	I - 2
2-1-5 Social conditions.....	I - 3
2-2 Economy.....	I - 5
2-2-1 Agricultural sector.....	I - 5
2-2-2 Agricultural problems.....	I - 8
2-2-3 Marketing problems.....	I - 8
2-2-4 Industry.....	I - 9
2-2-5 Development constraints for agriculture.....	I - 9
2-3 Farm Economic Survey.....	I - 10
2-3-1 General.....	I - 10
2-3-2 Farm economic survey for three(3) F/S area.....	I - 10
3. Project Evaluation.....	I - 11

LIST OF TABLES

	<i>Page</i>
Table I-1-1 Gross Regional Product of the Southern Region.....	I - 12
Table I 1-2 Gross Regional Product of the Narathiwat Province.....	I - 13
Table I-1-3 Land Documents Issued in the Narathiwat Province.....	I - 14
Table I-1-4 Land Documents Issued by Various Departments of the Thai Government.....	I - 15

	<i>Page</i>
Table I-1-5 Present Loan Distribution in Narathiwat by BACC.....	I - 16
Table I-1-6 Present Situation of Major Agro-Processing in the Narathiwat Province	I - 17
Table I-1-7 Major Agricultural Commodities Price.....	I - 18
Table I-1-8 Demand and Supply for Rice of the Narathiwat Province	I - 19
Table I-2-1 Comparison of the Official Village Name with Common Village Name for Farm Economic Survey	I - 20
Table I-2-2 Family Member	I - 21
Table I-2-3 Main Activity and Occupation	I - 21
Table I-2-4 Minor Activity and Occupation.....	I - 21
Table I-2-5 Background of Family.....	I - 21
Table I-2-6 Landholding	I - 22
Table I-2-7 Title of Land.....	I - 22
Table I-2-8 Present Agricultural Situation in Peat/Acid Soil.....	I - 23
Table I-2-9 Production Distribution	I - 23
Table I-2-10 Production Selling	I - 24
Table I-2-11 Agriculture in Peat/Acid Sulfate Soil.....	I - 24
Table I-2-12 Agriculture in Peat/Acid Surface Soil.....	I - 25
Table I-2-13 Other Cash Cost	I - 25
Table I-2-14 Marketing	I - 26
Table I-2-15 Off-Farm Income.....	I - 29
Table I-2-16 Household Expense	I - 30
Table I-2-17 Household Income and Expenditure	I - 30
Table I-2-18 Social Condition.....	I - 30
Table I-2-19 Agriculture Supporting Service.....	I - 31
Table I-2-20 Present Problem.....	I - 33
Table I-2-21 Requirement	I - 33
Table I-2-22 Farm Practice.....	I - 34
Table I-3-1 Financial and Economic Project Cost of 3 F/S Areas	I - 35
Table I-3-2 Financial and Economic Project Cost of 3 Development Types for the Narathiwat Province	I - 36
Table I-3-3 Economic Cost Stream in Bacho F/S Area	I - 37
Table I-3-4 Economic Cost Stream in Kab Daeng F/S Area	I - 38

	<i>Page</i>
Table I-3-5 Economic Cost Stream in Muno-Koknai F/S Area.....	I - 39
Table I-3-6 Economic Cost Stream in Bacho Development Type.....	I - 40
Table I-3-7 Economic Cost Stream in Kab Daeng Development Type.....	I - 41
Table I-3-8 Economic Cost Stream in Muno-Koknai Development Type	I - 42
Table I-3-9 Annual O & M Cost of 3 F/S Areas	I - 43
Table I-3-10 Annual O & M Cost of 3 Development Types.....	I - 43
Table I-3-11 Summary of Agricultural Commodity Prices.....	I - 44
Table I-3-12 Price Structure of Agricultural Commodities -Rice -	I - 45
Table I-3-13 Price Structure of Agricultural Commodities - Urea, 46 percent N -	I - 46
Table I-3-14 Price Structure of Agricultural Commodities - Potassium Chloride, 60 percent of K20 -	I - 47
Table I-3-15 Price Structure of Agricultural Commodities - Triple Super Phosphate, 45 percent of P205 -	I - 48
Table I-3-16 Incremental Benefits of Bacho Area	I - 49
Table I-3-17 Incremental Benefits of Kab Daeng Area	I - 50
Table I-3-18 Incremental Benefits of Muno-Koknai Area.....	I - 51
Table I-3-19 Incremental Benefits of Bacho Development Type	I - 53
Table I-3-20 Incremental Benefits of Kab-Daeng Development Type.....	I - 54
Table I-3-21 Incremental Benefits of Muno-Koknai Development Type.....	I - 55
Table I-3-22 Crop Budget per Rai for Without Project.....	I - 57
Table I-3-23 Crop Budget - Bacho -	I - 58
Table I-3-24 Crop Budget - Kab Daeng -	I - 62
Table I-3-25 Crop Budget - Muno Koknai -	I - 64
Table I-3-26 Inundation Prevention Benefit	I - 68
Table I-3-27 Economic Cash Flow of Bacho F/S Area.....	I - 69
Table I-3-28 Economic Cash Flow of Kab Daeng F/S Area.....	I - 70
Table I-3-29 Economic Cash Flow of Muno Koknai F/S Area	I - 71
Table I-3-30 Economic Cash Flow of Bacho Development Type.....	I - 72
Table I-3-31 Economic Cash Flow of Kab Daeng Development Type	I - 73
Table I-3-32 Economic Cash Flow of Muno Koknai Development Type.....	I - 74
Table I-3-33 Farm Budget Analysis.....	I - 75
Table I-3-34 Farm Income Sheet for Model Farm - Bacho -	I - 76
Table I-3-35 Farm Income Sheet for Model Farm - Kab Daeng -	I - 76
Table I-3-36 Farm Income Sheet for Model Farm - Muno Koknai -	I - 76

	<i>Page</i>
Table I-3-37 Foreign Loan Repayment Schedule	I - 80
Table I-3-38 Annual Budget Requirement.....	I - 80

LIST OF FIGURES

	<i>Page</i>
Figure I-1-1 Administration in the Narathiwat Province.....	I - 84
Figure I 1-2 District Basis Population of the Narathiwat Province.....	I - 85
Figure I-1-3 Structure of Producer's Cooperative.....	I - 86
Figure I-1-4 Organization Chart of the Mixed Farming Development Group Committee of Bangnara Basin	I - 87
Figure I-1-5 Marketing Flow of Para Rubber.....	I - 88
Figure I-1-6 Marketing Flow of Longkong	I - 88
Figure I-1-7 Marketing Flow of Rice	I - 88
Figure I-2-1 Location of Village Site-Bacho F/S Area	I - 89
Figure I 2-2 Location of Village Site-Kab Daeng F/S Area.....	I - 90
Figure I-2-3 Location of Village Site-Muno Koknai F/S Area	I - 91
Figure I-3-1 Flow of the Project Evaluation.....	I - 92

1. Introduction

This Appendix I on Agro-Economy consists of two(2) chapters, namely agro-economy and project evaluation.

Chapter 1 on agro-economy comprises : (i) socio-economic conditions in the Narathiwat province and; (ii) farm economic survey. The chapter addresses the present socio-economic conditions in the Narathiwat province based mainly on the statistics obtained at the provincial offices, and presents the results of farm economic survey. The tables attached at the end of the Chapter give general information on the Narathiwat province and supportes the main report concerning agro-economy as back data.

Chapter 2 on project evaluation presents in table farms the specific data and figures used in the main report.

2. Agro-Economy

2-1 Socio-Economic Conditions of the Narathiwat Province

2-1-1 General

The Narathiwat province is one of the province in the southern region, which is located in the southern part of the peninsula of Thailand connecting the border of Thailand-Malaysia, 1,150km from Bangkok. The province is clearly different from other provinces of the country with respect to religion, custom, culture, and language.

2-1-2 Demography

The province covers an area of 4,475 sq. km and has a population standing at 560,263 in 1990. There are 105,028 households with 5.3 persons per household. The population density of the Narathiwat province is 125 persons per sq. km. This is higher than that of the southern region and the whole Thailand with respectively 98 persons per sq. km and 106 persons per sq. km. The average annual population growth between 1981 to 1990 in the province exceeded three(3) percent. During the same period, the population of the whole Thailand increased approximately nine millions corresponding approximately to two(2) percent of annual growth rate. It can be found that the Narathiwat province still has a high population growth despite the decreasing trend at the national level. For the religion of the province, seventy eight(78) percent belong to Islam, twenty one(21) percent to Buddhism, and one(1) percent to other religions.

Demographic Condition of the Narathiwat Province

	Acreage ('000ha)	Population ('000ha)	Pop. density (pers./km ²)
Narathiwat	448	560	125
Southern Region	7,072	6,964	98
Whole Thailand	51,312	54,532	106

Source ; Population and Housing Census 1990

2-1-3 Labor force and Employment

Based on the data of the Narathiwat commercial office, there were 280,664 people who were classified as active population, out of this, 275,500 persons held some job and 5,164 persons were unemployed. The employment situation of the province in 1990 is tabled as below.

Total population	560,263 (100)
1. Active population	280,664 (50.1) (100)
1-1 Employed	275,500 (49.2) (98.2)
1-2 Unemployed	5,164 (0.9) (1.8)
2. Non-active population	279,599 (49.9)
2-1 Under 13 years old	192,743 (34.4)
2-2 Unable to work	86,856 (15.5)

Source ; Marketing data for the Narathiwat province,
Narathiwat commercial office

The employed persons accounted for 275,500, out of this 73 percent or 201,115 persons were estimated to work in agricultural activities, and 27 persons or 74,385 persons worked in non-agricultural activities.

2-1-4 Poverty

It is well known that although Thailand has kept a high economic growth, the regional unbalance between Bangkok metropolis and rural areas, and the sectoral unbalance between industry and agriculture have been expanding. Thailand Development Research Institute(TDRI) explained these unbalances from the poverty ratio (the percentage of households which get it's income under poverty line). The poverty line set by TDRI is the following.

The poverty Line (household income per one person) Unit ; Baht

	1975/76	1980/81	1985/86	1988/89
Urban area	1,981	3,454	3,823	4,141
Rural area	2,961	5,151	5,834	6,324

Source ; The OECF Research Quarterly 1991/4 No. 70

According to the Narathiwat provincial office, there are 111,481 poor people in the province with 27,979 households or approximately 40 percent of the total population. These people could not earn more than 20,000 Bahts per year. The majority is engaged in paddy cultivation, rubber plantation or farm employment. The average income of the province in 1990 was 24,926 Bahts.

2-1-5 Social Conditions

(1) Community System

In the Narathiwat province, there are only one principal community, Amphoe Muang Narathiwat municipality, and one secondary community, Sungai Kolok municipality. The rest consists of small communities including 8 sanitaries. On the community system of the province, it can be pointed out the lack of secondary communities. More secondary communities for helping the principal community are needed for the distribution of social service to local people.

(2) Language

The Narathiwat province has different religion, culture, and language from the other areas of the country. Most of the Thai people living in the Narathiwat province are Moslems and speak the Javi language which is a local language from Malaysia. They can hardly read, speak, and write the national language i.e. the Thai language. The language problem makes social services to people difficult.

From the educational survey made in 1985, there were 48,542 illiterates who could not understand the Thai language. The educational campaign made during 1987 to 1989 has contributed to decrease the number of illiterates to 10,471.

(3) Education

The Thai government has a policy to make the nation speak and use the Thai language as the national language in every level of education , from kindergarten to primary

school, secondary, high school and vocational school, specially for the southern border of the province. From the educational survey, the participation rate of compulsory education(primary 6) is summarized as follows.

Participation Rate of Compulsory Education

	1988	1989	1990
Participation rate	92.4 %	93.7 %	92.8 %

Source ; General data of the Narathiwat province made by the provincial office, 1991

(4) Electricity

The Regional Electricity Authority (REA) is responsible to the people, business, and industries for distributing and supplying electric current, which is a state enterprise under the control of the Ministry of Interior. In the Narathiwat province, there are two(2) working units of REA, i.e. the Narathiwat Electricity Authority and the Amphoe Sungai kolok Electricity Authority.

In March 1991, 477 villages in 70 Tambols had electric current; there are only 15 villages in the Narathiwat province.

(5) Public health

At present, the public health service covers all the Amphoe. These are 54 medical doctors, 5 dentists, 10 pharmacists, 541 nurses, 484 health personnels, 93 other officials including 587 regular employees, but the people still have problems on health as follows.

1) Sanitation and environmental health

It is very important for campaigning and educating the rural people about the knowledge on sanitation and health.

2) Family planning

The Narathiwat province is one of the high population growth area in the country. During the 1980s, the population of the Narathiwat has grown around 3 percent per year. The Thai government has set forth in the 7th National Economic and Social Development Plan (7th NESD plan) to reduce the population growth rate to 1.2 %

per year during the plan period. Therefore, the Narathiwat province should pay more attention on family planning.

3) Mother and child sanitation

This is also an important component for basic health services. The Thai government has set forth in the 7th NESD plan to provide health care for all the people within 10 years. The office of provincial public health is implementing projects for improving mother and child sanitation such as sanitary education.

2-2 Economy

2-2-1 Agricultural Sector

Considering the agricultural production structure in the Narathiwat province, it is clear that the agriculture sector from the stand point of production value was the important economic sector valued at 3,688,632 Baht or 38.0 % of the Gross Provincial Product in 1989. In the agricultural sector, crop sub sector was dominant and valued at 2,929,264 Baths or 30.2 % of GPP, other sub sectors such as livestock, fishery and forestry contributed only 1.9 %, 0.1 % and 0.9 % of GPP respectively.

As compared with the southern region, the agricultural production structure of the Narathiwat shows a dominant crop sub sector which contributes 79 % of agricultural value, that of the southern region is 57 %. These figures support the fact that the agriculture of the southern region is more diversified than that of the Narathiwat. Fishery sub sector of the Narathiwat is negligible, but that of the southern region contribute 18.5 % of agricultural value, for example, shrimp cultivation is recently expanding at the west coast of the southern region where it is suitable.

The important cash crops in the Narathiwat are para rubber, rice, coconut and fruit trees such as longkong, rambutan, durian and mongosteen etc. The vegetables, i.e. longbean, egg plant, cucumber etc. are becoming more important cash crops to increase farmer's income.

(1) Crops

As for crops, para rubber is an important cash crop of the Narathiwat province. The total planted area of para rubber in 1989 amounted to 948,636 rai or 62.8 % of agricultural land, out of which the planted area of High Yielding Varieties was 773,317 rai or 81.5

% of the total, that of local varieties amounted to 175,319 rai or 18.5 %. The characteristics of para rubber cultivation in the Narathiwat is tabled as below.

The Production and Value of Para Rubber in the Narathiwat Province

	HYV	Local	Total
Planted area (rai)	773,317	175,315	948,636
Harvestable (rai)	534,615	-	-
Young tree (rai)	283,702	-	-
Other (rai)	130,319	-	-
Production (ton)	120,215	21,551	141,766
Yield (kg/rai)	225	123	
Value (1,000bath)	-	-	2,410,011

Note ; Data are as of 1989/1990 crop year.

Rice is the second important crop. Rice production in the Narathiwat province does not cover the provincial demand and a lot of it is imported from other regions.

The cultivable area of rice is estimated at 318,976 rai. Out of which the actual planted area accounts for 220,607 rai or 69.2 %. The HYV rice occupies 104,250 rai or 47.3% and the local variety is 116,357 rai or 52.7 %.

Coconut cultivating farmers have in average 3 to 5 rai for cultivation. The total planted area accounts for 68,614 rai or 54 % of the total agricultural land. Out of which the harvestable area is 59,374 rai, the young trees area is 9,240 rai.

For fruit tree crops, longkong, rambutan and durian are important. The production of these fruits are tabled as below.

The Production and Value of Major Fruit Tree

	Longkong	Rambutan	Durian
Planted area (rai)	31,382	31,390	31,449
Harvested area (rai)	18,329	26,973	25,819
Production (ton)	38,566	40,888	60,466
Value (1,000baht)	134,817	172,100	403,500

Vegetables, as well as rice are imported from other provinces. Farmers plant vegetables such as cucumber, egg plant and chili etc. at their farm gate and sell their production to local market or a middleman. The planted area of vegetables is estimated as 47,731 rai.

(2) Livestock

The livestock sub sector contributed 5.1 % of GPR in 1989. In spite of low economic contribution, it is very important for people such as Moslems who raise animal as a secondary occupation to increase their incomes from other agricultural activities.

In 1990, 24,995 farmers were engaged in livestock. The number of heads and value are shown as below.

The Number of Heads and Value of Livestock

	No. heads	Value (1,000 baht)
Cattle	87,863	615,000
Buffalo	9,875	4,000
Gost	10,955	8,760
Sheep	3,665	2,930
Pigs	16,826	45,430
Duck	48,785	1,460
Chicken	391,518	19,570

(3) Fishery

The fishery sub sector is a low contributor accounting for 0.3 % of agricultural value.

There are 18,920 fishermen in the Narathiwat province. The fishery of the province is categorized as follows.

- 1) Sea faring fishery
- 2) Brackish water fishery
- 3) In land fishery

(4) Forestry

The forestry sub sector contributes only 2.4 % of agricultural value. There are 1,835 km² of forest area or 4.1 % of the total area of the province.

(5) Agro-processing

Agro-processing occupies 12.2 % of agricultural value. The majority of the industry is small scale and agro-based factories such as rubber factory, rice mill and vegetable oil extracting factory etc. The major agro-processing factories are shown as below.

Major Agro-Processing Factories in the Narathiwat Province

Type of Factory	Number of Factories	Capital Investment (million Baht)	Production Capacity	Number of Employees
1. Extracting coconut oil	3 (0.4)	1.6 (0.4)	316,00 ℓ	24 (0.6)
2. Rice milling	398 (58.1)	24.6 (5.0)	33,021 ¹⁾	747 (15.6)
3. Smoked rubber sheet	13 (1.9)	179.9 (36.5)	88,715 t	1,384 (28.9)
4. Rubber block	1 (0.2)	59.5 (12.1)	72,000 t	150 (3.1)
5. Sub total	415 (60.6)	265.6 (54.0)	-	2,305 (48.2)
6. Total of industry	685 (100)	492.3 (100)	-	4,784 (100)

Source ; Marketing data of The Narathiwat Province 1990, Provincial commercial office

2-2-2 Agricultural problems

There are approximately 320 thousand rai or 11.4 % of swamp areas in the Narathiwat province which represent unsuitable land for crop cultivation due to the predominance of acid/sulfate soils. Fishery is not also suitable in the swamp area because of sour water. As for the raising of livestock, it appears that the grass growing in the swamp area is not good for feed. Therefore, it is necessary to develop the swamp area for economical usage.

2-2-3 Marketing Problem

Agricultural marketing has two main functions, namely, selling and buying farm products and farm inputs. In the Narathiwat province, except specific crops like para rubber, durian etc., most farm products can not satisfy the provincial demand and are imported from other areas. The price of farm products at markets, therefore, is higher than other areas. Although the farmers of Narathiwat do not receive benefits because of some problems related to production and marketing. The farmers of Narathiwat have the following problems.

- production efficiency i.e. yield is considerably low
- products are of low quality

- soil is poor and of low fertility
- cultural method is traditional
- transportation is inconvenient
- lack of capital
- farmers are almost small scale farmers
- Farmer's groups are a few

Due to the above problems, the farmers can not properly perform the following operations, bargaining power, reduction of intermediates, and timely selling to take a higher sale price.

2-2-4 Industry

In the Narathiwat province, there are no large scale industries, and the majority of existing industries are small scale and almost based on agricultural produces, i.e. rubber factory, oil extracting factories, rice mills, etc.

From the survey made on Jan. 1991, there are 685 factories which the capital investments are 492,283 million Bahts with 4,784 employees. Out of 685 factories, 58 % are rice milling small factories. The average number of employees per factory is 5.9 persons, one plastic bag factory has the largest number of employees with 150. The characteristics of the industry of the Narathiwat province may be classified into 5 categories as follows ;

- 1) Agro-industries i.e. rubber, coconut, and rice etc.
- 2) Wood industries i.e. furniture, timber processing etc.
- 3) Food industries i.e. cake, bread and noodle etc.
- 4) Service industries i.e. repair service for car, machinery etc.
- 5) Other industries i.e. rock crushing, sand sucking etc.

2-2-5 Development constraints for agriculture

Major constraints of agriculture lie on the basic factors of production such as farmers, land and water resources. In addition, some other supplemental factors are concerned with capital or credit, technology and marketing. The main purpose of agricultural extension is to transfer the technology, knowledge and experience about agricultural practices to farmers so as to enable them to produce efficiently to gain high economic return and yield, good quality and price. At present, farmers in the province still obtain rather low yield per rai facing a high risk to lose or get low net income. Emphans should

be put on agricultural extension services to solve these problems and to allow for appropriate farming.

Major problems of agricultural development of the province are :

- (1) Declining fertility of natural resources due to the expansion of farm land, and poor farm land soils resulting in low crop yield.
- (2) Seasonal labor use : Farmers have two labor seasons through a year. One is a peak season involving planting and harvesting. The other is a low labor demand season following the peak season. Farmers should get job opportunities in other sectors.
- (3) Poor farming system : Most farmers plant one major crop a year with a native variety. This is a very weak point and a high risk for natural disaster and marketing change such the fluctuation of farm products.
- (4) Lack of technology : Most farmers have not yet practiced a modern agricultural technology. It is needed to promote the appropriate technology to increase crop yield despite the infertile soils of this province.

2-3 Farm Economic Survey

2-3-1 General

In Phase II field study period, the farm economic survey was planned and carried out in three(3) feasibility study areas i.e. Bacho F/S area, Kab Daeng F/S area and Muno-Koknai F/S area under the close cooperation of the DLD's counterparts and staffs of the Royal Development Study Center.

2-3-2 Farm Economic Survey for the three(3) F/S areas

(1) Objective

The farm economic survey aims to make clear not only the farmer's economic situation but also their actual farming, opinion and thinking concerning agricultural production on the peat/acid sulfate land in the three different areas.

(2) Survey village and farm household

There are few villages in the F/S areas. The survey villages were selected on the margin or border of the F/S areas from a map scaled 1/5,000.

The farm households were sampled from 6 farms per village selected by the village heads or their representatives which included 2 large farms, 2 middle farms and 2 small farms. In the Bacho F/S area, specially, 30 farms were selected from the Bacho land settlement cooperative.

The number of villages and farm households are as follows.

- Bacho F/S area	8 villages	48 farm household
	Bacho land settlement cooperative	30 farm household
- Kab Daeng F/S area	8 villages	48 farm household
- Muno - Koknai F/S area	7 villages	42 farm household

The selection of village was based on the village common name, the comparison between the common name and the official village name is shown in Table I-2-1.

(3) Results of the farm economic survey

The results of the farm economic survey are summarized and tabled on 21 items, which are shown in Table I-2-2 to I-2-22.

3. Project Justification

The justification of the project is assessed through the economic and financial analysis in farms of quantifiable benefits. The social benefits and influence on the environment are assessed comprehensively through quantitative examinations.

As a result of the economic evaluation, the economic viability of this project is considered low, however, if appropriate agricultural supporting service and agricultural loans are obtained at the farmers' level, it will be possible to continue financially healthy agricultural management. Furthermore, many social benefits and positive effects on the environment can be expected as non quantifiable benefits.

Table I-1-1 Gross Regional Product of the Southern Region

Sector	(at current market price)				Unit ; 1,000 Baths
	1985	1986	1987	1988	1989
Agriculture	33,911,922	36,749,843	45,453,236	55,019,661	53,033,292
Crops	17,931,418	19,377,335	24,706,802	31,558,136	30,497,450
Livestock	1,973,819	2,813,793	3,112,574	3,178,024	3,150,480
Fishery	5,504,479	6,654,225	8,372,975	10,522,572	9,795,991
Forestry	4,722,282	4,594,706	5,258,171	5,054,707	4,146,304
Agro-services	452,156	360,840	413,373	400,954	345,568
Agro-processing product	3,327,768	2,948,944	3,589,341	4,305,268	5,097,499
Mining and quarring	4,924,758	2,817,630	2,914,010	4,190,704	8,407,152
Manufacturing	5,906,176	5,796,807	6,474,524	7,670,609	8,766,644
Construction	5,970,276	6,369,427	6,583,458	8,994,230	9,391,481
Electricity and water supply	1,773,916	2,061,063	2,414,031	2,694,026	3,161,892
Transportation and communication	5,309,521	8,039,695	8,218,918	8,093,429	9,880,546
Wholesale and retail trade	16,608,143	19,604,763	22,021,648	27,064,938	30,075,434
Banking	2,227,833	2,486,393	3,159,453	4,066,099	5,500,546
Ownership of dwellings	4,100,882	4,609,758	4,870,440	5,074,720	5,568,379
Public administration	5,644,118	5,901,510	6,125,406	6,706,495	7,673,573
Service	11,857,944	12,982,722	14,328,134	16,248,390	19,823,272
Total of GRP	98,234,489	107,421,611	122,654,078	145,823,301	161,282,211
GRP per capita	14,779	15,749	17,519	20,329	21,958
Population (1,000)	6,647	6,821	6,996	7,173	7,346

Table I-1-2 Gross Regional Product of the Narathiwat Province

Sector	(at current market price)			Unit ; 1,000 Baths	
	1985	1986	1987	1988	1989
Agriculture	233,054	2,725,584	3,271,923	3,722,561	3,688,632
Crops	1,753,109	2,121,027	2,583,225	2,981,110	2,929,264
Livestock	133,299	171,109	183,740	190,410	187,460
Fishery	33,739	6,355	11,035	11,819	10,031
Forestry	99,802	23,999	122,320	126,487	89,263
Agro-services	30,378	15,552	22,101	22,454	20,423
Agro-processing product	282,738	207,651	349,512	390,253	451,121
Mining and quarring	50,195	42,082	45,540	151,461	201,103
Manufacturing	164,422	206,861	270,173	321,983	366,804
Construction	479,019	402,514	476,739	582,866	474,902
Electricity and water supply	72,765	89,224	107,169	110,543	132,098
Transportation and communication	292,788	417,859	401,337	421,465	474,983
Wholesale and retail trade	1,120,443	1,261,076	1,440,187	1,759,956	1,934,549
Banking	90,744	109,110	130,462	157,102	212,103
Ownership of dwellings	326,840	349,881	373,563	386,785	415,958
Public administration	332,803	345,990	261,222	391,384	450,812
Service	787,442	827,738	987,001	1,025,734	1,348,468
Total of GRP	6,058,465	6,779,935	7,876,939	9,092,230	9,700,411
GRP per capita	11,928	12,914	14,505	16,178	16,696
Population (1,000)	508	525	543	562	581

Table I-1-3 Land Documents Issued in the Narathiwat Province

District	Title Deed (edanode)		NS-3		NS-3K	
	Area		Area		Area	
	Plots	Rai	Plots	Rai	Plots	Rai
Muang	5,530	7,339	7,248	25,132	34,132	82,624
Surgaikolok	4,030	3,587	14,557	21,004	19,850	24,440
Sungaipadec	2,819	3,173	5,057	19,292	20,684	64,555
Rangae	702	1,164	8,941	51,461	1,678	6,066
Ruso	912	753	1,893	8,081	1,852	4,546
Takbai	531	3,001	1,474	29,883	1,328	3,243
Sisakhon	101	14	1,296	17,359	1,672	10,648
Yingo	67	1,245	1,778	10,723	537	2,228
Bacho	1	3	1,086	13,567	165	259
Waeng	-	-	297	1,259	586	3,569
Chanae	-	-	1,283	6,077	556	1,102
Sukhirin	-	-	-	-	-	-
Total	14,693	20,283	44,910	203,842	83,040	203,284

Table I-1-4 Land Documents Issued by Various Departments of the Thai Government

Document	Class	Thai name	Date introduced	Legal status	Survey method	Transfer rights	Used as collateral
Department of Land documents for plots outside the forest reserves							
NS-4	Title deed	Chanod	1954	Most secure; full, unrestricted ownership title registered with provincial land registrar; fully negotiable; sold, rented, subdivided, or mortgaged	Land demarcated by accurate ground survey or rectified aerial photo map; property clearly identified with boundary markers	Fully negotiable	Yes
NS-3	Certofocate of use	Nor-Sor-Sarm	1954	Secure; enables farmer to sell, transfer, or mortgage land; can be converted to title deed (NS-4)	Surveyed in isolation by triangulation, tape method	Because of boundary distortions, proposed transfers must be advertised for 30 days	Yes
NS-3K	Exploitation testimonial	Nor-Sor-Sarm Kor	1972	Secure; enables farmer to sell, transfer, or mortgage land; can be converted to title deed (NS-4)	Prepared from unrectified aerial photo map	Fully negotiable	Yes
NS-2	Preemptive certificate	Bai-Chong	1954	Attjprozes temporary occupation of land; after prescribed period and land use, can convert to NS-3 or NS-3K	Land described by metes and bounds	Only by inheritance	No
SK-1	Claim certificate	Sor-Kor-Neung	1954 (during process of implementing the code)	Claim to ownership based on possession or use of land before the enactment of the Land Code; can be converted to NS-3, NS-3k, NS-4	Land described by metes and bounds	Certificate transferable, after transfer advertised	No
Forestry Department: Land documents for plots inside the forest reserves							
STK	Temporary cultivation rights	Sor-Tor-Kor	1981	Usufruct certificate	Varies	Only by inheritance	No
Public Welfare Department: Issued in specific areas under small official programs							
NK-3		Nor-Kor-Sarm		Can be used legally as loan collateral but cannot be sold until 5 years after issue date		Subject to restrictions	Yes
NK-2, NK-1		Nor-Kor-Som Nor-Kor-Neung		Usufruct		Only by inheritance	No
Land Reform office: Issued in specific areas under official program							
SPK		Sor-Por-Kor		Usufruct		Only by inheritance	No

Source: Quoted from "Land Policies and Farm Productivity in Thailand, World bank, 1988"

Table I-1-5 Present Loan Distribution in Narathiwat by BACC

Unit : 1,000Baht

District	32			33			34		
	Loan	Pay back	Earners	Loan	Pay back	Earners	Loan	Pay back	Earners
Muang	25,232	17,463		38,211	22,341	2,949	46,184	31,184	3,240
Rargae	28,783	18,295		36,118	27,399	3,979	34,791	28,440	4,260
Ruso	28,567	15,122		41,992	21,473	3,420	23,946	15,538	2,366
Yingo	12,504	9,238		21,156	14,430	1,526	20,608	14,661	1,713
Bacho	13,266	8,645		15,033	12,119	1,611	19,428	14,809	1,747
Takbai	21,388	12,438		36,186	20,052	2,239	34,607	25,393	2,444
Sisakhon	-	-		-	-	-	15,374	10,628	1,346
Waeng	16,641	10,004		24,067	13,376	2,470	27,313	18,883	2,848
Sungai kolok	7,845	5,343		14,882	7,143	1,024	21,160	12,567	1,096
Sungai patee	23,586	15,900		33,179	20,578	2,979	28,717	21,450	3,140
Total	177,816	112,453	20,068	260,829	158,913	22,197	272,129	193,513	24,200
Institute	21,448	19,248	n.a.	27,955	22,730	5,200	30,676	24,502	5,636
Total Grand	199,264	131,701	25,075	288,784	181,643	27,397	302,805	218,015	29,836

Table I-1-6 Present Situation of Major Agro-Processing in the Narathiwat Province

Type of Factory	Number of Factory	Capital investment (Thousand B)	Capacity per Year	Number of Workers
<u>Muang Narathiwat</u>				
1. Rice Milling	51	3,100	4,644 t	95
2. Rice Noodle	1	726	226 t	13
3. Rubber Smoked Sheet	6	66,620	69,480 t	726
4. Rubber Bar	1	59,460	72,000 t	150
<u>Sungai-Kolok</u>				
1. Rice Milling	11	647	1,320 t	22
2. Rice Noodle	4	19,116	819 t	58
3. Rubber Smoked Sheet	4	20,057	1,200 t	215
<u>Rangae</u>				
1. Rice Milling	75	4,799	5,711 t	144
2. Rice Noodle	1	600	5,400 kg	3
<u>Takbai</u>				
1. Rice Milling	85	4,383	6,925 t	168
2. Rice Noodle	1	153	128 t	6
<u>Sungaipadi</u>				
1. Rice Milling	14	560	1,150 t	28
2. Rice Noodle	1	165	1,200 kg	4
3. Rubber Smoked Sheet	1	5,000	4,800 t	120
<u>Rueso</u>				
1. Rice Milling	31	1,132	2,148 t	61
2. Rubber Smoked Sheet	5	16,550	9,535	366
<u>Bacho</u>				
1. Rice Milling	41	1,446	3,360 t	82
<u>Waeng</u>				
1. Rice Milling	33	1,309	2,628	66
<u>Yi-Ngo</u>				
1. Rice Milling	66	2,547	5,300	130
<u>Chanae</u>				
1. Rice Milling	2	87	152	2
<u>Sisakhon</u>				
1. Rice Milling	4	159	314	7

Source ; Master Plan for the Agricultural Development of Narathiwat Province 1992 - 1996,
Ministry of Agriculture and Cooperative

Table I-1-7 Major Agricultural Commodities Price

Commodity	Unit	Price(Baht)	Origin
1. Rice (high quality)	kg	15	Central, North region
2. Rice (average)	kg	8	Narathiwat
3. Coconut (flesh)	kg	14	Narathiwat
4. Coconut (fruit)	one	6	Narathiwat
5. Mango	kg	25	Cental region
6. Banana	kg	12	Barathiwat
7. Pineapple	kg	7	Southern region
8. Orange	kg	16	Cetral region
9. Chilli (dried)	kg	40	Hat-rai market
10.Chilli (green)	kg	18	Narathiwat
11.Tomato (large)	kg	14	Hat-rai market
12.Tomato (small)	kg	17	Narathiwat
13.Cabbage	kg	10	Hat-rai market
14.Broccoli	kg	20	Hat-rai market
15.Chinese cabbage	kg	16	Hat-rai market
16.Snap bean	kg	35	Hat-rai market
17.Egg plant	kg	16	Narathiwat
18.Cucumber	kg	12	Narathiwat
19.Long bean	kg	16	Narathiwat
20.Ginger	kg	18	Hat-rai market
21.Baby corn	kg	30	Hat-rai market
22.Okra	kg	35	Narathiwat
23.Lettuce	kg	25	Narathiwat
24.Onion	kg	20	Hat-rai market
25.Garlic	kg	40	Hat-rai market
26.Egg	10	13	Narathiwat
27.Chicken	kg	35	Pattani

Table I-1-8 Demand and Supply for Rice of the Narathiwat Province

Narathiwat		
Production		
(1) Second rice	t	2,772
(2) Major rice	t	50,592
(3) Total production <u>1/</u>	t	53,364
(4) Seed stock <u>2/</u> = (3) × 0.9	t	48,027
(5) White rice <u>3/</u> = (4) × 0.65	t	31,218
(6) Population <u>4/</u>	pers.	560,263
(7) Con./pers. (5)/(6) kg	kg/pers	56
(8) Standard <u>5/</u> Con./pers.kg	kg/pers	140
(9) Demand = (6) × (8)	t	78,437
(10) Balance (5) - (9)	t	-47,219

- Note ; 1/ Based on the average production 1082 to 1991.
 2/ Seed stock is assumed to be 10 % of production.
 3/ The conversion factor is assumed to be 0.65.
 4/ Population and Housing Census 1990.
 5/ The standard consumption per person is assumed to be 140 kg.

Table 1-2-1 Comparison of the Official Village Name with Common Village Name for Farm Economic Surve

Official name	Common name	Amphoe	Population	Area(rai)	Household	Farmhousehold
<u>Bacho F/S area</u>						
1. Ban Thung Kong	Bacho Land Settlement Coop.	Muang	410	5,086	123	79
2. Ban Hu Tae Thu Wo(2)	Bacho Land Settlement Coop. Ban Nikhon Sahakan Bacho	Muang	838	1,654	124	38
3. Ban Bu Ke Chu Do	Ban Hu TAE Thu Wo (2) Ban Bu Ke Cue Do	Bacho	1,058	5,489	141	65
4. Ban Khok Khian	Ban Thung Khian Ban Khok Khian	Muang	1,106	2,935	190	87
5. Ban Khok Phayom	Ban khok Phayom	Muang	857	1,274	155	71
6. Ban Thon	Ban Bu Ke Ya Mu Ban Thon	Muang	3,955	2,945	458	215
<u>Kab Daeng F/S area</u>						
1. Ban Cha Roh Sato	Ban Ba Ya Ban Ba Pit Ban Cha Roh Sato	Muang	670	2,752	128	20
2. Ban Pro Kab Daeng I/	Ban Khok Kra duk Mu	Tak Bai	649	6,815	188	188
3. Ban Ko Sawat	Ban Ko Sawat	Tak Bai	609	6,352	135	11
4. Ban Ku Bae Salo	Ban Ku Bae Salo	Muang	715	15,000	142	15
5. Ban Ku Bu	Ban Ku Bu	Tak Bai	1,813	3,396	274	n.a.
6. Ban Sapom	Ban Sapom	Tak Bai	1,168	3,758	194	15
<u>Mu No-Khoknai F/S area</u>						
1. Ban Ba Wong	Ban Ba Wong	Tak Bai	453	3,150	110	110
2. Ban Saring	Ban khok Nibong	Tak Bai	990	2,700	157	157
3. Ban Khok Phai	Ban Khok Nai	Tak Bai	325	3,750	76	70
4. Ban Khok Yang	Ban Khok Phai	Tak Bai	1,010	3,765	219	205
5. Ban Thung Yang	Ban Thung Fai	Tak Bai	467	3,790	125	125
6. Ban Wat Mai	Ban Wat Mai	Tak Bai	323	810	88	88

Source ; Narathiwat provincial governor's office
1/Rural development village officer

Table I-2-2 Family Member

F/S area	Family Number	Age of Head	Active person
Bacho	6.1	50.8	2.9
Kab Daeng	6.4	51.4	3.1
Muno - Koknai	4.7	51.4	2.8

Table I-2-3 Main Activity and Occupation

F/S area	Paddy (%)	Rubber (%)	Fruit (%)	Vegetable (%)	Live-Stock (%)	Fishery (%)	Gov. ser. (%)	Business (%)	Farm Labor (%)	Non-Farm (%)
Bacho	46.0	2.0	2.0	18.0	3.0	0.0	0.0	3.0	8.0	18.0
Kab Daeng	33.5	27.0	6.1	6.3	4.3	2.1	4.3	0.0	4.3	12.8
Muno-Koknai	95.1	0.0	0.0	0.0	0.0	0.0	0.0	2.4	0.0	2.4

Note : The figure show that the proportion of persons answered to the total.

Table I-2-4 Minor Activity and Occupation

F/S area	Paddy (%)	Rubber (%)	Fruit (%)	Vegetable (%)	Live-Stock (%)	Fishery (%)	Gov. ser. (%)	Business (%)	Farm Labor (%)	Non-Farm (%)
Bacho	8.0	11.0	13.0	15.0	15.0	3.0	0.0	2.0	9.0	24.0
Kab Daeng	17.0	12.0	15.0	7.0	21.0	0.0	0.0	1.0	8.0	20.0
Muno-Koknai	1.4	7.6	16.1	18.4	36.7	0.0	3.4	0.7	1.3	14.3

Table I-2-5 Background of Family

F/S area	Before moving here lived in other place		Reasons for moved here			
	YES	NO	No land for cultivation	Not enough for cultivation	Change Occupation	Others
	(%)	(%)	(%)	(%)	(%)	(%)
Bacho	34.0	66.0	23.0	9.0	0.0	28.0
Kab Daeng	10.0	52.0	25.0	0.0	0.0	13.0
Muno-Koknai	14.0	71.0	4.0	0.0	0.0	39.0

Table I-2-6 Land Holding (1/2)

Owned Land

F/S area	Area		Under Culti- vation	House	Land Utilization			
	Plot no.	Area (rai)			Rent out		Fallow	Others
					Charged	Non		
Bacho	3.6	22.0	11.1	1.3	0.1	0.0	9.5	0.0
Kab Daeng	3.9	19.7	14.0	1.1	0.0	0.1	4.5	0.0
Muno-Koknai	4.2	24.7	14.5	1.1	0.1	0.4	8.7	0.00

Land Holding (2/2)

Lease In

F/S area	Area		Under Culti- vation	House	Land Utilization			
	Plot no.	Area (rai)			Rent out		Fallow	Others
					Charged	Non		
Bacho	0	0	0	0	0	0	0	0
Kab Daeng	0.1	0.1	0.1	0	0	0	0	0
Muno-Koknai	0.1	1.2	1.2	0	0	0	0	0

Table I-2-7 Title of Land

F/S area	Title of land (rai)			
	Title deed	N.S.3 or N.S.3k	S.K.1 or other	Total area
Bacho	0.4	8.8	12.8	22.0
Kab Daeng	0.0	10.7	5.8	19.7
Muno-Koknai	0.0	15.4	6.1	24.7

Table 1-2-8 Present Agricultural Situation in Peat/Acid Surface Soil

F/S area	Under cultivation (rai)			Under Rush (%)			Unused land (%)			Yield of crop (kg/rai)			
	Total Area (rai)	Paddy	Coconut	Vegetable	Other	Handicraft	Unused	Abandonment	Unused	Rubber	Paddy	Coconut	Vegetable
Bacho	9.6	0.2	0.0	0.1	0.9	17.9	82.1	53.6	46.4	-	79.7	-	-
Kab Daeng	4.1	0.0	0.0	0.0	0.0	2.1	97.6	50.0	50.0	0.0	79.7	1.3	0.0
Muno-Khoknai	8.4	0.0	0.0	0.0	0.0	2.4	97.6	59.6	40.4	0.0	69.0	0.0	4.3

Table 1-2-9 Production Distribution

F/S area	Paddy (kg)			Rubber (kg)			Coconut (kg)			Vegetable (kg)			Cashewnut (kg)								
	Total Prod.	Con-sum-ption	Sale	Seed	Total Prod.	Con-sum-ption	Sale	Seed	Total Prod.	Con-sum-ption	Sale	Seed	Total Prod.	Con-sum-ption	Sale	Seed					
																	Con-sum-ption	Sale	Seed	Con-sum-ption	Sale
Bacho	340.7	328.6	0.0	12.1	242.8	0.0	242.8	0.0	296.6	26.4	270.2	0.0	366.3	28.5	337.7	0.1	63.3	0.0	28.4	0.0	
Kab Daeng	554.0	439.0	103.0	13.0	432.0	0.0	432.0	0.0	341.0	17.0	325.0	0.0	359.0	15.0	345.0	0.0	13.0	0.0	23.0	0.0	
Muno-Khoknai	2,481.0	1,760.0	527.0	72.0	80.0	0.0	80.0	0.0	702.0	28.0	672.0	1.0	391.0	27.0	364.0	1.0	0.0	0.0	0.0	123.0	0.0

Table I-2-10 Production Selling (1/2)

F/S area	Paddy (Wet season) (kg)			Paddy (Dry season) (kg)			Rubber (kg)			Coconut (kg)						
	Area (rai)	Sale (kg)	Selling Price (B/kg)	Total (Baht)	Area (rai)	Sale (kg)	Selling Price (B/kg)	Total (Baht)	Area (rai)	Sale (kg)	Selling Price (B/kg)	Total (Baht)				
Bacho	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4	241.9	15.8	3,820.0	2.9	270.2	3.0	811.0
Kab Daeng	2.7	102.6	5.6	570.0	0.0	0.0	0.0	0.0	2.8	431.8	15.9	6,869.0	2.5	324.5	3.0	975.0
Muno-Khoknai	10.7	501.7	4.9	2,440.0	0.6	41.9	5.0	209.0	0.5	80.3	15.9	1,277.0	2.6	671.6	3.0	2,045.0

Production Selling (2/2)

F/S area	Vegetable (kg)			Others (kg)			Pinapple (kg)			Total (kg)						
	Area (rai)	Sale (kg)	Selling Price (B/kg)	Total (Baht)	Area (rai)	Sale (kg)	Selling Price (B/kg)	Total (Baht)	Area (rai)	Sale (kg)	Selling Price (B/kg)	Total (Baht)				
Bacho	0.6	337.7	8.0	2,691.0	1.3	64.1	12.8	819.0	0.03	20.0	5.0	100.0	-	-	-	8,240.0
Kab Daeng	0.7	344.5	6.7	2,305.0	0.4	13.0	13.9	181.0	0.0	25.0	5.0	125.0	-	-	-	11,023.0
Muno-Khoknai	0.5	363.7	5.1	1,856.0	0.04	16.0	5.9	95.0	0.0	0.0	0.0	0.0	-	-	-	7,922.0

Table I-2-11 Agriculture in Peat/Acid Sulfate Soil

F/S area	If 'abandonment', what are the reasons ?										What kinds of crops are suitable in peat/acid area					
	Soil Product (%)	Low Fertil (%)	Low Product (%)	Lack of water (%)	Lack of labor (%)	Lack of technic. (%)	Lack of maney (%)	Rubber (%)	Paddy (%)	Coconut (%)	Vegetable (%)	Durian (%)	Cashew-nut (%)	Long kong (%)	Live stock (%)	Fish pond (%)
Bacho	65.8	47.3	49.2	36.7	18.4	20.3	28.6	28.0	21.6	16.8	8.8	8.1	15.5	1.7	1.7	0.0
Kab Daeng	49.9	29.1	33.4	31.1	20.9	16.8	35.4	10.5	37.4	6.4	10.5	12.5	6.4	6.3	0.0	0.0
Muro Khoknai	52.3	38.0	38.0	35.6	4.9	14.3	30.9	4.9	37.9	0.0	0.0	0.0	2.4	0.0	2.4	0.0