Table I.3.86 Crop Budget

Crop	Season	Target Yield Project	Farmagate Price (Finance) B/t	Gross Income B/rai	Production Cost B/rai	Crop Income B/rai
Paddy	Wet	4 ton/ha				
		640 kg/rai	3.82	2,445	(T.P) 872	1,573
	Dry	4.5 ton/ha				
		720 kg/rai	3.82	2,750	(B.C) 852	1,898
Maize	Wet	2.1 ton/ha				
		336 kg/rai	2.66	894	524	367
	Dry	2.5 ton/ha				
		400 kg/rai	2.66	1,064	524	540
Soybean		1.9 kg/ha				
		304 kg/rai	6.77	2,058	1,130	928
Groundnuts		1.9 ton/ha				
		304 kg/rai	5.00	1,520	1,030	490
Mungbean		1.1 ton/ha				
		176 kg/rai	7.36	1,295	1,005	290
Vegetable		14.3 ton/ha				
		2,288 kg/rai				4,300
Mango		13.8 ton/ha				
		2,208 kg/ha	6.00	13,248	4,670	8,578

Note: 1. Vegetable

Plot 1. Green bean - Baby corn	2,280
Plot 2. Sweet corn - Chilli	680
Plot 3. Tomato - Chinese Cabbage	1,340
(Total)	(4,300)

2. Production cost does not include family labor.

3. These figures are those in the Progress Report Stage (June to July, 1990)

Table I.3.87 Alternative Farm Budget

Crop	Crop Income	20 rai				15 rai				10 rai			
		Wet	F.I	Dry	F.I	Wet	F.I	Dry	F.I	Wet	F.I	Dry	F.I
	Baht/rai	rai	Baht	rai	Baht	rai	Baht	rai	Baht	rai	Baht	rai	Baht
Paddy, Wet	1,573	16.18	25,451	-	-	12.1	19,033	-	-	8.09	12,726	-	-
Dry	1,898	-	-	3.3	6,263	-	-	2.60	4,935	-	-	1.63	3,094
Maize, Wet	367	0.32	117	-	-	0.24	88	-	-	0.16	59	-	-
Dry	540	-	-	0.2	108	-	-	0.18	97	-	-	0.11	59
Soybean	928	-	-	1.6	1,485	-	-	1.27	1,179	-	-	0.80	742
Groundnuts	490	-	-	1.4	686	-	-	1.11	544	-	-	0.70	343
Mungbean	290	-	-	1.5	435	-	-	1.20	348	-	-	0.73	212
Vegetable	4,300	0.14	602	2.0	8,600	0.11	473	1.64	7,052	0.07	301	1.03	4,429
Mango	8,578	3.36	28,822	-	-	2.53	21,702	-	-	1.68	14,411		-
Total (Wet + Dry)		20.00	54,992	10.0	17,577	15	41,296	8.00	14,155	10.00	27,497	5.00	8,879
				72,569				55,451				27,501	
Target farm income:													
At percent				41,000				41,000				41,000	
Growth rate		30 %		53,300				53,300				53,300	
in future		50 %		61,500				61,500				61,500	

(Footnotes)

Wet: Wet Season
Dry: Dry Season
F.I: Farm Income

Note: These figures are those in the Progress Report Stage (June to July, 1990).

TABLE I- 3-88 SOURCES OF INPUT MATERIALS PURCHASED BY FARMERS

- Khlong Si Yat Beneficial Areas - Unit : Percent of Sample

Item	Chemical Fertilizer	Pesticides Insecticides	Seed
Local Merchant / Landlord in Village	3.6 %	5.0 %	in & out 17.3%
Merchant / Landlord in Town	62.2	77.5	17.4
Relatives	0.9	-	13.0
Neighbors	1.8	-	21.7
State Entep.	9.0	-	-
Financial Institution	23.4	-	-
Government Agency	-	15.0	34.8
Group / Association	3.6	2.5	-
Total	100.0	100.0	100.0
Number of sample	(111)	(40)	(23)

Source : Socio - agro Economic Survey, 1989,RID

TABLE I- 3-89 TYPES OF PURCHASERS FOR AGRICULTURAL PRODUCTS

- Khlong Si Yat Beneficial Areas - Unit : Percent of Sample

Item	All Crops	Rice	Mangoes	Coconuts	Betel Nuts	Others
Local Merchants						
In village	40.0	35.1	37.5	58.3	53.8	57.1
Out village	23.6	22.3	0.0	33.3	30.8	0.0
Mercheant/Purchasers					15.4	28.6
Menchant in town	20.0	13.8	62.5	8.3	0.0	0.0
Rice mill	17.3	20.2	0.0	0.0	0.0	14.3
Factory	1.8	0.0	0.0	0.0	0.0	0.0
Relatives	0.9	1.1	0.0	0.0	0.0	0.0
Neighbours	0.9	1.1	0.0	0.0	0.0	0.0
Government agency	3.6	4.3	0.0	0.0	0.0	0.0
Money institution	4.5	5.3	0.0	0.0	0.0	0,0
Total	100.0	100.0	100.0	100.0	100.0	100.0
Number of sample	(110)	(94)	(8)	(12)	(13)	(7)

Source : Socio - agro Economic Survey, 1989,RID

TABLE I- 3-90 CREDIT OBTAINED DURING YEAR PER FARM BY SOURCES

- Khlong Si Yat Beneficial Areas - Unit : Percent of Sample

Item	Unit	Total	- Debts Insured During Year by Sources - BAAC	Com.Bank	Cooperative	Merchant	Relatives	Neighbors
% of farm having	%	49.2	36.9	2.5	2.5	0.8	2.5	4.1
Principal	Baht	12,307	7,853	2,459	815	4.0	910	467
Interest Rato	%	14.8	12.3	13.5	12.5	58.0	0.0	29.0
Outstanding. end Yrs	Baht	1,896	1,582	0.0	205	0.0	0.0	110
Loan Period	Yrs	1.0	1.0	0.3	1.0	1.0	1.0	0.8
Purpose of Loams for	:							
Agriculture								
Purchased								
Equip./Tools	%	2.5	2.8	0.0	0.0	0.0	9.0	0.0
Land	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Animal	%	26.3	28.9	26.7	50.7	0.0	0.0	0.0
Farm-imput	%	19.7	28.6	0.0	26.7	0.0	0.0	4.4
Hired Labor	%	19.7	27.4	6.7	22.7	0.0	0.0	0.0
Sub-total	%	68.4	87.7	33.3	100.0	0.0	9.0	4.4
Non Agriculture	%	31.6	12.3	66.7	0.0	100.0	91.0	95.6
Total	%	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source : Socio - agro Economic Survey, 1989,RID

TABLE I-3-91 INCREMENTAL VOLUME OF AGRICULTURAL PRODUCTION

Crop	At Present	With Project	Incremental Volume	Existing Production in 10 Pistricts
Paddy (Wet Season)	73,003t	137,600 t	64,597 t	552,163t ('89/87-'88/87)
Paddy (Dry Season)	600	30,960	30,360	
Maize	-	2,620	2,620	4,927
Soybean	-	5,025	5,025	2,645
Groundnuts	-	4,395	4,395	551
Mungbean	-	3,476	3,476	73
Vegetables	5,760	65,637	59,877	11,075
Orchard (mango)	16,865	98,808	81,943	50,860
Cassava	38,689	-	-	about 6% of Sanam Chaiket
Total	134,917	348,521		

TABLE I-3-92 APPLICATION VOLUME OF INPUTS, AT PRESENT AND WITH THE PROJECT

(A) At Present

	Chemical Fertilizer			Pesticide		
Crop	Per Rai	Cropped Area	Per Farm	Per Rai	Cropped Area	Per Farm
Paddy (Wet)	29.5 kg	27.27 rai	804 kg	6.6 ฿	27.27 rai	180 ฿
Vegetable (Wet)	100.0	0.03	3	289.4	0.03	9
Vegetable(Dry)	116.0	0.03	3	660.0	0.03	20
Fruits/Tree Crops	55.0	2.25	124	268.1	2.25	603
Total		29.58	934		29.58	812

Per Rai 32kg

(B) With the Project

Chemical fertilize	40,200	ton
Cultivate Area	42,500	ha
Application Volume per ha	945	kg
Application Volume per rai	151	kg

(D) Growth rate of fertilize 151Kg/rai ÷ 32 Kg/rai = 472 %

TABLE I-3-93 ALLOCATION OF JOINT COST, AGRICULTURE AND INDUSTRY & DOMESTIC SECTOR

Item	Diversion Dam		Si Yat Dam Storage	
	Financial	Economic	Financial	Economic
	Million Baht		Million Baht	
1. Construction Cost	1,670	1,450 (0.868)	1,060	901 (0.850)
2. Compensation Cost	155	68	150	68
3. Engineering Services	167	148 (0.848)	106	94 (0.884)
4. Administration	83	76 (0.920)	71	65 (0.920)
5. Physical Contingency	208	174	138	113
Total	2,283	1,916	1,514	1,241
6. Cost Allocation				
Agriculture (63%)	1,438	1,207	954	782
Industry & Domestic (37%)	845	709	560	459

TABLE I-3-94 COST ALLOCATION FOR INDUSTRIAL & DOMESTIC SECTOR

Item	Diversion Dam		Si Yat Dam storage	
	Financial	Economic	Financial	Economic
Cost (Mill. Baht)	845	709	560	459
Intake Water				
Industry (MCM)	100 (83%)	100	70 (84%)	70
Domestic (MCM)	20 (17%)	20	15 (17%)	15
Total	120	120	85	85
Cost Allocation				
Industry (Mill .Baht)	701 (83%)	588	465 (83%)	381
Domestic (Mill. Baht)	144 (17%)	121	95 (17%)	78

TABLE I-3-95 ESTIMATION OF UNIT PRICE OF RAW WATER

A. Diversion Dam

Industry: (Financial Price)

$$\frac{701\text{MB}\,(1 + 0.208) \times 0.15 + 701\text{MB} \times 0.005}{93\ \text{MCM}}$$

$$= \frac{127\ \text{MB} + 3.5\ \text{MB}}{93\ \text{MCM}} = 1.40\ \text{Baht/CM}$$

Note: MB = Million Baht

(Ecnomic price)

$$\frac{588\text{MB}\,(1 + 0.208) \times 0.15 + 588\text{MB} \times 0.005}{93\ \text{MCM}}$$

$$= \frac{106.5\ \text{MB} + 2.9\ \text{MB}}{93\ \text{MCM}} = 1.18\ \text{Baht/CM}$$

Domestic: (Financial Price)

$$\frac{144\text{MB}\,(1 + 0.208) \times 0.15 + 144\text{MB} \times 0.005}{13.95\ \text{MCM}}$$

$$= \frac{26.1\ \text{MB} + 0.7\ \text{MB}}{13.95\ \text{MCM}} = 1.97\ \text{Baht/CM}$$

(Economic price)

$$\frac{121\text{MB}\,(1 + 0.208) \times 0.15 + 121\text{MB} \times 0.005}{13.95\ \text{MCM}}$$

$$= \frac{21.9\ \text{MB} + 0.6\ \text{MB}}{13.95\ \text{MCM}} = 1.61\ \text{Baht/CM}$$

B. Si Yat Dam

Industry: (Financial Price)

$$\frac{465\text{MB}\,(1 + 0.26) \times 0.1425 + 465\text{MB} \times 0.005}{65.1\ \text{MCM}}$$

$$= \frac{83.5\ \text{MB} + 2.3\ \text{MB}}{65.1\text{MCM}} = 1.32\ \text{Baht/CM}$$

(Ecnomic price)

$$\frac{381\text{MB}\,(1 + 0.26) \times 0.1425 + 381\text{MB} \times 0.005}{65.1\ \text{MCM}}$$

$$= \frac{68.4\ \text{MB} + 1.9\ \text{MB}}{65.1\ \text{MCM}} = 1.08\ \text{Baht/CM}$$

Domestic: (Financial Price)

$$\frac{95\text{MB}\,(1 + 0.26) \times 0.1425 + 95\text{MB} \times 0.005}{10.46\ \text{MCM}}$$

$$= \frac{17.06\ \text{MB} + 0.48\ \text{MB}}{10.46\ \text{MCM}} = 1.68\ \text{Baht/CM}$$

(Economic price)

$$\frac{78\text{MB}\,(1 + 0.26) \times 0.1425 + 78\text{MB} \times 0.005}{10.46\ \text{MCM}}$$

$$= \frac{14.0\ \text{MB} + 0.39\ \text{MB}}{10.46\ \text{MCM}} = 1.38\ \text{Baht/CM}$$

TABLE I-3-96 PROJECT OF INTAKE WATER VOLUME IN INDUSTRY WATER AND DOMESTIC WATER SECTOR

	1996	1997	1998	1999	2000	2001	2002
Phase I							
Water Demand (120 McM)							
1. Industry	50	60	70	80	100	100	100
	(50%)	(60%)	(70%)	*80%)	(100%)		
(120 MCM × 83%)	4	8	12	16	20	20	20
2. Domestic	(20%)	(40%)	(60%)	(80%)	(100%)	(100%)	(100%)
(120 MCM × 17%)	54	68	82	96	120	120	120
Total							
Phase II							
Water Demand (85 MCM)							
1. Industry	-	-	35	42	49	56	70
(85 MCM × 17%)			(35%)	(60%)	(70%)	(80%)	(100%)
2. Domestic	-	-	3	6	9	12	15
(85 MCM × 17%)			(20%)	(40%)	(60%)	(80%)	(100%)
Total	-	-	38	48	58	68	85
Grand Total	54	68	120	144	178	188	205

TABLE I-3-97 PROJECTION OF COLLECTIBLE SUPPLY WATER VOLUME IN INDUSTRY & DOMESTIC SECTOR WATER

	1996	1997	1998	1999	2000	2001	2002
Phase I (Diversion Dam)							
Industry (MCM)	45.50	55.80	65.10	74.40	93.00	93.00	93.00
Domesti (MCM)	2.79	5.58	8.37	11.16	13.95	13.95	13.95
Sub-Total (MCM)	49.29	61.38	73.47	85.56	106.95	106.95	106.95
Phase II (Si Yat Dam)							
Industry (MCM)	-	-	32.55	39.06	45.57	52.08	65.10
Domestic (MCM)	-	-	2.09	4.19	6.28	8.37	10.46
Sub-Total (MCM)	-	-	34.64	43.25	51.85	60.45	75.56
Total	49.29	61.38	108.11	128.81	158.80	167.40	182.51

FIG I-3-1 OPPORTUNITY COST CURVE FOR FARM LABOR

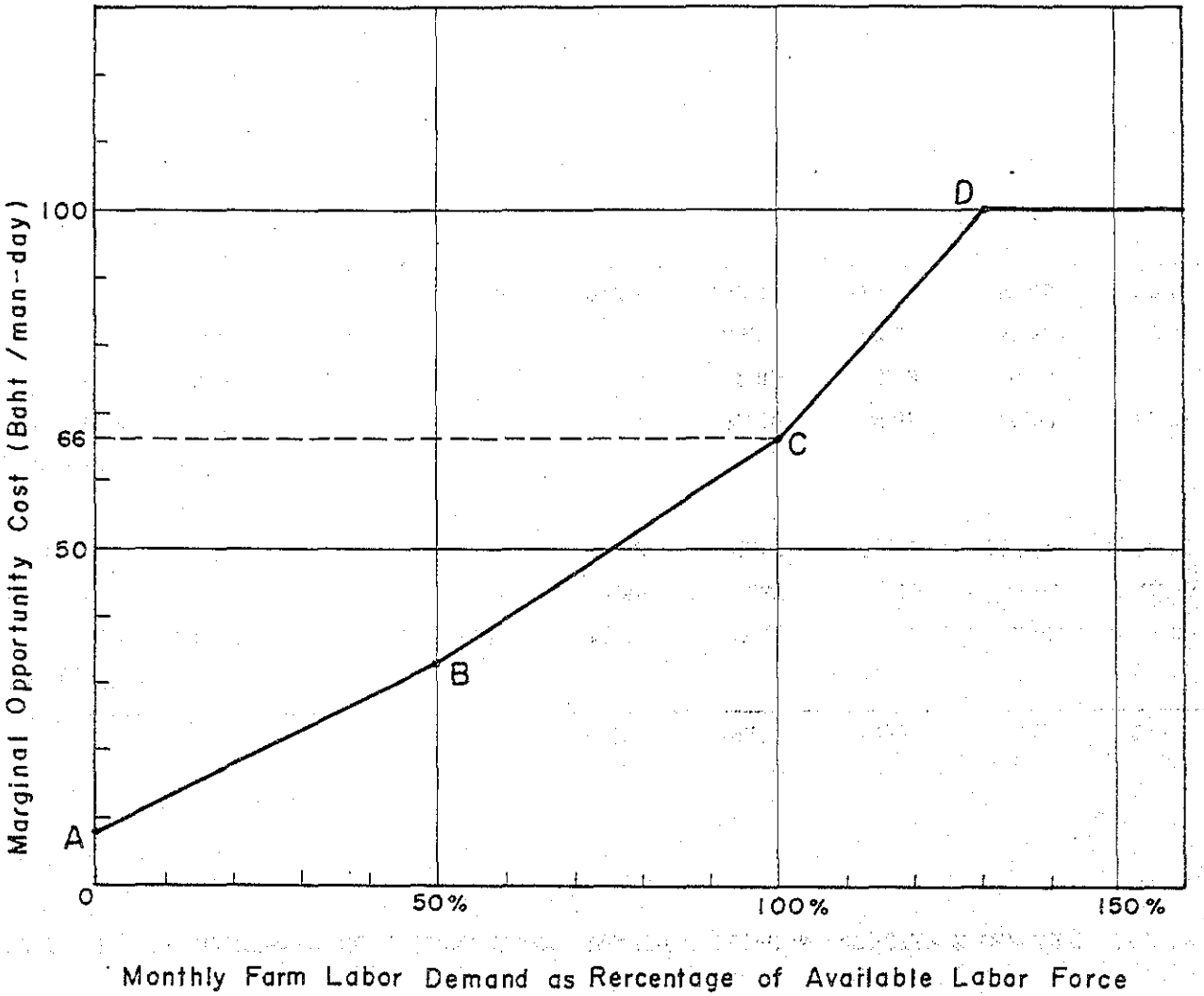

FIG I-3-2 TYPICAL OPPORTUNITY COST CURVE FOR FARM LABOR

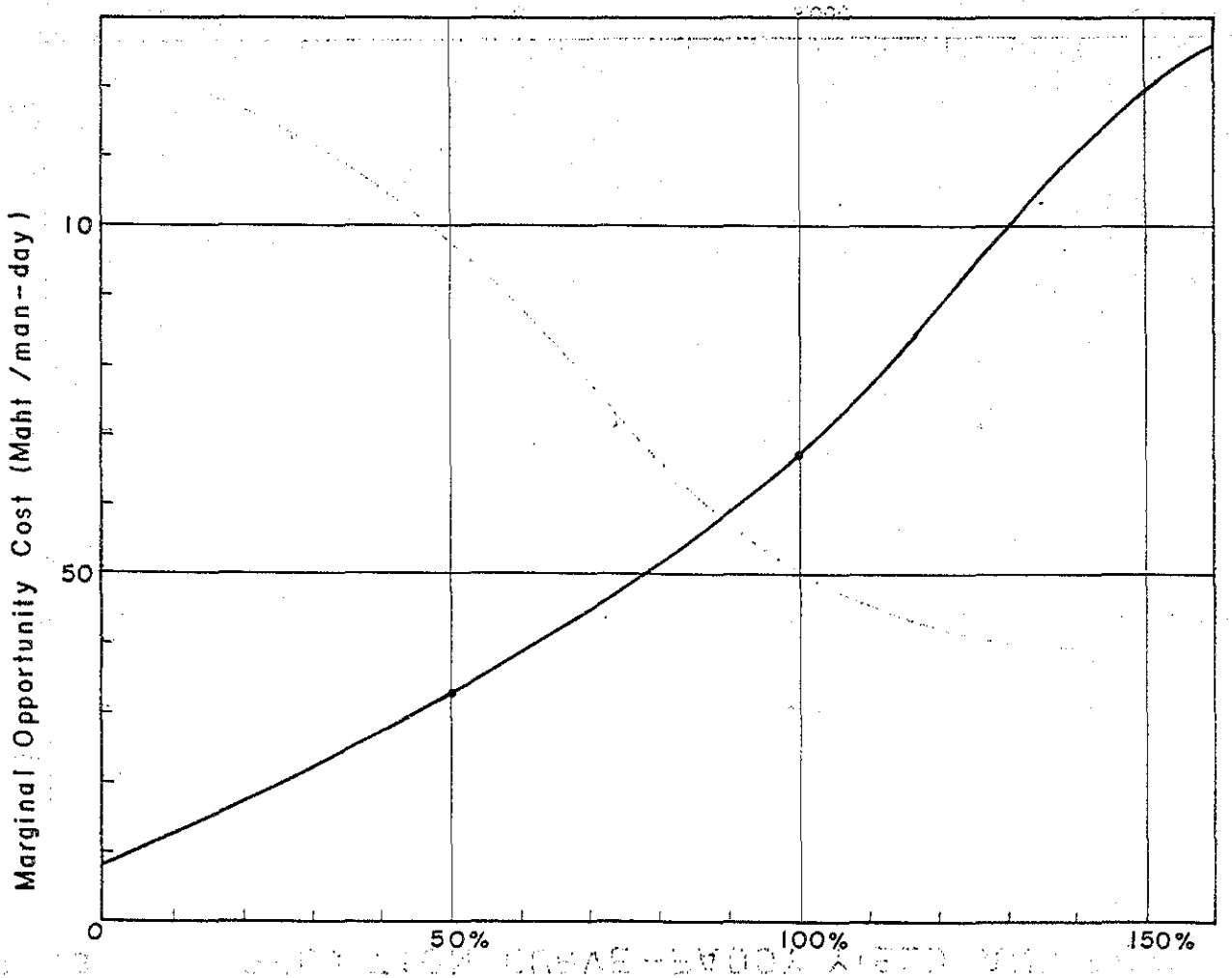

FIG I-3-3 CORRELATION CURVE-PADDY YIELD AND FERTILIZER

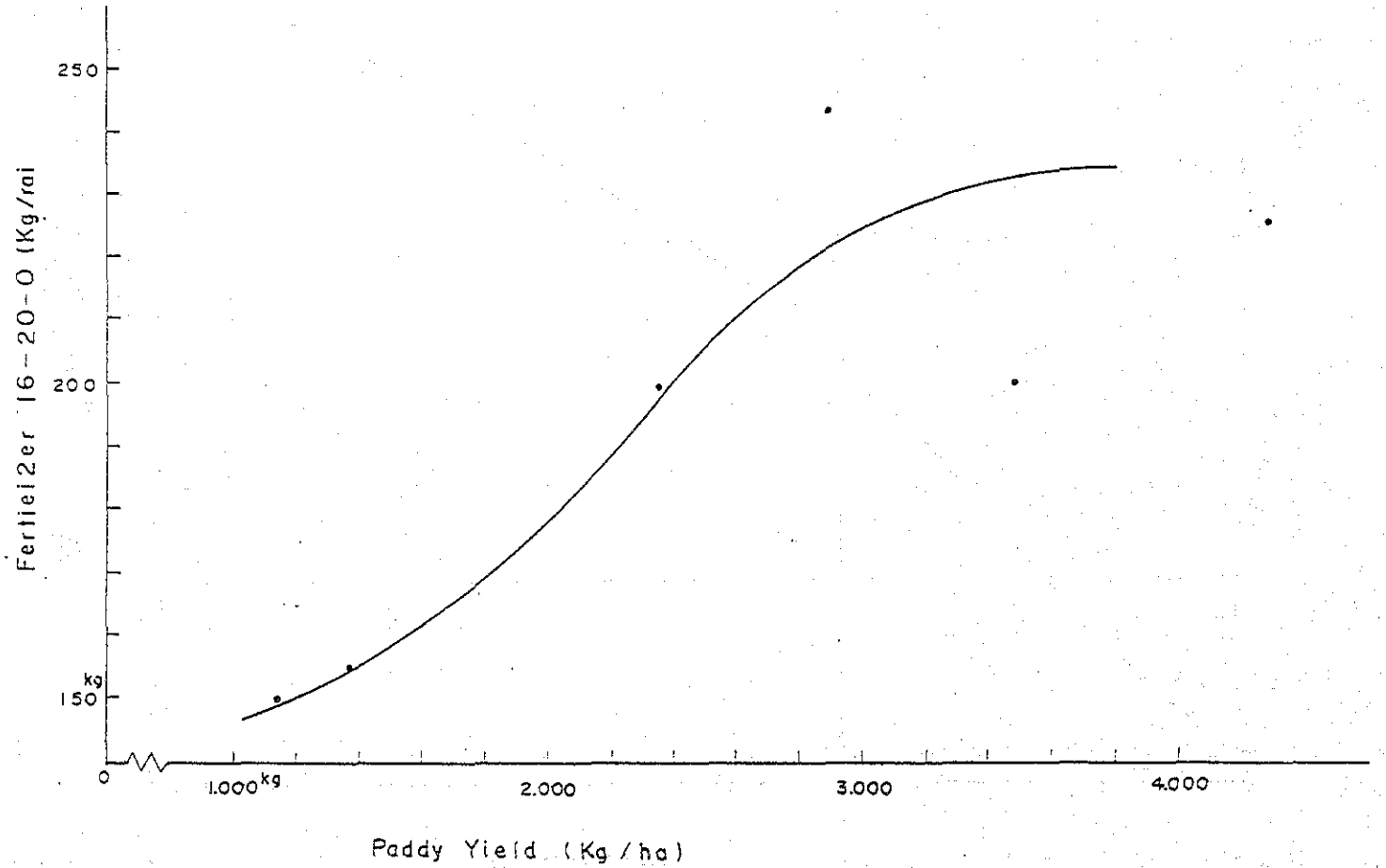

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FIGURE I-3-4 VILLAGE SUBMERGED BY KHLONG SI YAT RESERVOIR

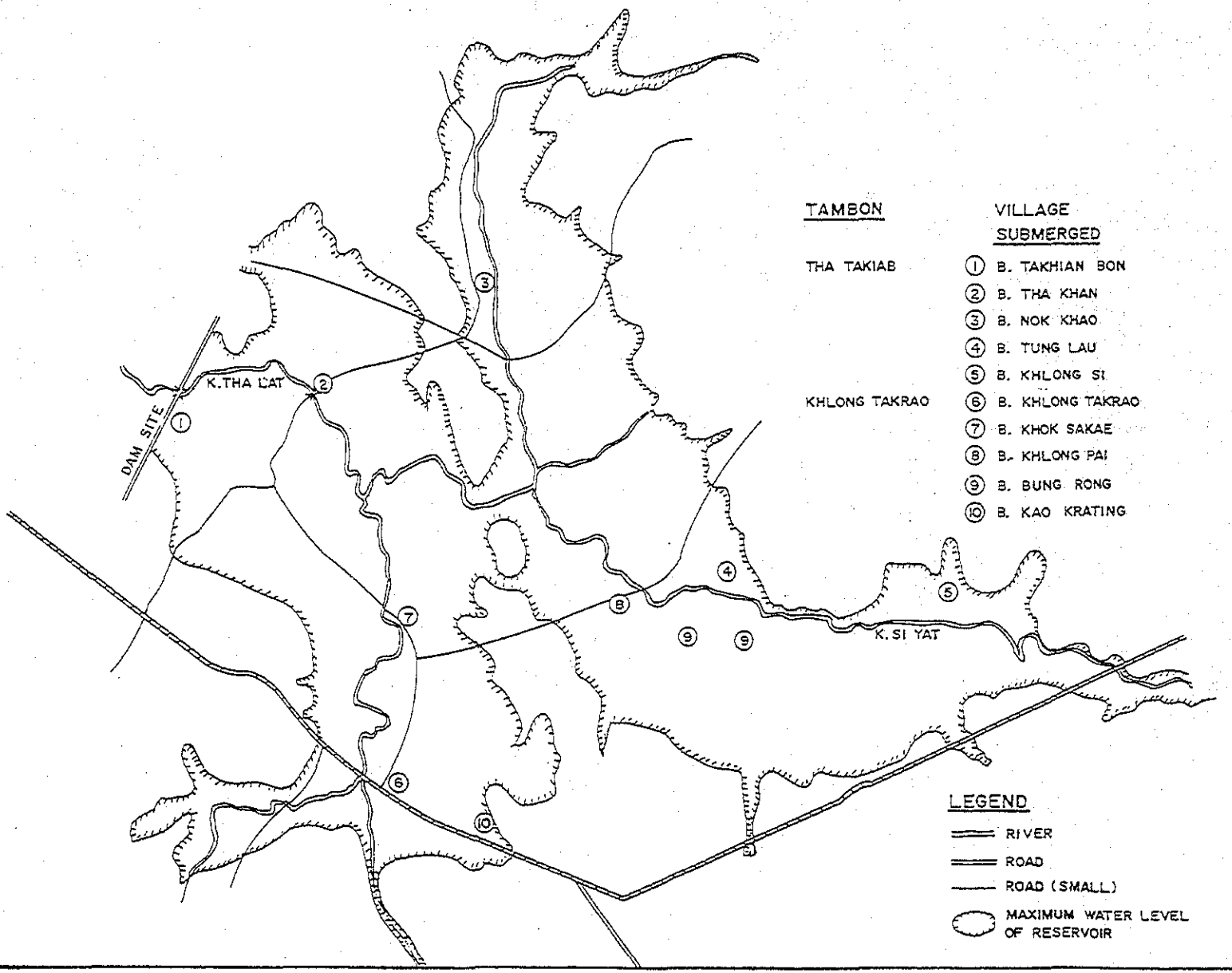


FIGURE I-3-5 SELECTION OF RESETTLEMENT SITE

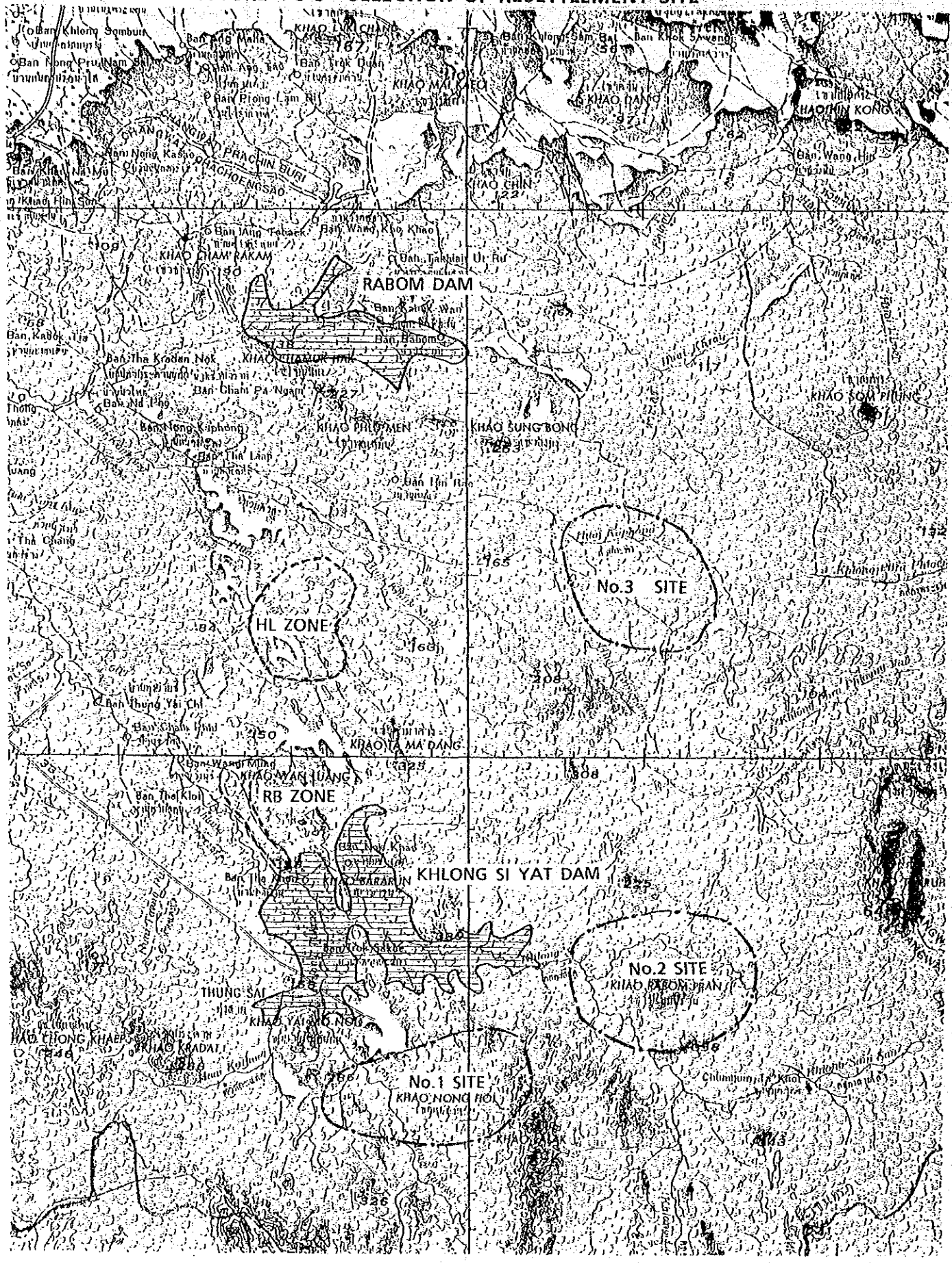


FIGURE I-3-6 RECONNAISSANCE SURVEY

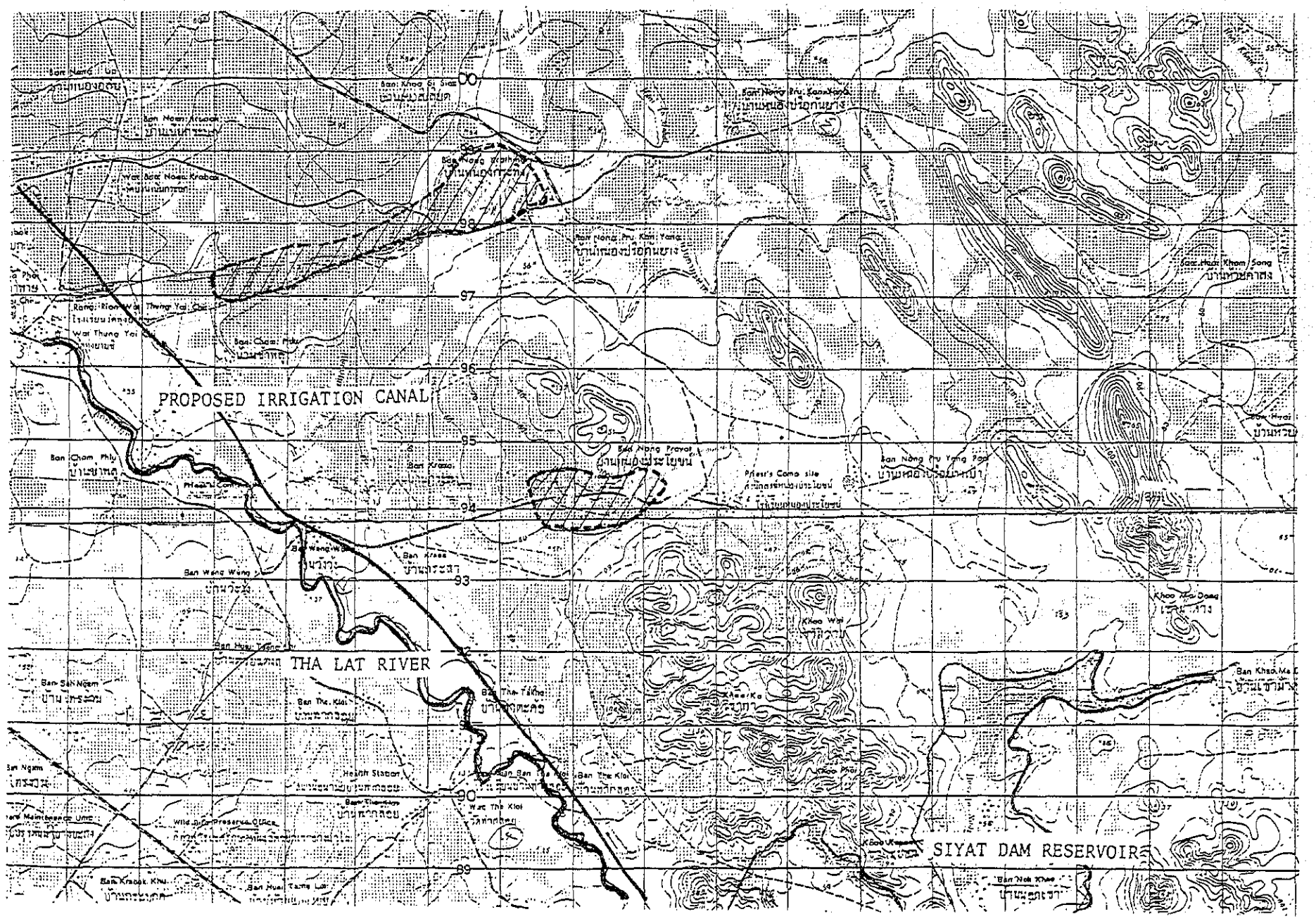


FIG. I.3.7 VILLAGES AND MAIN SOCIAL STRUCTURE
IN TAMBON THA THAKIAB

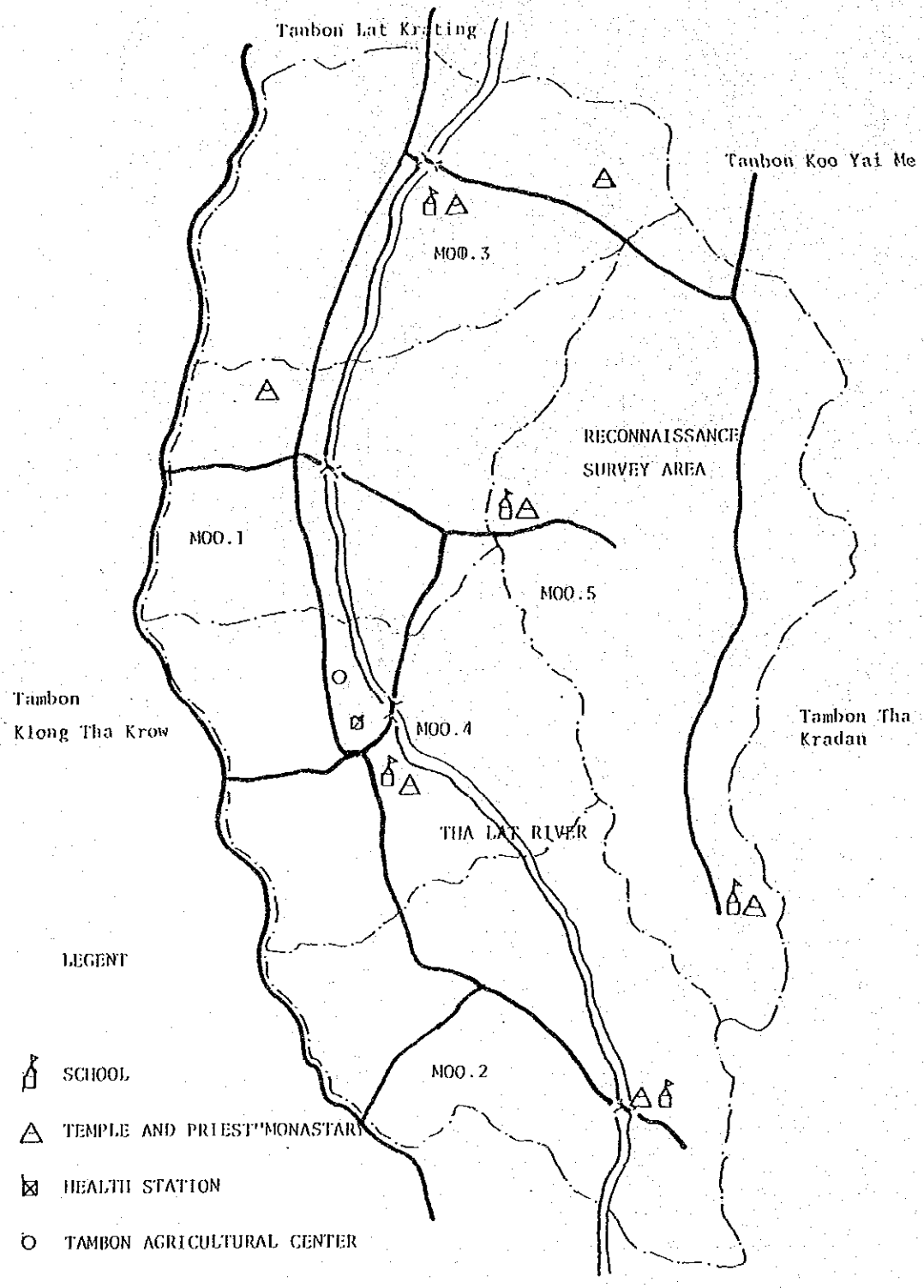
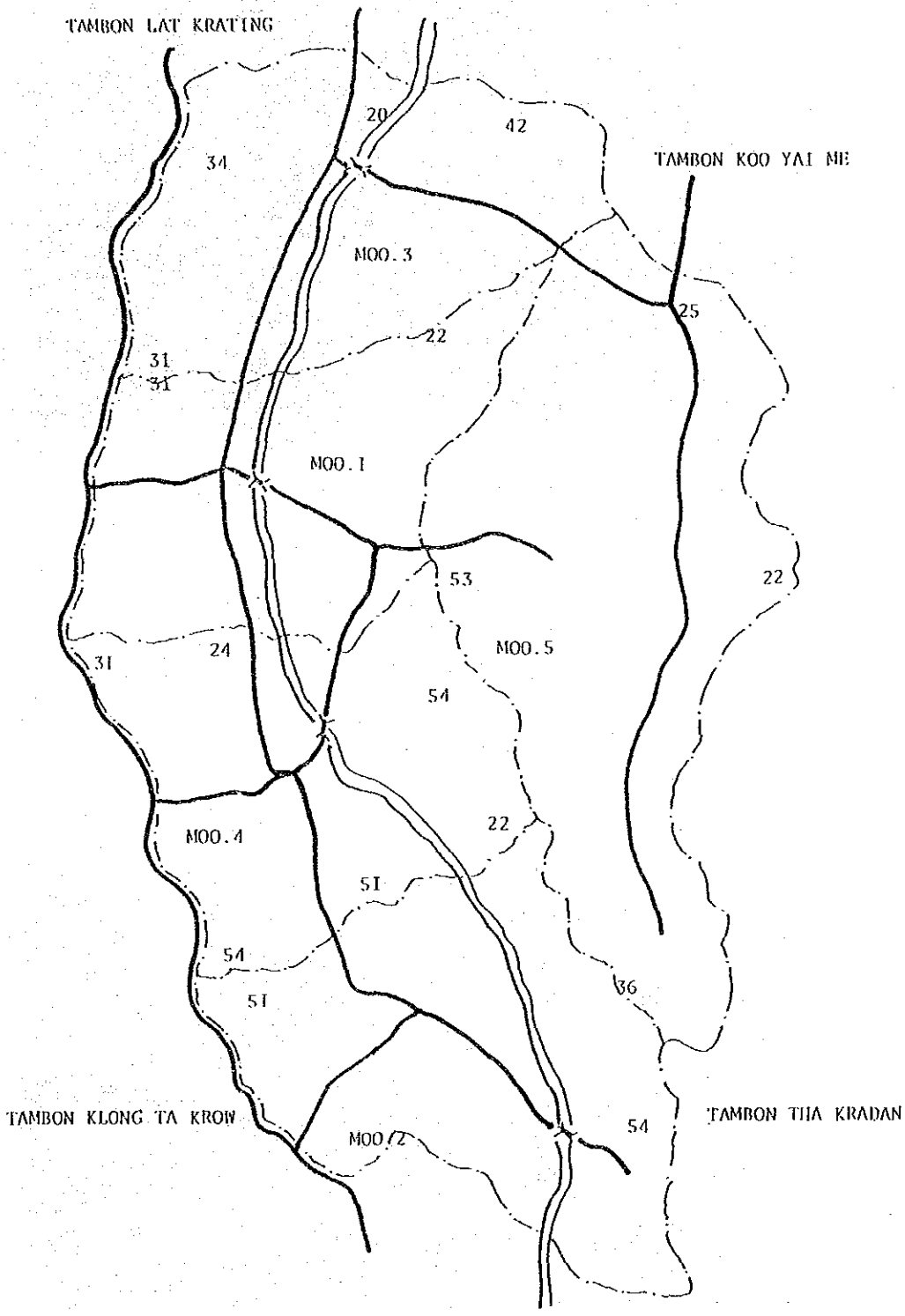
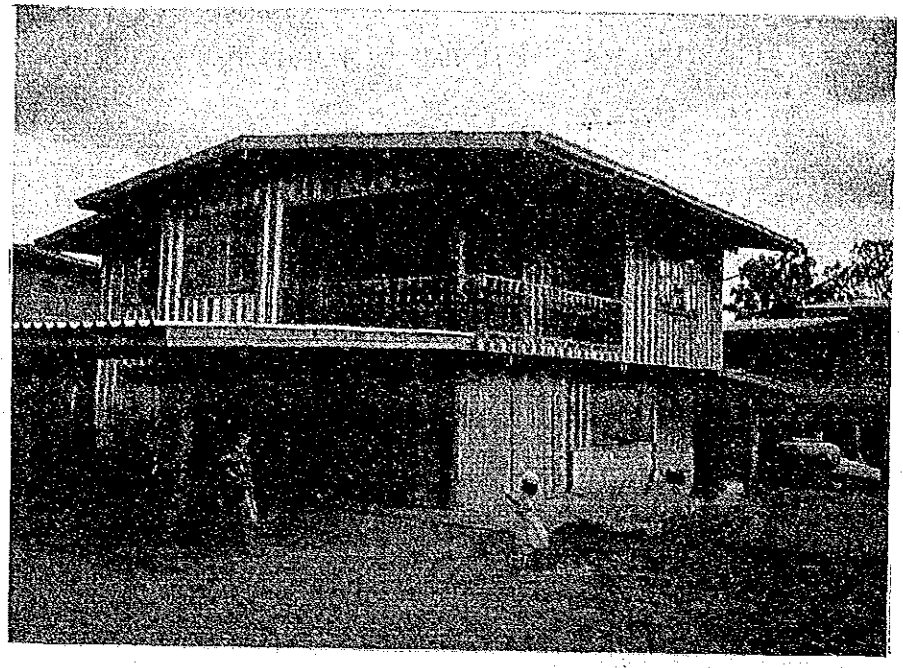
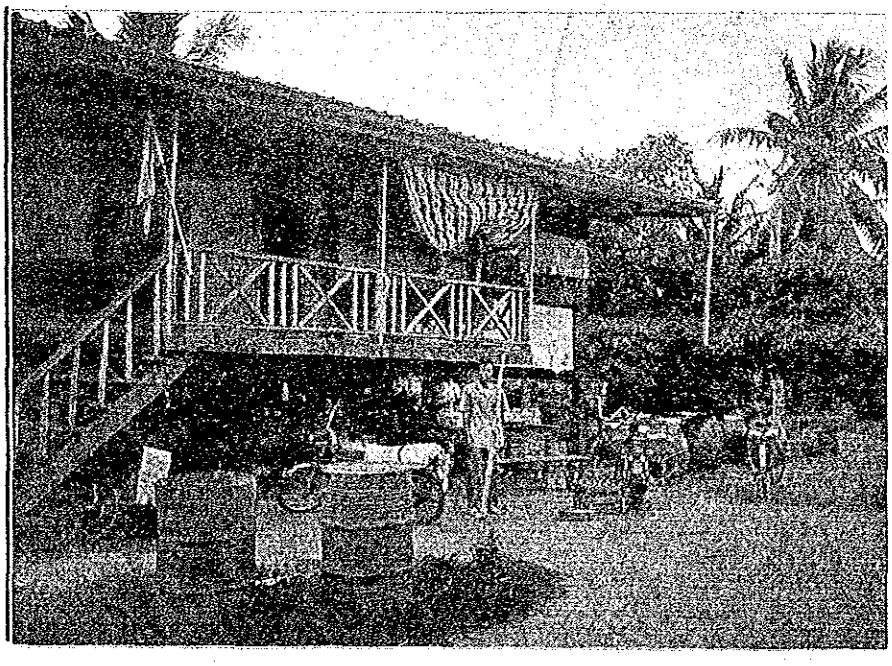


FIG. I.3.8 SOIL MAP IN TAMBON THA TAKIAB

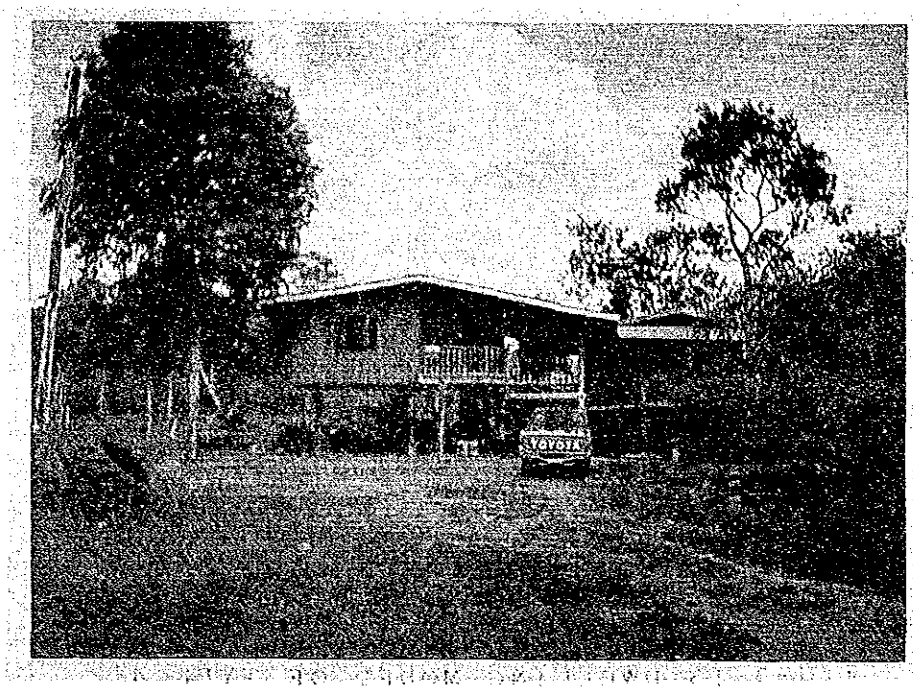




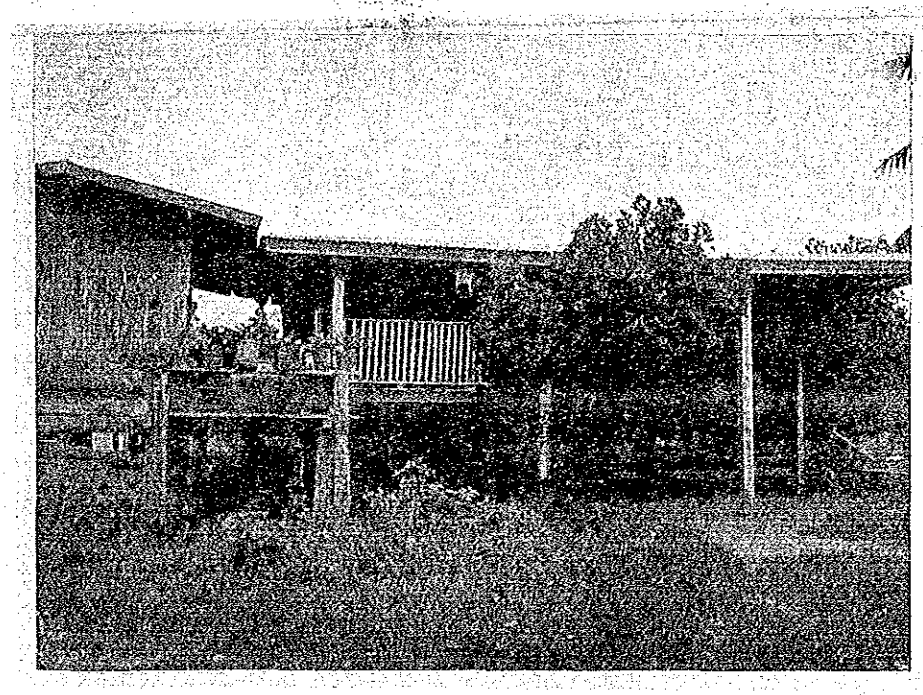
FIG·3·9 DWELLING MODEL OF TYPE 3



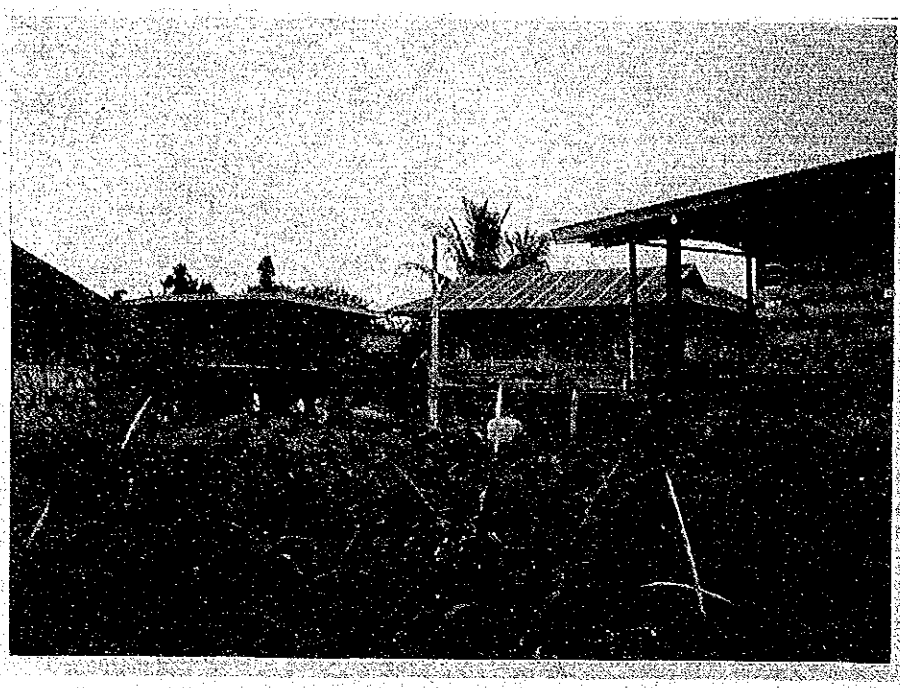
FIG·3·10 DWELLING MODEL OF TYPE 4



FIG·3·11 DWELLING MODEL OF TYPE 4

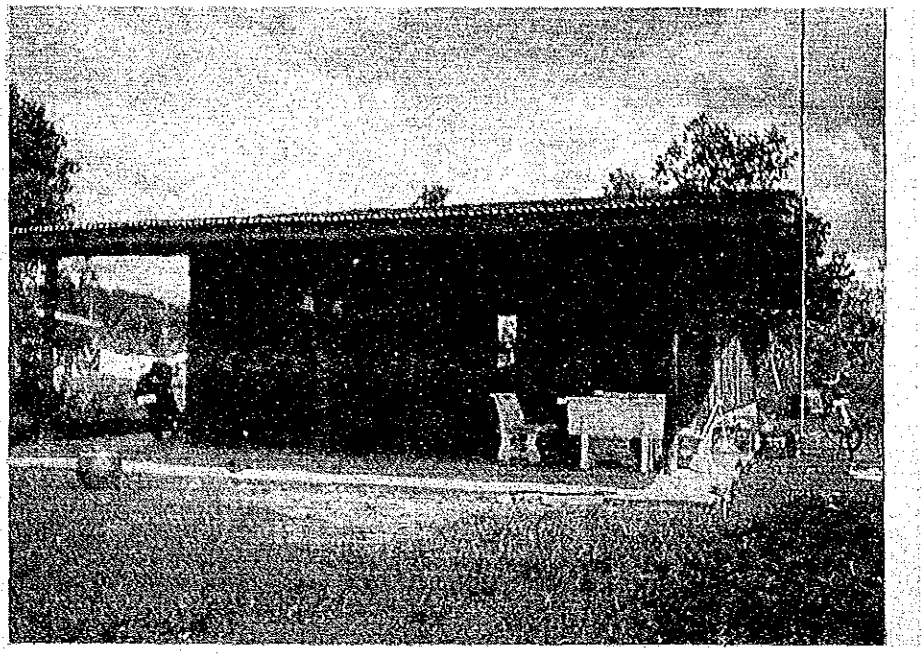


FIG·3·12 DWELLING MODEL OF TYPE 4

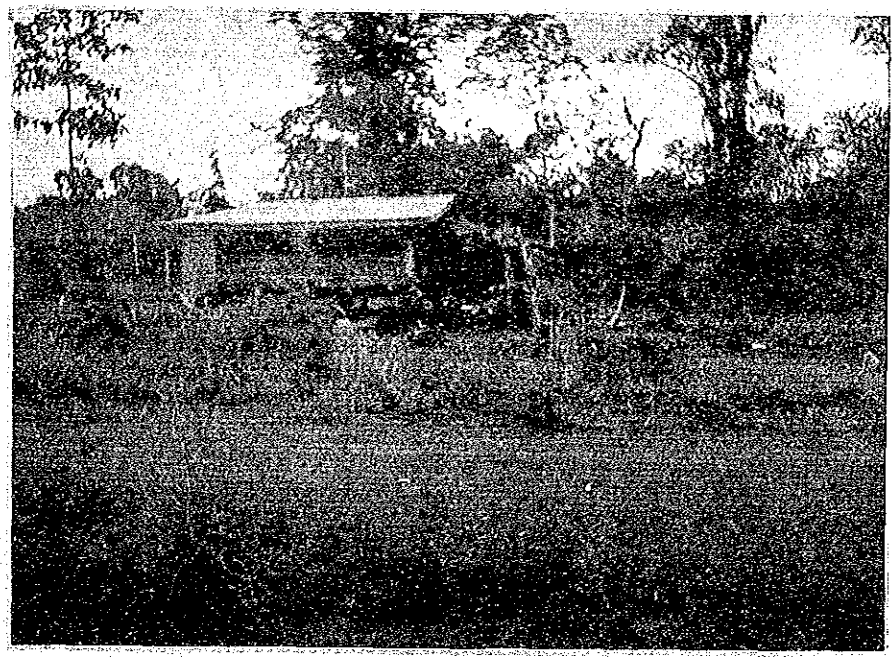


FIG·3·13 DWELLING MODEL OF TYPE 4

FIG·3·14 DWELLING MODEL OF TYPE 5

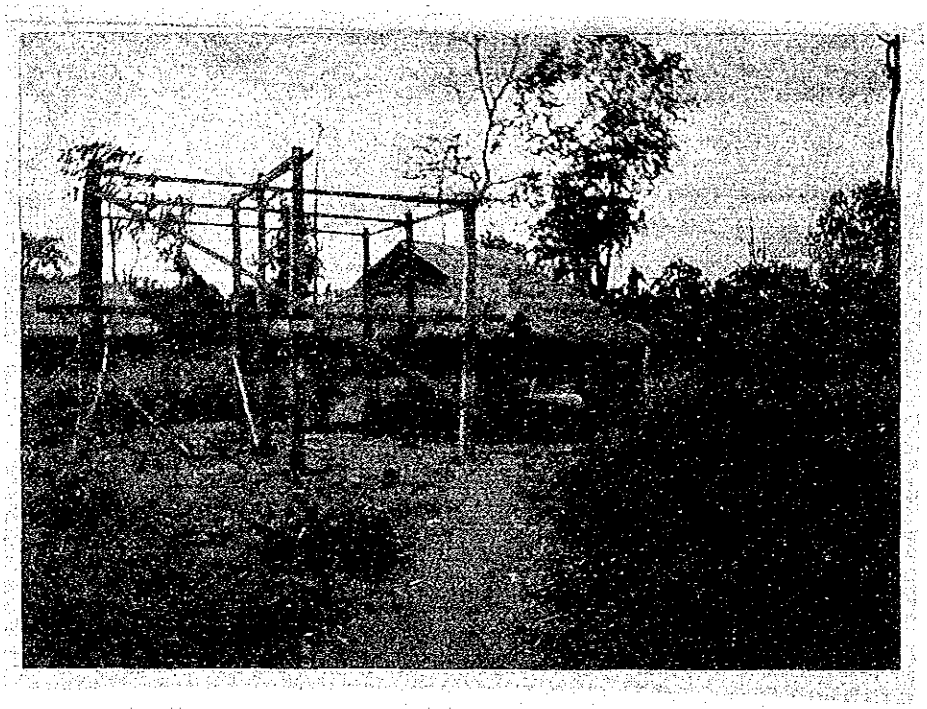


FIG·3·15 DWELLING MODEL OF TYPE 6



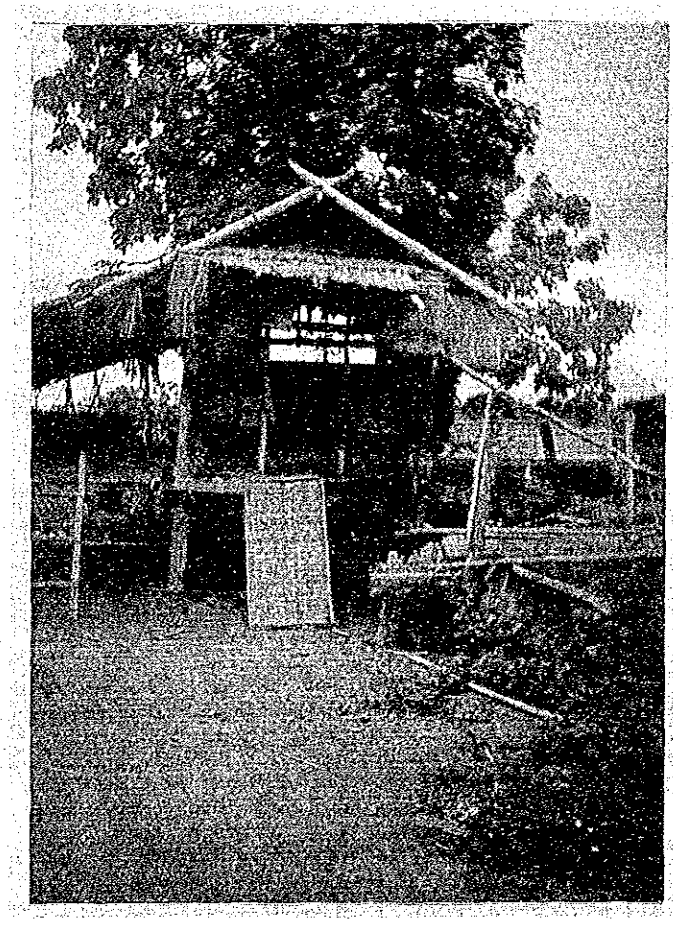
FIG·3·16 DWELLING MODEL OF TYPE 8

FIG·3·17 DWELLING MODEL OF TYPE 8



FIG·3·18 DWELLING MODEL OF TYPE 9

FIG·3·19 DWELLING MODEL OF TYPE 10

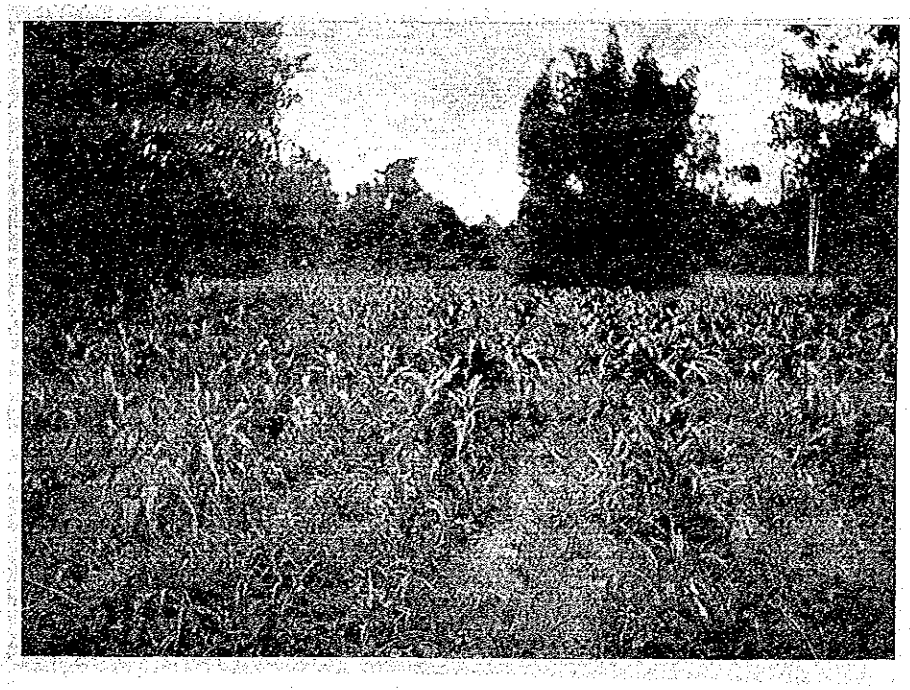


FIG·3·20 DWELLING MODEL OF TYPE 11

FIG·3·21 Paddy Field at Ban Tha Kan

FIG·3·22 Paddy Field at Khok Sakae

FIG·3·23 Cassava Cultivation, Ban Tha Khan



FIG·3·24 Maize Cultivation , Ban khok Sak ae

FIG 3-25 Groungnuts Cultivation, Ban Khlong Takrao

FIG 3-26 Sesame Cultivation at Ban Khlong Takrao

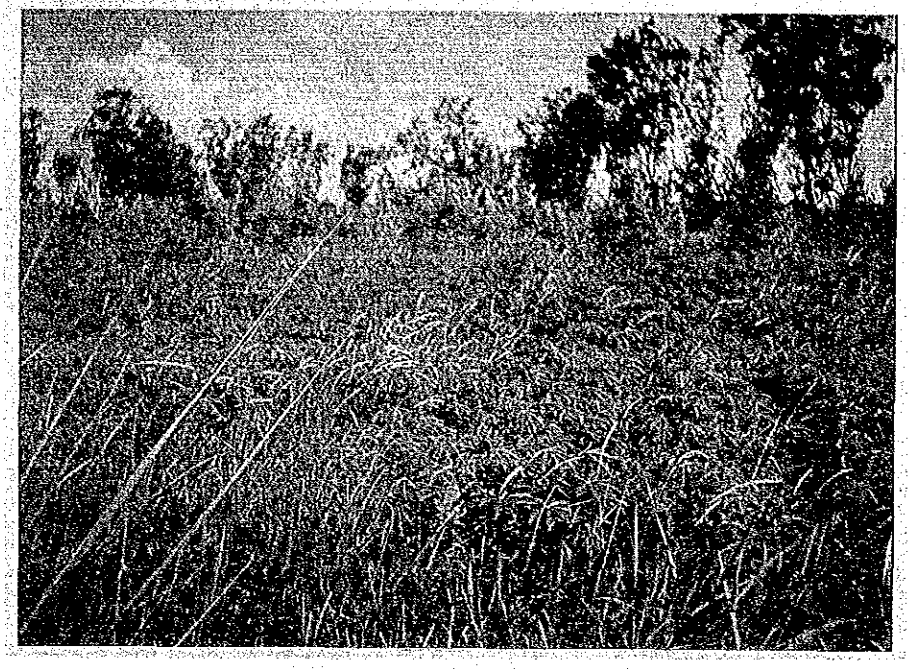


FIG-3-27 EUCALYPTUS at Ban Tha Khan

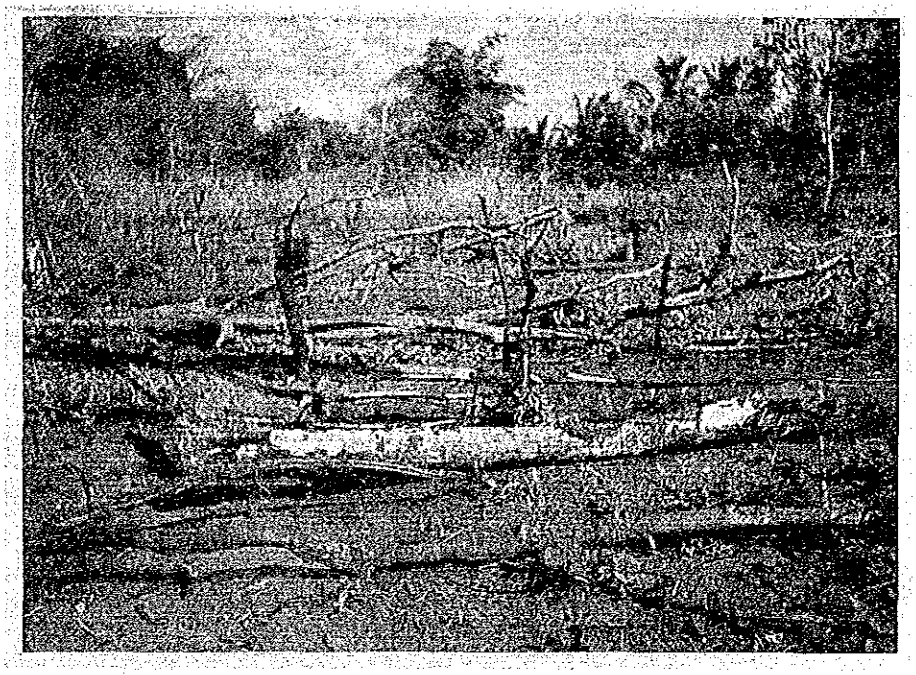
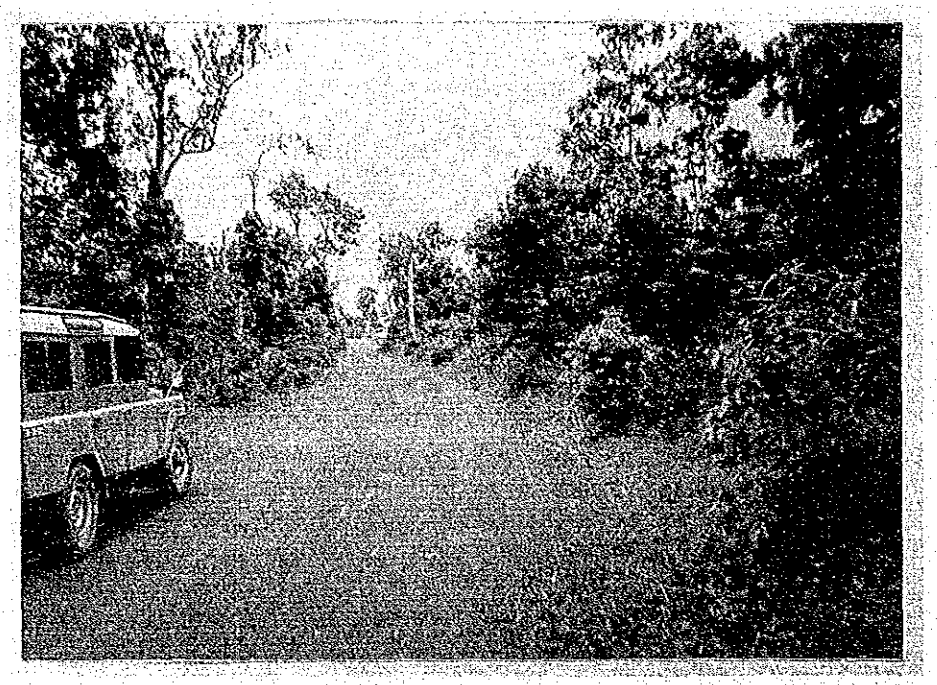
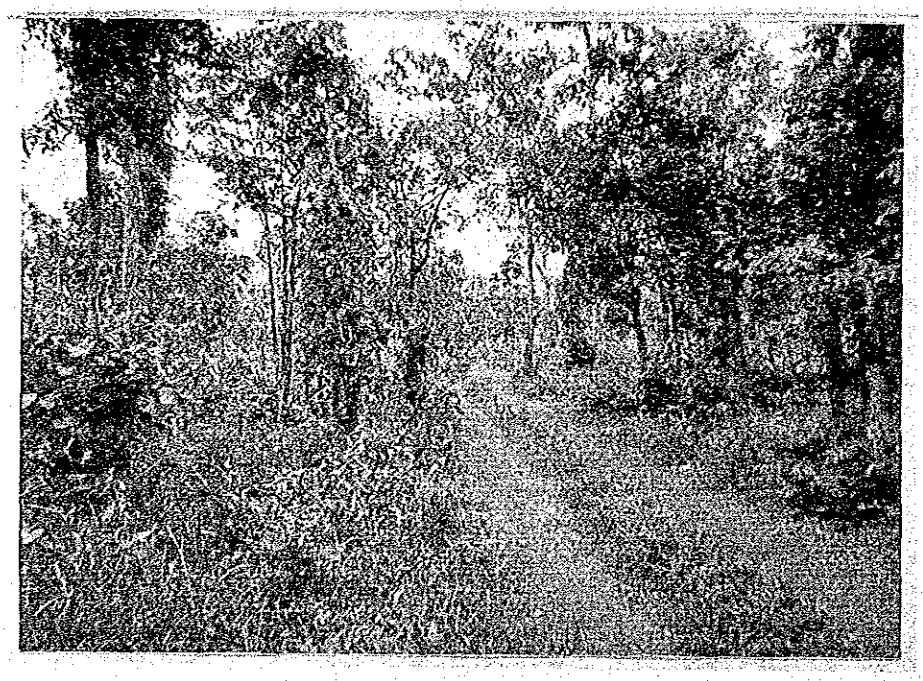


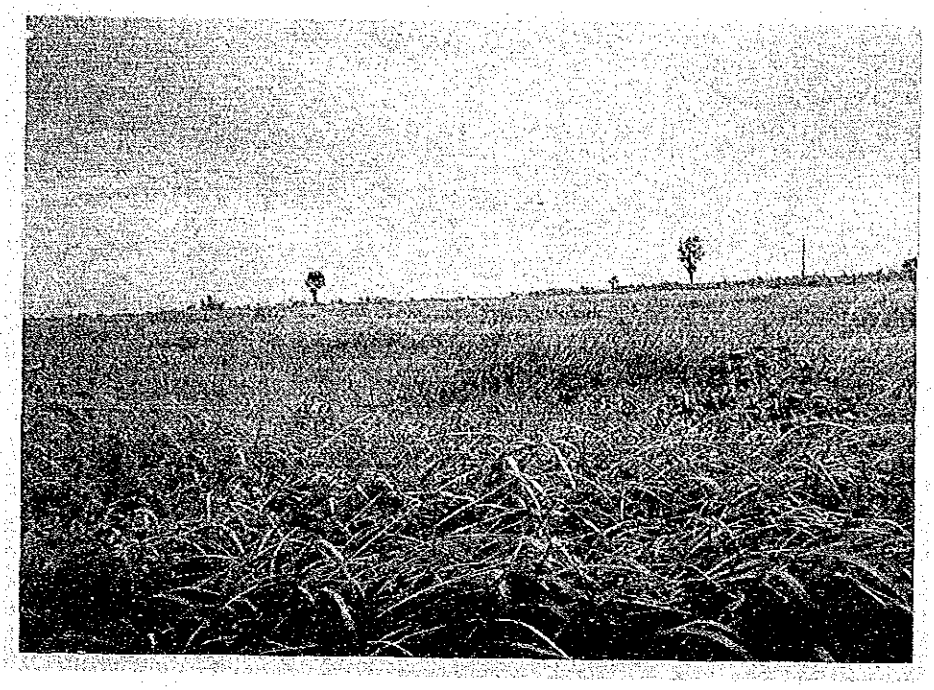
FIG-3-28 Cleaning Land at BAN Nok Khao



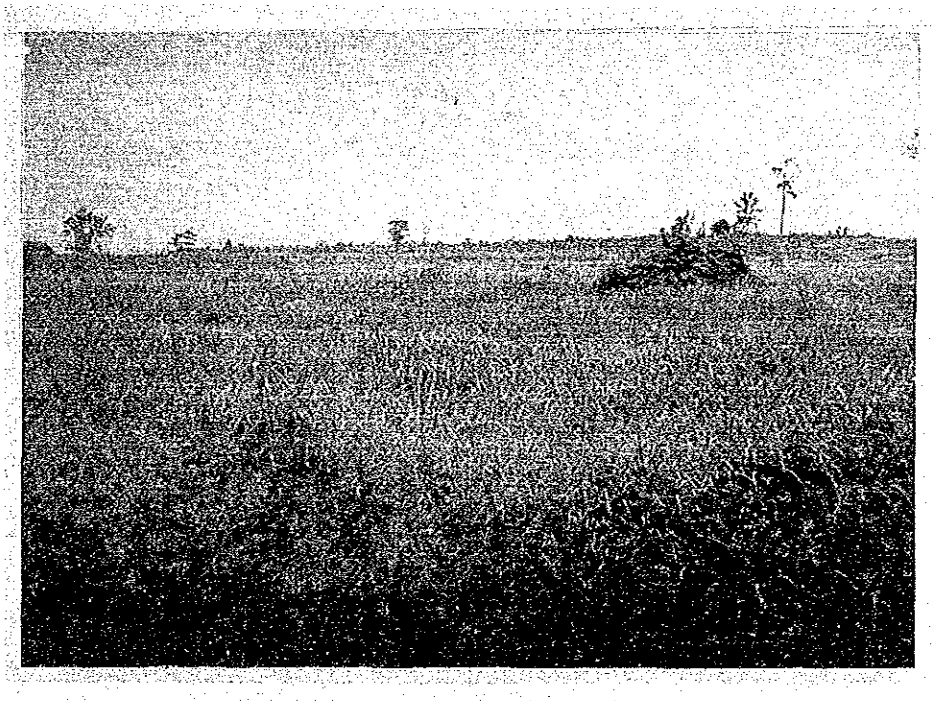
FIG·3·29 Reconnaisance Survey for Resettlement Area at Ban Nong Krating



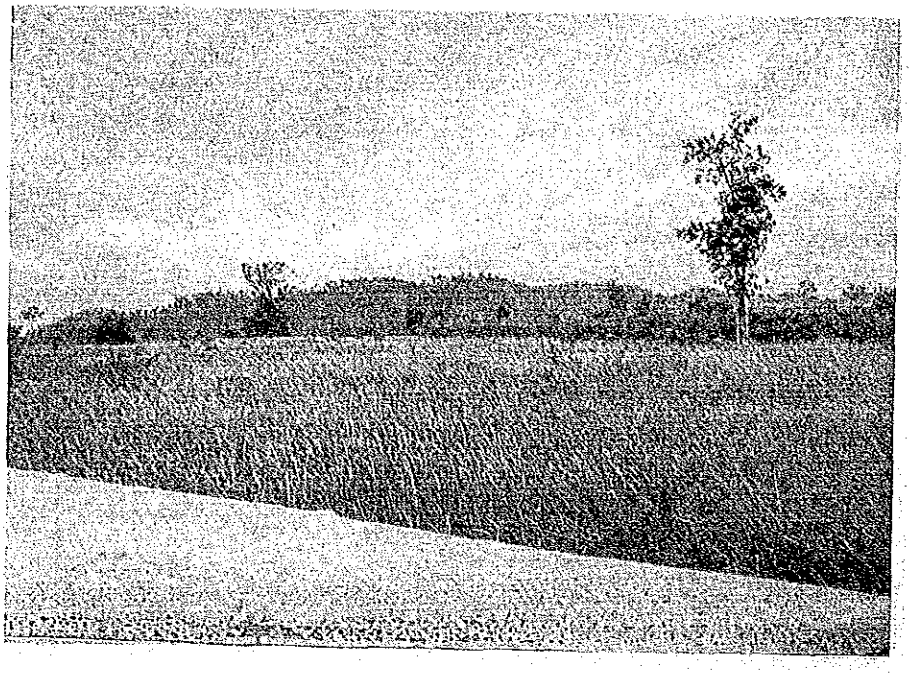
FIG·3·30 Reconnaisance Survey for Resettlement Area at Ban Nong Krating



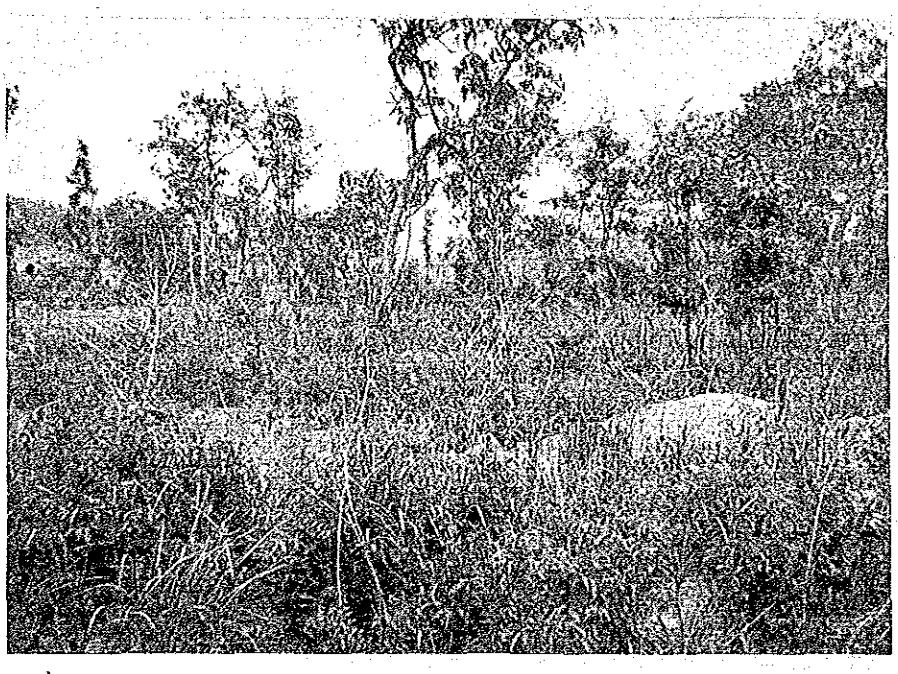
FIG·3·31 Reconnaisance Survey for Resettlement Area at Ban Nong Krating



FIG·3·32 Reconnaisance Survey for Resettlement Area at Ban Noug Krating



FIG·3·33 Reconnaisance Survey for Resettlement at Ban Nong Prayat



FIG·3·34 Reconnaisance Survey for Resettlement Area at Ban Nong Prayat

APPENDIX-J. ENVIRONMENTAL ASSESSMENT

APPENDIX-J. ENVIRONMENTAL ASSESSMENT

LIST OF CONTENTS

J.1 TASKS TO BE CARRIED OUT FOR ENVIRONMENTAL IMPACT ASSESSMENT OF SI YAT DAM AND BANG PAKONG DIVERSION

Environmental Component	Data Collection	Review	Field Observation	Field Survey	Data Analysis	Effect Evaluation	Recommendation
1. Physical Resources							
1.1 Climate	X	√	NN	NN	NN	√	√
1.2 Surface Water Hydrology	X	√	NN	NN	NN	√	√
1.3 Surface Water Quality	√	√	√	√	√	√	√
1.4 Ground Water	√	√	√	NN	√	√	√
1.5 Geology	X	√	√	NN	NN	√	√
1.6 Erosion/ Sedimentation	X	√	√	NN	PA	√	√
1.7 Soils in Reservoir Area	√	√	√	√	√	√	√
1.8 Soils in Resettlement	√	√	√	√	√	√	√
1.9 Soils in Irrigation Area	X	√	√	NN	NN	√	√
2. Ecological Resources							
2.1 Fisheries /Aquatic Biology	√	√	√	√	√	√	√
2.2 Forestry/Wildlife	√	√	√	√	√	√	√
3. Human Use Values							
3.1 Land Use in Reservoir	√	√	√	√	√	√	√
3.2 Irrigation/Water Supply	X	√	√	NN	PA	√	√
3.3 Land tansportation	√	√	√	NN	√	√	√
3.4 Navigation	√	√	√	NN	√	√	√
3.5 Mineral Resources	√	√	√	√	√	√	√
4. Quality of Life Values							
4.1 Socio-economic in Reservoir	√	√	√	√	√	√	√
4.2 Socio-economic in Irri. Area	X	√	√	NN	√	√	√
4.3 Compensation/ Resettlement	√	√	√	√	√	√	√
4.4 Public Health	√	√	√	√	√	√	√
4.5 Archaeology/ Tourism	√	√	√	√	√	√	√

Notes: X = Data available in the feasibility study
√ = Activities to be carried out by Envi. team
NN = Not necessary as work will be done by the feasibility study team
PA = Part of data might need further analysis for EIA

J. 2 LAND OWNERSHIP IN THAILAND

No.	Item	Item		Legal Ground	Existance of Certificate	Tax	Right			
		Land	Novable Properties				Use	Rent	Sale	Inheritrance
1	Title Deed	Yes	Yes	Land Code 1954	Yes	Yes	Full	Full	Full	C3
2	Pre-Registered Title Deed	Yes	Yes	Land Code 1954	Yes	Yes	Full	Full	Full	C3
3	Nor Sor 3	Yes	Yes	Land Code 1954	Yes	Yes	C1	Full	C2	C3
4	Sor Kor 1	Yes	Yes	Land Code 1954	Yes	Yes	C1	Full	C4	C4
5	Sor Tor kor	Yes (Conditional)	Yes	Gov. Agencies' permit *	Yes (permit)	Yes	Full	No	Full	Full
6	Por Bor Tor 5	Yes	Yes	No (Illegal)	no	Yes	Full	No	Full	No

Source : Land Ownership Sub-Division, Law and Land Division, RID

* Public Welfare Department ahs Royal Registration of Land Allocation for Cultivation (1972) and Forestory Department, MOA, has Royal Registration of Forestry for their ground of permittance.

C1 : Five years consecutive use is required.

C2 : Public notice for 30 days at the district office is required.

C3 : Public notice for 60 days at the district office is required.

C4 : Public notice for 60 days at the district office is required, and it will transfer the title to Nor Sor 3.

J.3 NEB's Water Quality Standard in Natural Stream

NEB's Water Quality Standard in Natural Stream (Excluded Sea Water)

Constituent	Unit	Classes of Water Quality based on Utilization				
		1	2	3	4	5
Salinity	ppt	ND	ND	ND	ND	ND
Dissolved Oxygen	ppm	N	6	4	2	ND
pH	-	N	5-9	5-9	5-9	ND
Eletrical Conductivity	µmhos/cm	←	< 750 [1]			→
Total Coliform Bacteria	MPN/100 ml	N	5,000	20,000	ND	ND
BOD	ppm	N	1.5	2.0	4.0	ND
NO_3 - N	ppm	N	5.0	5.0	5.0	ND
NH_3 - N	ppm	N	0.5	0.5	0.5	ND
Total Phosphorus	ppm	←	0.05 [2]			→
Total hardness as $CaCO_3$	ppm	←	300 [3]			→
Alkalinity as $CaCO_3$	ppm	←	> 20 [2]			→
Total Solid (T.S.)	ppm	←	< 1,500 [3]			→
Total Disssolved Solid	ppm	←	< 500 [4]			→
Suspended Solid (S.S.)	ppm	←	ND			→
Chloride (CL)	ppm	←	< 250 [3]			→
Heavy Metal Cu	ppm	N	0.1	0.1	0.1	ND
Zn	ppm	N	1.0	1.0	1.0	ND
Cd	ppm	N	←0.005 * , 0.05 **			→ ND
Cr	ppm	N	0.05	0.05	0.05	ND
Mn	ppm	N	1.0	1.0	1.0	ND
Pesticides:- α BHC	ppb	N	0.02	0.02	0.02	ND
Aldrin	ppb	N	0.1	0.1	0.1	ND
Heptachlor	ppb	N	0.2	0.2	0.2	ND
γ BHC	ppb	ND	ND	ND	ND	ND

Notes :
- N = Normal condition of natural water
- ND = Not defined
- * = For stream having less than 100 ppm hardness (as $CaCO_3$)
- ** = For stream having more than 100 ppm hardness (as $CaCO_3$)
- [1] = Irrigation water supply standard of RID
- [2] = USA's environmental standard
- [3] = Drinking water standard of MWA
- [4] = USA's public water supply standard

J.4 NEB's Water Quality Classification of Natural Stream

NEB's Water Quality Classification of Natural Stream

Class 1 : Water quality is still natural condition, without contamination from any activities, and it can be utilized for

- Drinking and domestic use with simple treatment facilities
- Natural breeding of primary aquatic life
- Conservation of aquatic eco-system

Class 2 : The stream with contamination from some activities, and can be utilized for

- Drinking and domestic use with normal treatment facilities
- Conservation of aquatic animals
- Fisheries
- Swimming and water sport

Class 3 : The stream with contamination from some activities, and can be utilized for

- Drinking and domestic use with normal treatment facilities
- Agriculture

Class 4 : The stream with contamination from some activities, and can be utilized for

- Drinking and domestic use with special treatment facilities
- Industry

Class 5 : The stream with contamination from some activities, and can be utilized for

- Navigation

J.5 PROPERTIES OF WATER SAMPLES FROM KHLONG SI YAT

Sampling No.	Item	pH	Conductivity (μmhos/cm)	TDS (ppm)	Turbidity (NTU)	Hardness (ppm $CaCO_3$)	Soluble Sodium (%)	Ca (ppm)	Mg (ppm)	Na (ppm)	HCO_3 (ppm)	SO_4 (ppm)	Cl (ppm)
1	Jun. 28, 1986	7.5	148	95	25	51	28	15	3	9	72	4	6
2	Jun. 22, 1986	6.7	95	61	110	33	31	9	2	7	42	7	5
3	Jun. 22, 1986	7.2	160	102	110	56	35	16	4	14	88	5	4
4	Jun. 22, 1986	6.5	99	63	100	37	29	10	3	7	48	6	5
5	Aug. 13, 1986	7.2	171	109	34	46	49	12.4	3.8	20.7	110.7	3.8	4.6
6	Sep. 28, 1986	6.8	112	72	22	43	26	12.0	3.3	6.9	53.1	1.0	6.7
7	Oct. 12, 1986	6.7	109	70	15	42	26	12.0	2.9	6.9	55.5	1.9	6.4

Source : Land Ownership Sub-Division, Law and Land Division, RID

Note : TDS = Total dissolved solids
ppm = parts per million

J.6 PROPERTIES OF WATER SAMPLES FROM BANG PAKONG RIVER (NEB)

TABLE J-6-1 PROPERTIES OF WATER SAMPLES FROM BANG PAKONG RIVER (1986)

(Year=1986)

Sample No.	pH	Conductivity (μmhos/cm)	DO (mg/l)	BOD (mg/l)	COD (mg/l)	Total Coliform (MPN/100ml)	Fecal Coliform (MPN/10ml)	Total P (mg/l)	Alkalinity (mg/l)	NH_3-N (mg/l)
1. Bang Pakong River										
1	7.47	17,991	4.68	1.41	47.05	2,463	235	0.015	57.63	0.314
2	7.45	11,116	4.69	1.98	38.20	4,448	1,170	0.016	44.03	0.189
3	7.33	9,616	4.29	0.95	16.57	3,825	935	0.031	40.78	0.025
4	7.29	9,147	4.30	1.78	21.67	6,763	9,200	0.026	36.40	0.049
5	7.23	7,986	4.18	0.92	23.19	5,095	1,310	0.021	35.30	0.109
6	7.15	6,630	4.20	0.88	15.33	5,118	910	0.026	38.80	0.105
7	7.12	5,854	4.20	1.03	14.07	12,625	960	0.018	32.68	0.138
8	7.25	7,346	4.10	1.06	15.23	3,703	2,705	0.021	32.48	0.129
9	7.21	4,616	4.18	0.61	15.49	4,660	1,205	0.032	34.21	-
10	7.17	3,463	4.61	0.88	13.24	1,783	198	0.028	35.78	-
11	7.18	3,465	4.61	0.89	12.90	10,180	1,678	0.024	37.50	0.050
12	7.22	3,085	4.86	0.42	12.97	1,810	125	0.038	38.70	0.140
13	7.21	2,831	4.50	0.93	14.14	1,558	155	0.029	37.48	0.013
14	7.17	2,081	4.55	0.59	9.83	1,865	140	0.018	33.68	0.010
15	7.26	723	4.61	0.65	8.57	1,028	960	0.010	36.71	0.005
16	7.19	375	4.83	0.81	13.59	3,305	220	0.032	33.00	0.065
2. Nakhon Nayok River										
1	7.27	356	4.04	1.04	17.80	2,475	2,945	0.005	28.38	0.135
2	6.78	121	3.61	0.84	8.62	2,918	1,270	0.007	11.48	0.375
3	6.67	116	2.70	0.88	11.80	2,598	275	0.013	7.00	0.123
4	6.50	146	2.58	0.88	6.33	13,367	4,195	0.009	8.96	0.010
3. Prachin River										
1	7.22	298	5.45	0.99	12.88	36,113	8,165	0.025	41.30	0.074
2	7.29	137	5.60	0.98	8.22	49,125	1,160	0.004	43.88	0.140
3	7.51	140	5.95	1.19	14.81	13,575	13,100	0.004	43.48	0.005
4	7.61	161	5.98	1.10	11.08	9,270	860	0.015	47.60	0.120

TABLE J-6-2 PROPERTIES OF WATER SAMPLES FROM BANG PAKONG RIVER (1987)

(Year=1987)

Sample No.	pH	Conductivity (μmhos/cm)	DO (mg/l)	BOD (mg/l)	COD (mg/l)	Total Coliform (MPN/100ml)	Fecal Coliform (MPN/10ml)	Total P (mg/l)	Alkalinity (mg/l)	NH_3-N (mg/l)
1. Bang Pakong River										
1	7.44	19,175	5.74	1.18	20.41	11,875	7,270	0.016	65.63	0.055
2	7.49	16,986	4.57	0.81	13.60	24,625	1,155	0.015	65.80	0.060
3	7.33	14,305	4.25	0.91	14.60	1,050	735	0.007	53.28	-
4	7.31	13,255	4.29	0.98	31.75	7,443	1,385	0.025	49.98	0.020
5	7.26	11,176	3.89	0.98	27.05	10,325	1,273	0.012	42.90	0.034
6	7.21	9,216	3.72	0.71	26.80	3,585	1,115	0.011	39.33	0.025
7	7.21	8,451	3.75	0.83	23.10	12,300	3,533	0.015	45.05	0.035
8	6.94	7,115	4.40	0.85	14.80	5,253	3,023	0.020	45.75	-
9	7.01	5,911	4.79	0.85	15.05	2,225	1,110	0.030	36.10	0.005
10	7.02	4,482	5.11	0.62	23.23	10,693	660	0.013	43.59	0.024
11	7.11	4,356	5.25	0.70	22.30	5,785	845	0.009	42.70	-
12	7.05	3,630	5.00	0.53	21.63	1,170	555	0.009	44.05	0.009
13	7.19	3,025	4.97	0.80	21.98	1,733	293	0.015	41.15	-
14	7.18	1,654	5.35	1.25	16.91	1,698	365	0.009	40.42	0.020
15	7.23	428	5.65	0.75	13.98	1,455	248	0.010	36.95	-
16	7.21	197	5.63	1.03	12.09	8,553	200	0.015	37.88	0.040
2. Nakhon Nayok River										
1	6.77	182	4.94	0.90	22.00	2,098	255	0.021	35.81	0.030
2	6.42	170	4.50	0.85	11.00	2,125	245	0.040	22.60	0.079
3	6.21	169	4.30	0.89	11.00	1,683	148	0.031	13.04	0.060
4	6.08	171	3.40	1.19	9.80	2,943	200	0.019	9.80	0.055
3. Prachin River										
1	7.45	247	6.06	0.94	12.00	3,673	1,828	0.004	47.44	0.043
2	7.34	172	6.08	0.70	-	2,090	880	0.067	60.88	0.010
3	7.38	131	5.96	0.86	10.00	2,225	1,175	0.011	57.80	0.060
4	7.26	149	6.10	0.45	-	5,350	725	0.020	56.50	0.051
5	8.10	28	6.00	1.00	11.00	5,400	1,700	0.010	14.00	0.100
6	7.47	100	6.00	1.65	11.00	-	-	0.010	57.45	0.065

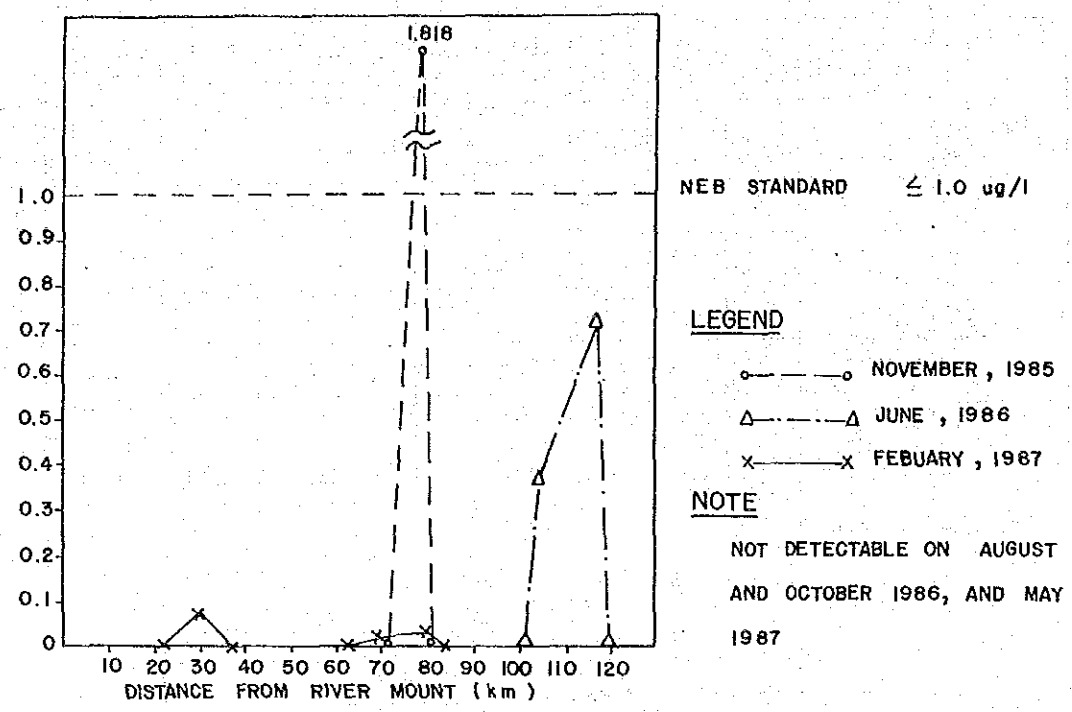


Figure J-6-1 DDT CONCENTRATION VALUE DURING 1985-1987

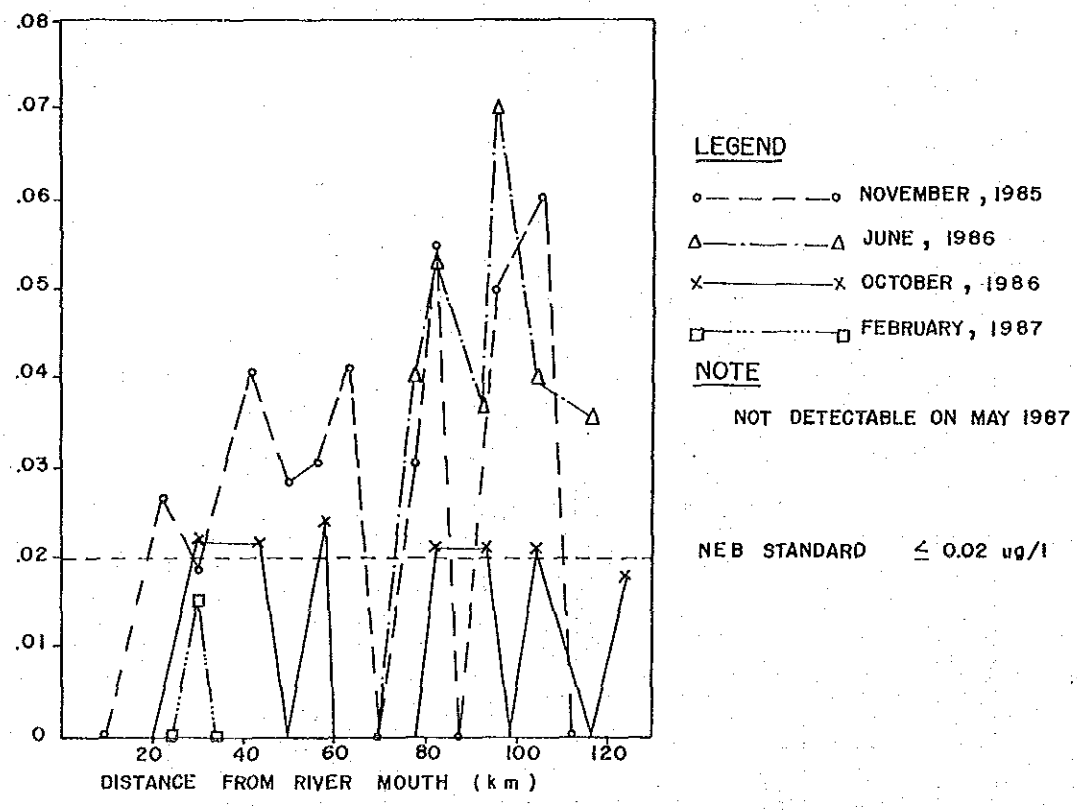


Figure J-6-2 α-BHC CONCENTRATION VALUE DURING 1985-1987

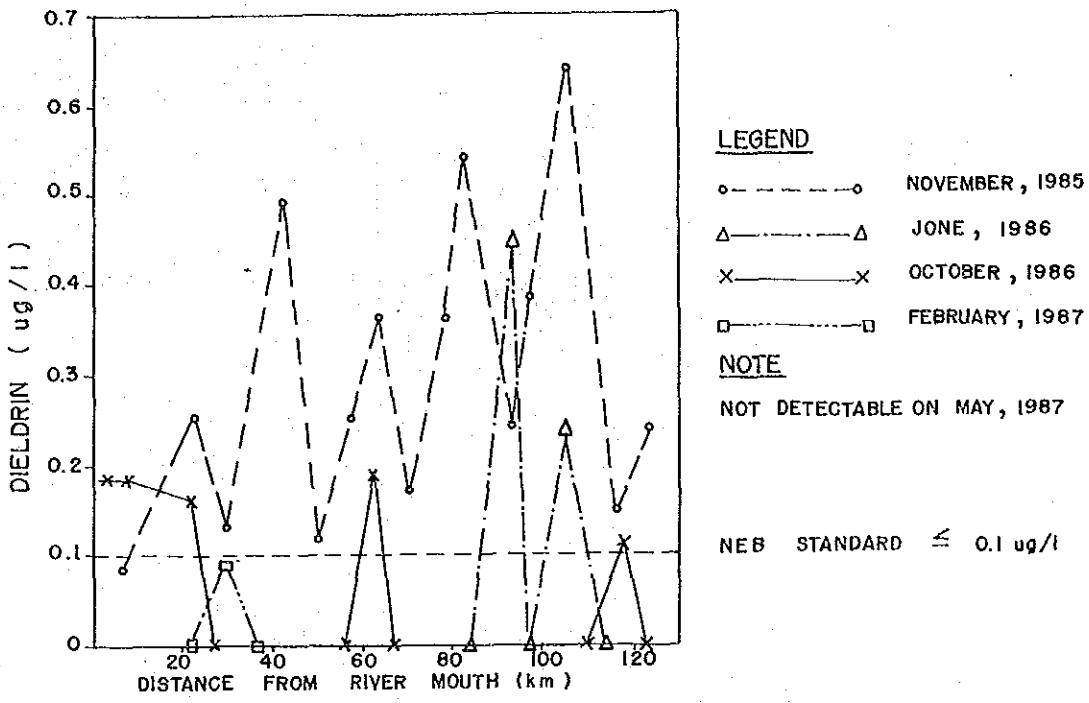


Figure J-6-3 DIELDRIN CONCENTRATION VALUE DURING 1985-1987

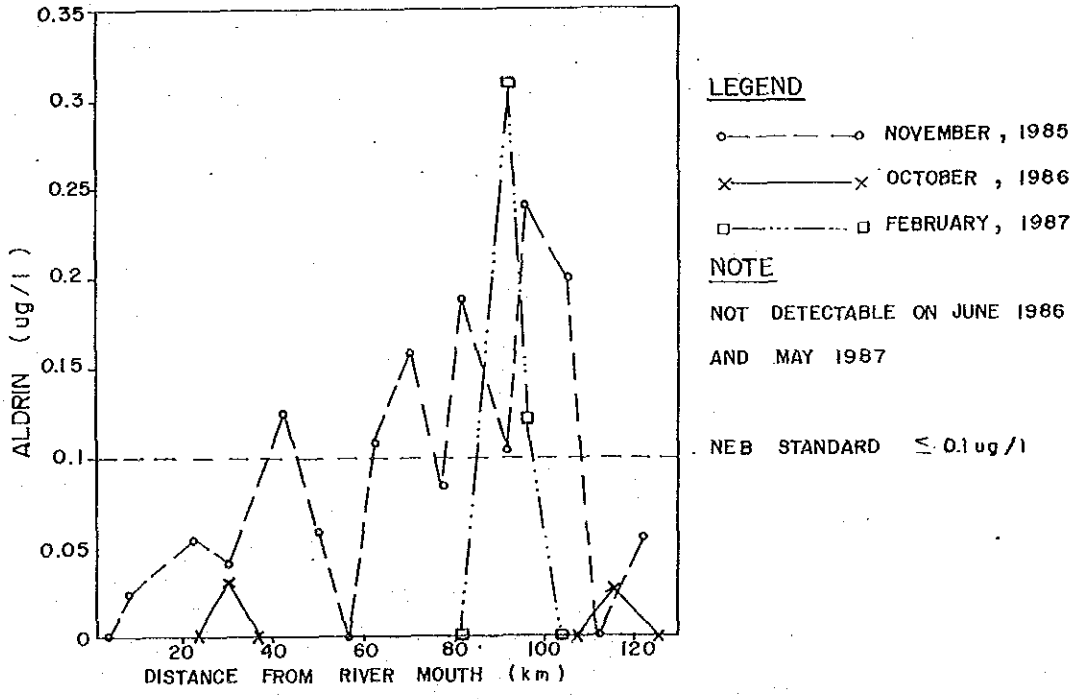


Figure J-6-4 ALDRIN CONCENTRATION VALUE DURING 1985-1987

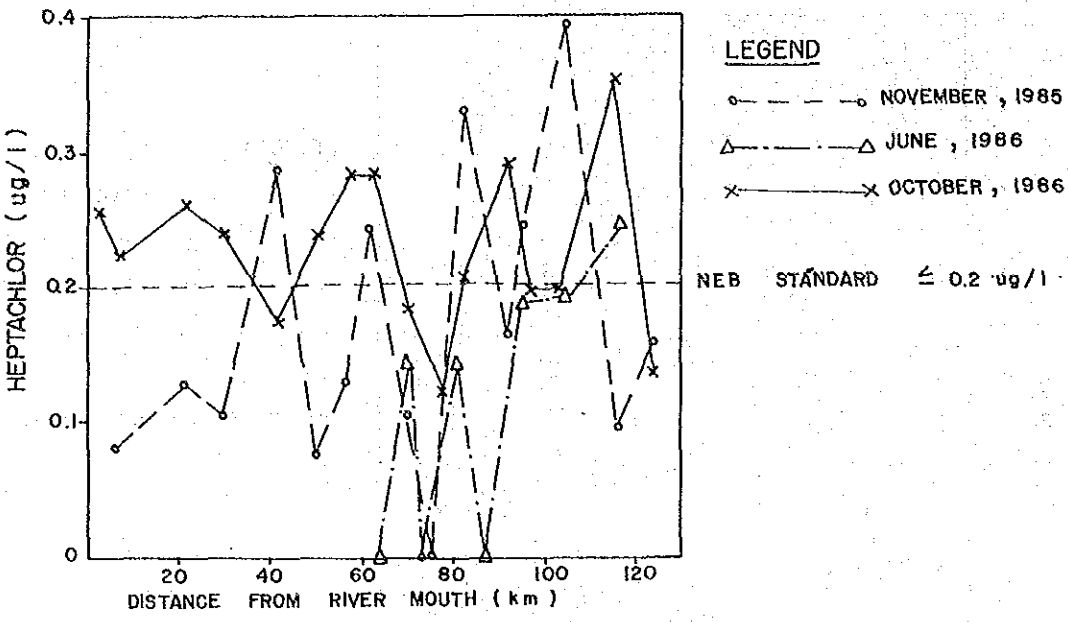


Figure J-6-5 HEPTACHLOR CONCENTRATION DURING 1986-1986

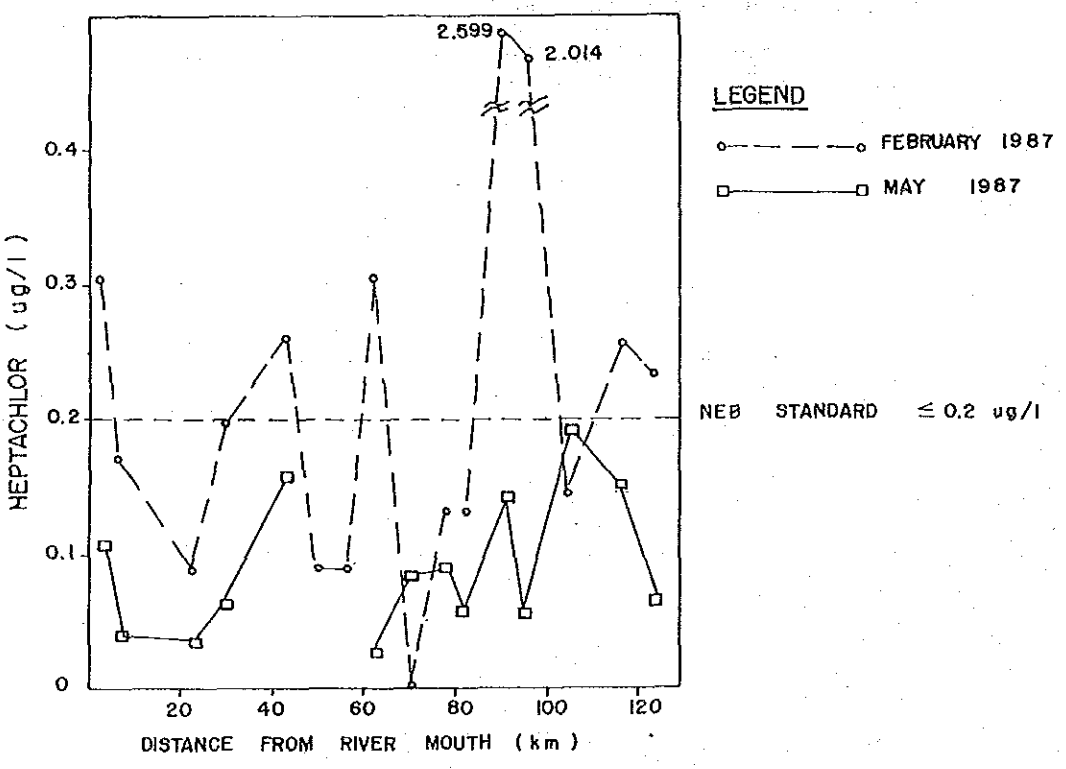


Figure J-6-6 HEPTACHLOR CONCENTRATION IN 1987

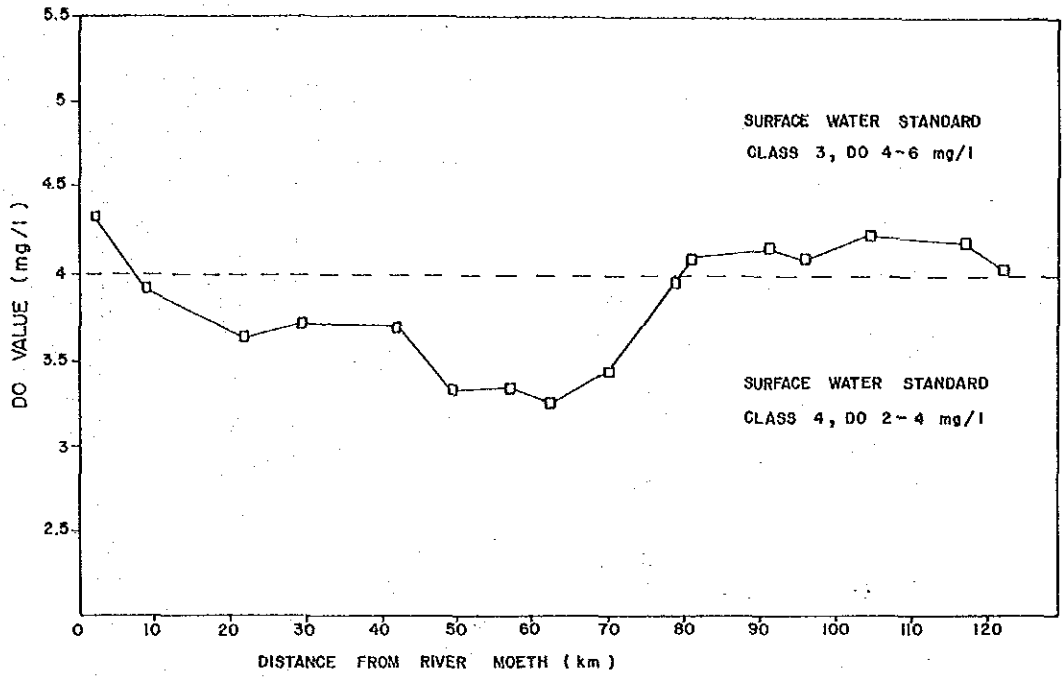


Figure J-6-7 DISSOLVED OXYGEN VALUE AT PERCENTILE 20 IN BANG PAKONG RIVER

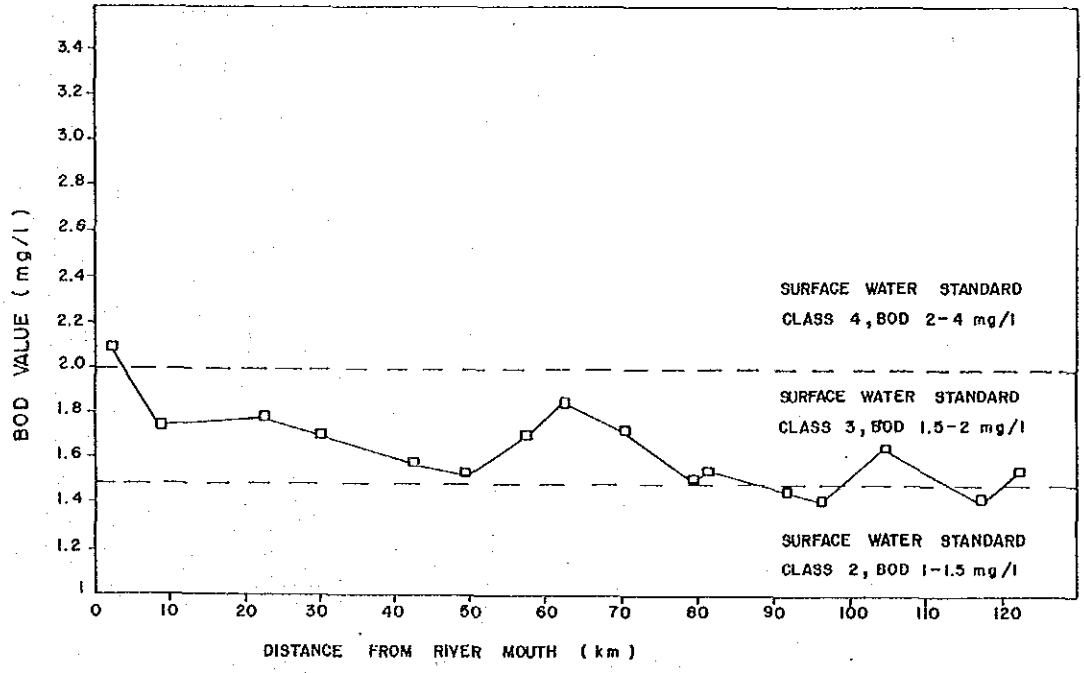


Figure J-6-8 BOD VALUE AT PERCENTILE 80 IN BANG PAKONG RIVER (1981-1987)

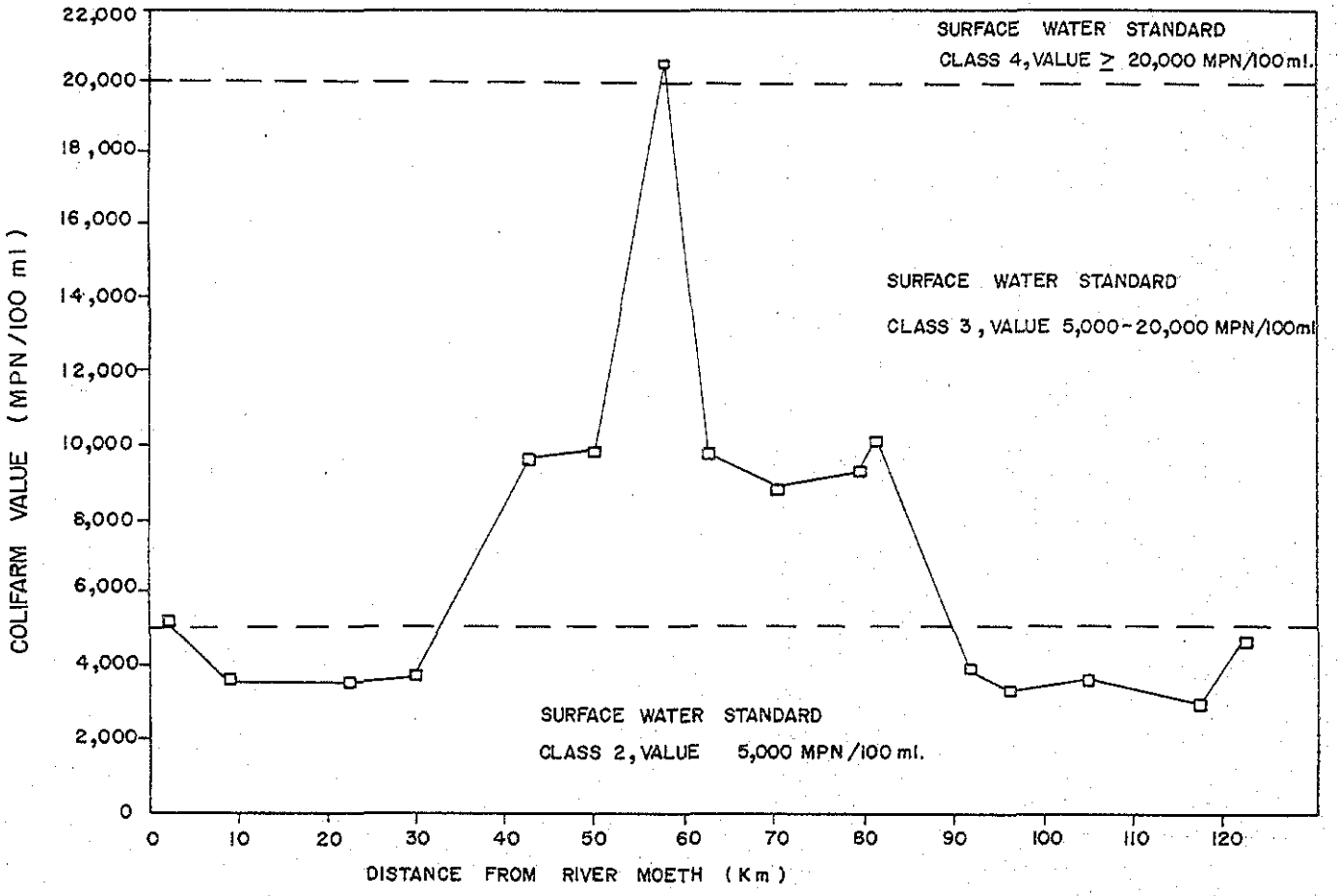


Figure J-6-9 TOTAL COLIFORM BACTERIA VALUE AT PERCENTILE 20 (1981-1987)

J.7 Properties of Water Samples from Bang Pakong River (JICA)

Table J-7-1 Result of Water Quality Survey (1)

Results of Water Quality Survey in Bang Pakong River
December 20, 1989

Constituent		Sampling Station No.			
		1	2	3	4
Salinity	ppt.	0.0163	0.0172	0.0185	0.055
Dissolved Oxygen	ppm.	6.1	6.0	4.9	4.3
Hydrogen ion activity (pH)	-	7.0	7.0	6.7	6.7
Electrical Conductivity μmhos/cm at 25°C		166	172	207	304
Biochemical Oxygen demand (BOD5)	ppm.	0.74	1.02	0.88	0.61
NO3 - N	ppm.	0.18	0.19	0.34	0.56
NH3 - N	ppm.	0	0	0	0
Total dissolved Phosphorus	ppm.	trace	0.01	0.01	0.07
Total hardness as CaCO3	ppm.	43.0	43.0	42.5	47.5
Alkalinity as CaCO3	ppm.	26.0	24.0	19.5	21.0
Total Solid (T.S.)	ppm.	264	256	244	668
Total Dissolved Solid (T.D.S)	ppm.	122	126	152	202
Suspended Solid (S.S.)	ppm.	142	130	92	466
Chloride (Cl)	ppm.	15.6	16.7	25.2	46.4
Heavy Metal :- Cu	ppm.	0.006	0.003	0.002	0.008
Zn	ppm.	0.013	0.013	0.005	0.013
Cd	ppm.	0	0	0	0
Cr	ppm.	0.015	0.022	0.005	0.013
Mn	ppm.	0.074	0.090	0.067	0.098

Results of Water Quality Survey in Bang Pakong River
January 9, 1990

Constituent		Sampling Station No.			
		1	2	3	4
Salinity	ppt.	0.850	1.326	6.000	12.500
Dissolved Oxygen	ppm.	6.7	6.7	6.1	6.2
Hydrogen ion activity (pH)	-	6.7	6.9	7.3	7.7
Electrical Conductivity μmhos/cm at 25°C		1,560	2,530	8,910	20,500
Biochemical Oxygen demand (BOD5)	ppm.	2.18	1.38	1.36	1.37
NO3 - N	ppm.	0.92	1.04	1.02	0.82
NH3 - N	ppm.	0	0	0	0
Total dissolved Phosphorus	ppm.	0.04	0.04	0.05	0.03
Total hardness as CaCO3	ppm.	167.1	264.7	920.8	2075.4
Alkalinity as CaCO3	ppm.	35.5	35.5	46.0	63.6
Total Solid (T.S.)	ppm.	1308	2072	6044	13630
Total Dissolved Solid (T.D.S)	ppm.	984	1578	5950	13554
Suspended Solid (S.S.)	ppm.	324	494	94	76
Chloride (Cl)	ppm.	427.3	690.4	2770.5	6527.5
Heavy Metal :- Cu	ppm.	0	0	0	0
Zn	ppm.	0	0	0.003	0
Cd	ppm.	0	0	0.001	0.001
Cr	ppm.	0	0.024	0.015	0.008
Mn	ppm.	0.006	0.003	0.014	0.021
Pesticides : BHC	ppb.	NM	0.0111	NM	0.0317
Aldrin	ppb.	NM	0.2673	NM	0.2828

Notes : NM = No Measurement

Table J-7-2 Result of Water Quality Survey (2)

Results of Water Quality Survey in Bang Pakong River
February 7, 1990

Constituent		Sampling Station No.			
		1	2	3	4
Salinity	ppt.	13.550	15.163	18.603	20.900
Dissolved Oxygen	ppm.	4.5	4.7	4.6	4.7
Hydrogen ion activity (pH)	-	7.3	7.4	7.3	7.4
Electrical Conductivity μmhos/cm at 25 ℃		21,000	22,900	28,600	33,500
Biochemical Oxygen demand (BOD5)	ppm.	1.04	1.58	1.63	2.19
NO3 - N	ppm.	1.69	1.81	1.15	1.04
NH3 - N	ppm.	0	0	0	0
Total dissolved Phosphorus	ppm.	0	0	0	0
Total hardness as CaCO3	ppm.	2394.6	2572.8	3337.0	3897.5
Alkalinity as CaCO3	ppm.	61.5	66.6	75.1	85.1
Total Solid (T.S.)	ppm.	15,180	16,450	21,800	25,860
Total Dissolved Solid (T.D.S)	ppm.	14,600	16,190	21,140	25,300
Suspended Solid (S.S.)	ppm.	580	260	660	560
Chloride (Cl)	ppm.	6153.4	6652.3	8396.9	10227.7
Heavy Metal :- Cu	ppm.	0.012	0.014	0.019	0.019
Zn	ppm.	0.017	0.023	0.022	0.024
Cd	ppm.	0.020	0.020	0.002	0.001
Cr	ppm.	0.030	0.034	0.037	0.025
Mn	ppm.	0.014	0.017	0.025	0.029

Results of Water Quality Survey in Bang Pakong River
March 8, 1990

Constituent		Sampling Station No.			
		1	2	3	4
Salinity	ppt.	17.409	17.971	20.919	23.446
Dissolved Oxygen	ppm.	5.6	6.2	5.7	5.6
Hydrogen ion activity (pH)	-	7.2	7.3	7.4	7.1
Electrical Conductivity μmhos/cm at 25 C		26,700	28,300	28,500	35,900
Biochemical Oxygen demand (BOD5)	ppm.	0.59	1.68	2.80	2.72
NO3 - N	ppm.	1.43	1.50	1.32	1.04
NH3 - N	ppm.	0	0	0	0
Total dissolved Phosphorus	ppm.	0	0	0	0
Total hardness as CaCO3	ppm.	2965.17	3077.27	3311.48	4187.77
Alkalinity as CaCO3	ppm.	65.06	66.56	69.56	80.07
Total Solid (T.S.)	ppm.	18,250	18,800	20,270	25,880
Total Dissolved Solid (T.D.S)	ppm.	18,190	18,700	20,170	25,690
Suspended Solid (S.S.)	ppm.	60	100	100	190
Chloride (Cl)	ppm.	8597.99	8855.78	9562.50	12456.4
Heavy Metal :- Cu	ppm.	0.014	0.020	0.017	0.024
Zn	ppm.	0.049	0.048	0.066	0.094
Cd	ppm.	0.050	0.050	0.025	0.025
Cr	ppm.	0.027	0.022	0.029	0.041
Mn	ppm.	0.017	0.019	0.018	0.029

Table J-7-3 Result of Water Quality Survey (3)

Results of Water Quality Survey in Bang Pakong River

May 3, 1990

Constituent		Sampling Station No.			
		1	2	3	4
Salinity	ppt.	15.303	15.724	19.305	22.253
Dissolved Oxygen	ppm.	4.3	4.8	3.2	3.2
Hydrogen ion activity (pH)	-	7.00	7.04	6.86	6.75
Electrical Conductivity EC x 10^6 at 25 C		21,800	22,400	27,500	31,700

Results of Water Quality Survey in Bang Pakong River

April 28, 1990

Constituent		Sampling Station No.			
		1	2	3	4
Salinity	ppt.	13.325	13.950	18.252	21.130
Dissolved Oxygen	ppm.	5.4	5.3	4.6	3.8
Hydrogen ion activity (pH)	-	7.28	7.05	6.36	6.52
Electrical Conductivity EC x 10^6 at 25 C		19,100	19,900	16,000	30,100
Pesticides : BHC	ppb.	NM	0.1374	NM	0.1257
Heptachlor	ppb.	NM	0.0468	NM	0
Aldrin	ppb.	NM	0.0923	NM	0.1720
BHC	ppb.	NM	0	NM	0.3366

Results of Water Quality Survey in Bang Pakong River

June 5, 1990

Constituent		Sampling Station No.			
		1	2	3	4
Salinity	ppt.	1.008	1.292	3.48	6.20
Dissolved Oxygen	ppm.	8.2	8.0	6.3	4.9
Hydrogen ion activity (pH)	-	7.5	7.9	7.0	6.9
Electrical Conductivity EC x 10^6 at 25 C		2,000	2,550	5,950	9,700

Table J-7-4 Result of Water Quality Survey (4)

Result of Water Quality Survey in Bang Pakong River
April 20, 1990

Constituent		Sampling Station No.			
		1	2	3	4
Salinity	ppt	13.325	13.950	18.252	21.130
Dissolved Oxygen	ppm	5.4	5.3	4.6	3.8
Hydrogen ion activity (pH)	-	7.28	7.05	6.36	6.52
Eletrical Conductivity	μmhos/cm	19,900	21,300	27,100	31,900
Biochemical Oxygen demand (BOD_5)	ppm	0.64	3.37	1.60	0.90
No_3 - N	ppm	0.87	1.30	1.89	1.88
NH_3 - N	ppm	0	0	0	0
Total Phosphorus	ppm	0.09	0.12	0.12	0.08
Total hardness as $CaCO_3$	ppm	2,343.6	2,496.2	3,209.4	3,872.0
Alkalinity as $CaCO_3$	ppm	36.5	51.0	62.0	73.1
Total Solid (T.S.)	ppm	13,280	14,450	18,940	22,940
Total Dissolved Solid (T.D.S)	ppm	13,020	14,230	18,720	22,610
Suspended Solid (S.S.)	ppm	260	220	220	330
Chloride (CL)	ppm	6,580.3	7,007.6	9,058.6	10,938.7
Heavy Metal Cu	ppm	0.022	0.023	0.032	0.040
Zn	ppm	0.002	0.015	0.017	0.032
Cd	ppm	0.003	0.001	0	0.001
Cr	ppm	0.040	0.050	0.046	0.046
Mn	ppm	0.024	0.028	0.045	0.048
Pesticides : α BHC	ppb	NM	0.1374	NM	0.1257
Heptachlor	ppb	NM	0.0468	NM	0
Aldrin	ppb	NM	0.0923	NM	0.1720
γ BHC	ppb	NM	0	NM	0.3366

Notes : NM - No. Measurement

Table J-7-5 Result of Water Quality Survey (5)

Result of Water Quality Survey in Bang Pakong River
May 3, 1990

Constituent		Sampling Station No.			
		1	2	3	4
Salinity	ppt	15.303	15.724	19.305	22.253
Dissolved Oxygen	ppm	4.3	4.8	3.2	3.2
Hydrogen ion activity (pH)	-	7.00	7.04	6.86	6.75
Eletrical Conductivity	μmhos/cm	21,600	22,200	27,700	31,600
Biochemical Oxygen demand (BOD_5)	ppm	0.40	0.32	0.80	1.04
NO_3 - N	ppm	1.33	1.29	1.61	1.19
NH_3 - N	ppm	0	0	0	0
Total Phosphorus	ppm	0.08	0.09	0.15	0.12
Total hardness as $CaCO_3$	ppm	2,547.3	2,649.4	3,158.8	3,718.8
Alkalinity as $CaCO_3$	ppm	43.54	45.54	55.05	64.06
Total Solid (T.S.)	ppm	15,455	16,095	20,890	23,945
Total Dissolved Solid (T.D.S)	ppm	15,295	16,040	20,490	23,920
Suspended Solid (S.S.)	ppm	160	55	400	25
Chloride (CL)	ppm	7,434.9	7,605.8	9,400.4	11,280.5
Heavy Metal Cu	ppm	0.033	0.026	0.033	0.044
Zn	ppm	0.025	0.005	0.011	0.101
Cd	ppm	0.002	0.006	0.006	0.007
Cr	ppm	0.038	0.047	0.046	0.045
Pb	ppm	0	0	0	0
Mn	ppm	0.030	0.033	0.033	0.040