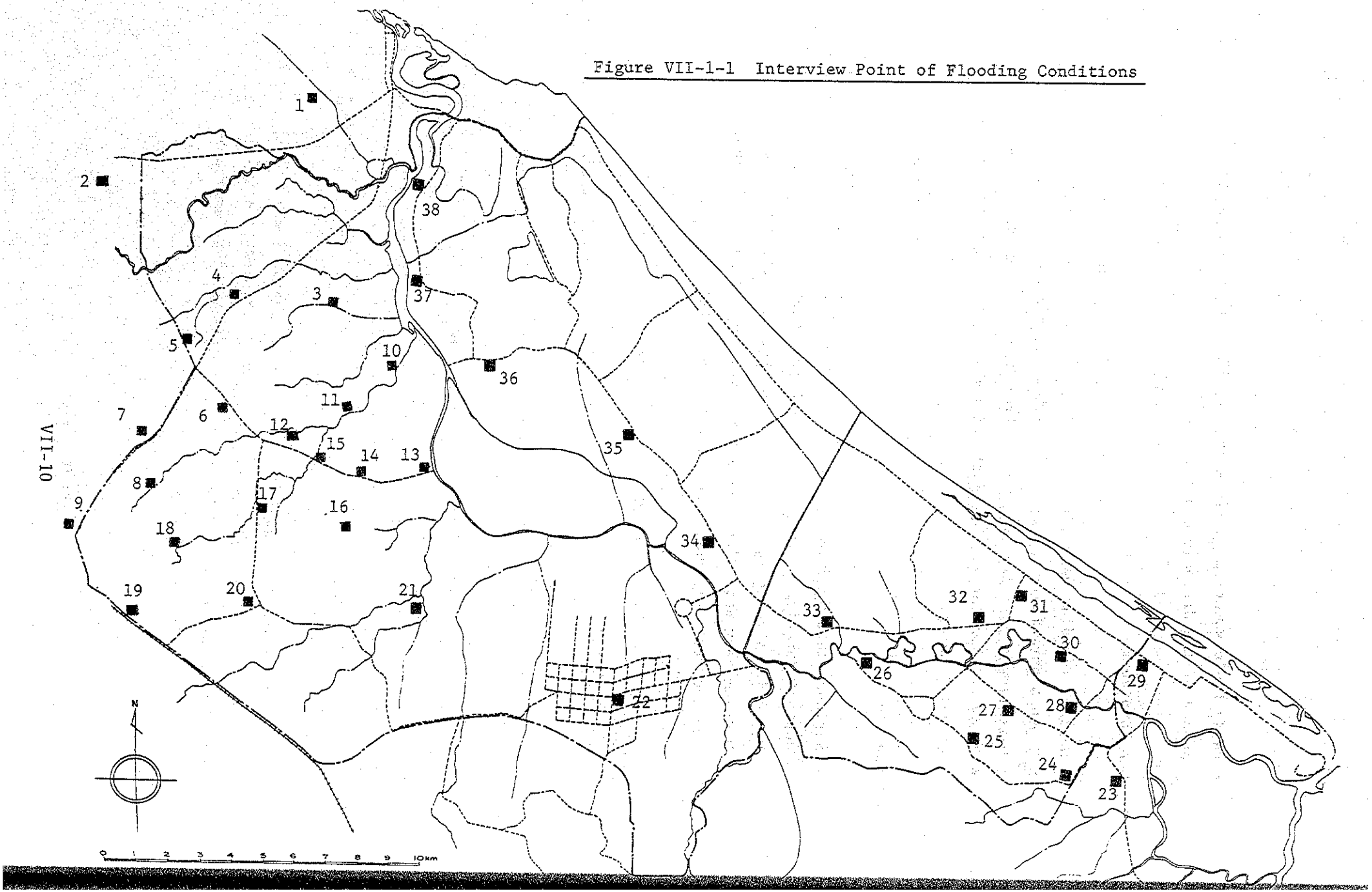


Figure VII-1-1 Interview Point of Flooding Conditions

Table VII-2-1 Medium Scale Irrigation Project

No.	Project	Type	Project's Area (ha)	Construction in	Budget Allocated(Baht)	Size of Structure
(1)	Klaiban Project					
(i)	Ton Phikun	Drainage and Conservation	1,280	1980	1,800,000	Drainage canal : Bottom width 2.00 m, Depth 2.8 m, Length 8.3 km
(ii)	Sa Pi Yo	"	160	1981	1,931,000	Regulator : 2.0 m x 2.0 m x 2 gates
(iii)	Ya Bi	"	320	1982	3,195,300	Regulator : 2.0 m x 2.0 m x 2 gates, Drainage Canal : W = 2.0 m , D = 2.5 m, L = 2.8 km
	* Above mentioned, projects which were constructed in early stage as a Small Scale Irrigation Project are merged in the Klaiban Medium Scale Irrigation Project which is mentioned below.					
(iv)	Klaiban	Storage and Irrigation	3,200	1982 - 1983	25,035,000	Reservoir : Catchment area 4.5km^2 Effective capacity 2.72 MCM Dam : H = 5.00 m, L = 663 m Crest W = 6.0 m
	* On-farm facilities are due to be completed in 1986.					

No.	Project	Type	Project's Area (ha)	Construction in	Budget Allocated(Baht)	Size of Structure
						Irrigation Canal : Right main; Concrete lining ° W=1.2 m, D=0.9 m, S=1:1.5, L=0.555 km ° W=0.8 m, D=0.8 m, S=1:1.5, L=4.500 km Left main; Concrete lining ° W=1.2 m, D=0.9 m, S=1:1.5, L=0.610 km ° W=0.8 m, D=0.8 m, S=1:1.5, L=1.800 km
(2)	Nam Baeng	Drainage and Conservation	8,000	1977 - 1983	50,000,000	Regulator : W = 6.0 m, H = 3.5 m, 3 gates

No.	Project	Type	Project's Area (ha)	Construction in	Budget Allocated(Baht)	Size of Structure
						Canal : W = 45.0 m, D = 4.0 m, L = 8.388 km
(3)	Pileng	Drainage and Conservation	5,120	1982 - 1986	155,000,000	Flood protection dike : L = 25.6 km ° Completed: 11.0 km ° Construction in 1985 - 1986 : 14.6 km Regulator : 4 places ° No.1 W=6.0m, H=5.0m, 2 gates ° No.3 W=2.4m, H=2.0m, 3 gates ° No.5 W=2.4m, H=2.0m, 3 gates ° No.7 W=6.0m, H=5.0m, 3 gates

No.	Project	Type	Project's Area (ha)	Construction in	Budget Allocated(Baht)	Size of Structure
						Drainage Canal : L = 33.695 km ° No.1(Khlong Pileng) L=6.256 km ° No.2(Newly digging) L=5.5 km ° No.3(Khlong Airong) L=4.088 km ° No.4(Newly digging) L=3.112 km ° No.5(Newly digging) L=4.099 km ° No.6(Newly digging) L=5.876 km ° No.7(Khlong Chuap) L=4.764 km

Table VII-2-2 Small Scale Irrigation Project

No.	Project	Type	Project's Area (ha)	Construction in	Budget Allocated(Baht)	Size of Structure
(1)	Khao Tan Yong	Fisheries	N.A.	1978	1,186,600	Weir: H=1.5m, L=10.0m, 11 places Canal: L=4.7 km
(2)	Plak Pla	Drainage and Conservation	1,440	1979	1,950,350	Drainage canal: W=3.0m, D=3.0m, S=1:1.5, L=6.0 km
				1980	2,138,700	Regulator: 2.0m x 2.0m x 2 gates
	* Due to the drainage facilities completed as above, the inundation was mitigated.					
(3)	Ku Bae Ya Hae	Drainage and Conservation	480	1983	1,735,300	Drainage canal: W=3-5m, D=2.2m, S=1:1.5, L=8.0 km
	* Beside the improved drainage owing to the canal completed, the condition of paddy cultivation became worse because of the too much drainage caused without regulator in the downstream.					

No.	Project	Type	Project's Area (ha)	Construction in	Budget Allocated(Baht)	Size of Structure
(4)	Khok Sumu	Irrigation	320	1984	2,737,300	Head regulator: (W)1.55m x (H)1.7m x 2 gates Intake: ϕ1.0 pipe-culvert, 1.0m x 1.0m x 1 gate Irrigation canal: Concrete lining W=0.9m, D=1.0m S=1:1.5, L=200m
	* The project was so planned to stabilize the paddy production in rainy season. The yield level is 80 kg/kg in case of W/O. project and 200 kg/rai in case of W. project.					
(5)	Khlong Khud	Irrigation	800	1981	442,200	Intake culvert: ϕ1.0m, L=21.0m Irrigation canal (earth canal) : W=1.0m, D=0.5m S=1:1.5, L=1.68km Weir: H≒2.0m, L≒2.0m Sand drain 70m x 2 span
	* At the just downstream of the intake on Khlong Ma Ru Bo, Bu Ke Ta Mong Weir was constructed with the cost of ฿3.2 million by ARD in 1982. Owing to the completion of irrigation facilities as above, the double cropping of paddy became possible.					

No.	Project	Type	Project's Area (ha)	Construction in	Budget Allocated(Baht)	Size of Structure
(6)	Khok Ngu	Drainage and Conservation	480	1977	2,000,000	Drainage canal (I) W=20m, D=4.0m, S=1:2.0, L=2.0km Drainage canal (II) W=12m, D=3.0m S=1:2.0, L=2.8km
	* The farmers in this area revealed the fact that drainage condition was really improved.					
(7)	To Lang	Drainage and Conservation	480	1978	1,200,000	Drainage canal : ° W=6.0m, D=2.0m, L=1.9km ° W=10.0m, D=3.0m, L=3.0km
				1981	2,296,300	Regulator: 2.0m x 2.0m x 2 gates
	* According to the farmers' information, 300 kg/rai of paddy yield in outskirt of the project area and 600 kg/rai in the service area are endorsed.					

No.	Project	Type	Project's Area (ha)	Construction in	Budget Allocated(Baht)	Size of Structure
(8)	Pru Kab Daeng	Drainage and Conservation	640	1981	3,959,000	Regulator: 2.0m x 2.0m x 2 gates Drainage canal: W=3.0m, D=2.0m, S=1:2.0, L=7.0km
	* The cultivation pattern is being forced to be changed due to the lack of appropriate operator to control the regulator and the over-drain took place.					
(9)	Bang Toei	Drainage and Conservation	640	1981	3,191,000	Regulator: 2.0m x 2.0m x 2 gates Drainage canal: W=3.0m, D=2.0m, S=1:2.0, L=4.4km Wooden bridge: 4m x 12m, 1 place
	* The regulator is not operated at present, because this regulator alone cannot stop the inflow of salty water from Mae Nam Bang Nara into this area due to the non-perfect flood protection of dike.					

No.	Project	Type	Project's Area (ha)	Construction in	Budget Allocated(Baht)	Size of Structure
(10)	Tha Phru	Drainage and Conservation	N.A.	N.A.	N.A.	Regulator: 2.0m x 2.0m x 3 gates Drainage canal: W= ? m, D= ? m S= ? m L= ? km
	* Regulator is not used effectively. The inflow of salty water from Mae Nam Tak Bai is not stopped completely even in the regulator closed. It is said that water tightness of gate is poor.					
(11)	Tha Phru Upper	Drainage and Conservation	400	1979	2,560,780	Regulator: 2.0m x 2.0m x 3 gates Drainage canal: L=0.5 km
				1980	1,528,270	Regulator: 2.0m x 2.0m x 1 gate Drainage canal: W=3.0m, D=2.0m, L=3.0km
	* In the rainy season, the regulator is properly operated. Paddy yield is 350 kg/rai.					

Table VII-2-3 Koh Soh Choh Project

No.	Project	Type	Project's Area (ha)	Cosntruction in	Budget Allocated(Baht)	Size of Structure
(1)	Pu Ta	Drainage ditch	N.A.	1981	32,653	W=1.0m, D=1.0m, L=500m
	* Due to the drainage ditch completed as above, the inundation on the paddy field was mitigated.					
(2)	Sungai Ba La	Irrigation canal	80	1980	45,000	W=1.0m, D=1.0m, L=1,500m
	* The project was so planned to stabilize the paddy cultivation in rainy season. It is said that the effect of the project is obvious.					
(3)	To No	Irrigation canal	N.A.	1981	50,000	W=1.0m, D=0.8m, L=2,000m
	* Paddy cultivation is done by the irrigation water from the small pond in the up-stream. The irrigation area is limited.					
(4)	Bu Nae Lae	Irrigation canal	145	1980	35,000	W=1.0m, D=1.0m, L=500m
	* The effects of project are in the case of W/O. project 220-230 kg/rai and in case of W. project 270 kg/rai of paddy yield.					

No.	Project	Type	Project's Area (ha)	Construction in	Budget Allocated(Baht)	Size of Structure
(5)	Ta Lo Naeng	Irrigation canal	575	1980	30,200	W=1.5m, D=1.0m, L=1,500 m
	* The effects of project are in case of W/O. project 250 kg/rai and in case of W. project 400 kg/rai of paddy yield.					
(6)	Khok Ti Te	Pond (Fisheries)	N.A.	1980	34,200	W=6.0m, L=40.0m, D=3.0m
	* Outlet for the irrigation was provided in the pond, but the pond is not used effectively since the normal water level is so low compared to the paddy field elevation.					
(7)	Ya Ro	Irrigation canal	80	1980	92,700	W=1.0m, D=1.0m, L=2,000m
	* On the origin of the irrigation canal the pond is located. But irrigation water is not sufficient in dry season due to the pond water source is too small to irrigate the area.					

No.	Project	Type	Project's Area (ha)	Construction in	Budget Allocated(Baht)	Size of Structure
(8)	Ya Bi	Pond (Fisheries)	N.A.	1980	22,330	W=15.0m, L=30.0m, D=2.0m
	* Capture of fish must be deliberated by Muban people.					
(9)	Ro Tae Ba Tu	Pond (Fisheries)	N.A.	1980	28,420	W=15.0m, L=30.0m, D=2.0m
	* Fingerling had been released three time during six years after completion of the pond but capture of fish was done only one time.					
(10)	Ka Mu Rae	Pond (Fisheries)	N.A.	1976	22,330	W=15.0m, L=30.0m, D=2.0m
	* Capture of fish does not take place, because the fish is not grown up.					
(11)	Ku Bae Sa Lo	Pond (Fisheries)	N.A.	1980	37,420	W=15.0m, L=30.0m, D=2.0m
	* Capture of fish from the pond is not taken due to a fact that the Muban people do not like fresh-water fish.					

No.	Project	Type	Project's Area (ha)	Construction in	Budget Allocated(Baht)	Size of Structure
(12)	Sala Mai	Drainage canal	N.A.	1980	N.A.	W=1.0m, L=3,000m
	* The project's aim is to prevent the inflow of the drain water from the high-land to the low paddy field. The Muban headman revealed the fact that drainage canal is not functioned well due to the sedimentation of the soil.					
(13)	Ta Pang	Pond (Fisheries)	N.A.	N.A.	N.A.	W=15.0m, L=20.0m, D=1.0m
	* The pond water is used for the drinking water of cattle and for the cultivation of vegetables. The pond is not used as a fishery.					
(14)	Khok Mafuang	Pond (Fisheries)	N.A.	N.A.	N.A.	W=20.0m, L=50.0m D=1.0m
	* Capture of fish from the pond is not taken due to the small quantity of fish.					

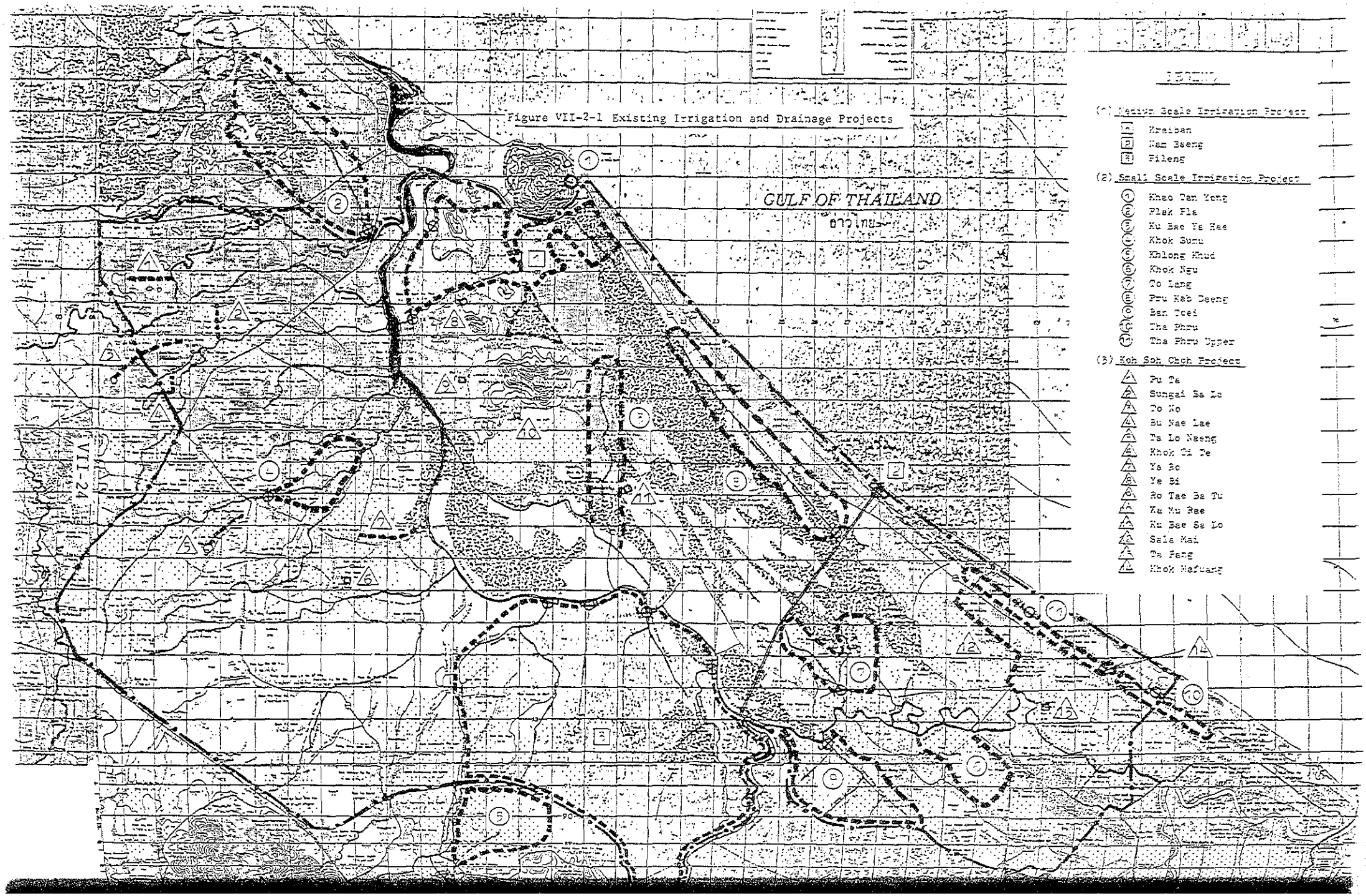
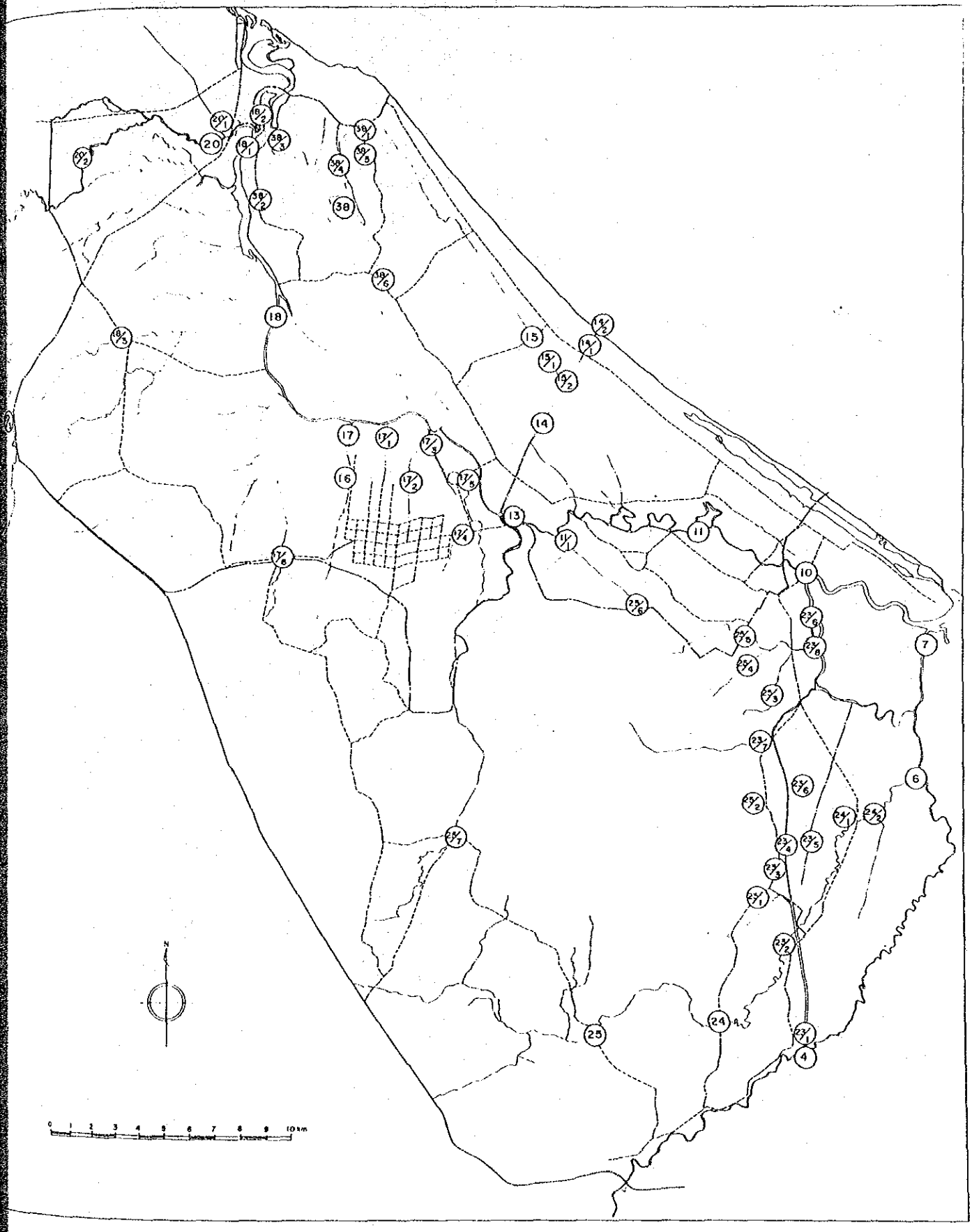


Figure VII-2-1 Existing Irrigation and Drainage Projects

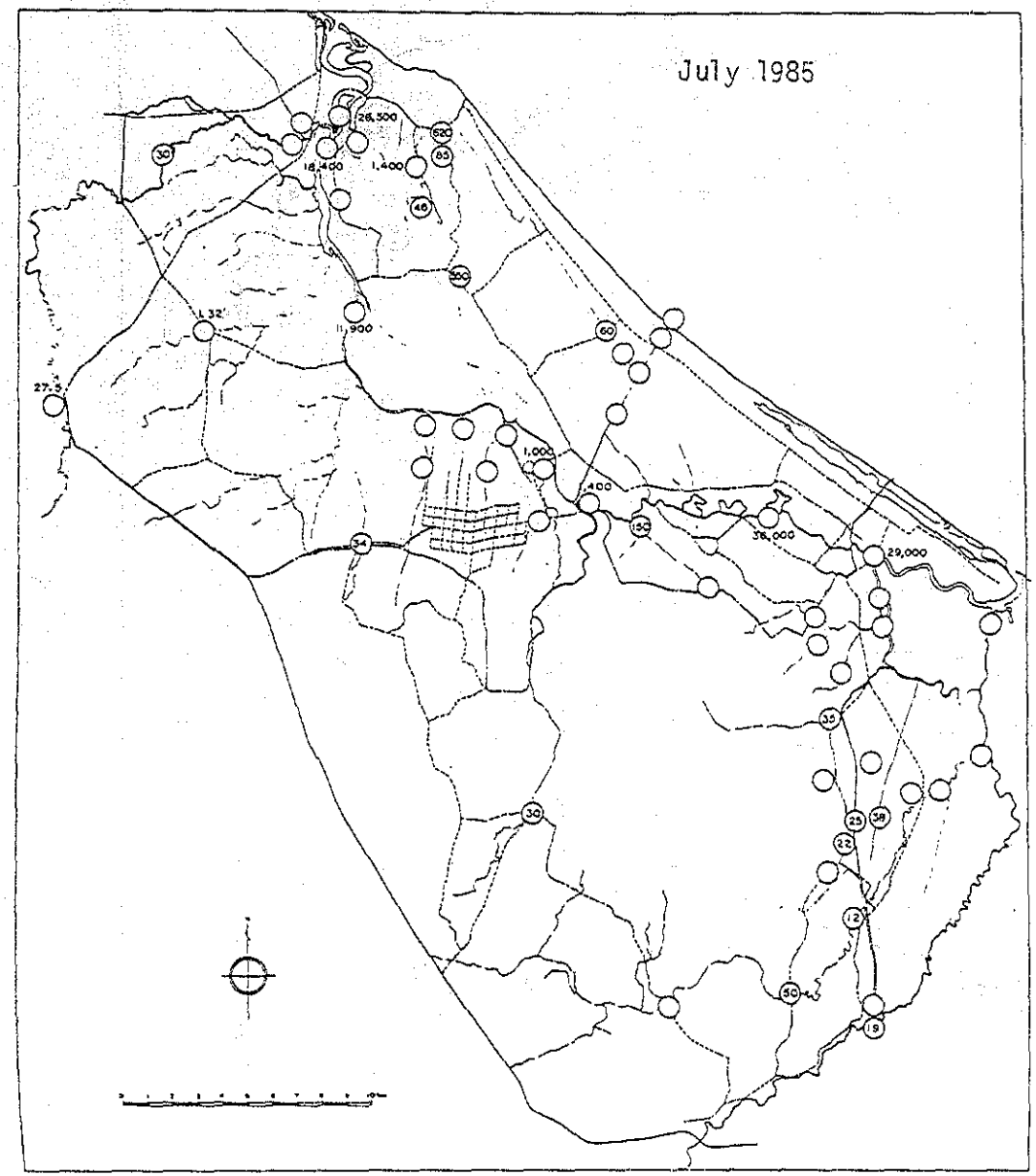
APPENDIX VIII. WATER QUALITY, IRRIGATION AND DRAINAGE

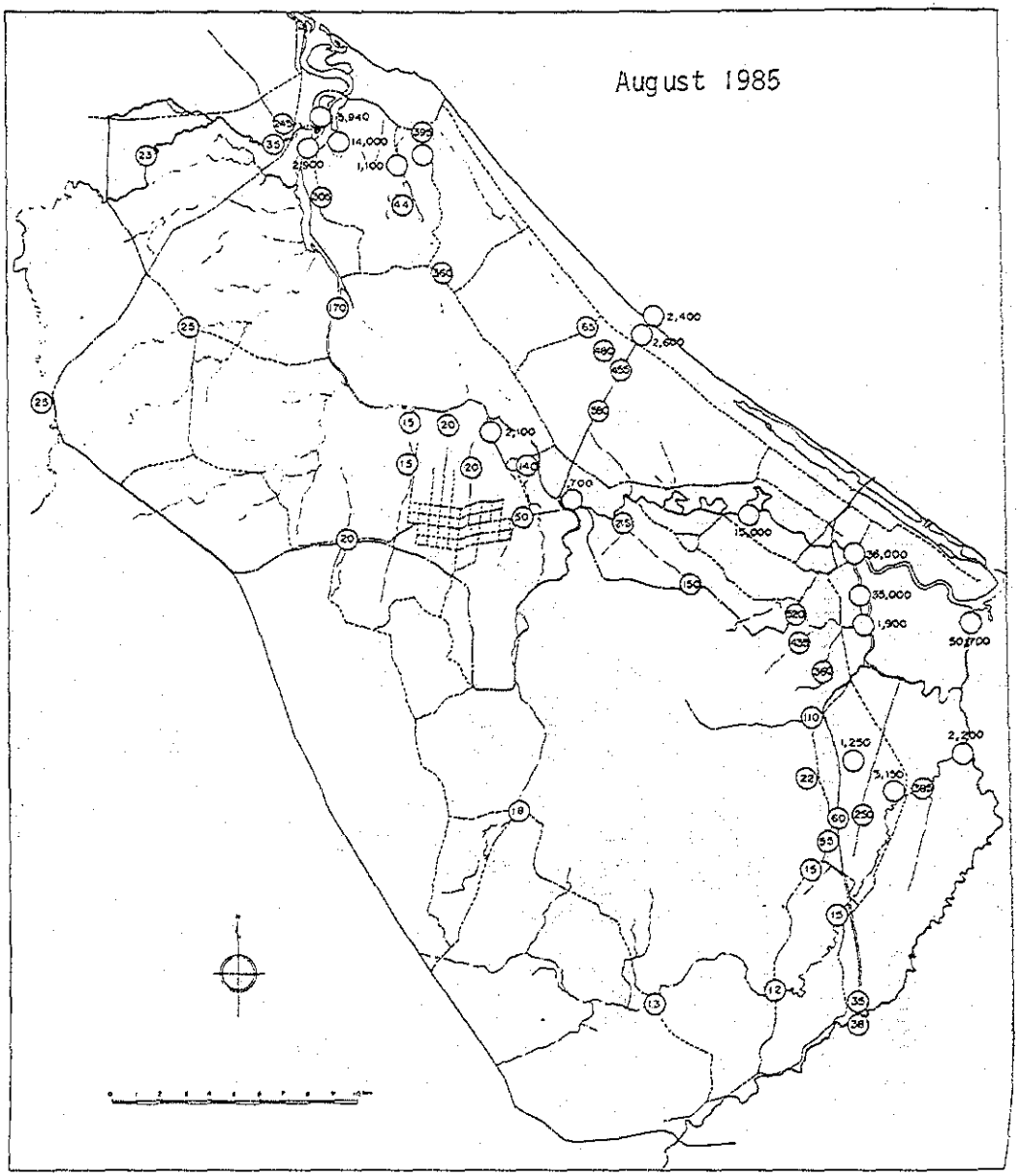
III-1. Water Quality

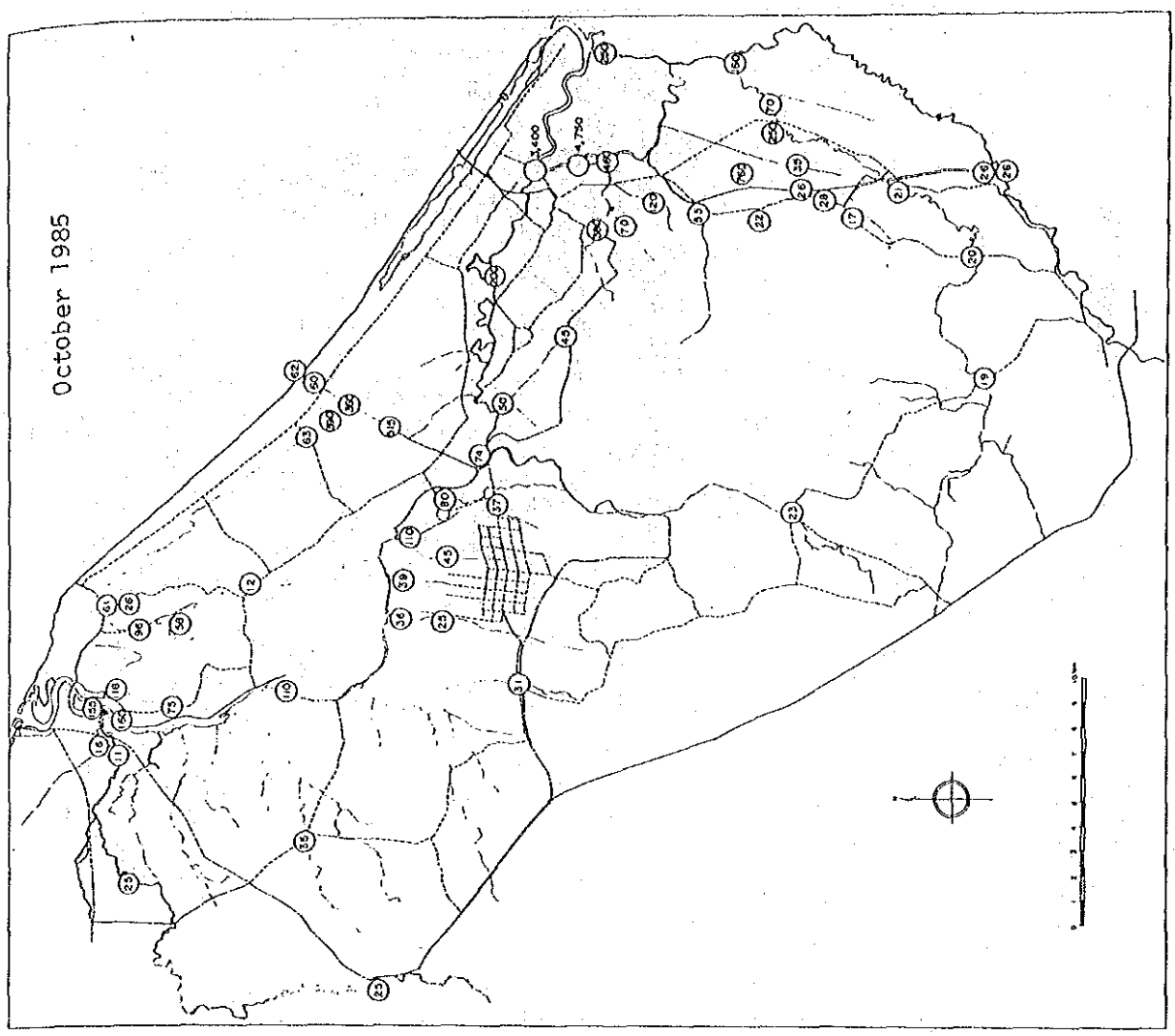
III-1-1. Location of Water Quality Monitoring by RID

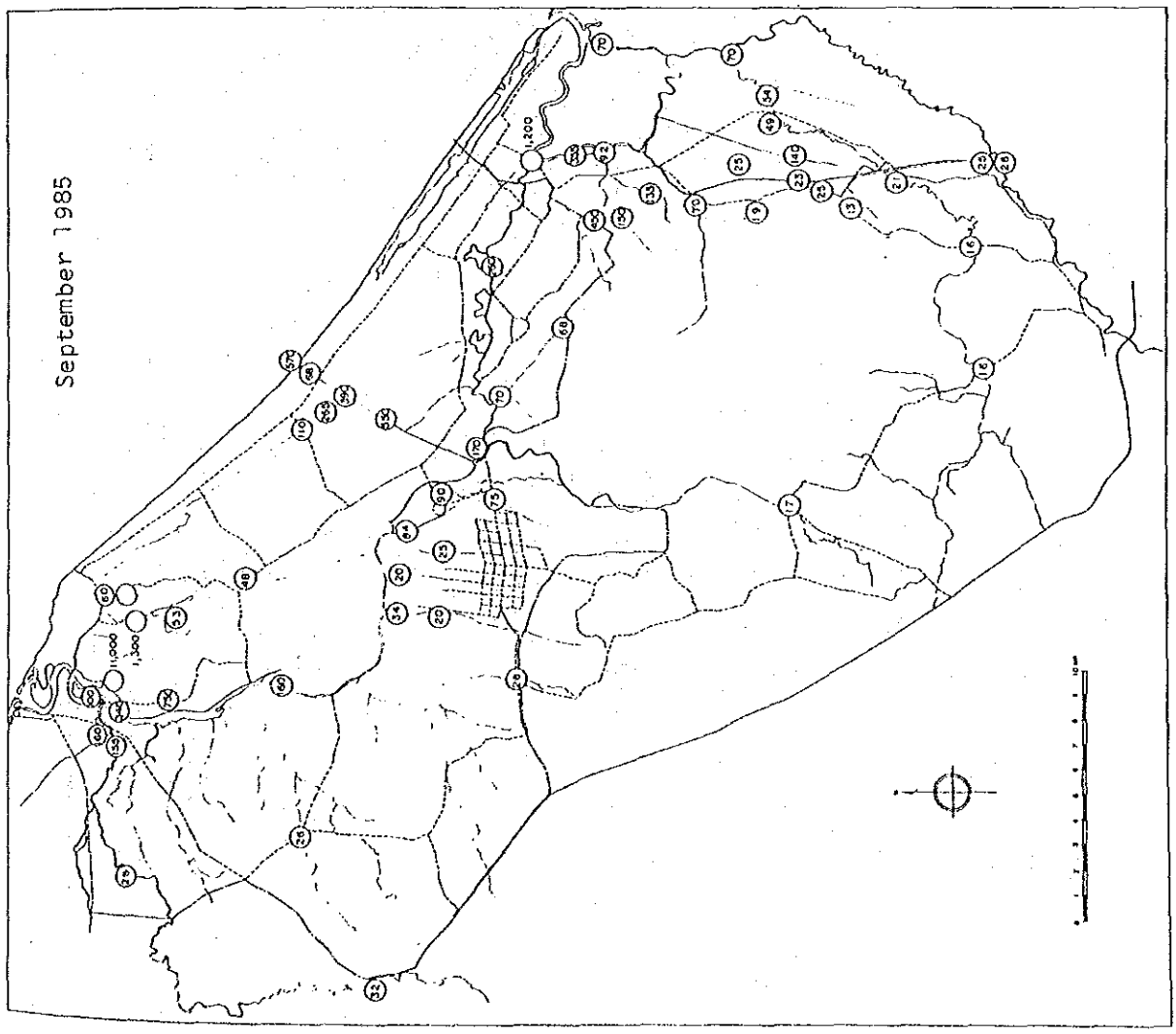


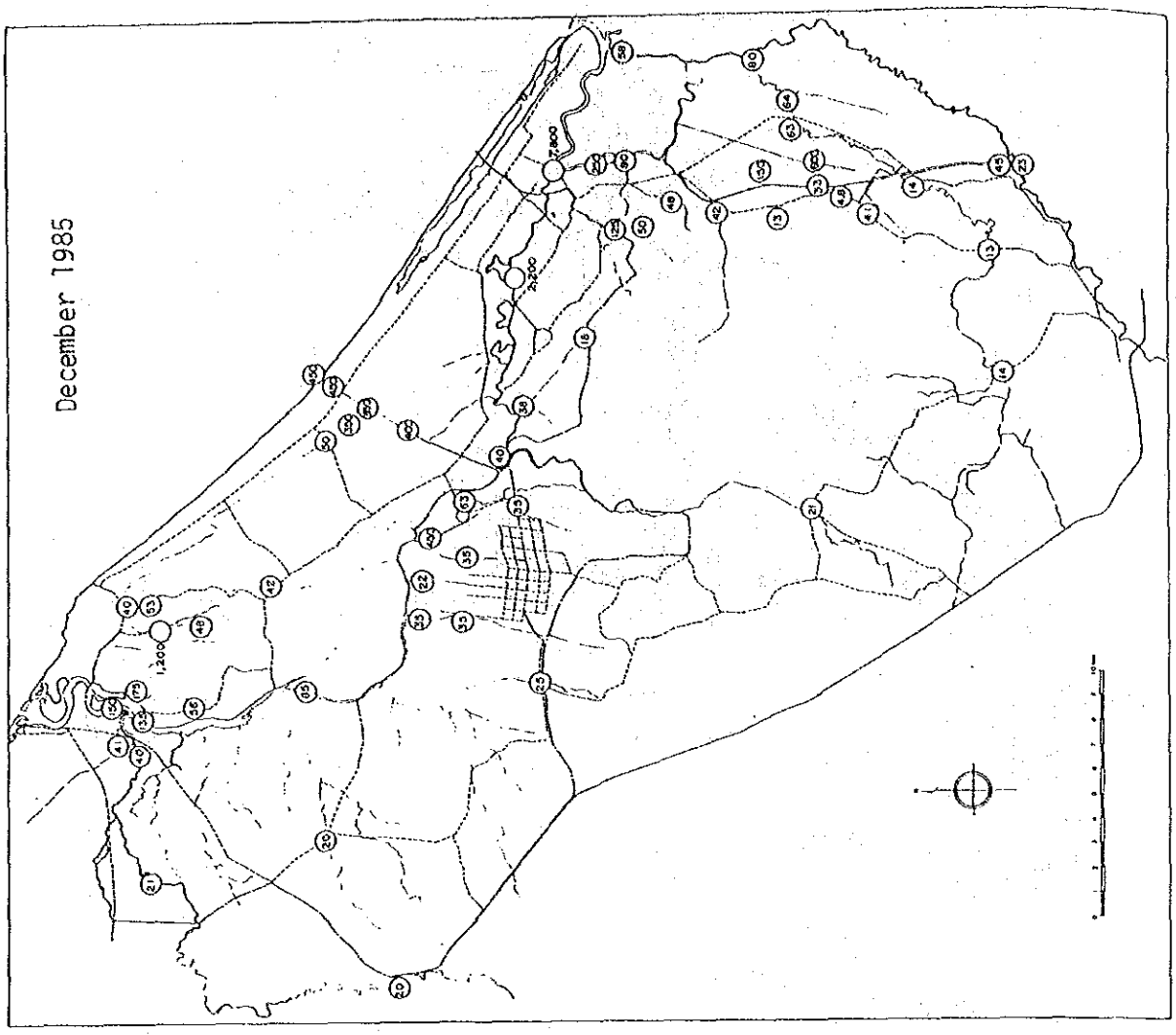
VIII-1-2. Spatial Distribution of Water Salinity by Month

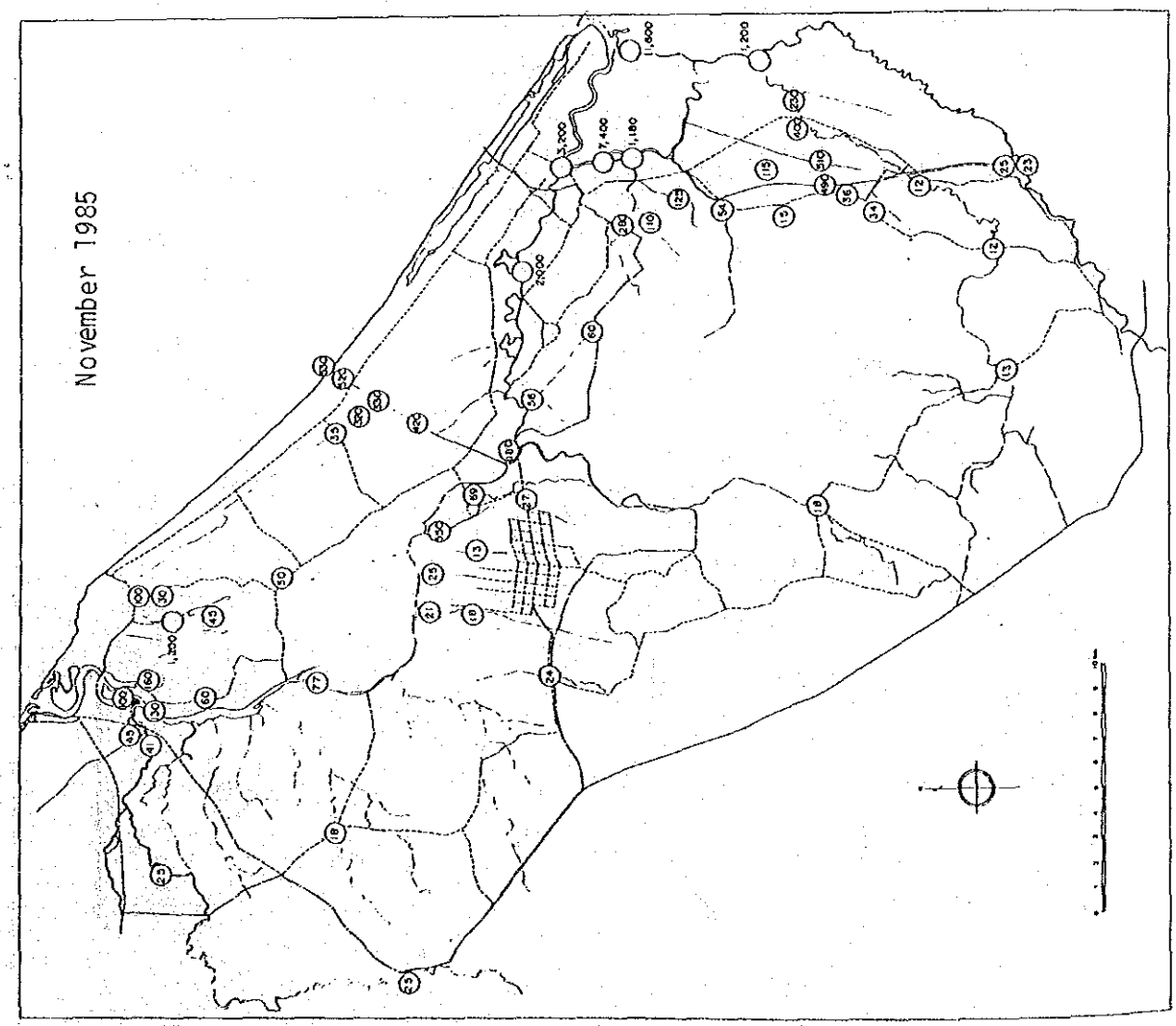


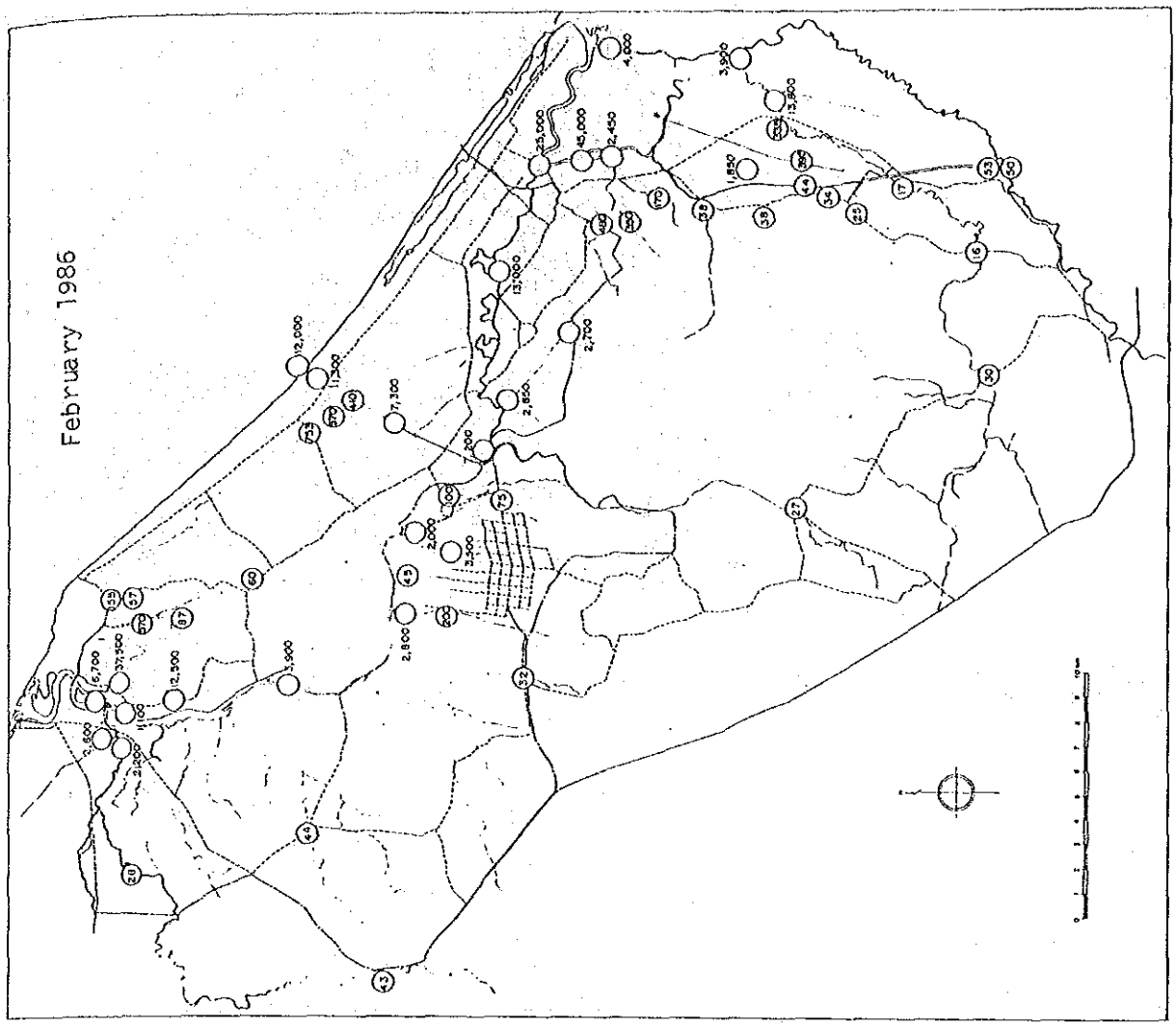


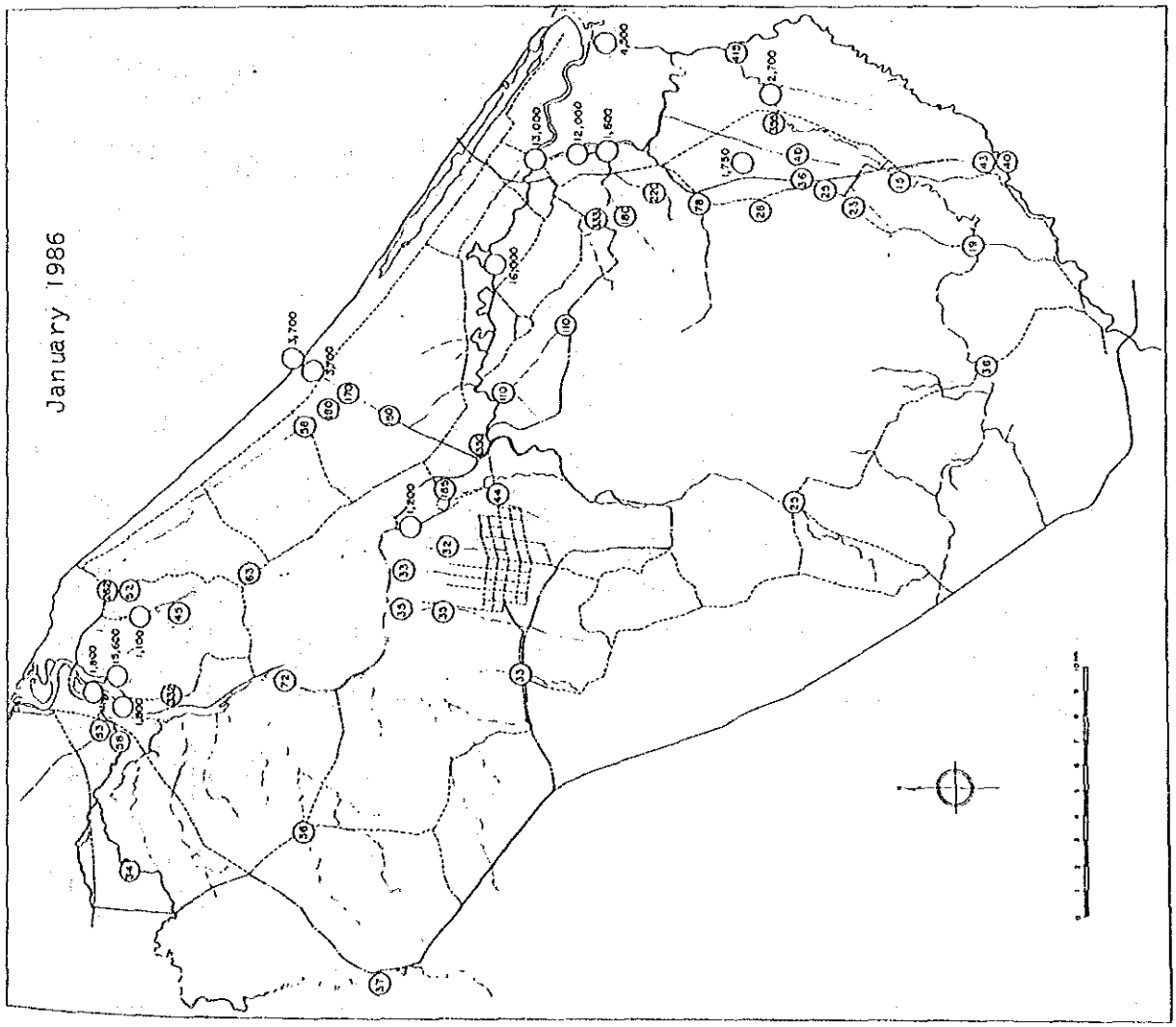

October 1985

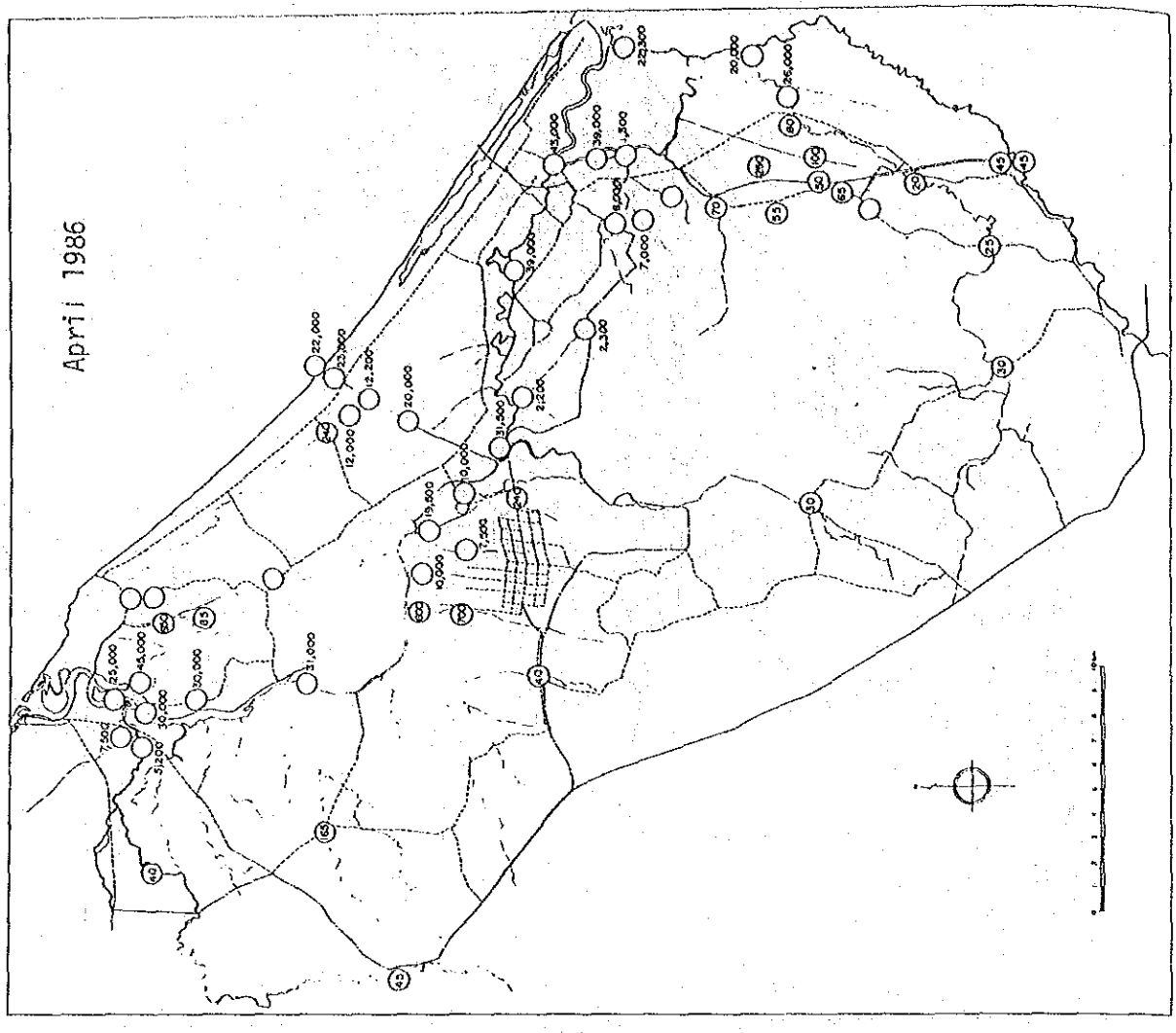

September 1985

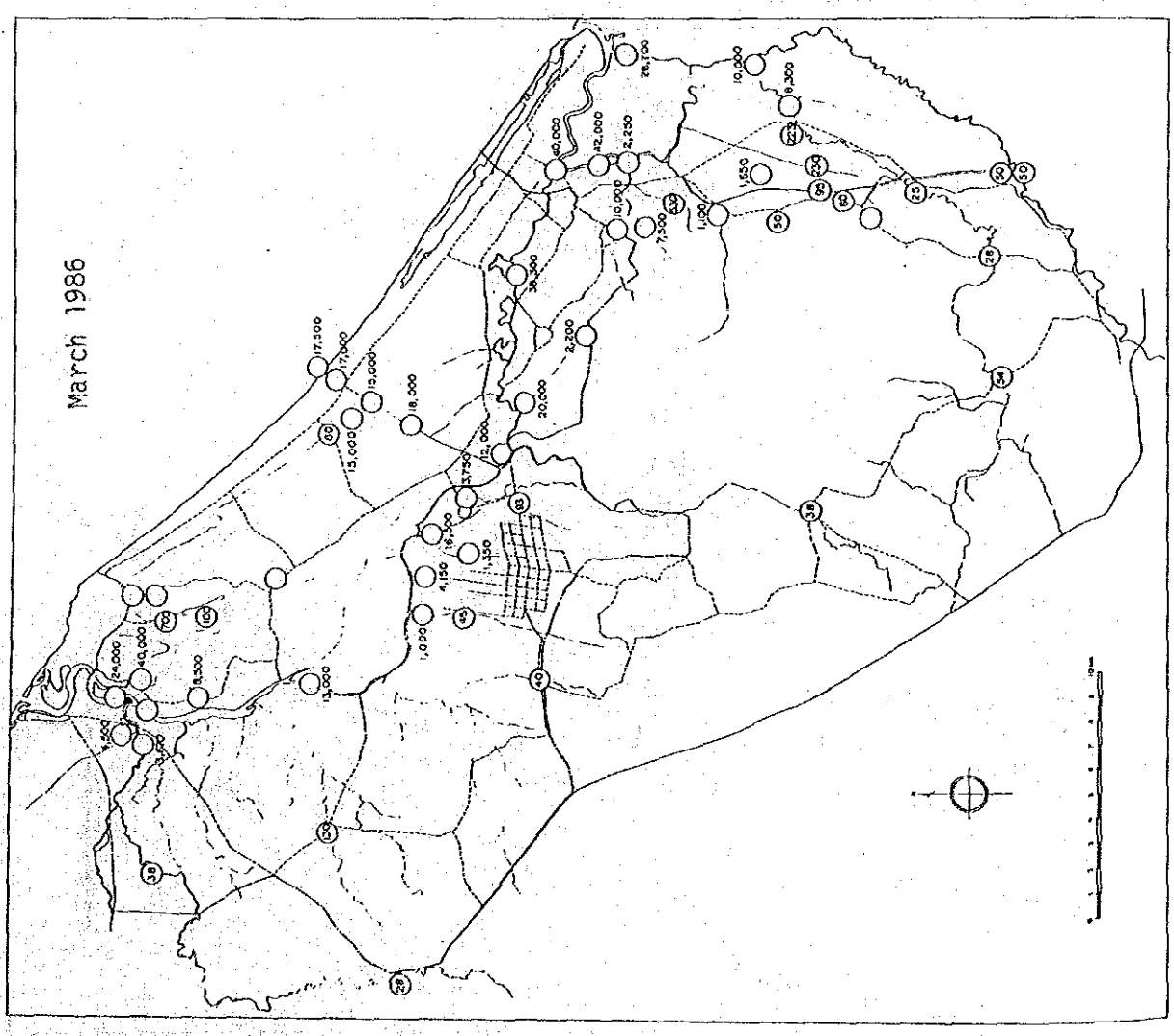

December 1985


November 1985

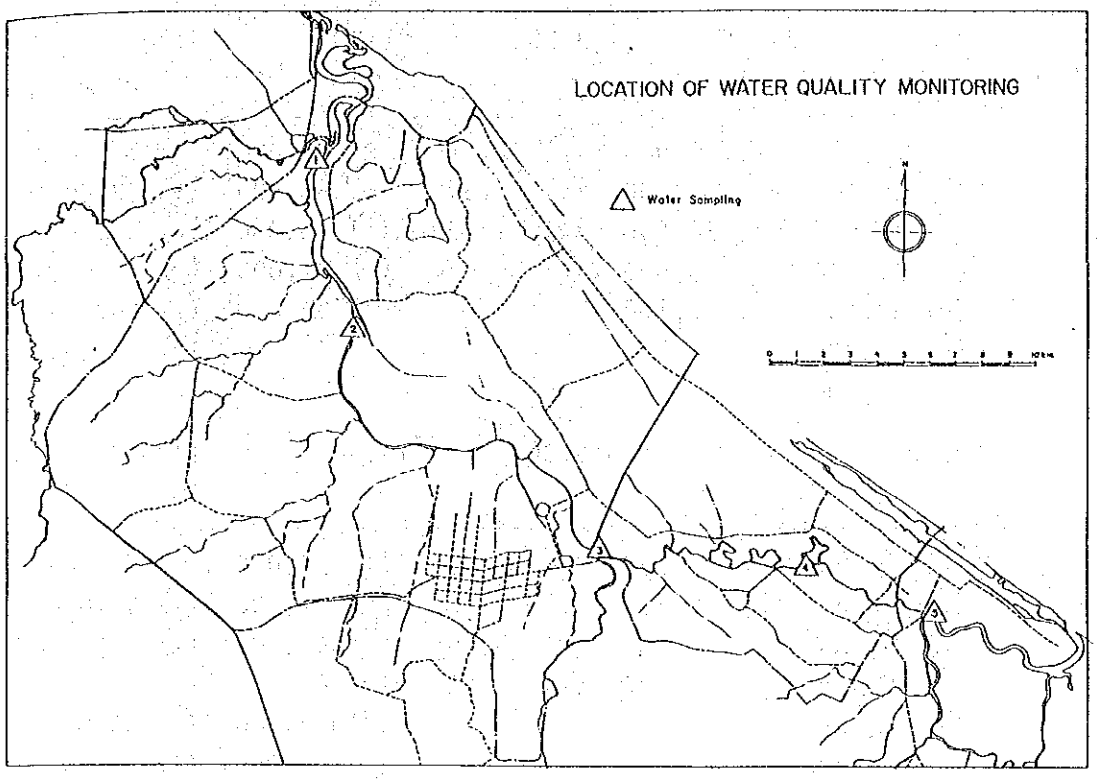

February 1986


January 1986


April 1986


March 1986

VIII-1-3. Vertical Distribution of EC Values in Mae Nam Bang Nara Showing Sea Water Intrusion



LEGEND

EC (μS/cm)

ⓐ	<300	sweet water	
ⓑ	300 - 1,000	could be used for irrigation of tolereat crops	
ⓒ	1,000 - 11,000		
ⓓ	11,000 - 22,000	brackish water	(1/4 salinity of seawater)
ⓔ	22,000 - 45,000	" "	(1/2 salinity of seawater)
ⓕ	>45,000	same as seawater[1/]	

1/ EC of seawater is 45,000 μS/cm, approximately.

(unit : μS/cm)

← Narathiwat — Tak Bai →

Point	1	2	3	4	5
Time	10:00	11:30	9:30	11:30	12:00
Flow Direction	→	→	←	←	← flow direction
Jul 22,23					
	ⓓ 18,400	ⓓ 11,900	ⓒ 1,320	ⓔ 36,000	ⓔ 29,000
	ⓓ 20,500	ⓒ 9,500	ⓒ 1,390	ⓔ 36,000	ⓔ 32,000
	ⓔ 27,000	ⓓ 14,200	ⓒ 1,390	ⓔ 38,000	ⓔ 43,000
	ⓔ 31,800	ⓓ 15,000	ⓒ 1,480	ⓔ 37,000	ⓔ 44,000
	ⓔ 33,400	ⓓ 16,100		ⓔ 39,000	ⓕ 50,000
	ⓔ 35,800				ⓕ 52,000
	ⓔ 34,200				
	13:00	12:00	9:30	10:30	11:00
	→	(→)	←	←	←
Aug 6,7					
	ⓒ 2,900	ⓐ 170	ⓒ 1,700	ⓓ 15,000	ⓔ 36,000
	ⓒ 5,500	ⓐ 170	ⓒ 1,600	ⓔ 31,000	ⓔ 35,000
	ⓓ 16,000	ⓐ 190	ⓒ 1,300	ⓔ 44,000	ⓕ 51,000
	ⓔ 27,000	ⓐ 170	ⓑ 920	ⓔ 43,000	ⓕ 53,000
	ⓔ 31,000			ⓕ 47,000	ⓕ 53,000
	ⓔ 33,000			ⓕ 47,000	ⓕ 53,000
	ⓔ 33,000				
	13:00	12:30	10:30	11:00	12:00
	(←)	(←)	←	←	←
Aug 21,22					
	ⓑ 330	ⓐ 150	ⓐ 120	ⓒ 2,600	ⓒ 6,700
	ⓑ 340	ⓐ 140	ⓐ 110	ⓒ 3,900	ⓒ 9,000
	ⓑ 310	ⓐ 140	ⓐ 130	ⓔ 23,000	ⓕ 47,000
	ⓑ 310	ⓐ 150	ⓐ 130	ⓔ 33,000	ⓕ 49,000
	ⓒ 2,500		ⓐ 130	ⓔ 33,000	ⓕ 53,000
					ⓕ 53,000
	11:00	10:00	11:00	12:30	13:00
	→	→	→	→	→
Sep 14,15					
	ⓒ 7,300	ⓒ 1,200	ⓐ 220	ⓓ 19,000	ⓔ 23,000
	ⓒ 8,800	ⓒ 1,100	ⓐ 260	ⓓ 19,000	ⓔ 23,000
	ⓓ 21,000	ⓒ 1,300	ⓐ 270	ⓓ 19,000	ⓔ 24,000
	ⓔ 32,000	ⓒ 1,200	ⓐ 380	ⓓ 19,000	ⓔ 29,000
	ⓔ 33,000	ⓒ 1,100		ⓓ 19,000	ⓔ 35,000
	ⓔ 39,000				ⓔ 40,000
	ⓔ 39,000				
	ⓔ 31,000				

(unit : μS/cm)

← Narathiwat　　Tak Bai →

	1		2		3		4		5	
Sep 23,24	11:00		9:00		13:00		14:30		15:00	
	(←)		←		(→)		→		→	
	(b)	340	(a)	160	(a)	170	(a)	260	(c)	1,200
	(b)	345	(a)	155	(a)	150	(b)	320	(c)	1,300
	(b)	350	(a)	160	(a)	130	(a)	290	(c)	2,100
	(b)	365	(a)	155	(a)	230			(c)	2,700
	(b)	450	(a)	150	(a)	65			(f)	48,000
	(b)	485								
	(f)	74,000								
Oct 28,29	12:30		12:00		10:30		11:00		12:30	
	←		←		→		→		→	
	(a)	160	(a)	110	(a)	74	(a)	200	(c)	3,400
	(a)	140	(a)	110	(a)	73	(a)	200	(c)	3,900
	(a)	150	(a)	120	(a)	71	(a)	200	(c)	4,200
	(a)	140	(a)	130	(a)	67	(a)	200	(d)	14,000
	(a)	150			(a)	72	(a)	140	(e)	34,000
	(c)	1,300							(e)	40,000
	(c)	3,300								
Nov 13,14	11:30		10:30		10:00		11:00		12:00	
	←		←		(→)		→		→	
	(a)	47	(a)	57	(a)	120	(a)	210	(c)	2,300
	(a)	45	(a)	69	(a)	120	(a)	210	(c)	3,200
	(a)	86	(a)	67	(a)	130	(a)	220	(c)	3,100
	(a)	87	(a)	84	(a)	130	(a)	210	(c)	5,600
	(a)	86			(a)	130	(a)	220	(e)	42,000
	(a)	90							(e)	38,000
	(c)	4,900								
Nov 26,27	13:00		12:00		10:30		11:30		12:00	
	←		(←)		→		→		→	
	(a)	130	(a)	77	(a)	180	(c)	2,000	(c)	3,200
	(a)	130	(a)	76	(a)	180	(c)	2,000	(c)	6,200
	(a)	130	(a)	60	(a)	170	(c)	2,000	(e)	37,000
	(a)	130	(a)	55	(a)	130	(c)	2,000	(e)	43,000
	(a)	140					(c)	2,100	(e)	37,000
	(a)	150								
	(c)	1,500								

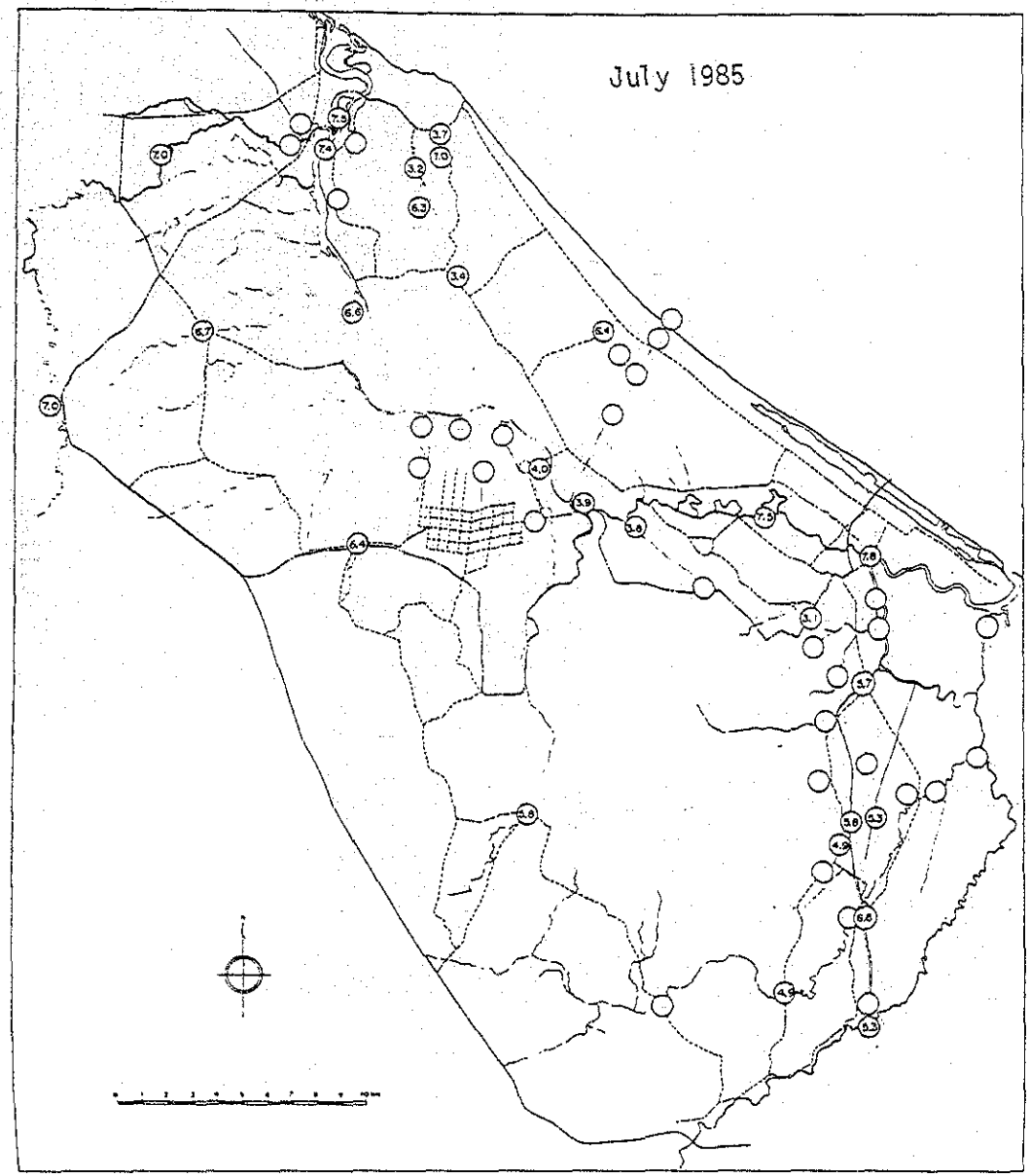
(unit : μS/cm)

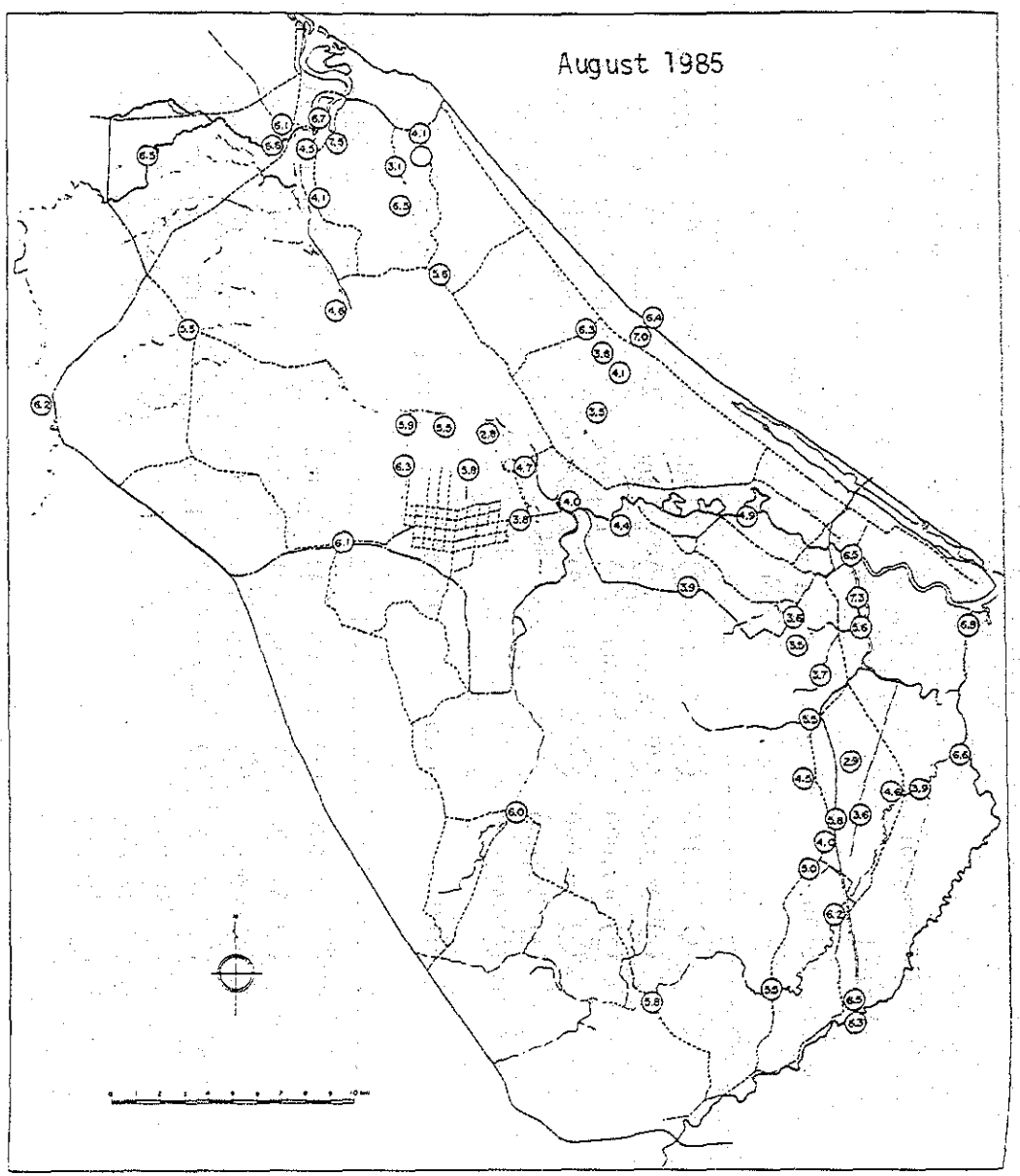
	← Narathiwat									Tak Bai →
	1		2		3		4		5	
	12:30		12:00		10:00		11:30		12:30	
	←		←		→		→		→	
Dec. 11,12										
	ⓐ	35	ⓐ	26	ⓐ	160	ⓐ	170	ⓑ	380
	ⓐ	34	ⓐ	26	ⓐ	130	ⓐ	166	ⓑ	540
	ⓐ	35	ⓐ	26	ⓐ	130	ⓐ	166	ⓓ	1,100
	ⓐ	35	ⓐ	28	ⓐ	110	ⓐ	170	ⓓ	1,400
	ⓐ	35	ⓐ	42	ⓐ	40	ⓐ	92	ⓔ	36,000
	ⓐ	40								
	ⓑ	530								
	11:30		10:30		10:00		11:00		12:00	
	←		(←)		→		→		→	
Dec.27,30										
	ⓐ	135	ⓐ	85	ⓐ	40	ⓒ	2,200	ⓒ	7,800
	ⓐ	135	ⓐ	85	ⓐ	160	ⓒ	2,200	ⓒ	8,200
	ⓐ	135	ⓐ	85	ⓐ	90	ⓒ	2,500	ⓒ	8,300
	ⓐ	135	ⓐ	50	ⓐ	30	ⓒ	1,800	ⓒ	8,200
	ⓐ	160					ⓒ	940	ⓔ	23,000
	ⓐ	250							ⓔ	28,000
	ⓑ	1,500								
	11:00		10:30		10:00		11:00		12:00	
	(→)		(←)		→		→		→	
Jan 27,28										
	ⓒ	1,800	ⓐ	72	ⓑ	350	ⓓ	16,000	ⓓ	13,000
	ⓒ	1,700	ⓐ	73	ⓑ	340	ⓓ	16,000	ⓔ	25,000
	ⓔ	34,000	ⓐ	99	ⓑ	350	ⓓ	16,000	ⓔ	33,000
	ⓔ	39,000	ⓐ	110	ⓐ	290	ⓓ	17,000	ⓕ	46,000
	ⓔ	43,000			ⓑ	330	ⓓ	17,000	ⓕ	45,000
	ⓔ	44,000					ⓓ	17,000		
	ⓔ	37,000								
	12:30		12:00		10:00		11:00		12:00	
	←		←		→		→		→	
Feb 7,8										
	ⓒ	8,200	ⓑ	730	ⓑ	910	ⓒ	2,800	ⓓ	21,000
	ⓓ	11,000	ⓒ	1,500	ⓒ	1,200	ⓒ	3,200	ⓔ	38,000
	ⓔ	44,000	ⓒ	7,500	ⓒ	1,300	ⓒ	3,300	ⓕ	45,000
	ⓕ	46,000	ⓓ	19,000	ⓒ	4,000	ⓒ	3,300	ⓕ	48,000
	ⓕ	45,000							ⓔ	22,000
	ⓔ	23,000								

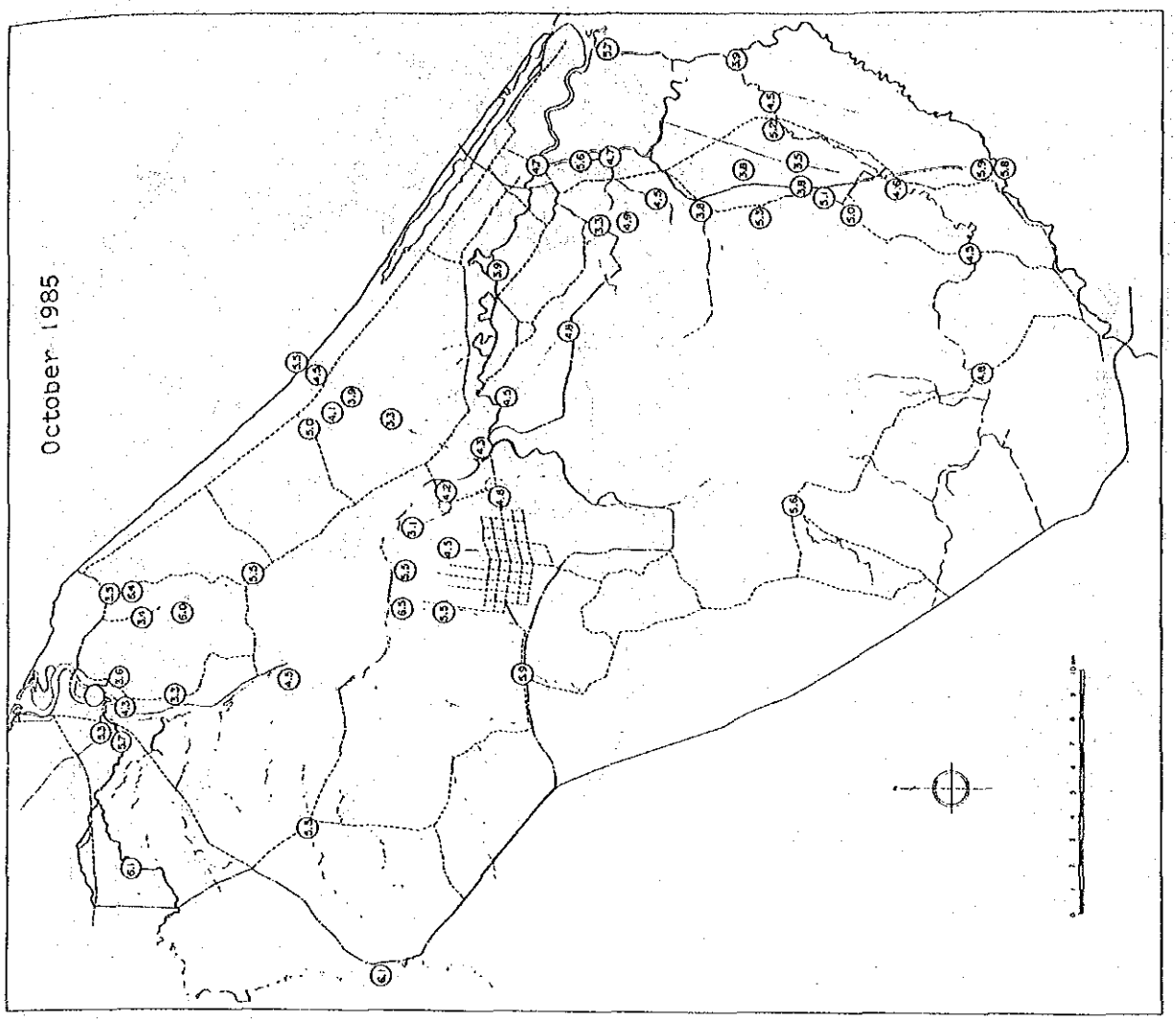
(unit : μS/cm)

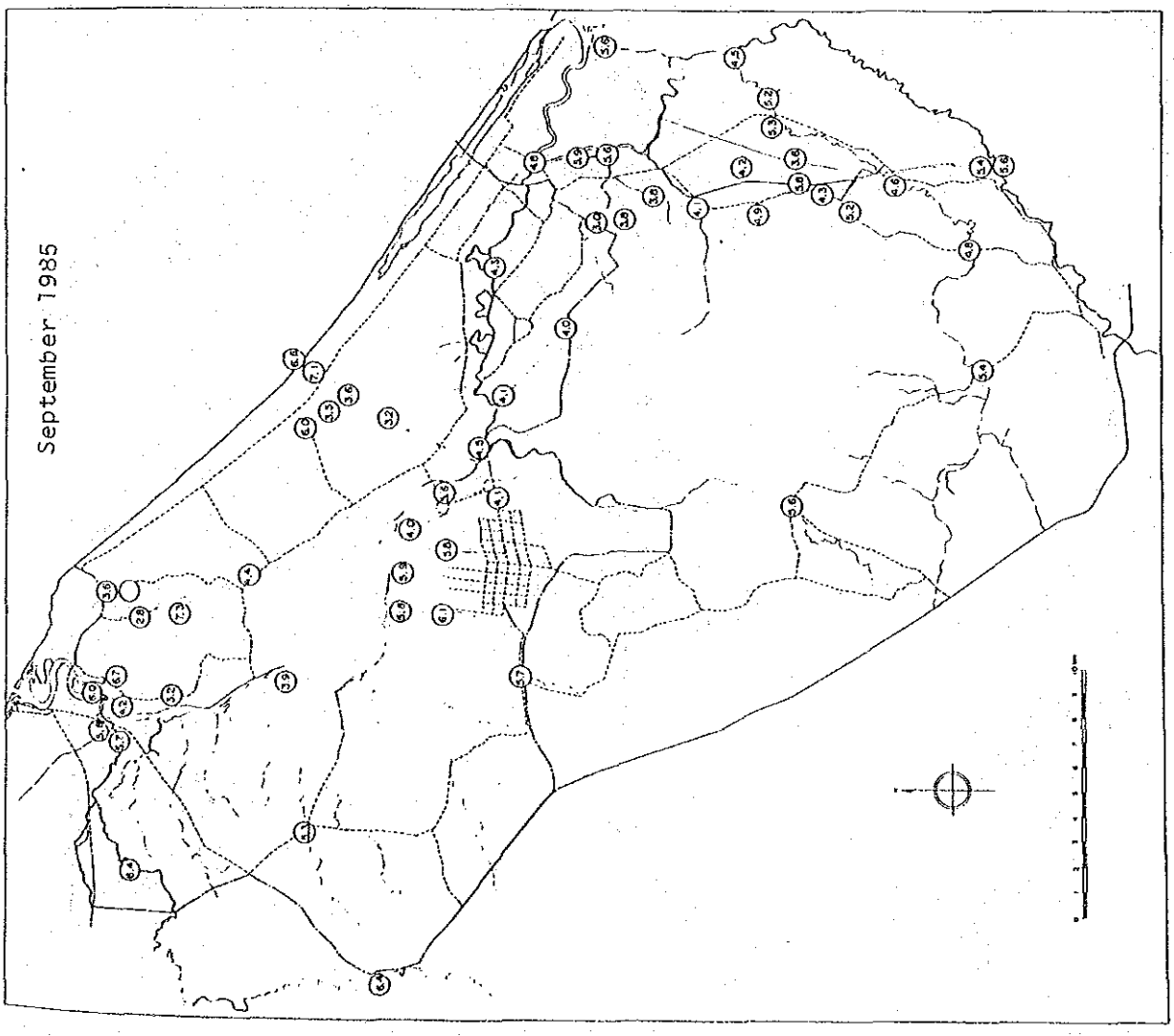
	← Narathiwat				Tak Bai →
	1	2	3	4	5
	10:30 →	10:00 ←	8:30 →	9:30 →	10:00 →
Feb 15,16					
	ⓒ 1,100	ⓒ 3,900	ⓒ 7,200	ⓓ 13,000	ⓔ 25,000
	ⓔ 34,000	ⓓ 18,000	ⓓ 13,000	ⓓ 15,000	ⓕ 48,000
	ⓔ 43,000	ⓔ 23,000	ⓓ 17,000	ⓔ 23,000	ⓕ 48,000
	ⓔ 43,000	ⓔ 23,000	ⓓ 20,000	ⓔ 29,000	ⓕ 48,000
	ⓔ 43,000			ⓔ 27,000	ⓔ 42,000
	ⓔ 43,000				
	9:00 →	10:00 ←	11:00 →	12:00 ←	12:30 ←
Mar 6					
	ⓓ 15,000	ⓔ 27,000	ⓓ 18,000	ⓔ 30,000	ⓓ 19,000
	ⓔ 31,000	ⓔ 35,000	ⓓ 21,000	ⓔ 30,000	ⓔ 25,000
	ⓔ 40,000	ⓔ 41,000	ⓔ 36,000	ⓔ 31,000	ⓔ 31,000
	ⓕ 45,000	ⓔ 43,000	ⓔ 38,000	ⓔ 30,000	ⓔ 37,000
	ⓕ 46,000			ⓔ 30,000	ⓕ 49,000
	ⓕ 46,000				ⓕ 49,000
	ⓔ 42,000				

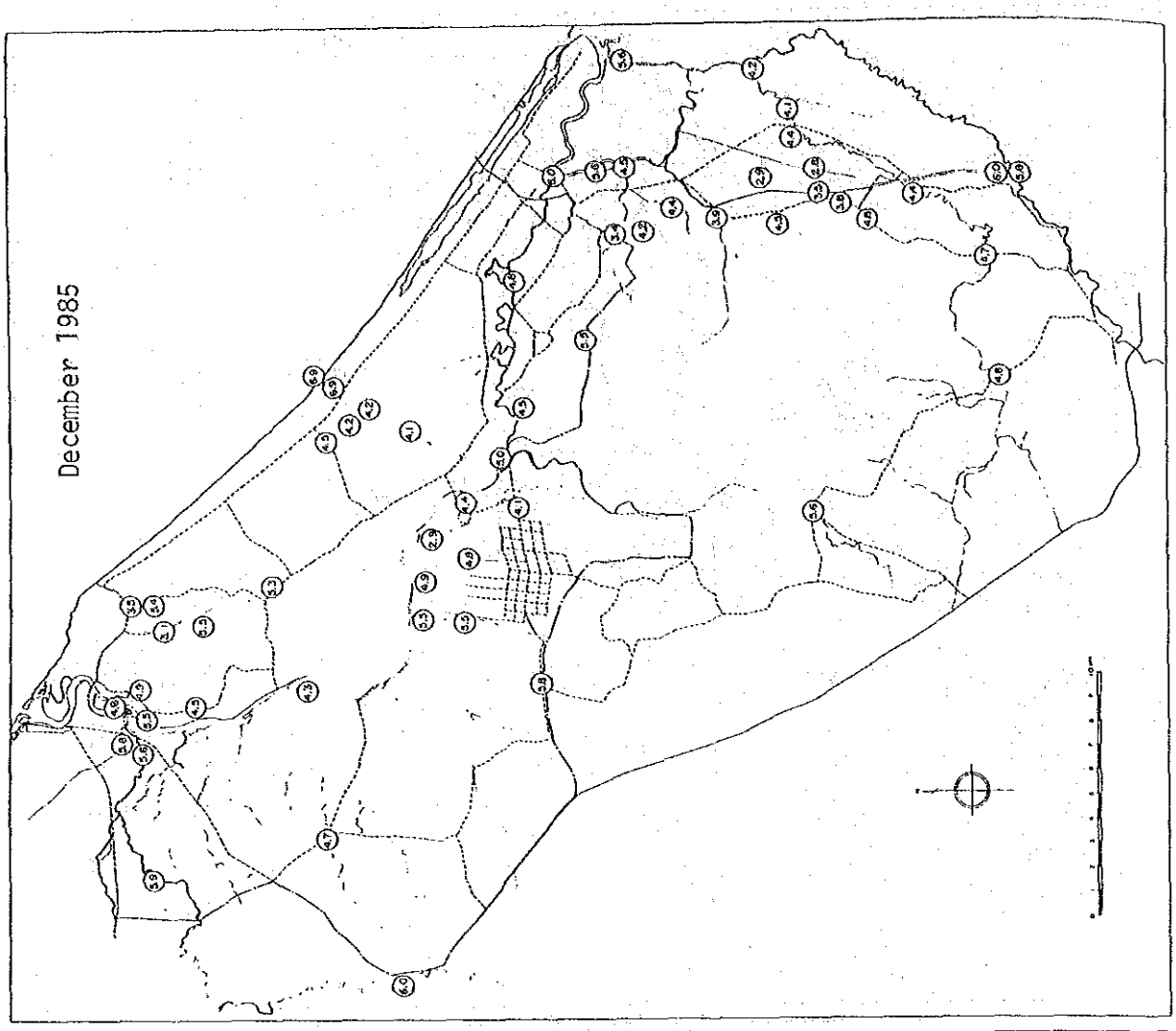
VIII-1-4. Spatial Distribution of Water Acidity by Month

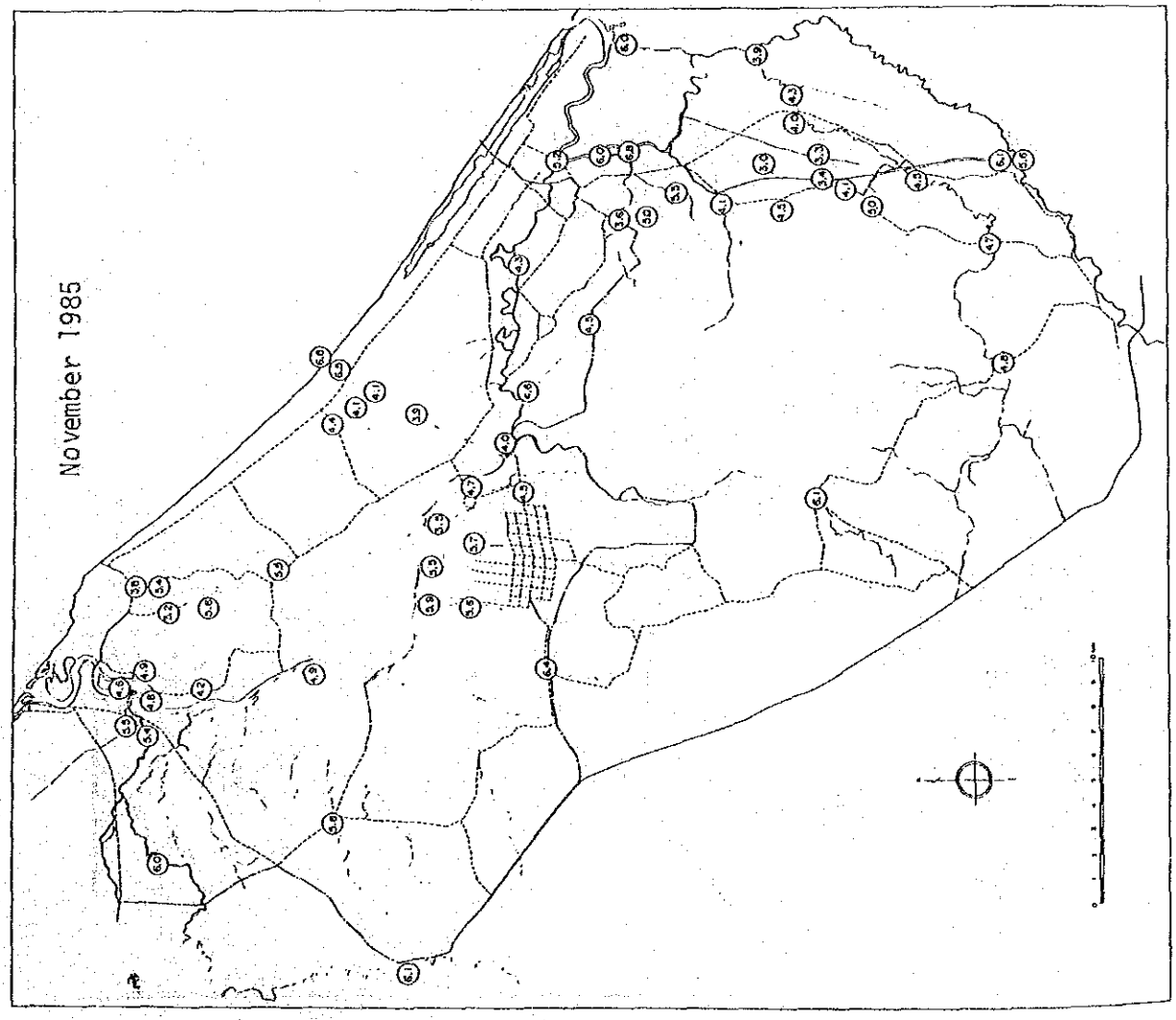


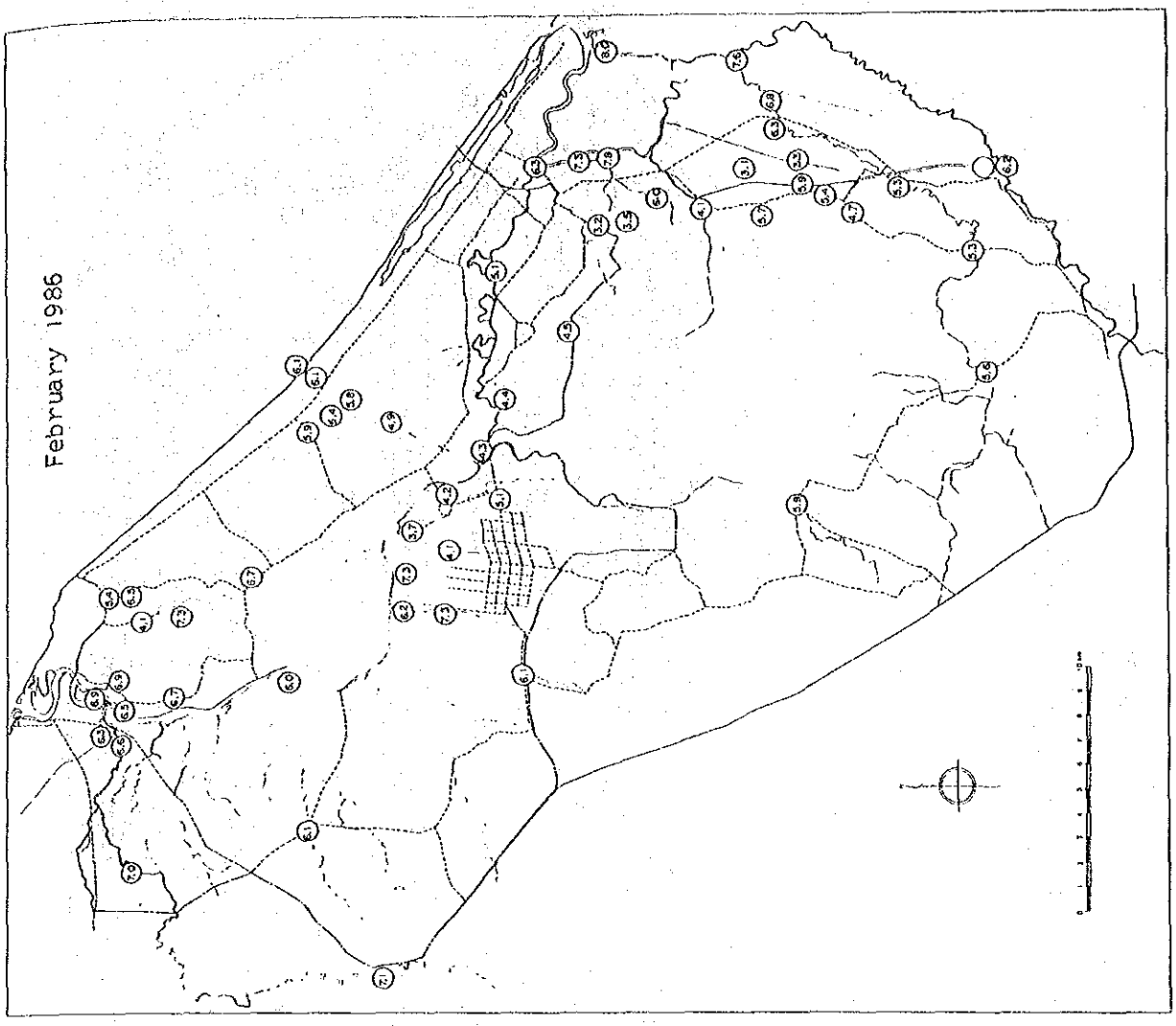


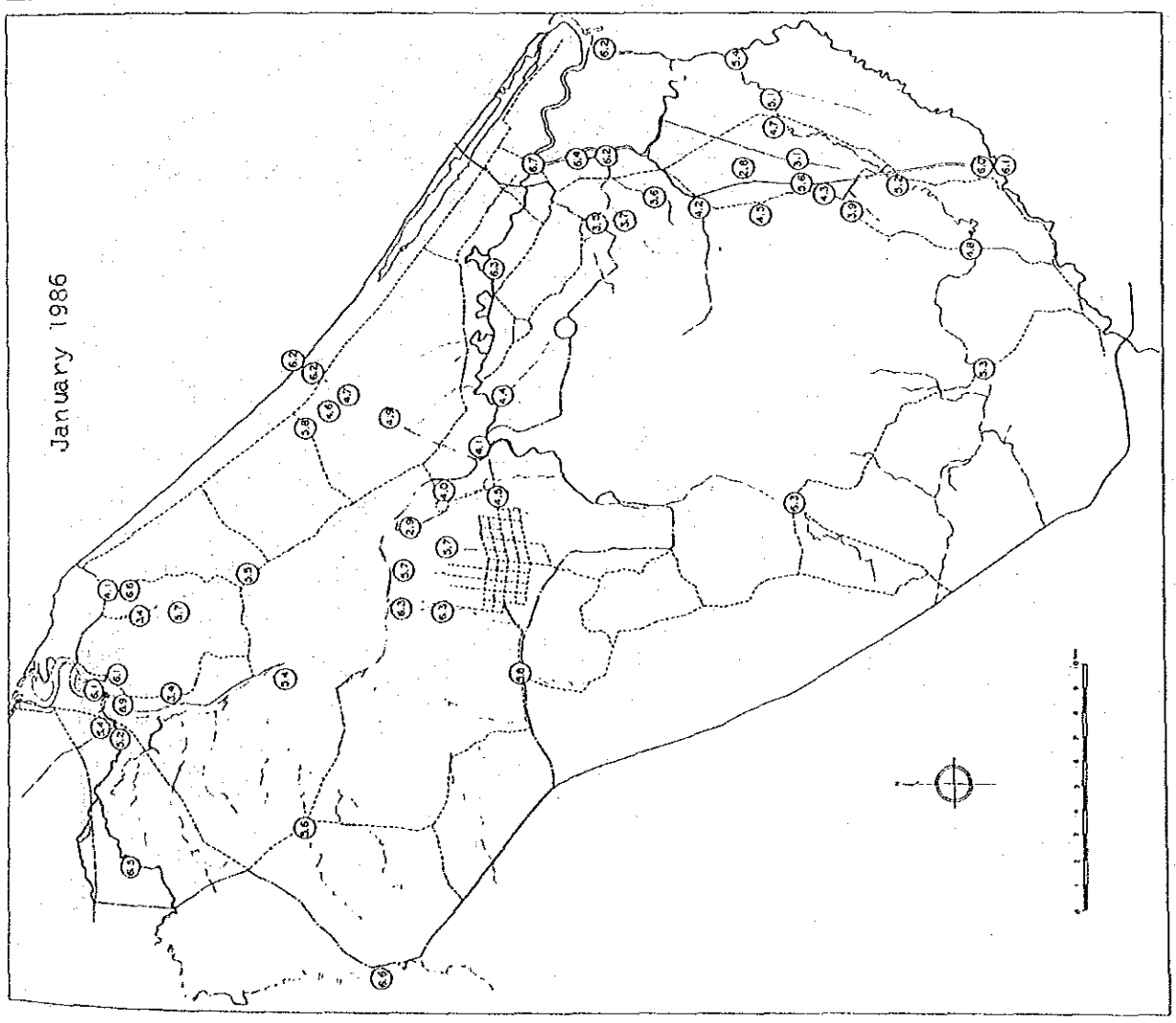

October 1985

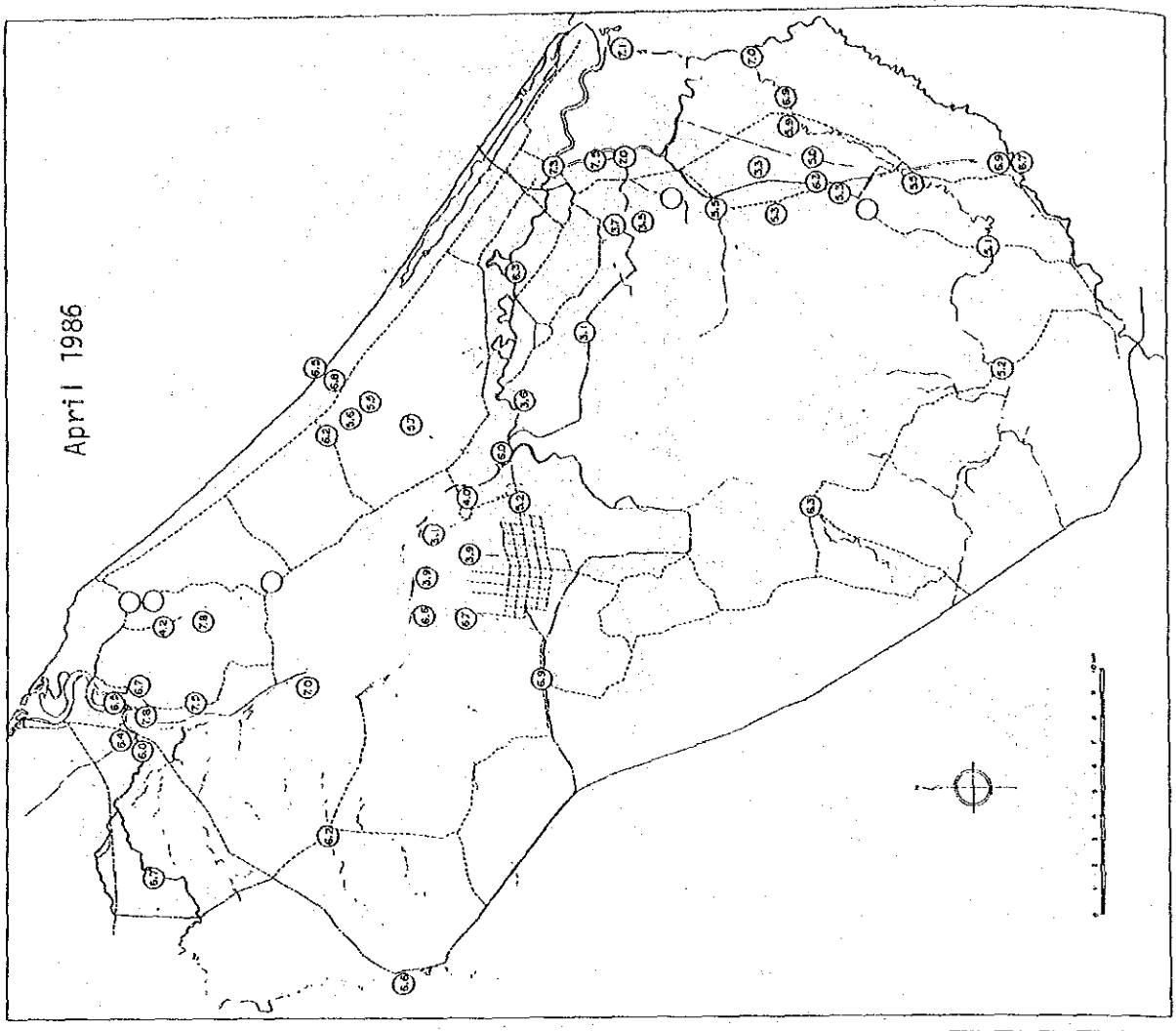

September 1985

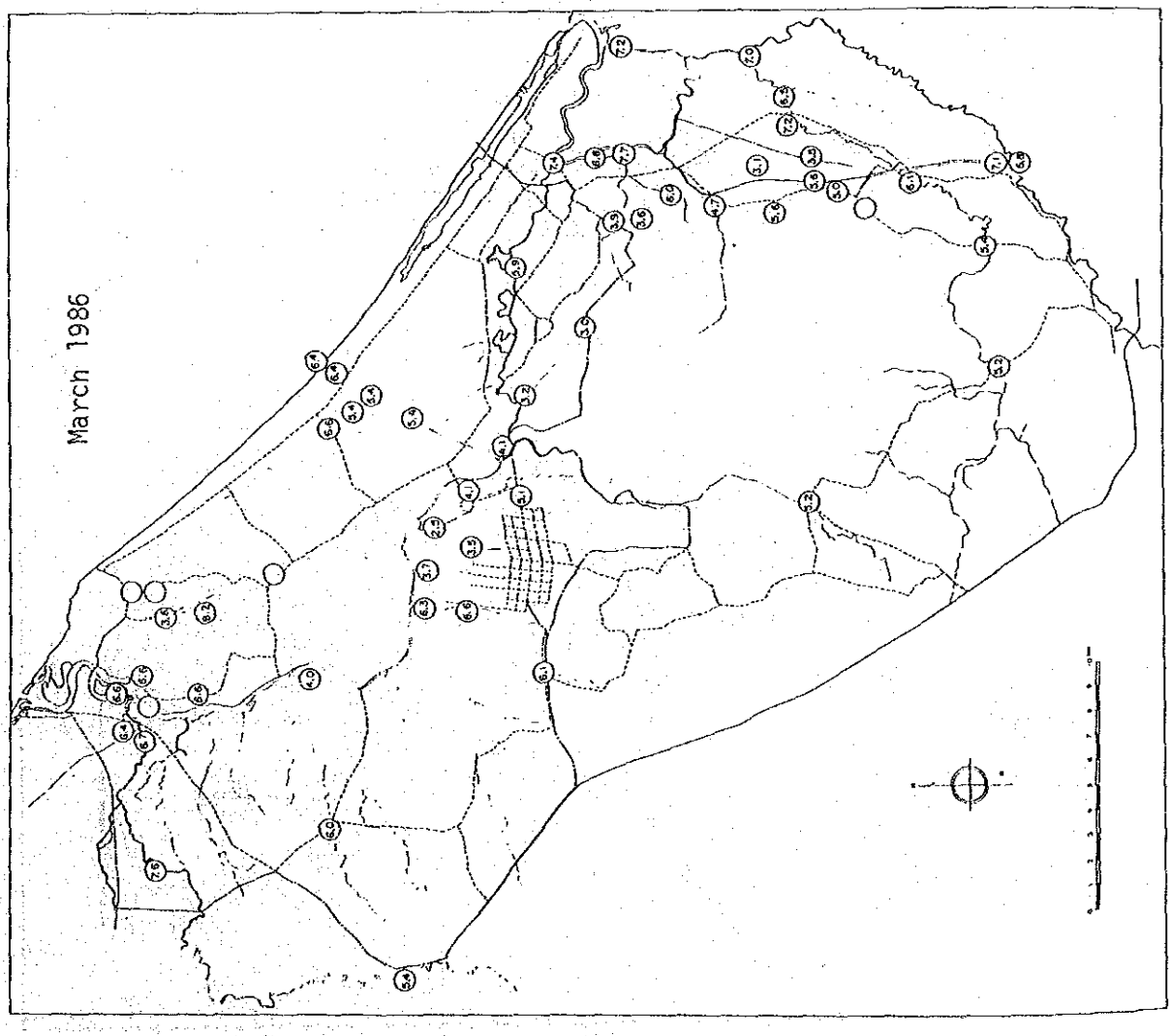

December 1985


November 1985


February 1986

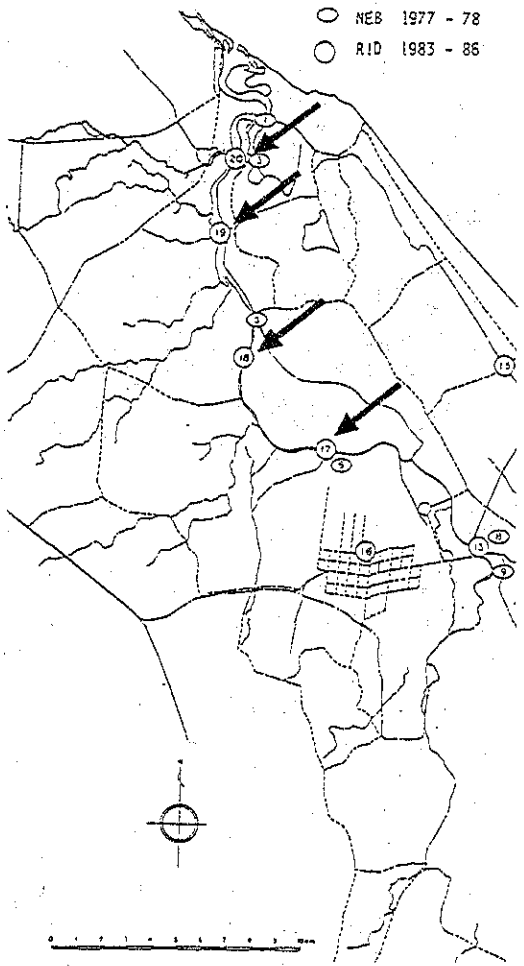

January 1986

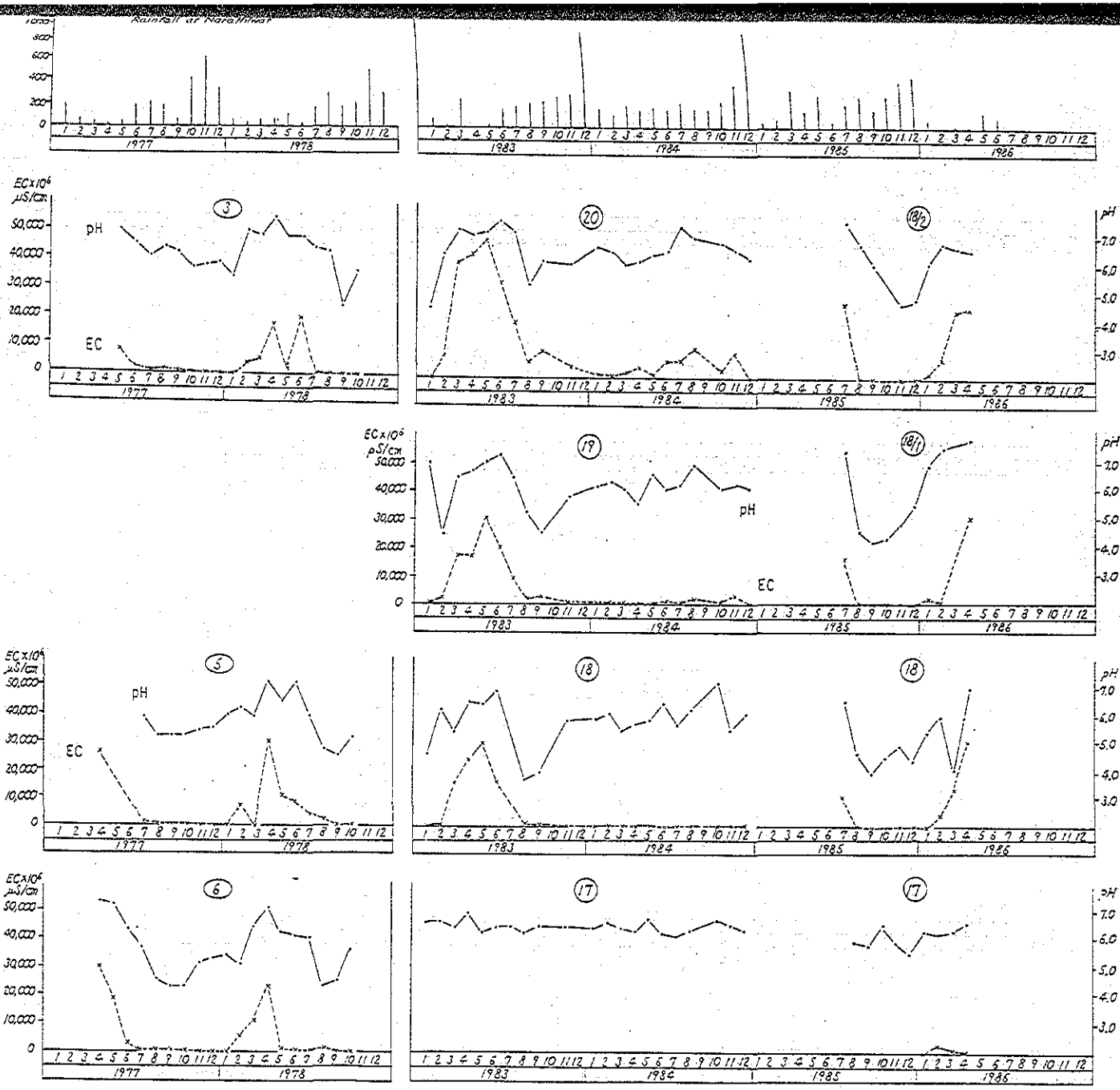

April 1986


March 1986

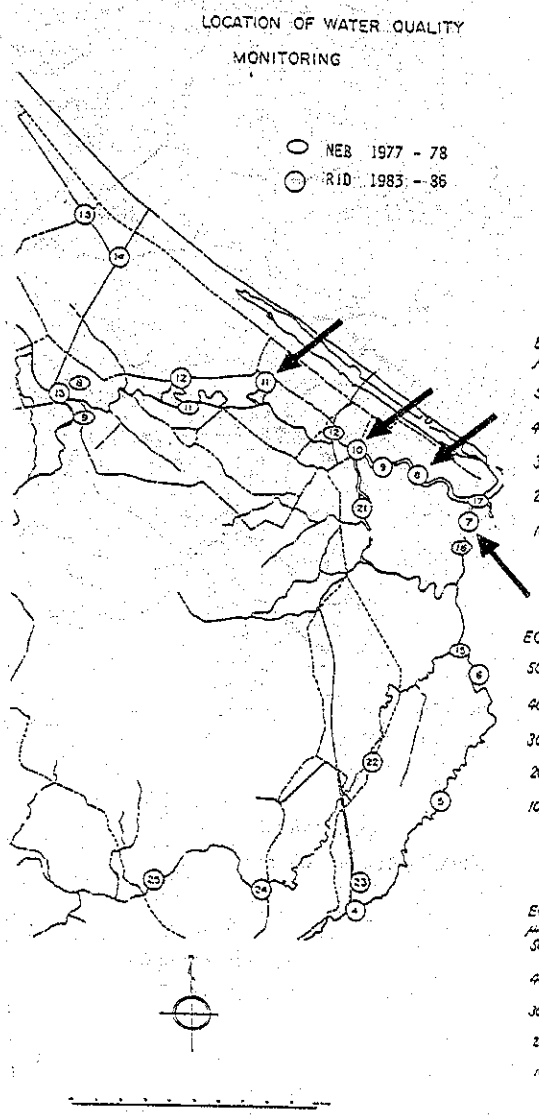
VIII-1-5. Monthly Fluctuation of EC and pH Values

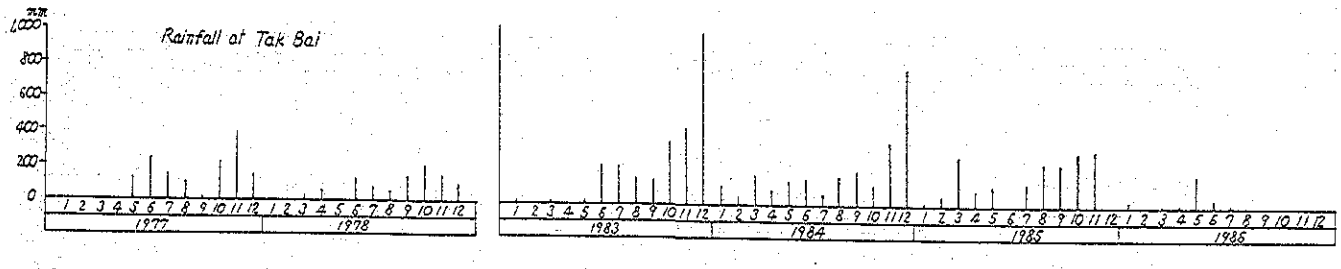
Bang Nara River (1977 - '86)
- Narathiwat Side -

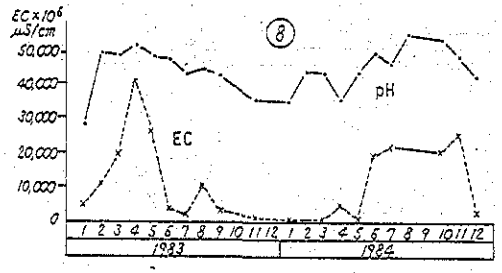


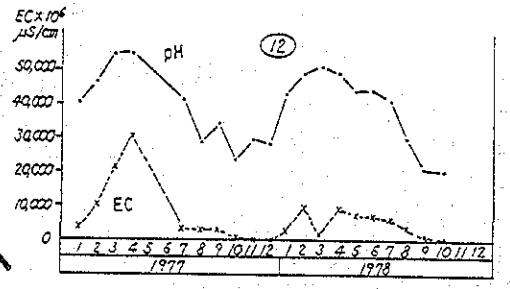


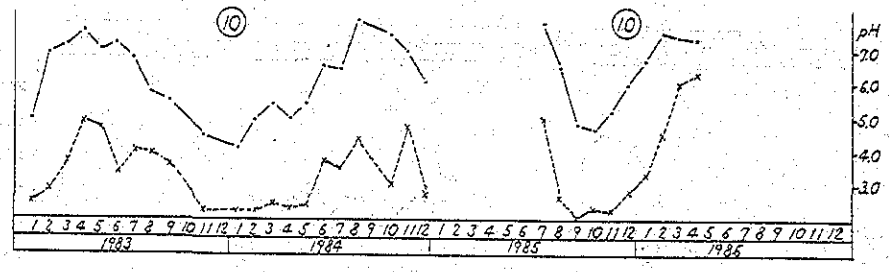
Bang Nara River (1977 - '86)
- Tak Bai Side -

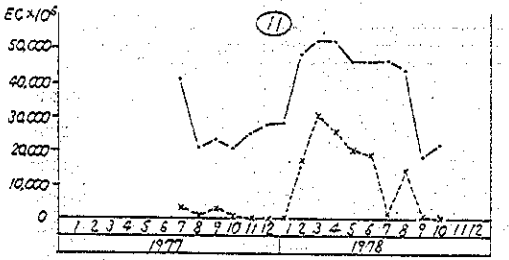


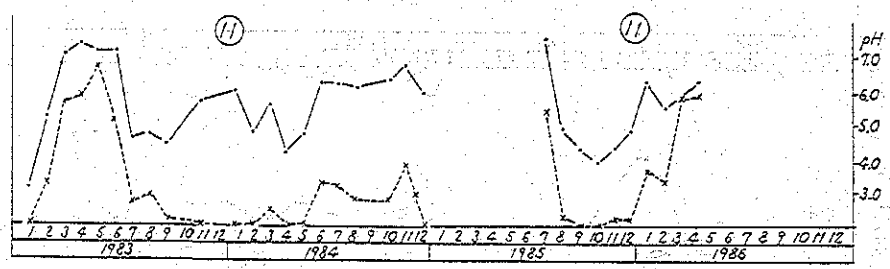


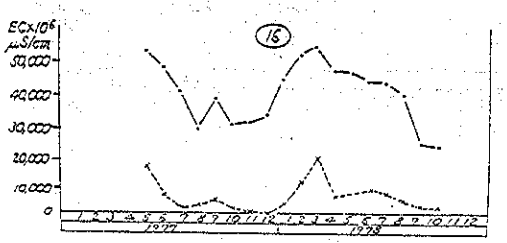


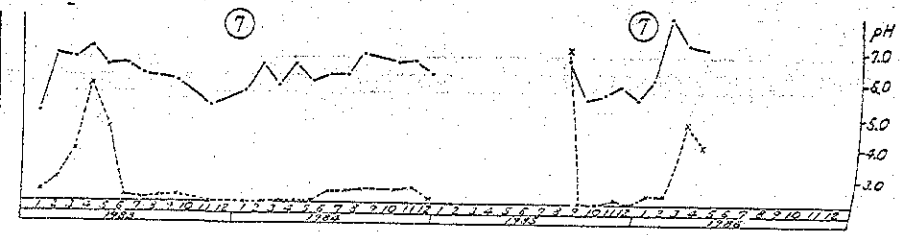






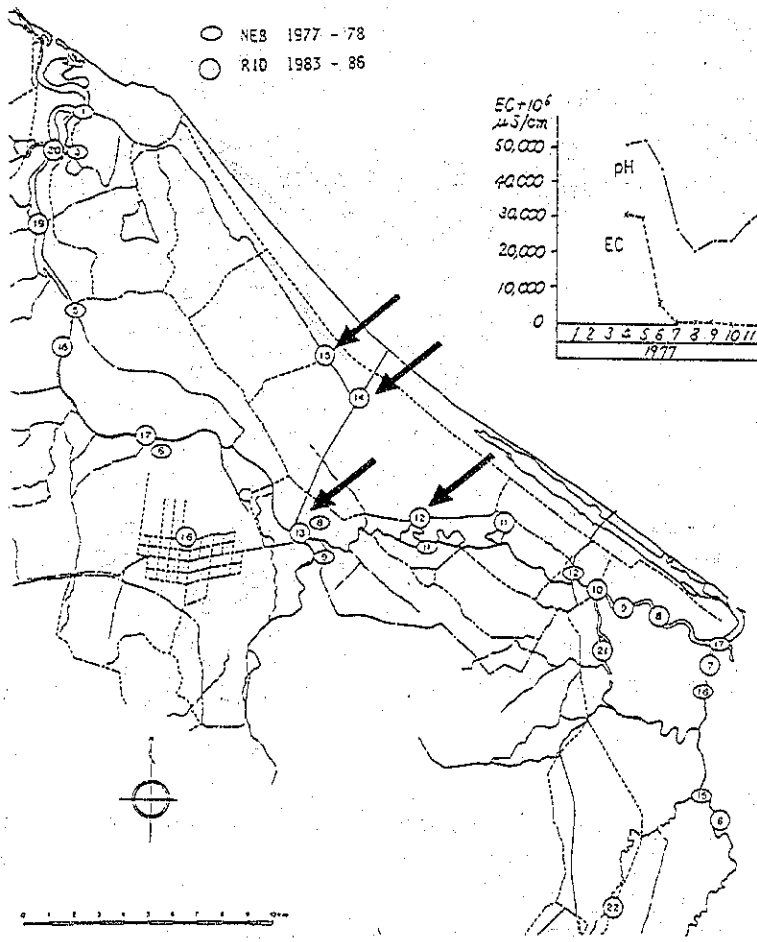


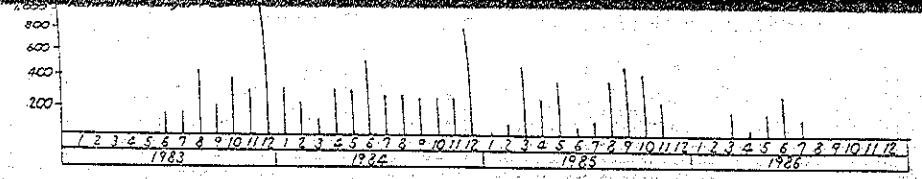


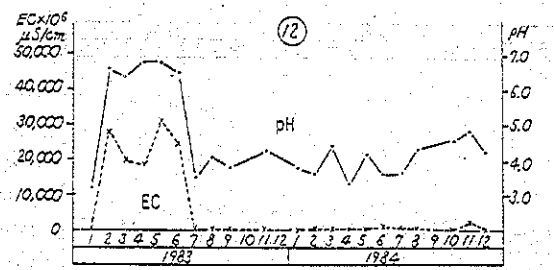


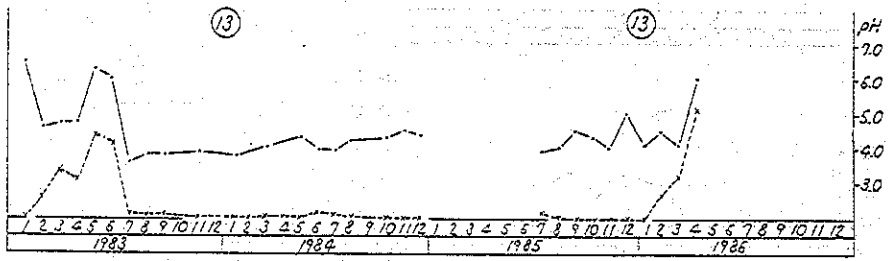
Mid-Stream of Bang Nara River, Khlong Phru Kap Daeng and Nam Baeng Canal (1977 - '86)

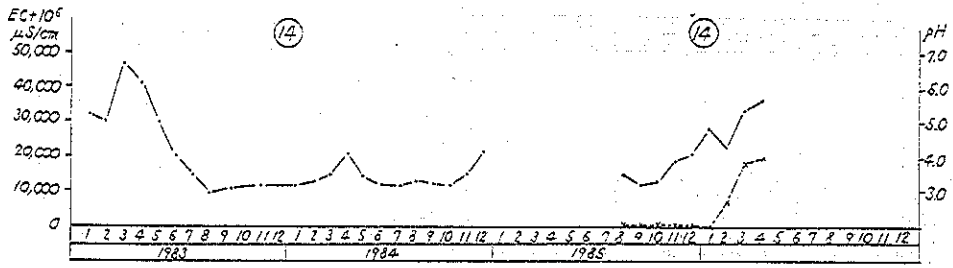
LOCATION OF WATER QUALITY MONITORING

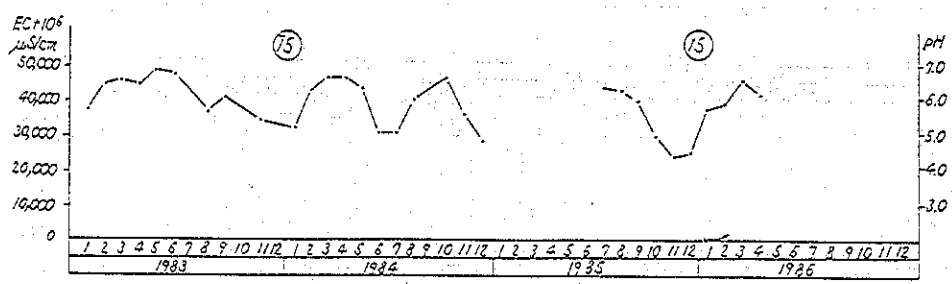




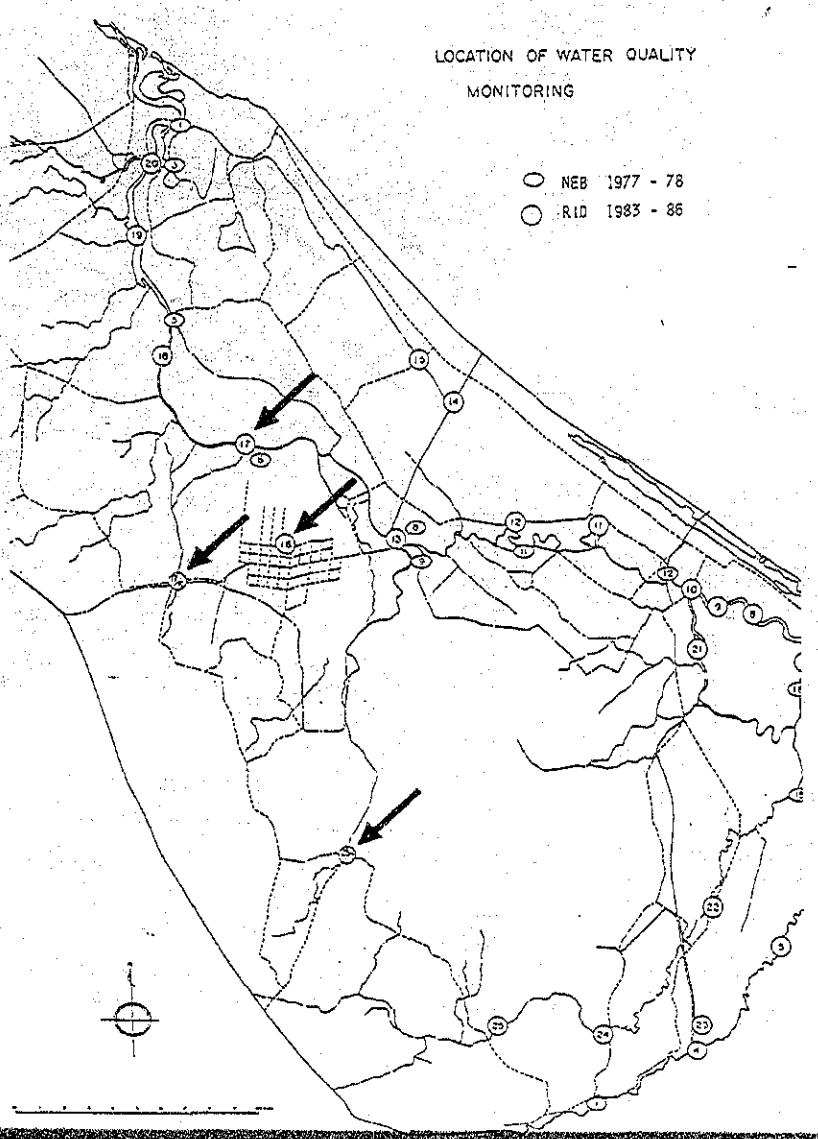


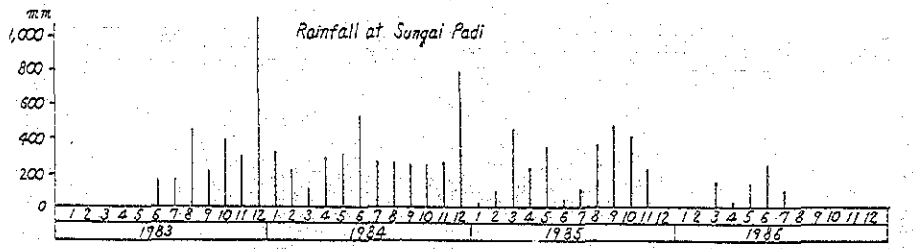


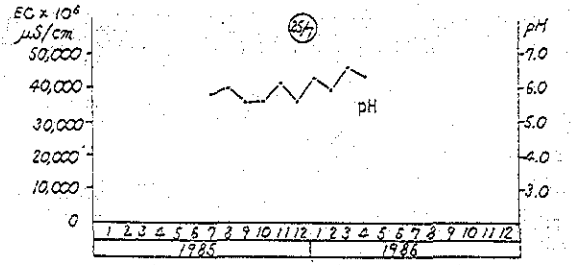


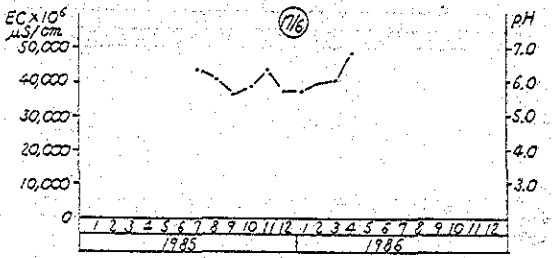


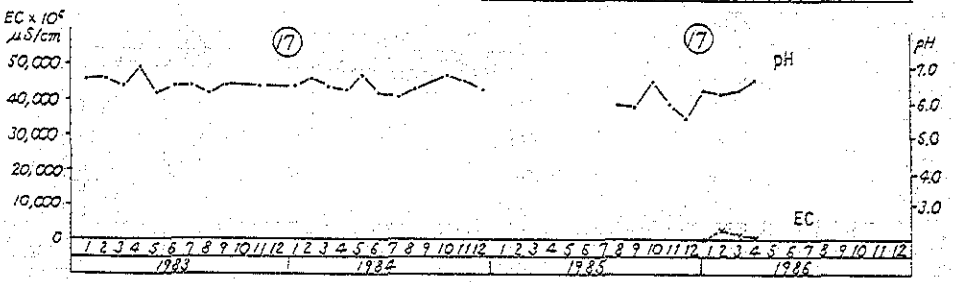
Khlong Sungai Padi and Pileng Project Drain (1983 - '86)

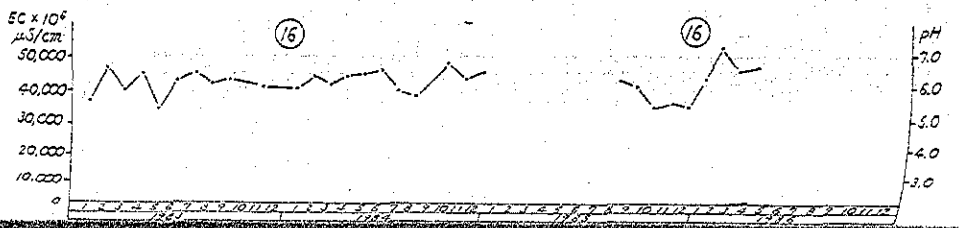






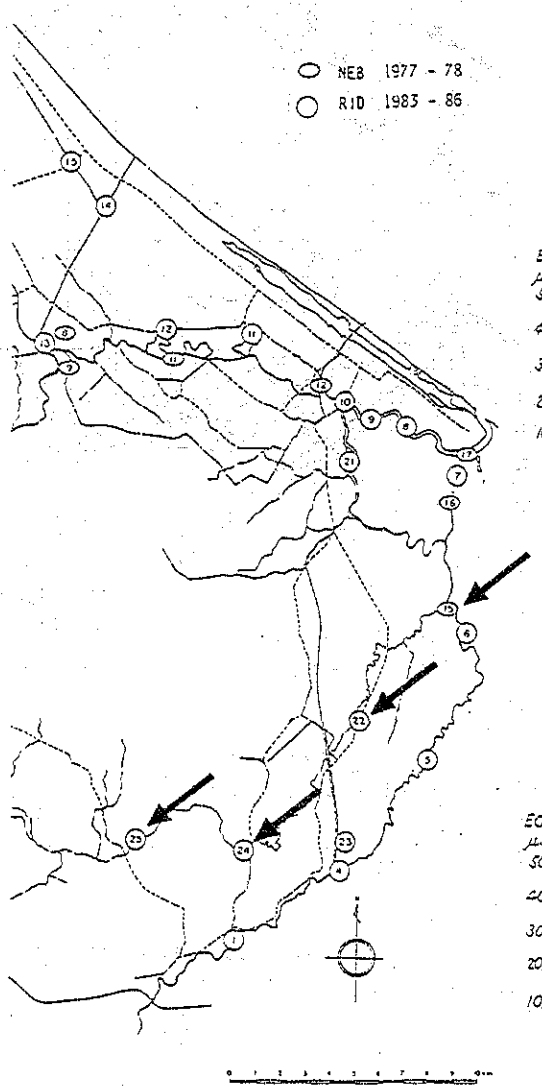


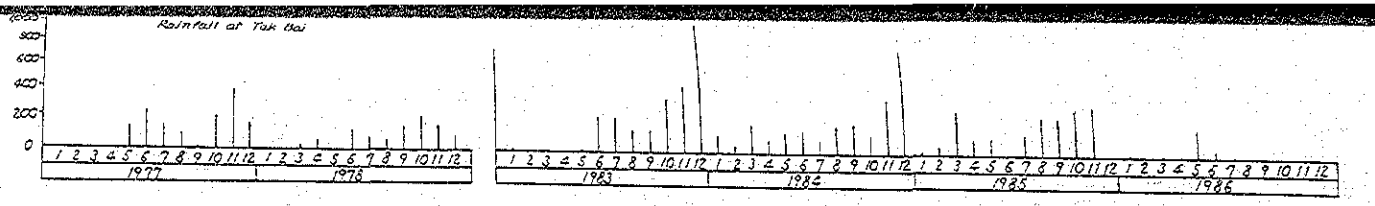


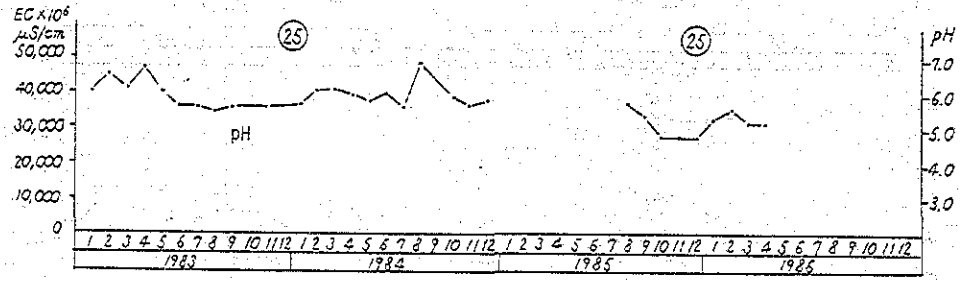


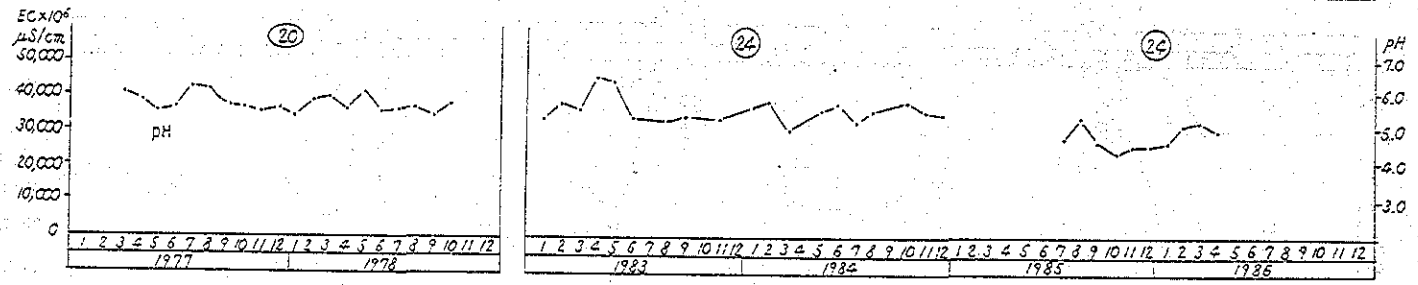
Khlong To Daeng (1977 - '86)

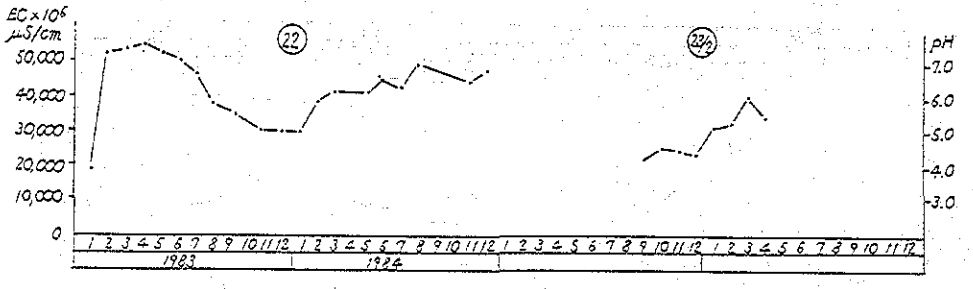
LOCATION OF WATER QUALITY MONITORING

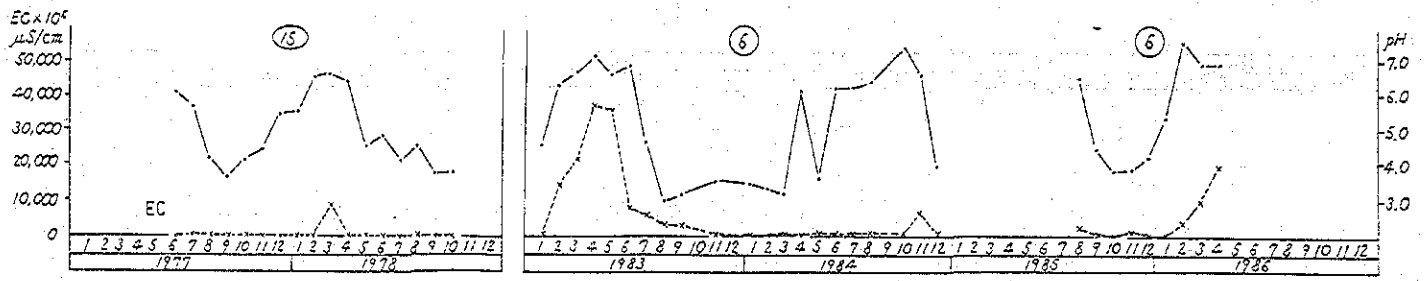




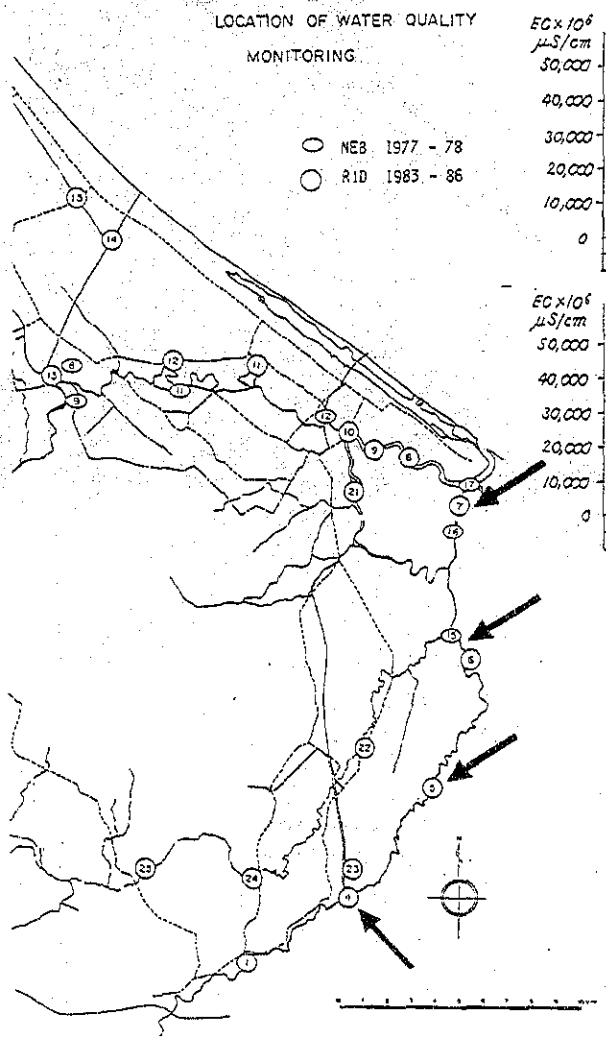


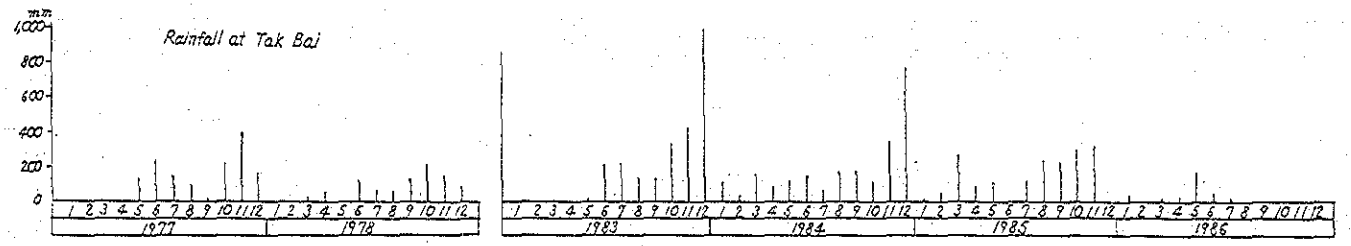


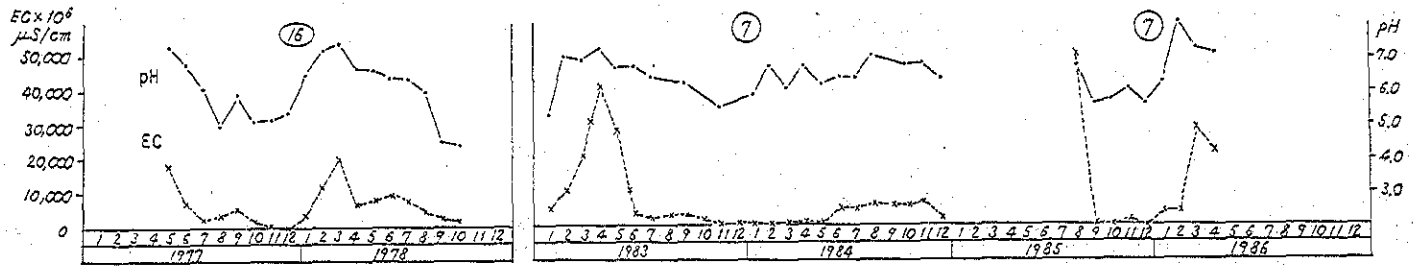


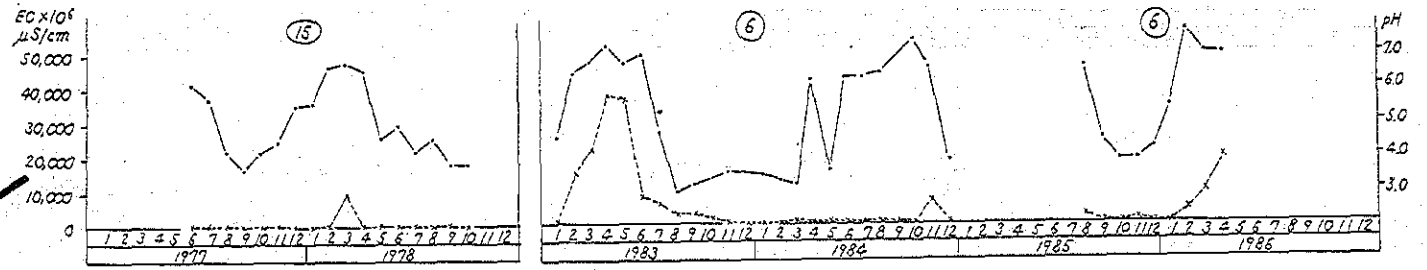


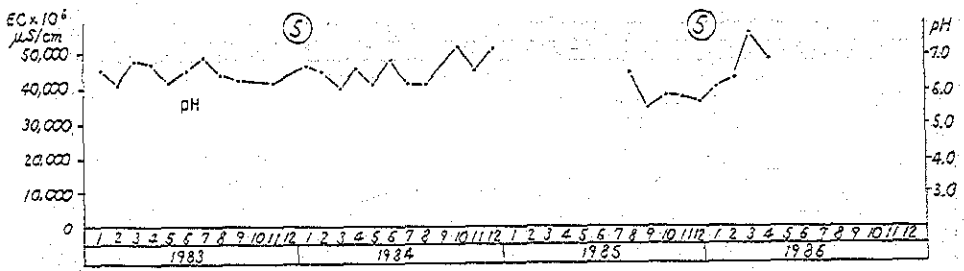
Golok River (1977 - '86)

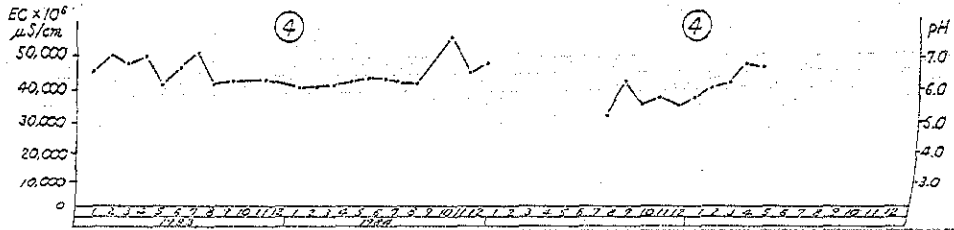


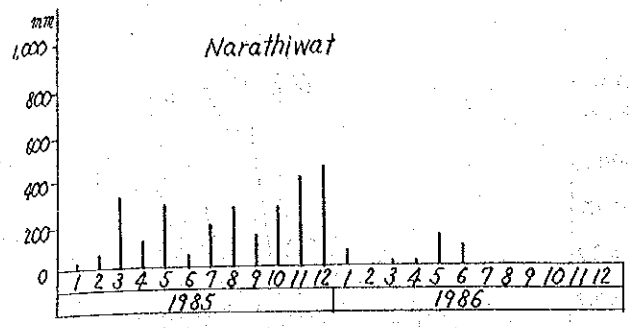




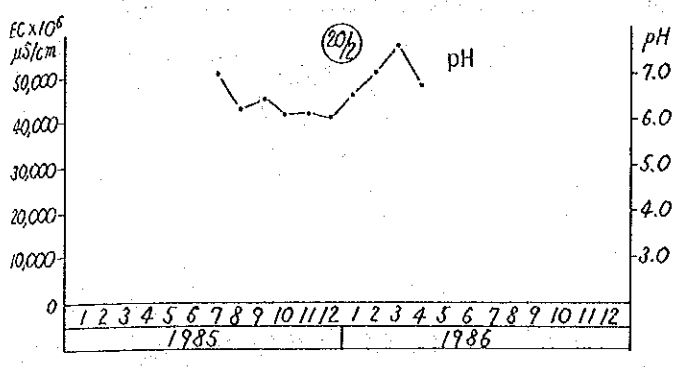


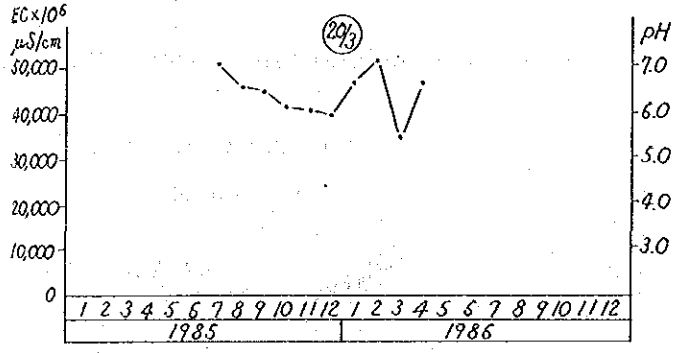


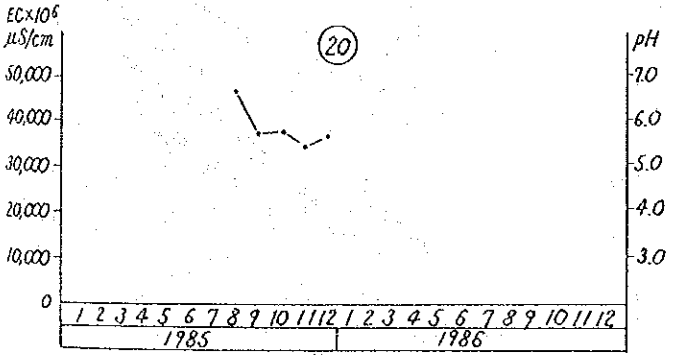


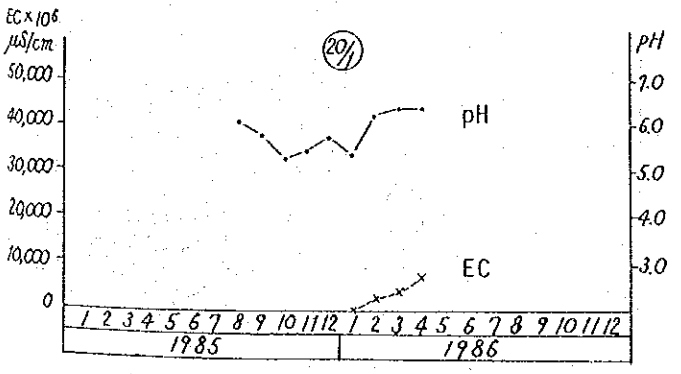


Mae Nam Yakang (1985 - '86)

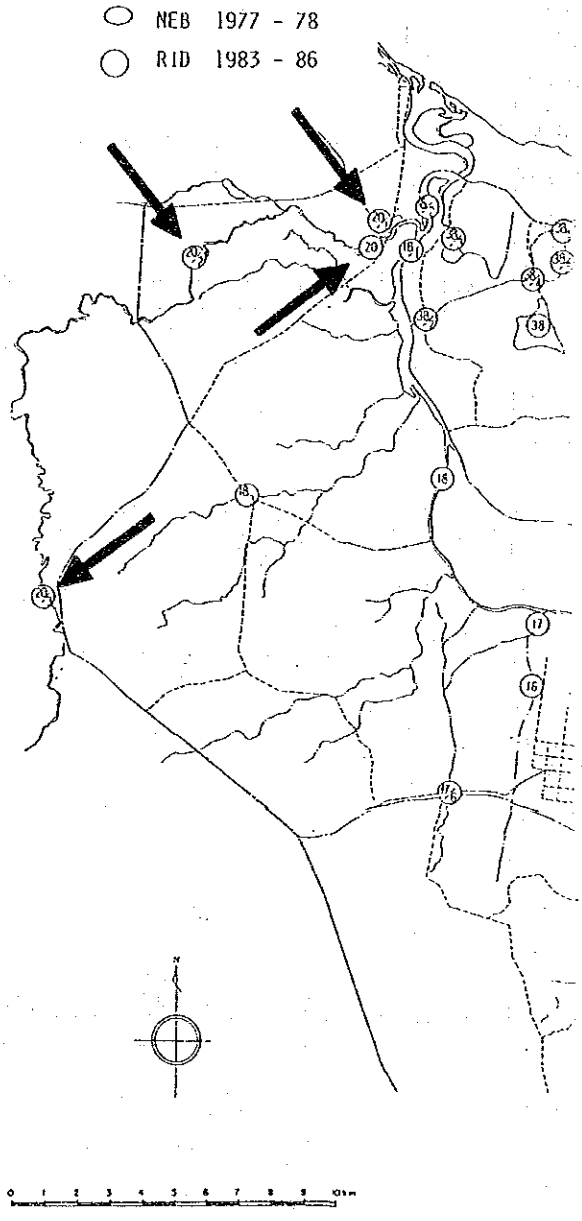


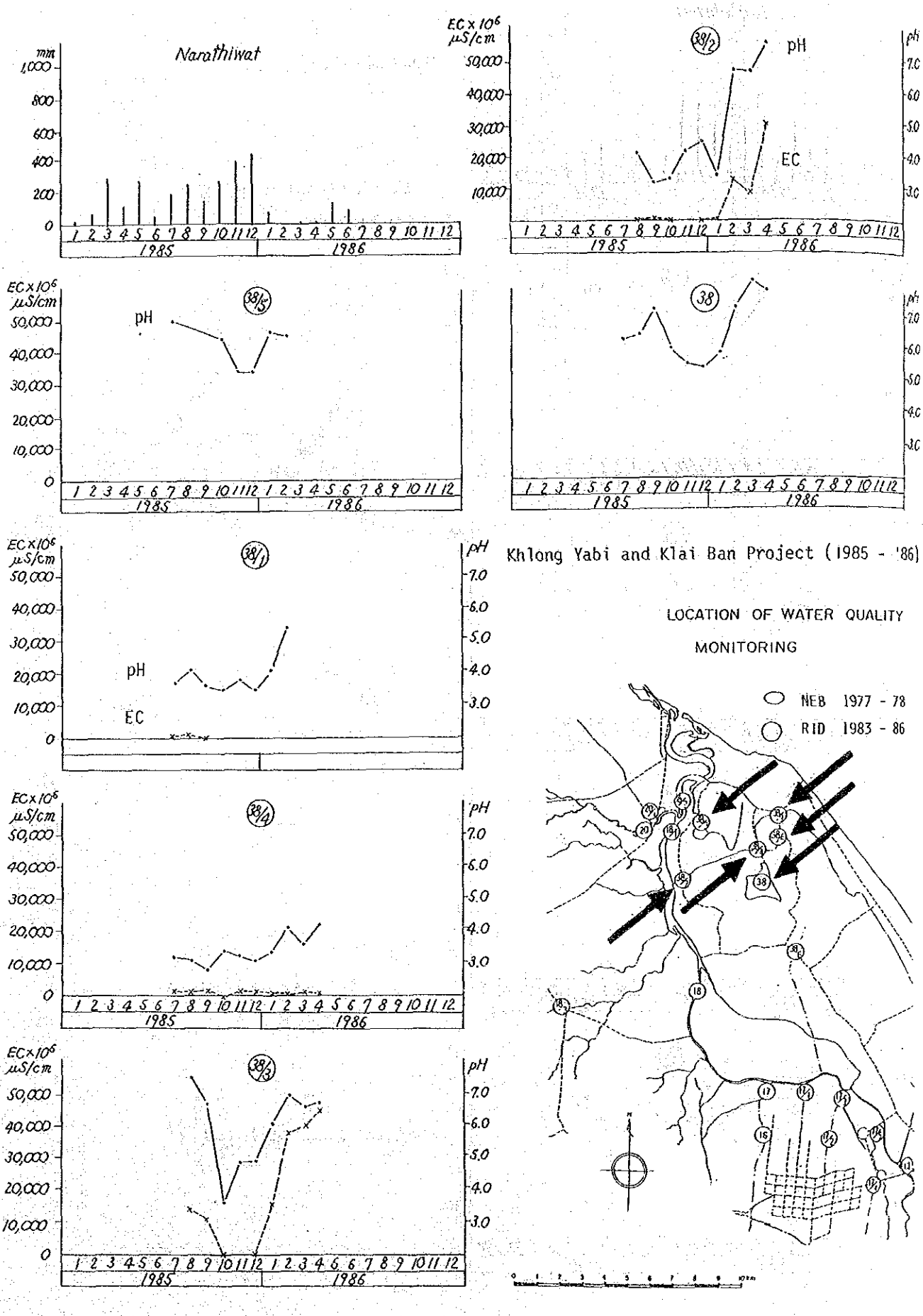






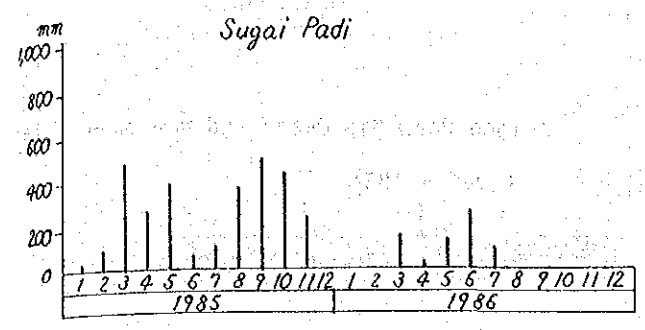
LOCATION OF WATER QUALITY MONITORING





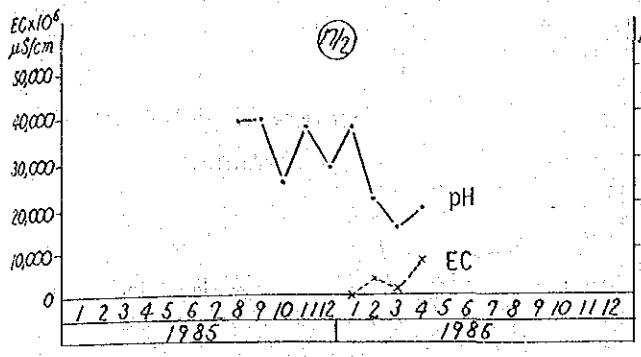
Khlong Yabi and Klai Ban Project (1985 - '86)

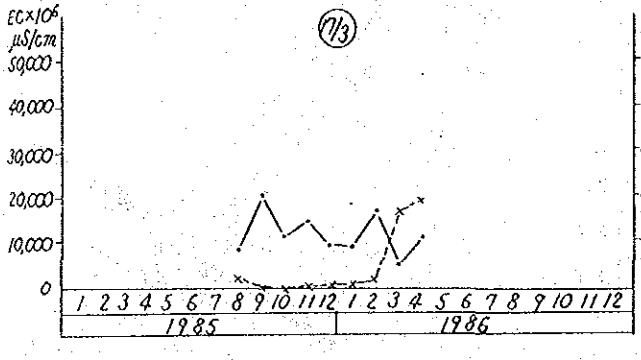
LOCATION OF WATER QUALITY MONITORING

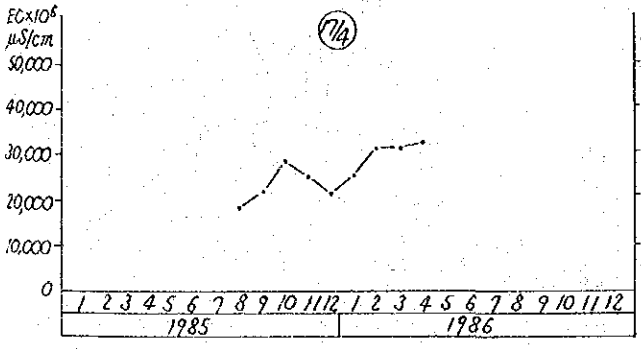


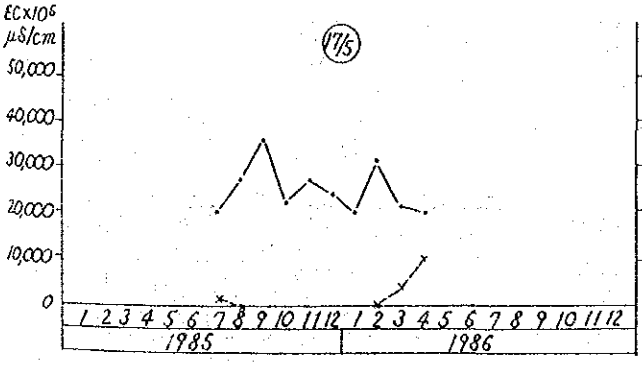
Pileng Project (1985 - '86)

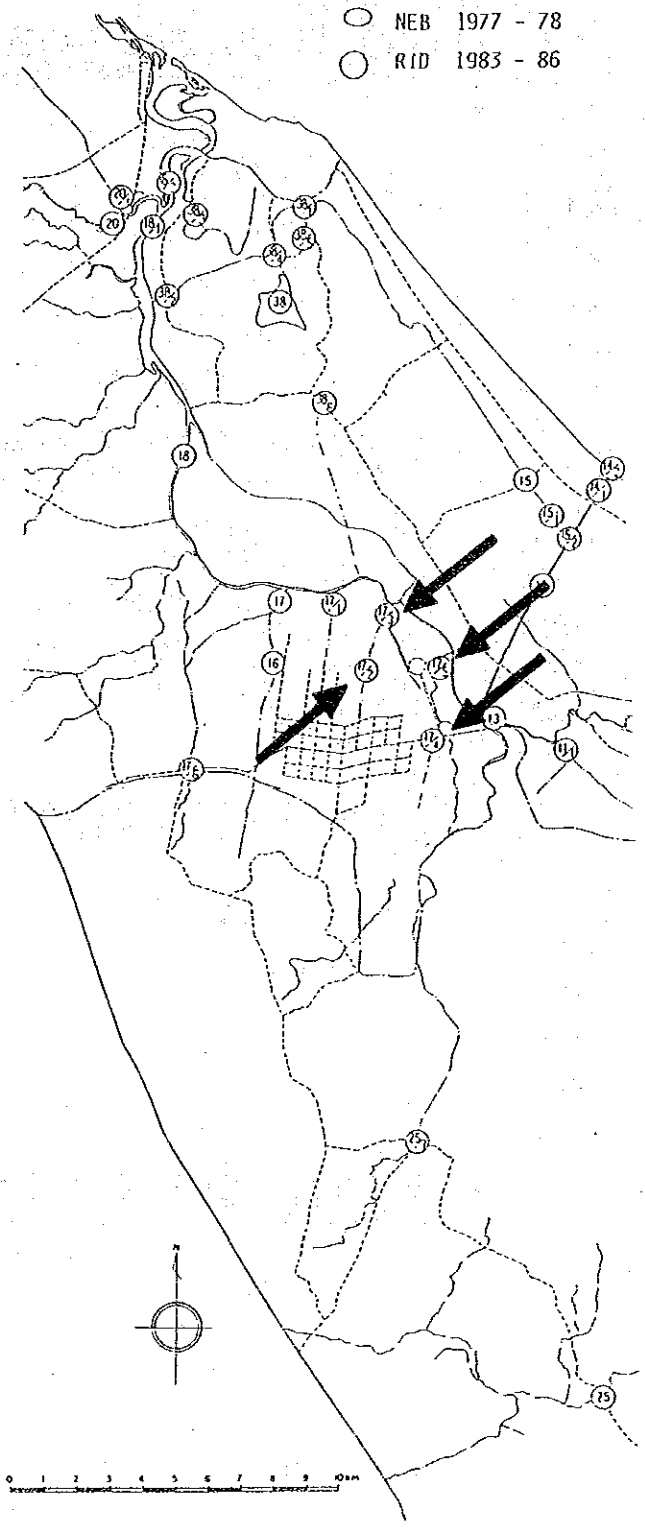
LOCATION OF WATER QUALITY MONITORING





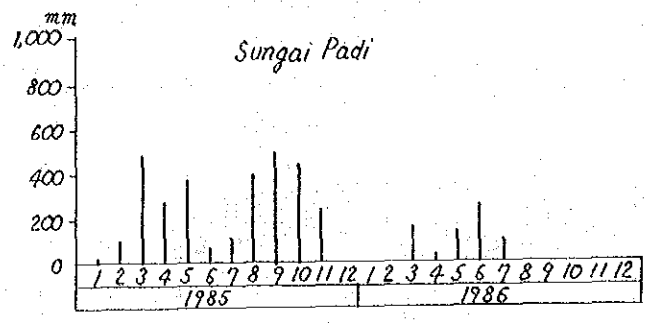


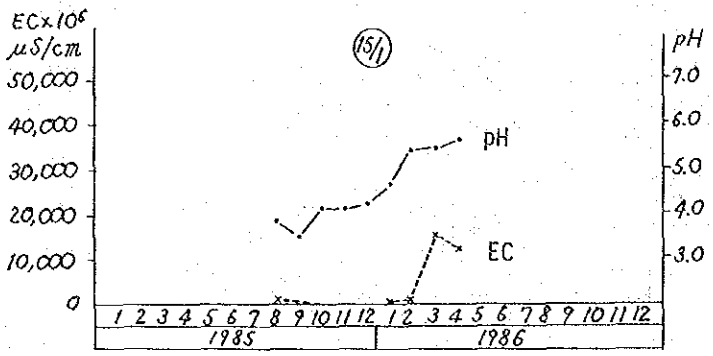


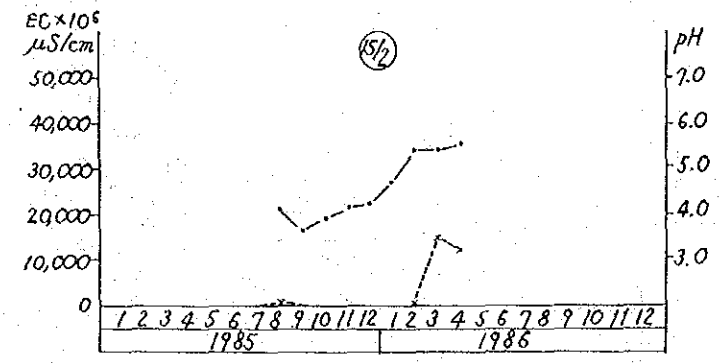


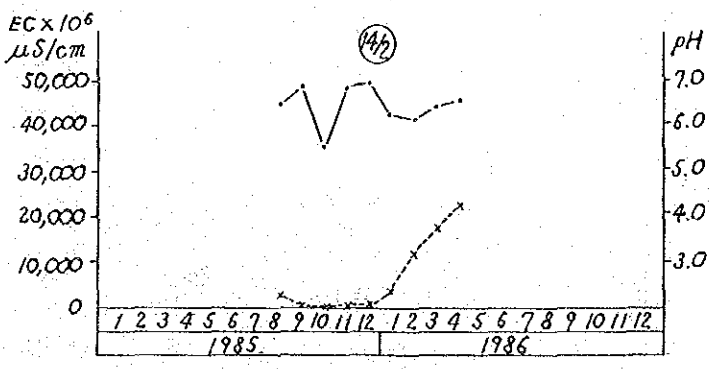
Khlong Phru Kap Daeng and Nam Baeng Canal

(1985 - '86)

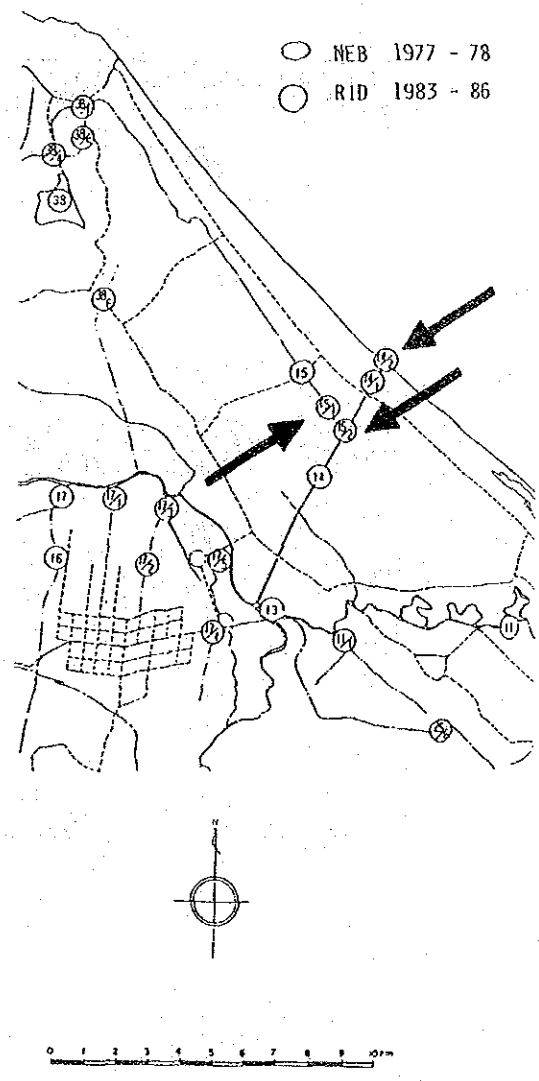


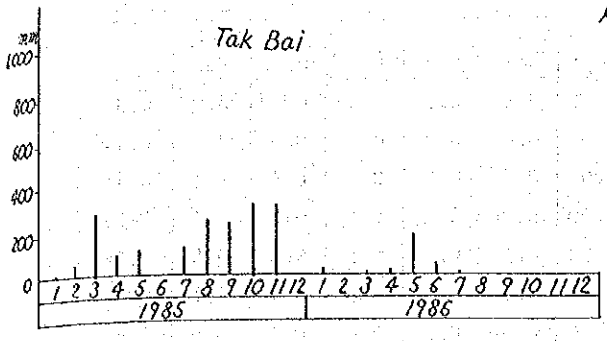


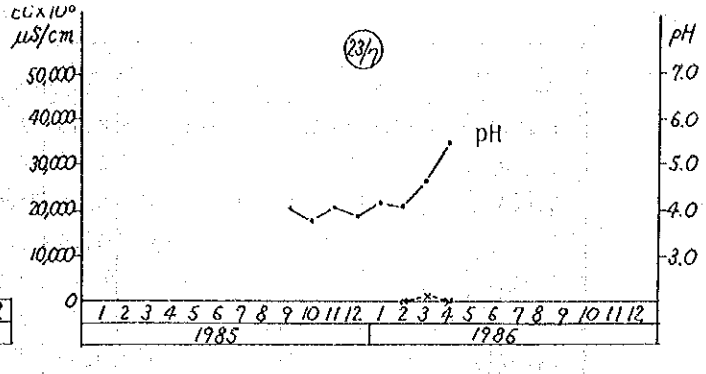


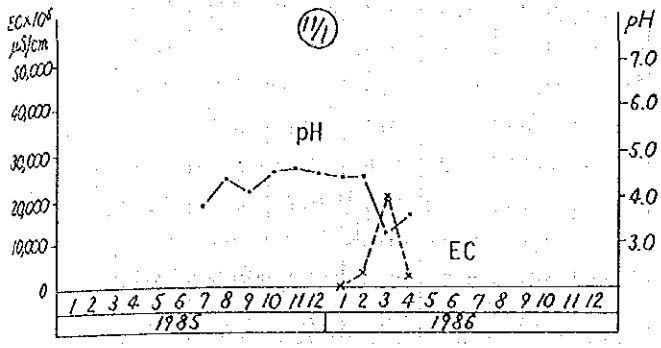


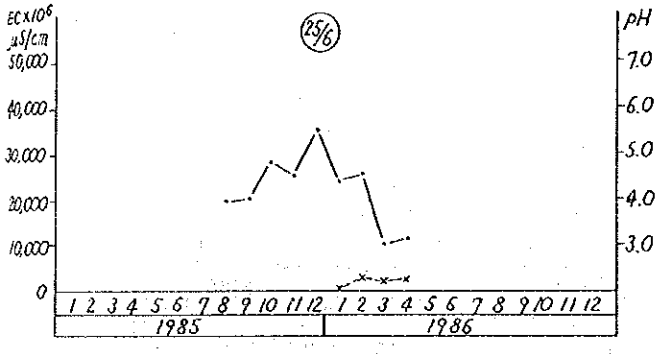
LOCATION OF WATER QUALITY MONITORING

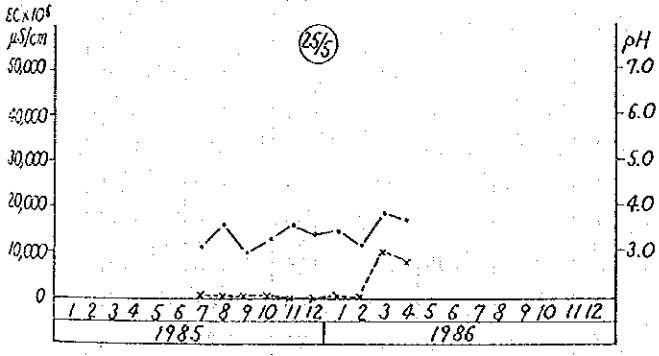


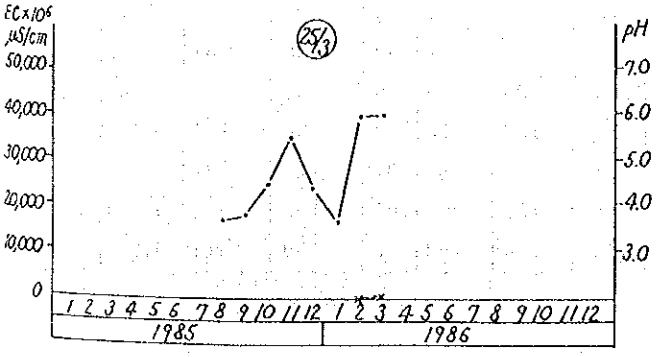




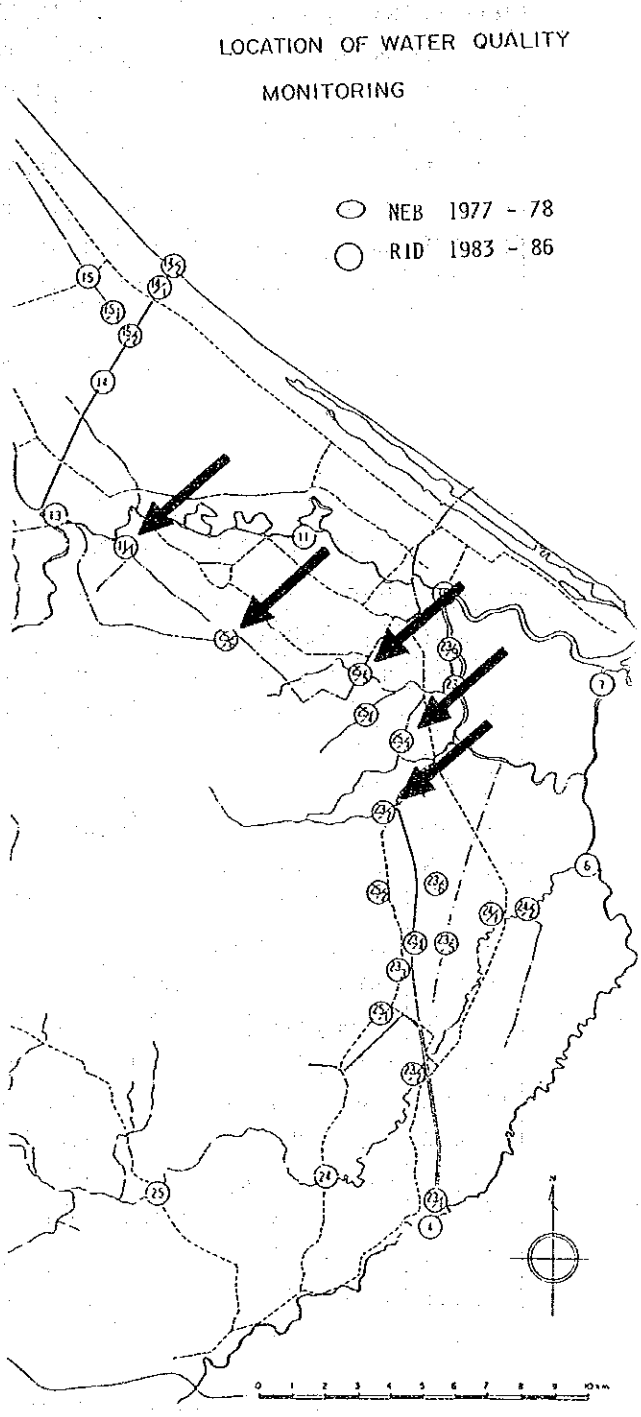








Streams from To Daeng Swamp (1985 - '86)



VIII-1-6. Result of Water Analysis (17 points)

BOD (mg/ℓ)

Location No. 1/	Name of Tributaries	1985						1986		
		Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar
1(18/1)	Mae Nam Bang Nara	×	0.45	2.15	0.40	0.5	0.4	0.4	0.9	0.3
2 (18)	"	×	0.10	1.05	0.60	0.2	0.4	0.4	0.6	0.44
3 (13)	"	×	0.40	1.05	0.70	0.3	0.4	0.9	1.1	0.46
4 (11)	"	×	0.70	1.00	0.70	0.1	0.6	0.4	0.4	0.35
5 (10)	"	×	0.15	2.00	0.45	0.2	0.5	0.6	0.5	0.55
6 (24)	Khlong To Daeng	×	1.15	2.15	0.90	0.1	0.3	0.4	0.1	0.55
7(23/2)	"	×	0.65	2.20	0.30	0.2	0.6	0.4	0.6	0.6
8(23/7)	Khlong Khok Ko	×	1.45	2.40	1.55	0.3	0.2	0.5	0.7	0.55
9(25/7)	Khlong Sungai Padi	×	0.50	1.85	0.25	0.1	0.3	0.1	0.3	0.85
10(17/6)	Khlong Chuap	×	0.55	1.50	0.25	0.3	0.5	0.4	0.7	0.5
11(18/3)	Khlong To Che	×	1.00	2.80	0.90	0.6	0.5	0.8	0.8	0.5
12(20/2)	Mae Nam Yakang	×	0.60	1.60	0.45	0.1	0.2	0.2	0.4	0.4
13(38/6)	Khlong Ku Bae Ya Hae	×	0.80	2.40	2.15	0.1	0.6	0.7	1.0	1.9
14(17/5)	Khlong Pileng	×	0.35	1.25	1.10	0.1	0.4	0.7	0.3	0.5
15 (15)	Khlong Phru Kap Daeng	×	1.00	2.30	0.85	0.3	0.8	0.7	0.2	32.63
16(11/1)	Khlong Bang Toei	×	0.65	1.90	1.50	0.7	0.8	0.7	0.8	0.35
17(25/5)	Khlong Khok Phai	×	0.60	0.50	1.50	0.1	0.5	0.7	0.5	0.8

Suspended Solid (mg/ℓ)

Location No. 1/	Name of Tributaries	1985						1986		
		Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar
1(18/1)	Mae Nam Bang Nara	7,339	×	231	4,764	76	48	852	5,560	12,162
2 (18)	"	6,365	×	125	4,598	58	68	103	154	17,105
3 (13)	"	587	×	125	2,689	169	36	195	3,609	10,384
4 (11)	"	24,520	×	243	5,093	140	61	9,139	6,577	18,842
5 (10)	"	26,847	×	643	3,618	1,740	52	12,466	13,679	10,847
6 (24)	Khlong To Daeng	44	×	67	104	98	90	157	178	248
7(23/2)	"	68	×	92	104	55	5	187	133	126
8(23/7)	Khlong Khok Ko	176	×	107	114	105	58	164	164	79
9(25/7)	Khlong Sungai Padi	73	×	60	30	21	10	85	83	61
10(17/6)	Khlong Chuap	74	×	86	58	29	11	91	95	87
11(18/3)	Khlong To Che	74	×	74	184	31	15	96	74	75
12(20/2)	Mae Nam Yakang	90	×	92	104	39	32	108	87	55
13(38/6)	Khlong Ku Bae Ya Hae	431	×	146	105	79	29	150	120	664
14(17/5)	Khlong Pileng	764	×	83	102	68	37	138	113	3,459
15 (15)	Khlong Phru Kap Daeng	97	×	183	111	82	37	129	101	155
16(11/1)	Khlong Bang Toei	194	×	313	169	200	109	192	1,531	9,540
17(25/5)	Khlong Khok Phai	700	×	302	298	187	77	159	314	5,734

1/ No. of Narathiwat Irrigation Office

2/ – Not detected; × Not analyzed

3/ Analyzed by Prince of Songkhla University

Acidity (mg/ℓ as $CaCO_3$)

Location No. 1/	Name of Tributaries	1985						1986		
		Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar
1(18/1)	Mae Nam Bang Nara	-	×	12.28	3420	12.53	-	1.71	-	-
2 (18)	"	-	×	16.01	2960	11.09	7.17	7.12	4.61	22.06
3 (13)	"	31.34	×	18.43	3180	49.45	9.94	20.59	6.98	23.92
4 (11)	"	-	×	22.21	3090	25.25	11.95	-	5.54	-
5 (10)	"	-	×	16.28	3700	13.71	11.23	-	-	-
6 (24)	Khlong To Daeng	9.29	×	13.87	16.40	15.34	11.48	4.13	9.33	3.92
7(23/2)	"	1.87	×	18.40	14.07	17.92	10.08	6.71	8.64	6.80
8(23/7)	Khlong Khok Ko	7.63	×	33.49	27.63	24.98	31.35	16.65	19.83	20.36
9(25/7)	Khlong Sungai Padi	5.47	×	7.72	7.83	6.50	-	-	-	-
10(17/6)	Khlong Chuap	0.80	×	1.58	2.55	0.70	-	-	-	-
11(18/3)	Khlong To Che	-	×	6.53	8.17	3.96	0.32	0.22	-	-
12(20/2)	Mae Nam Yakang	1.00	×	1.28	3.61	7.36	-	-	-	-
13(38/6)	Khlong Ku Bae Ya Hae	61.86	×	10.26	6.38	4.11	-	-	2.20	74.42
14(17/5)	Khlong Pileng	21.80	×	12.68	11.98	14.06	4.91	10.38	14.87	48.13
15 (15)	Khlong Phru Kap Daeng	-	×	28.46	23.92	20.97	11.27	-	-	-
16(11/1)	Khlong Bang Toei	26.60	×	14.94	18.98	34.74	23.17	13.74	16.73	68.20
17(25/5)	Khlong Khok Phai	21.37	×	85.54	25.52	57.26	29.78	38.05	79.87	48.62

Sulfate (mg/ℓ)

Location No. 1/	Name of Tributaries	1985						1986		
		Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar
1(18/1)	Mae Nam Bang Nara	593.9	×	31.5	97.7	2.0	4.6	52.8	301.2	467.1
2 (18)	"	466.4	×	23.5	99.8	1.9	4.5	12.1	136.6	509.2
3 (13)	"	99.4	×	26.0	99.1	27.2	7.2	30.3	223.7	435.5
4 (11)	"	1523.3	×	41.0	99.1	5.9	6.9	338.6	349.6	509.2
5 (10)	"	968.3	×	68.5	104.6	45.6	6.3	365.3	469.7	446.1
6 (24)	Khlong To Daeng	9.9	×	16.5	3.0	4.8	7.1	19.5	32.0	25.2
7(23/2)	"	4.7	×	19.0	2.6	4.5	6.1	24.5	28.2	18.9
8(23/7)	Khlong Khok Ko	6.7	×	23.0	4.4	9.5	12.4	25.4	35.9	33.6
9(25/7)	Khlong Sungai Padi	6.3	×	6.0	2.0	0.6	2.8	13.3	8.8	5.0
10(17/6)	Khlong Chuap	3.9	×	7.0	2.3	1.3	3.3	11.8	8.8	6.3
11(18/3)	Khlong To Che	3.1	×	10.8	4.1	1.5	3.5	13.2	8.8	-
12(20/2)	Mae Nam Yakang	4.5	×	8.0	2.3	0.5	3.7	10.3	8.8	-
13(38/6)	Khlong Ku Bae Ya Hae	148.4	×	18.3	2.9	3.1	4.4	13.8	12.7	166.2
14(17/5)	Khlong Pileng	63.4	×	13.0	3.0	2.9	7.7	23.2	28.2	269.3
15 (15)	Khlong Phru Kap Daeng	8.8	×	43.5	4.8	7.5	8.7	18.4	20.4	16.4
16(11/1)	Khlong Bang Toei	54.6	×	16.5	4.7	12.4	10.3	22.0	119.2	446.1
17(25/5)	Khlong Khok Phai	339.9	×	62.5	4.5	21.9	11.3	49.2	123.1	340.9

1/ No. of Narathiwat Irrigation Office

2/ - Not detected; × Not analyzed

3/ Analyzed by Prince of Songkhla University

Total N (mg/ℓ)

Location No. 1/	Name of Tributaries	1985						1986		
		Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar
1(18/1)	Mae Nam Bang Nara	2.06	×	0.14	1.12	2.80	4.76	0.28	–	×
2 (18)	"	1.38	×	–	1.96	11.76	2.80	0.84	1.40	×
3 (13)	"	0.44	×	8.15	–	5.60	3.64	–	3.64	×
4 (11)	"	4.70	×	1.67	7.84	3.36	2.52	2.24	3.08	×
5 (10)	"	–	×	–	1.29	12.60	6.16	1.12	1.06	×
6 (24)	Khlong To Daeng	0.98	×	0.82	12.88	9.52	3.92	1.68	6.72	×
7(23/2)	"	–	×	–	3.64	24.08	5.60	3.64	5.60	×
8(23/7)	Khlong Khok Ko	32.11	×	12.65	3.08	6.72	6.16	3.08	10.64	×
9(25/7)	Khlong Sungai Padi	0.71	×	1.87	–	–	0.84	3.92	3.08	×
10(17/6)	Khlong Chuap	–	×	–	1.12	5.04	5.32	1.40	–	×
11(18/3)	Khlong To Che	6.77	×	–	–	4.48	1.68	5.32	5.88	×
12(20/2)	Mae Nam Yakang	–	×	3.95	0.73	5.60	4.48	2.24	3.08	×
13(38/6)	Khlong Ku Bae Ya Hae	2.35	×	6.19	7.28	1.61	4.76	1.68	–	×
14(17/5)	Khlong Pileng	4.62	×	–	0.56	6.16	2.80	–	11.76	×
15 (15)	Khlong Phru Kap Daeng	1.31	×	0.97	3.36	2.94	5.88	3.92	4.20	×
16(11/1)	Khlong Bang Toei	0.46	×	1.37	2.63	3.64	2.52	3.92	8.68	×
17(25/5)	Khlong Khok Phai	2.40	×	–	1.68	5.60	16.80	7.00	–	×

Total P (µg/ℓ)

Location No. 1/	Name of Tributaries	1985						1986		
		Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar
1(18/1)	Mae Nam Bang Nara	6.55	×	0.16	–	4.96	11.43	–	–	×
2 (18)	"	15.12	×	–	0.35	3.29	14.27	–	–	×
3 (13)	"	17.41	×	0.02	0.81	12.06	5.83	–	–	×
4 (11)	"	6.55	×	–	–	10.33	25.79	–	–	×
5 (10)	"	9.41	×	–	–	1.65	–	–	–	×
6 (24)	Khlong To Daeng	19.69	×	1.00	2.02	5.55	21.95	–	–	×
7(23/2)	"	20.26	×	0.02	1.20	8.10	12.84	–	–	×
8(23/7)	Khlong Khok Ko	15.69	×	0.02	3.68	3.42	–	–	–	×
9(25/7)	Khlong Sungai Padi	18.55	×	0.03	–	7.09	12.84	–	–	×
10(17/6)	Khlong Chuap	8.84	×	–	–	1.65	10.64	–	–	×
11(18/3)	Khlong To Che	18.55	×	–	1.59	1.32	7.22	–	–	×
12(20/2)	Mae Nam Yakang	15.12	×	0.01	0.81	2.78	25.40	–	–	×
13(38/6)	Khlong Ku Bae Ya Hae	15.69	×	–	–	10.41	9.74	–	–	×
14(17/5)	Khlong Pileng	10.55	×	–	–	0.002	10.86	–	–	×
15 (15)	Khlong Phru Kap Daeng	13.41	×	–	–	1.64	14.27	–	–	×
16(11/1)	Khlong Bang Toei	10.55	×	0.03	–	1.98	11.43	–	–	×
17(25/5)	Khlong Khok Phai	9.98	×	–	0.64	0.82	5.83	–	–	×

1/ No. of Narathiwat Irrigation Office

2/ – Not detected; × Not analyzed

3/ Analyzed by Prince of Songkhla University

Total Fe (mg/ℓ)

Location No. 1/	Name of Tributaries	1985						1986		
		Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar
1(18/1)	Mae Nam Bang Nara	-	×	1.53	14.51	0.09	3.75	0.73	0.75	0.76
2 (18)	"	-	×	0.65	2.18	0.09	1.55	1.05	0.70	8.48
3 (13)	"	0.20	×	1.66	10.20	2.70	3.03	1.13	2.38	7.65
4 (11)	"	0.20	×	2.90	12.50	2.70	3.39	4.12	1.52	1.04
5 (10)	"	0.15	×	1.35	8.20	0.08	2.15	1.36	1.30	1.15
6 (24)	Khlong To Daeng	0.16	×	1.18	18.01	1.25	1.98	1.46	3.30	3.78
7(23/2)	"	-	×	2.95	5.10	1.60	1.15	1.85	2.40	2.26
8(23/7)	Khlong Khok Ko	-	×	3.85	18.50	4.00	2.85	7.81	4.75	6.60
9(25/7)	Khlong Sungai Padi	-	×	1.03	14.80	0.09	×	2.30	1.20	0.95
10(17/6)	Khlong Chuap	-	×	1.97	3.20	1.90	2.10	1.75	1.84	1.44
11(18/3)	Khlong To Che	-	×	2.95	3.80	2.30	0.75	3.11	5.40	1.88
12(20/2)	Mae Nam Yakang	-	×	2.46	3.50	1.45	3.13	1.30	1.03	0.85
13(38/6)	Khlong Ku Bae Ya Hae	0.45	×	1.72	3.37	1.60	0.93	3.00	1.58	3.80
14(17/5)	Khlong Pileng	0.20	×	1.50	2.10	4.00	3.25	3.35	9.29	12.20
15 (15)	Khlong Phru Kap Daeng	-	×	8.88	5.10	2.50	1.23	3.51	4.56	4.06
16(11/1)	Khlong Bang Toei	0.55	×	5.68	9.16	11.60	3.39	6.75	4.37	6.60
17(25/5)	Khlong Khok Phai	5.10	×	4.38	16.10	17.00	1.63	4.38	22.80	5.78

Heavy Metals

July, 1985

Location No. 1/	Name of Tributaries	Heavy Metals (mg/ℓ)							
		As	Cd	Cr	Cu	Hg	Pb	Sn	Zn
1(18/1)	Mae Nam Bang Nara	-	0.005	-	-	-	-	-	0.036
2 (18)	"	×	×	×	×	×	×	×	×
3 (13)	"	×	×	×	×	×	×	×	×
4 (11)	"	×	×	×	×	×	×	×	×
5 (10)	"	×	×	×	×	×	×	×	×
6 (24)	Khlong To Daeng	×	×	×	×	×	×	×	×
7(23/2)	"	-	-	-	-	-	-	-	-
8(23/7)	Khlong Khok Ko	×	×	×	×	×	×	×	×
9(25/7)	Khlong Sungai Padi	×	×	×	×	×	×	×	×
10(17/6)	Khlong Chuap	×	×	×	×	×	×	×	×
11(18/3)	Khlong To Che	×	×	×	×	×	×	×	×
12(20/2)	Mae Nam Yakang	-	-	-	-	-	-	-	0.020
13(38/6)	Khlong Ku Bae Ya Hae	×	×	×	×	×	×	×	×
14(17/5)	Khlong Pileng	×	×	×	×	×	×	×	×
15 (15)	Khlong Phru Kap Daeng	×	×	×	×	×	×	×	×
16(11/1)	Khlong Bang Toei	×	×	×	×	×	×	×	×
17(25/5)	Khlong Khok Phai	×	×	×	×	×	×	×	×

1/ No. of Narathiwat Irrigation Office

2/ - Not detected; × Not analyzed

3/ Analyzed by Prince of Songkhla University

List of Water Sampling Points

No.	Name of River	Location
1 (18/1) 1/	Mae Nam Bang Nara	Ban Ple
2 (18)	"	Ban Ba Ngo Pa Se Pu Tae
3 (13)	"	Ban Choli Mat
4 (11)	"	Ban Ta Pang
5 (10)	"	Ban Tha Phraek
6 (24)	Khlong To Daeng	Ban Ko Te Mung
7 (23/2)	"	Before conjunction with Muno Canal
8 (23/7)	Khlong Khok Ko	Before conjunction with Muno Canal
9 (25/7)	Khlong Sungai Padi	Ban Yai
10 (17/6)	Khlong Chuap	Ban Marubo Ok
11 (18/3)	Khlong To Che	Ban Khok Su Mu
12 (20/2)	Mae Nam Yakang	Ban Sungai Bala
13 (38/6)	Khlong Ku Bae Ya Hoe	Ban Ku Bae Ya Hae
14 (17/5)	Khlong Pileng	In front of Pileng Regulator #1
15 (15)	Khlong Phru Kap Daeng	At Rural Accelerated Bridge
16 (11/1)	Khlong Bang Toei	Ban Yu Yo
17 (25/5)	Khlong Khok Phai	Ban Khok Phai

1/ No. of Narathiwat Irrigation Office

VIII-1-7. Drainage Area Concerned With Acidic Water Outflow

No.	Sub-Area	Basin Area (sq.km)	Drainage Area (sq.km)	Remarks
1	Mae Nam Yakang	16.2	-	
2	Khlong Ba Keng	12.6	-	
3	Khlong Ku Ra Po	11.0	-	
4	Khlong Mae Lamphu	11.0	-	
5	Khlong Na Ko	12.0	-	
6	Khlong To Che	37.6	-	
7	Bang Nara -1	6.3	-	
8	Khlong Chang	53.4	-	
9	Khlong Maru Bo	7.7	-	
10	Existing Pileng	51.2	51.2	A
11	Khlong Bang Toei	13.0	13.0	B
12	Khlong Khok Ngu	6.5	-	
13	Khlong Lan	9.2	-	
14	Bang Nara -2	6.2	-	
15	Bang Nara -3	10.3	-	
16	Khlong Sala Mai	6.8	-	
17	NBR - East	16.5	-	
18	Khlong Lai	9.1	-	
19	Khlong To Lang	12.8	12.8	B
20	Bang Nara -4	8.5	-	
21	Bang Nara -5	6.0	-	
22	Khlong Ku Cham	14.5	-	
23	Khlong Pru Kab Daeng	22.4	8.9	A
24	NBR - West	15.3	-	
25	Khlong Ku Bae Ya Hae	14.3	14.3	B
26	Bang Nara - 6	9.8	-	
27	Khlong Pu Cho Ya Mu	21.3	-	
28	Khlong Sapi Yo	35.0	21.0	A
29	Bang Nara - 7	10.5	-	
	Sg. Padi*	78.2*	78.2	B
	Total	467.0**	199.4	

Note : A figure of 78.2 sq.km with * mark means that the basin area is out of the Study area. The total of 467.0 sq.km with ** mark is not including the above 78.2 sq.km of Sg. Padi, however, the total area of 199.4 sq.km is including the above area. No facility is recommended on Khlong Lan because acidic water does not flow into the Bang Nara water storage. In the column of remarks, "A" stream is to be controlled by the existing facility and "B" by the "B" proposed facility.

VIII-2. Irrigation

VIII-2-1 Water Balance Analysis

TABLE VIII-2-1 MULTIPLICATION FACTORS TO RELATE MONTHLY EFFECTIVE RAINFALL VALUE OBTAINED

d (mm)	factor	d (mm)	factor
10.00	0.620	45.00	0.905
12.50	0.650	50.00	0.930
15.00	0.676	55.00	0.947
17.50	0.703	60.00	0.963
18.75	0.720	65.00	0.977
20.00	0.728	70.00	0.990
22.50	0.749	75.00	1.000
25.00	0.770	80.00	1.004
27.50	0.790	85.00	1.008
30.00	0.808	90.00	1.012
31.25	0.818	95.00	1.016
32.50	0.826	100.00	1.020
35.00	0.842	125.00	1.040
37.50	0.860	150.00	1.050
40.00	0.876	175.00	1,070

Note : d - Net depth of irrigation application in mm

TABLE VIII-2-2 AVERAGE MONTHLY EFFECTIVE RAINFALL AS RELATED TO MEAN MONTHLY RAINFALL AND MEAN MONTHLY CONSUMPTIVE USE (USDA, SCS)

Monthly Mean Rainfall	Mean monthly consumptive use (mm)													
	25	50	75	100	125	150	175	200	225	250	275	300	325	350
(mm)	Mean monthly effective rainfall (mm)													
12.5	7.5	8.0	8.7	9.0	9.2	10.0	10.5	11.2	11.7	12.5	12.5	12.5	12.5	12.5
25.0	15.0	16.2	17.5	18.0	18.5	19.7	20.5	22.0	24.5	25.0	25.0	25.0	25.0	25.0
37.5	22.5	24.0	26.2	27.5	28.2	29.2	30.5	33.0	36.2	37.5	37.5	37.5	37.5	37.5
50.0	25.0*	32.2	34.5	35.7	36.7	39.0	40.5	43.7	47.0	50.0	50.0	50.0	50.0	50.0
62.5	25.0	39.7	42.5	44.5	46.0	48.5	50.5	53.7	57.5	62.5	62.5	62.5	62.5	62.5
75.0	25.0	46.2	49.7	52.7	55.0	57.5	60.2	63.7	67.5	73.7	75.0	75.0	75.0	75.0
98.5	25.0	50.0*	56.7	60.2	63.7	66.0	69.7	73.7	77.7	84.5	87.5	87.5	87.5	87.5
100.0	25.0	50.0	63.7	67.7	72.0	74.2	78.7	83.0	87.7	95.0	100.0	100.0	100.0	100.0
112.5	25.0	50.0	70.5	75.0	80.2	82.5	87.2	92.7	98.0	105.0	111.0	112.0	112.0	112.0
125.0	25.0	50.0	75.0*	81.5	87.7	90.5	95.7	102.0	108.0	115.0	121.0	125.0	125.0	125.0
137.5	25.0	50.0	75.0	88.7	95.2	98.7	104.0	111.0	118.0	126.0	132.0	137.0	137.0	137.0
150.0	25.0	50.0	75.0	95.2	102.0	106.0	112.0	120.0	127.0	136.0	143.0	150.0	150.0	150.0
162.5	25.0	50.0	75.0	100.0*	109.0	113.0	120.0	128.0	135.0	145.0	153.0	160.0	162.0	162.0
175.0	25.0	50.0	75.0	100.0	115.0	120.0	127.0	135.0	143.0	154.0	164.0	170.0	175.0	175.0
187.5	25.0	50.0	75.0	100.0	121.0	126.0	134.0	142.0	151.0	161.0	170.0	179.0	185.0	187.0
200.0	25.0	50.0	75.0	100.0	125.0*	133.0	140.0	148.0	158.0	168.0	178.0	188.0	196.0	200.0
225.0	25.0	50.0	75.0	100.0	125.0	144.0	151.0	160.0	171.0	182.0				
250.0	25.0	50.0	75.0	100.0	125.0	150.0*	161.0	170.0	183.0	194.0				
275.0	25.0	50.0	75.0	100.0	125.0	150.0	171.0	181.0	194.0	205.0				
300.0	25.0	50.0	75.0	100.0	125.0	150.0	175.0*	190.0	203.0	215.0				
325.0	25.0	50.0	75.0	100.0	125.0	150.0	175.0	198.0	213.0	224.0				
350.0	25.0	50.0	75.0	100.0	125.0	150.0	175.0	200.0*	200.0	232.0				
375.0	25.0	50.0	75.0	100.0	125.0	150.0	175.0	200.0	225.0*	240.0				
400.0	25.0	50.0	75.0	100.0	125.0	150.0	175.0	200.0	225.0	247.0				
425.0	25.0	50.0	75.0	100.0	125.0	150.0	175.0	200.0	225.0	250.0*				
450.0	25.0	50.0	75.0	100.0	125.0	150.0	175.0	200.0	225.0	250.0				

Note: The max. effective rainfall of 25.0 mm with * marks is taken at 41.7 mm of monthly rainfall, 50 mm at 80.7 mm, 75 mm at 122 mm, 100 mm at 160 mm, 125 mm at 197 mm, 150 mm at 240 mm, 175 mm at 287 mm, 200 mm at 331 mm, 225 mm at 372 mm, 250 mm at 412 mm, respectively.

TABLE VIII-2-3 RESULTS OF WATER BALANCE STUDY

WATER BALANCE ANALYSIS IN THAILAND
PROJECT NAME : BANG NARA IRRIGATION AND DRAINAGE PROJECT, THAILAND

*** CASE STUDY : ALTERNATIVE CASE ***

*** CROOPED ACREAGE			REMARKS ***
PADDY -ILV :	3370. HA (	21063. RAI)	WET SEASON
PADDY -HYV(1):	4810. HA (	30063. RAI)	WET SEASON (RD-13)
PADDY -HYV(2):	1600. HA (	10000. RAI)	WET SEASON (RD-7)
MUNGBEAN (1) :	210. HA (	1313. RAI)	DRY SEASON
MUNGBEAN (2) :	310. HA (	1938. RAI)	DRY SEASON
MUNGBEAN (3) :	100. HA (	625. RAI)	DRY SEASON
CORN (1) :	210. HA (	1313. RAI)	DRY SEASON
CORN (2) :	310. HA (	1938. RAI)	DRY SEASON
CORN (3) :	100. HA (	625. RAI)	DRY SEASON
GROUNDNUT(1) :	210. HA (	1313. RAI)	DRY SEASON
GROUNDNUT(2) :	310. HA (	1938. RAI)	DRY SEASON
GROUNDNUT(3) :	100. HA (	625. RAI)	DRY SEASON
VEGETABLE(1) :	210. HA (	1313. RAI)	DRY SEASON
VEGETABLE(2) :	310. HA (	1938. RAI)	DRY SEASON
VEGETABLE(3) :	100. HA (	625. RAI)	DRY SEASON
FORAGE CROPS :	200. HA (	1250. RAI)	DRY SEASON

*** DIMENSION OF BASIC ITEMS ***

MAXIMUM STORAGE VOLUME	:	15839000 CUM
MAXIMUM WATER SURFACE AREA	:	1386. HA
MAXIMUM WATER LEVEL	:	0.40 M
RIVER MOUTH MAINTENANCE FLOW	:	5.00 CUM/SEC
IRRIGATION EFFICENCY		
PADDY CULTIVATION	:	57.0 %
UPLAND CROPS CULTIVATION	:	46.0 %
RETURN FLOW RATE	:	30.00 %

*** CULTIVATION CONDITION ***

LIV	CULTIVATION	AUG-2ND DECADE START
HYV (RD-13)	CULTIVATION	SEP-1ST DECADE START
HYV (RD-7)	CULTIVATION	SEP-2ND DECADE START
MUNGBEAN (1)	CULTIVATION	MAR-2ND DECADE START
MUNGBEAN (2)	CULTIVATION	FEB-3RD DECADE START
MUNGBEAN (3)	CULTIVATION	APR-2ND DECADE START
CORN (1)	CULTIVATION	MAR-3RD DECADE START
CORN (2)	CULTIVATION	MAR-2ND DECADE START
CORN (3)	CULTIVATION	APR-3RD DECADE START
GROUNDNUT(1)	CULTIVATION	MAR-2ND DECADE START
GROUNDNUT(2)	CULTIVATION	MAR-1ST DECADE START
GROUNDNUT(3)	CULTIVATION	APR-2ND DECADE START
VEGETABLE(1)	CULTIVATION	FEB-3RD DECADE START
VEGETABLE(2)	CULTIVATION	FEB-1ST DECADE START
VEGETABLE(3)	CULTIVATION	MAR-2ND DECADE START
FORAGE CROPS	CULTIVATION	THROUGH A YEAR

TABLE VIII-2-4 SUMMARY OF WATER BALANCE ANALYSIS

WATER BALANCE ANALYSIS
ANNUAL MEAN

(UNIT : 1000 CUM OR M)

YEAR	INFLOW	WATER DEMAND	NON-EFF. DISCHARGE	EFFECTIVE DISCHARGE	RETURN FLOW	EVAPO-RATION
1955	1183886.	51978.	1108505.	75380.	5137.	28539.
1956	1183454.	57305.	1104270.	79182.	6893.	28770.
1957	856432.	64416.	772879.	83552.	7353.	26489.
1958	1039459.	43962.	977674.	61785.	4475.	22297.
1959	946749.	36349.	893475.	53274.	4740.	21664.
1960	1013765.	39109.	959482.	54282.	5289.	20462.
1961	833886.	32264.	787216.	46669.	3613.	18019.
1962	1392082.	32960.	1343544.	48535.	3953.	19528.
1963	1209774.	36565.	1156266.	53506.	3701.	20642.
1964	884428.	44066.	825620.	58808.	5751.	20492.
1965	1725398.	25127.	1683815.	41580.	3449.	19902.
1967	3486529.	48627.	3422421.	64088.	6126.	21586.
1968	1138172.	42420.	1076446.	61724.	4885.	24189.
1969	1776368.	35649.	1722452.	53908.	4301.	22560.
1970	1246473.	35676.	1193152.	53318.	3976.	21618.
1971	1595983.	37090.	1540526.	55452.	3746.	22109.
1972	1361732.	30982.	1312196.	49526.	3392.	21935.
1973	870345.	35601.	817698.	52646.	4174.	21219.
1974	1942117.	28764.	1895003.	47102.	3515.	21852.
1975	2408529.	27630.	2363404.	45107.	3582.	21059.
1976	1776646.	34536.	1726297.	50342.	4471.	20277.
1977	1500374.	40813.	1444224.	56145.	4871.	20203.
1978	1187264.	39030.	1133086.	54176.	4600.	19747.
1979	1420982.	31856.	1374025.	46955.	4447.	19546.
1980	1160566.	34897.	1109912.	50653.	4561.	20316.
1981	1318824.	46760.	1258768.	60055.	6098.	19393.
1982	1424982.	42109.	1369897.	55080.	5940.	18911.
1983	1720142.	38751.	1670113.	50022.	4399.	19119.
1984	3137189.	30320.	3092883.	44291.	4534.	18505.
1985	2514509.	31424.	2467984.	46513.	4076.	19164.
MEAN	1508563.	38568.	1453437.	55122.	4668.	21337.

TABLE VIII-2-5 OCCURRENCE OF DRAWDOWN OF WATER LEVEL ON BANG NARA WATER STORAGE

Decade	Occurrence	Calculated Water Level (EL-m)						30-yr's Mean (m)
Dec-1	-			-				0.40
Dec-2	-			-				0.40
Dec-3	-			-				0.40
Jan-1	-			-				0.40
Jan-2	-			-				0.40
Jan-3	-			-				0.40
Feb-1	-			-				0.40
Feb-2	-			-				0.40
Feb-3	-			-				0.40
Mar-1	-			-				0.40
Mar-2	2	0.38	0.28					0.40
Mar-3	2	0.30	0.36					0.40
Apr-1	3	0.22	0.35	0.17				0.38
Apr-2	5	-0.08	0.24	0.11	0.23	0.24		0.36
Apr-3	6	-0.67	0.37	0.20	0.36	0.21	-0.03	0.33
May-1	4	-1.16	0.33	0.15	0.35			0.34
May-2	4	-1.84	0.26	0.25	0.22			0.31
May-3	3	-1.62	0.08	0.02				0.31
Jun-1	2	0.32	-0.04					0.38
Jun-2	1	0.32						0.40
Jun-3	1	0.39						0.40
Jul-1	1	0.31						0.40
Jul-2	1	0.24						0.39
Jul-3	-			-				0.40
Aug-1	-			-				0.40
Aug-2	-			-				0.40
Aug-3	-			-				0.40
Sep-1	1	0.15						0.39
Sep-2	-			-				0.40
Sep-3	2	-0.02	0.38					0.39
Oct-1	3	0.05	-0.90	0.14				0.34
Oct-2	2	0.18	-0.41					0.37
Oct-3	-			-				0.40
Nov-1	-			-				0.40
Nov-2	-			-				0.40
Nov-3	-			-				0.40

Note: - means no occurrence or no draw-down of water level

TABLE VIII-2-6 CALCULATED WATER LEVEL ON BANG NARA WATER STORAGE (1955 to 1964)

(unit: EL-m)

Decade	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964
Dec-1	-	-	-	-	-	-	-	-	-	-
Dec-2	-	-	-	-	-	-	-	-	-	-
Dec-3	-	-	-	-	-	-	-	-	-	-
Jan-1	-	-	-	-	-	-	-	-	-	-
Jan-2	-	-	-	-	-	-	-	-	-	-
Jan-3	-	-	-	-	-	-	-	-	-	-
Feb-1	-	-	-	-	-	-	-	-	-	-
Feb-2	-	-	-	-	-	-	-	-	-	-
Feb-3	-	-	-	-	-	-	-	-	-	-
Mar-1	-	-	-	-	-	-	-	-	-	-
Mar-2	-	-	-	-	-	-	-	-	-	-
Mar-3	-	-	-	-	-	-	0.30	-	-	-
Apr-1	-	-	-	0.22	0.35	-	0.17	-	-	-
Apr-2	-	-	-	-0.08	0.24	-	0.11	-	-	-
Apr-3	-	-	-	-0.67	-	0.37	0.20	-	0.36	-
May-1	-	-	-	-1.16	0.33	-	0.15	-	-	-
May-2	-	-	-	-1.84	0.26	-	0.25	-	-	-
May-3	-	-	-	-0.62	-	-	0.08	-	-	-
Jun-1	-	-	-	0.32	-	-	-0.04	-	-	-
Jun-2	-	-	-	-	-	-	-	-	0.32	-
Jun-3	-	-	-	-	-	-	0.39	-	-	-
Jul-1	-	-	-	-	-	-	0.31	-	-	-
Jul-2	-	-	-	-	-	-	0.24	-	-	-
Jul-3	-	-	-	-	-	-	-	-	-	-
Aug-1	-	-	-	-	-	-	-	-	-	-
Aug-2	-	-	-	-	-	-	-	-	-	-
Aug-3	-	-	-	-	-	-	-	-	-	-
Sep-1	-	-	-	-	0.15	-	-	-	-	-
Sep-2	-	-	-	-	-	-	-	-	-	-
Sep-3	-	-	-	-	-	-	-	-	-	-0.02
Oct-1	-	-	-	-	0.05	0.05	-	-	-	-0.90
Oct-2	-	-	-	-	-	0.18	-	-	-	-0.41
Oct-3	-	-	-	-	-	-	-	-	-	-
Nov-1	-	-	-	-	-	-	-	-	-	-
Nov-2	-	-	-	-	-	-	-	-	-	-
Nov-3	-	-	-	-	-	-	-	-	-	-

Note: - means that water level would be kept at the normal impounding water level of +0.40 m.

TABLE VIII-2-7 CALCULATED WATER LEVEL ON BANG NARA WATER STORAGE (1965 to 1975)

(unit : EL-m)

Decade	1965	1967	1968	1969	1970	1971	1972	1973	1974	1975
Dec-1	-	-	-	-	-	-	-	-	-	-
Dec-2	-	-	-	-	-	-	-	-	-	-
Dec-3	-	-	-	-	-	-	-	-	-	-
Jan-1	-	-	-	-	-	-	-	-	-	-
Jan-2	-	-	-	-	-	-	-	-	-	-
Jan-3	-	-	-	-	-	-	-	-	-	-
Feb-1	-	-	-	-	-	-	-	-	-	-
Feb-2	-	-	-	-	-	-	-	-	-	-
Feb-3	-	-	-	-	-	-	-	-	-	-
Mar-1	-	-	-	-	-	-	-	-	-	-
Mar-2	0.38	-	-	-	-	-	-	-	-	-
Mar-3	-	-	-	-	-	-	-	-	-	-
Apr-1	-	-	-	-	-	-	-	-	-	-
Apr-2	-	-	-	-	-	-	-	0.23	-	-
Apr-3	-	-	-	-	-	-	-	0.21	-	-
May-1	-	-	-	-	-	-	-	0.35	-	-
May-2	-	-	-	-	-	-	-	0.22	-	-
May-3	-	-	-	-	-	-	-	0.02	-	-
Jun-1	-	-	-	-	-	-	-	-	-	-
Jun-2	-	-	-	-	-	-	-	-	-	-
Jun-3	-	-	-	-	-	-	-	-	-	-
Jul-1	-	-	-	-	-	-	-	-	-	-
Jul-2	-	-	-	-	-	-	-	-	-	-
Jul-3	-	-	-	-	-	-	-	-	-	-
Aug-1	-	-	-	-	-	-	-	-	-	-
Aug-2	-	-	-	-	-	-	-	-	-	-
Aug-3	-	-	-	-	-	-	-	-	-	-
Sep-1	-	-	-	-	-	-	-	-	-	-
Sep-2	-	-	-	-	-	-	-	-	-	-
Sep-3	-	-	-	-	-	-	-	-	-	-
Oct-1	-	-	-	-	-	-	-	-	-	-
Oct-2	-	-	-	-	-	-	-	-	-	-
Oct-3	-	-	-	-	-	-	-	-	-	-
Nov-1	-	-	-	-	-	-	-	-	-	-
Nov-2	-	-	-	-	-	-	-	-	-	-
Nov-3	-	-	-	-	-	-	-	-	-	-

Note: - means that water level would be kept at the normal impounding water level of +0.40 m.

TABLE VIII-2-8 CALCULATED WATER LEVEL
ON BANG NARA WATER STORAGE
(1976 to 1985)

(unit : EL-m)

Decade	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
Dec-1	-	-	-	-	-	-	-	-	-	-
Dec-2	-	-	-	-	-	-	-	-	-	-
Dec-3	-	-	-	-	-	-	-	-	-	-
Jan-1	-	-	-	-	-	-	-	-	-	-
Jan-2	-	-	-	-	-	-	-	-	-	-
Jan-3	-	-	-	-	-	-	-	-	-	-
Feb-1	-	-	-	-	-	-	-	-	-	-
Feb-2	-	-	-	-	-	-	-	-	-	-
Feb-3	-	-	-	-	-	-	-	-	-	-
Mar-1	-	-	-	-	-	-	-	-	-	-
Mar-2	-	-	-	-	-	-	0.28	-	-	-
Mar-3	-	-	-	-	-	-	0.36	-	-	-
Apr-1	-	-	-	-	-	-	-	-	-	-
Apr-2	-	-	-	-	-	-	-	0.24	-	-
Apr-3	-	-	-	-	-	-	-	-0.03	-	-
May-1	-	-	-	-	-	-	-	-	-	-
May-2	-	-	-	-	-	-	-	-	-	-
May-3	-	-	-	-	-	-	-	-	-	-
Jun-1	-	-	-	-	-	-	-	-	-	-
Jun-2	-	-	-	-	-	-	-	-	-	-
Jun-3	-	-	-	-	-	-	-	-	-	-
Jul-1	-	-	-	-	-	-	-	-	-	-
Jul-2	-	-	-	-	-	-	-	-	-	-
Jul-3	-	-	-	-	-	-	-	-	-	-
Aug-1	-	-	-	-	-	-	-	-	-	-
Aug-2	-	-	-	-	-	-	-	-	-	-
Aug-3	-	-	-	-	-	-	-	-	-	-
Sep-1	-	-	-	-	-	-	-	-	-	-
Sep-2	-	-	-	-	-	-	-	-	-	-
Sep-3	-	0.38	-	-	-	-	-	-	-	-
Oct-1	-	-	-	-	-	0.14	-	-	-	-
Oct-2	-	-	-	-	-	-	-	-	-	-
Oct-3	-	-	-	-	-	-	-	-	-	-
Nov-1	-	-	-	-	-	-	-	-	-	-
Nov-2	-	-	-	-	-	-	-	-	-	-
Nov-3	-	-	-	-	-	-	-	-	-	-

Note: - means that water level would be kept at the normal impounding water level of +0.40 m.

TABLE VIII-2-9 PROBABLE LOW WATER LEVEL ON BANG NARA WATER STORAGE

1. Full water level and full capacity

Full Water level +0.4m
Full capacity 15.84 MCM

2. Condition of water balance study

2.1. Crop intensity 125%

2.2. Cropped Area

Paddy ILV	3,370 ha	
" HYV	4,810 ha	(RD-13)
" HYV	1,600 ha	(RD-7)
Mungbeans	620 ha	
Corn	620 ha	
Groundnut	620 ha	
Vegetables	620 ha	
Forage crop	200 ha	
Total	12,460 ha	

3. Annual lowest water level and Capacity

Year	Lowest W.L. (m)	Capacity (MCM)
1955	0.40	15.84
1956	0.40	15.84
1957	0.40	15.84
1958	-1.84	5.00
1959	0.15	13.78
1960	0.05	12.96
1961	-0.04	12.37
1962	0.40	15.84
1963	0.32	15.18
1964	-0.90	8.42
1965	0.38	15.68
1967	0.40	15.84
1968	0.40	15.84
1969	0.40	15.84
1970	0.40	15.84
1971	0.40	15.84
1972	0.40	15.84
1973	0.02	12.71
1974	0.40	15.84
1975	0.40	15.84
1976	0.40	15.84
1977	0.38	15.68
1978	0.40	15.84
1979	0.40	15.84
1980	0.40	15.84
1981	0.14	13.70
1982	0.28	14.85
1983	-0.03	12.41
1984	0.40	15.84
1985	0.40	15.84

4. Result of probable analysis

No.	Capacity (MCM)
1	5.00
2	8.42
3	12.37
4	12.41
5	12.71
6	12.96
7	13.70
8	13.78
9	14.85
10	15.18
11	15.68
12	15.68
13	15.84
14	15.84
15	15.84
16	15.84
17	15.84
18	15.84
19	15.84
20	15.84
21	15.84
22	15.84
23	15.84
24	15.84
25	15.84
26	15.84
27	15.84
28	15.84
29	15.84
30	15.84

Probable Capacity	
Return Period (year)	Capacity (MCM)
2	14.28
5	11.67
10	10.50
20	9.63
25	9.39
30	9.20
50	8.73
100	8.18
200	7.70

5. Probable water level with return period of 10-year

$$0.0m - \frac{(12.55 - 11.67)}{(12.55 - 7.96)}$$

$$= -0.19 \text{ m}$$

Note: Storage capacity on WL-1.0m
= 7.96 MCM

Storage capacity on WL 0.0m
=12.55 MCM

Storage capacity with 5-year return period
=11.67 MCM

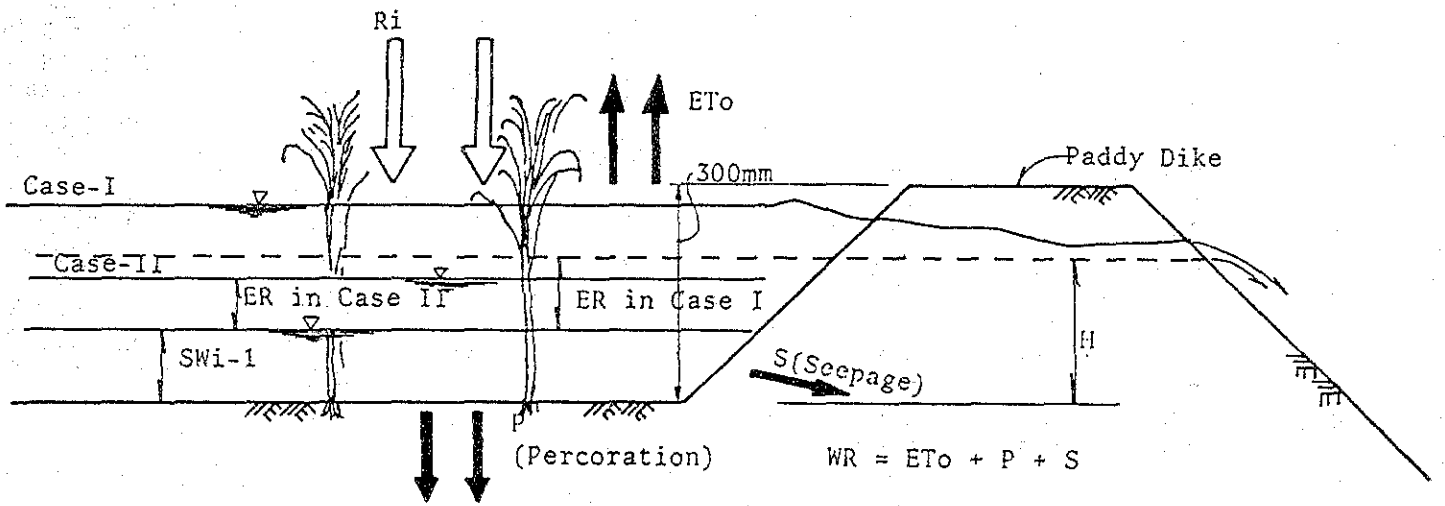
TABLE VIII-2-10 IRRIGABLE AREA BY SUB-PROJECT AREA

(unit: ha)

No.	Sub-Project	W/O Project(Existing paddy field*1)				W/ Project					
						Irrigable Area					
		Total	under WUG*2	under RID*2	Others*3	Total	WUG	RID	Gravity	Others*3	Others*4
1	Mae Nam Yakang	410	146	242	22	370	140	230	-	30	10
2	Khlong Ba Keng	280	129	140	11	250	120	130	-	20	10
3	Khlong Ku Ra Po	620	168	452	-	590	160	430	-	10	20
4	Khlong Mae Lamphu	440	178	262	-	420	170	250	-	10	10
5	Khlong Na Ko	550	150	400	-	520	140	380	-	10	20
6	Khlong To Che	2,400	-	2,240	160	2,130	-	2,130	-	200	70
7	Bang Nara-1	50	50	-	-	40	40	-	-	10	0
8	Khlong Chang	740	114	455	171	540	110	430	-	180	20
9	Khlong Maru Bo	650	74	387	189	620	70	370	180	10	20
11	Khlong Bang Toei	240	-	-	240	-	-	-	-	240	-
12	Khlong Khok Ngu	570	570	-	-	540	540	-	-	10	20
13	Khlong Lan	400	-	-	400	-	-	-	-	400	-
14	Bang Nara-2	250	250	-	-	240	240	-	-	-	10
15	Bang Nara-3	570	285	285	-	540	270	270	-	10	20
16	Khlong Sala Mai	400	-	400	-	380	-	380	-	10	10
17	NBR-East	40	-	40	-	40	-	40	-	-	0
18	Khlong Lai	340	-	340	-	320	-	320	-	10	10
19	Khlong To Lang	410	-	-	410	-	-	-	-	410	-
20	Bang Nara-4	560	560	-	-	530	530	-	-	10	20
22	Khlong Ku Cham	230	35	195	-	220	30	190	-	-	10
23	Khlong Pru Kap Daeng	400	-	400	-	380	-	380	-	10	10
25	Khlong Ku Bae Hai	70	-	-	70	-	-	-	-	70	-
26	Bang Nara-6	190	190	-	-	180	180	-	-	-	10
27	Khlong Pu Cho Ya Mu	250	250	-	-	240	240	-	-	-	10
28	Khlong Sapi Yo	920	482	-	438	460	460	-	-	440	20
29	Bang Nara-7	450	450	-	-	430	430	-	-	10	10
	Total	12,430	4,081	6,238	2,111	9,980	3,870	5,930	180	2,110	340

Note: *1 inclusive of fallow area, *2 existing paddy and fallow areas to be irrigated by WUG and RID pumps, *3 out of irrigable area, *4 right of way for proposed facilities.

FIGURE VIII–2–1. TYPICAL MODEL OF EFFECTIVE RAINFALL ON A PADDY FIELD



Case I $SWi\text{-}1 + Ri - WR > H$

$ERi = H - SWi\text{-}1 + WR$

Case II $SWi\text{-}1 + Ri - WR \leq H$

$ERi = Ri$

FIGURE VIII-2-2. H-A OF IRR. AREA BY PORTABLE PUMP

(Paddy Field)

WL	Area	Acc. Area
0 m	— (ha)	— (ha)
1	1,630	1,630
2	1,850	3,480
3	280	3,760
4	110	3,870
Total	3,870	

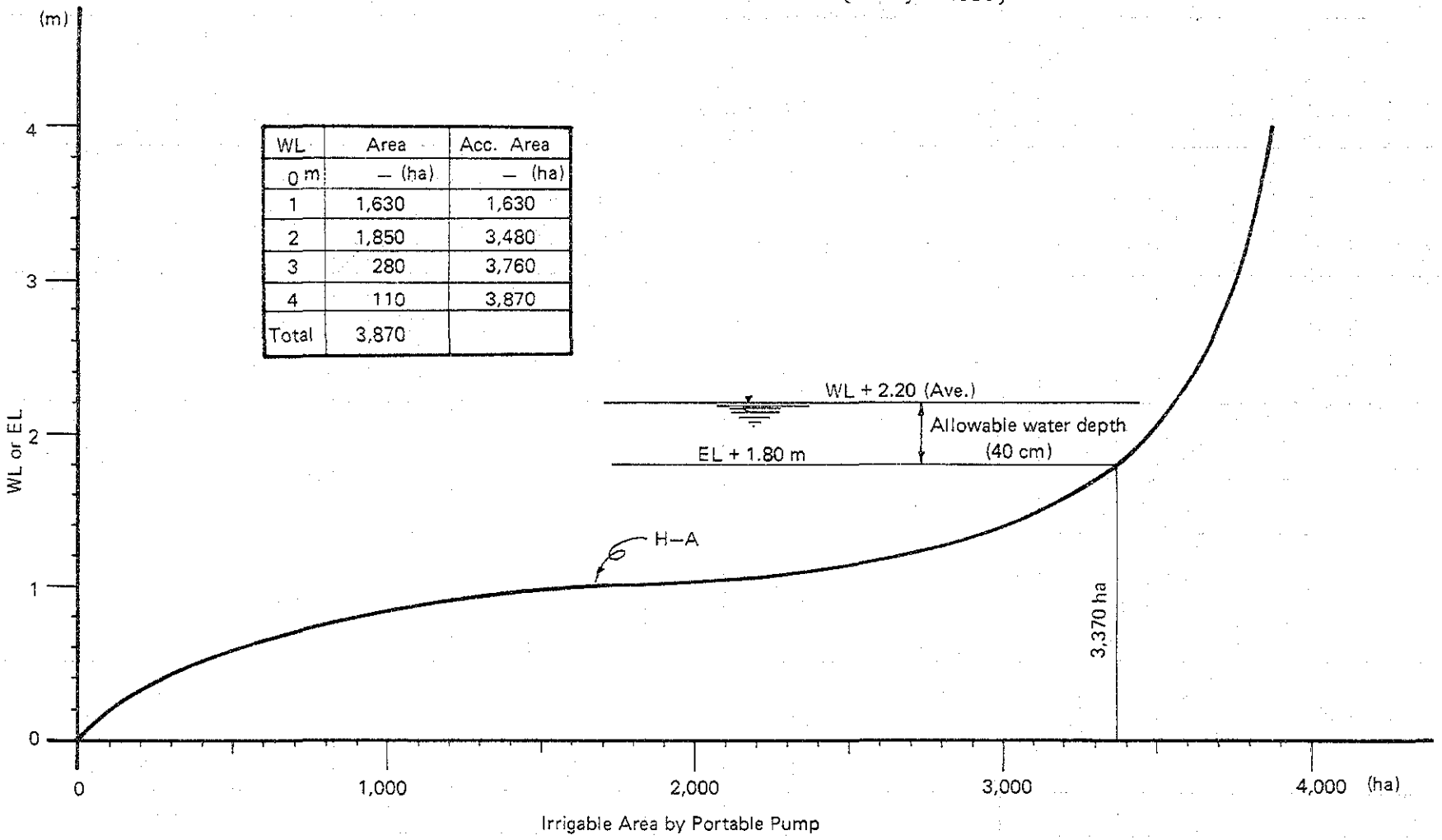


FIGURE VIII–2–3. CROPPING CALENDAR

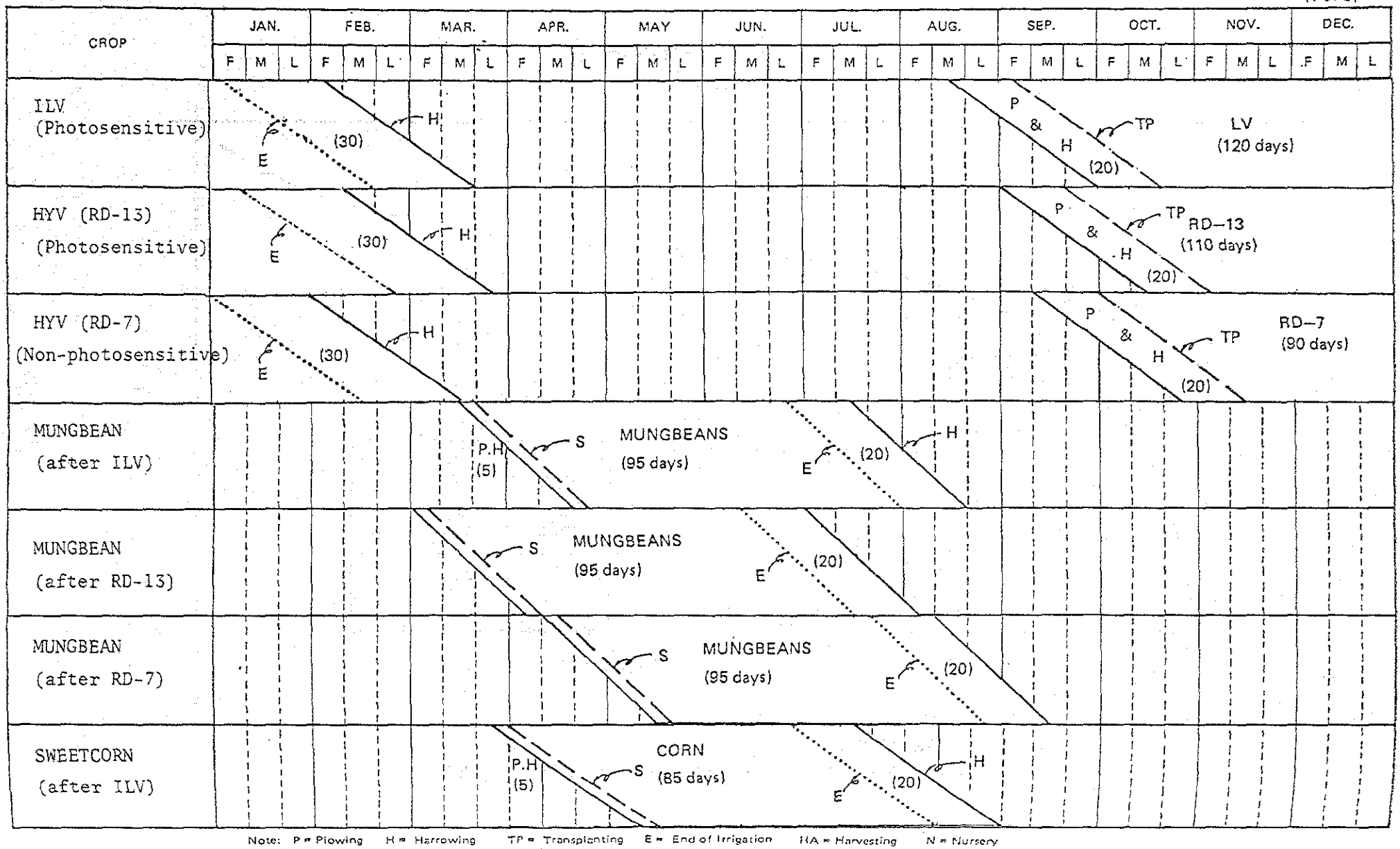
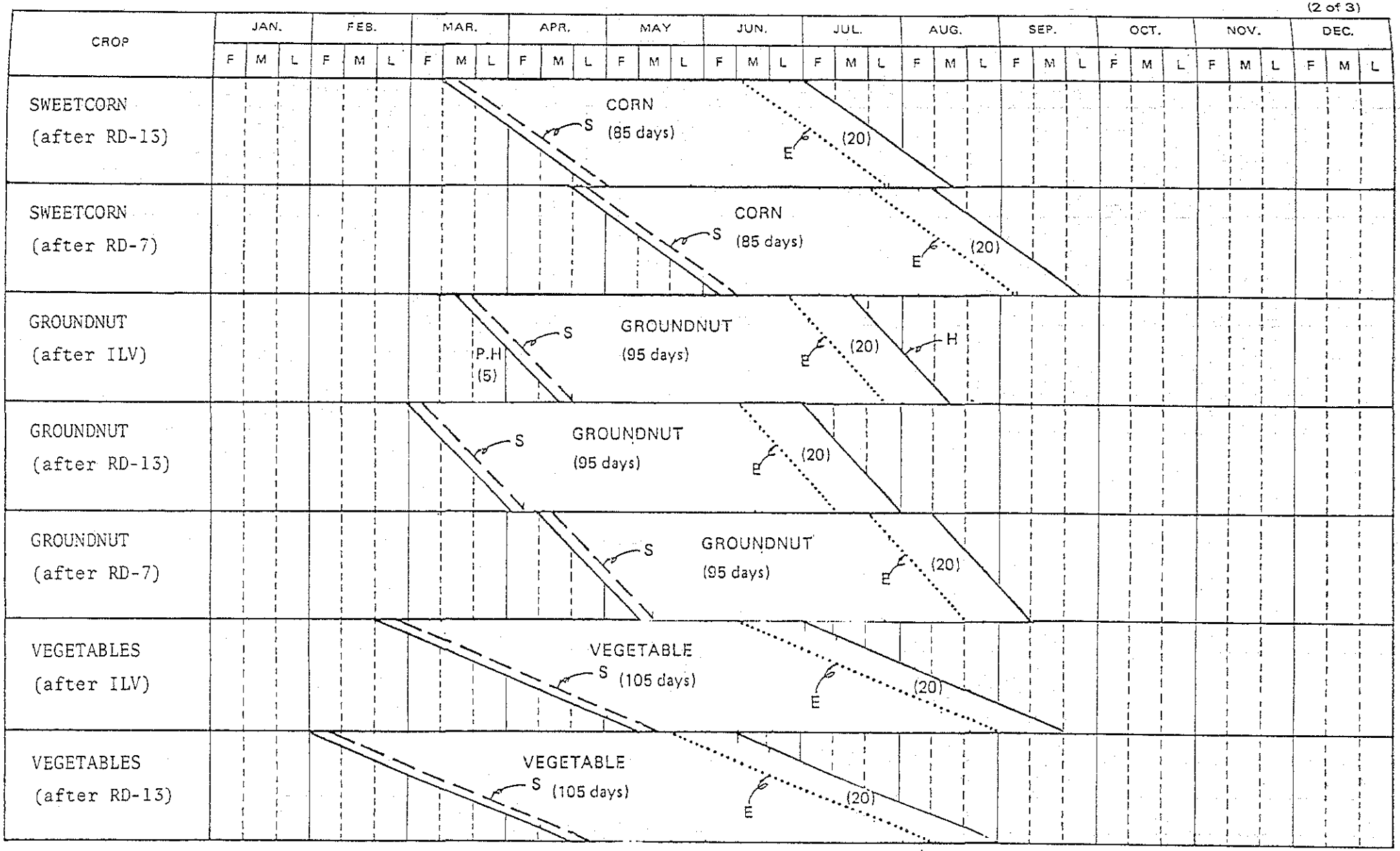


FIGURE VIII–2–3. CROPPING CALENDAR

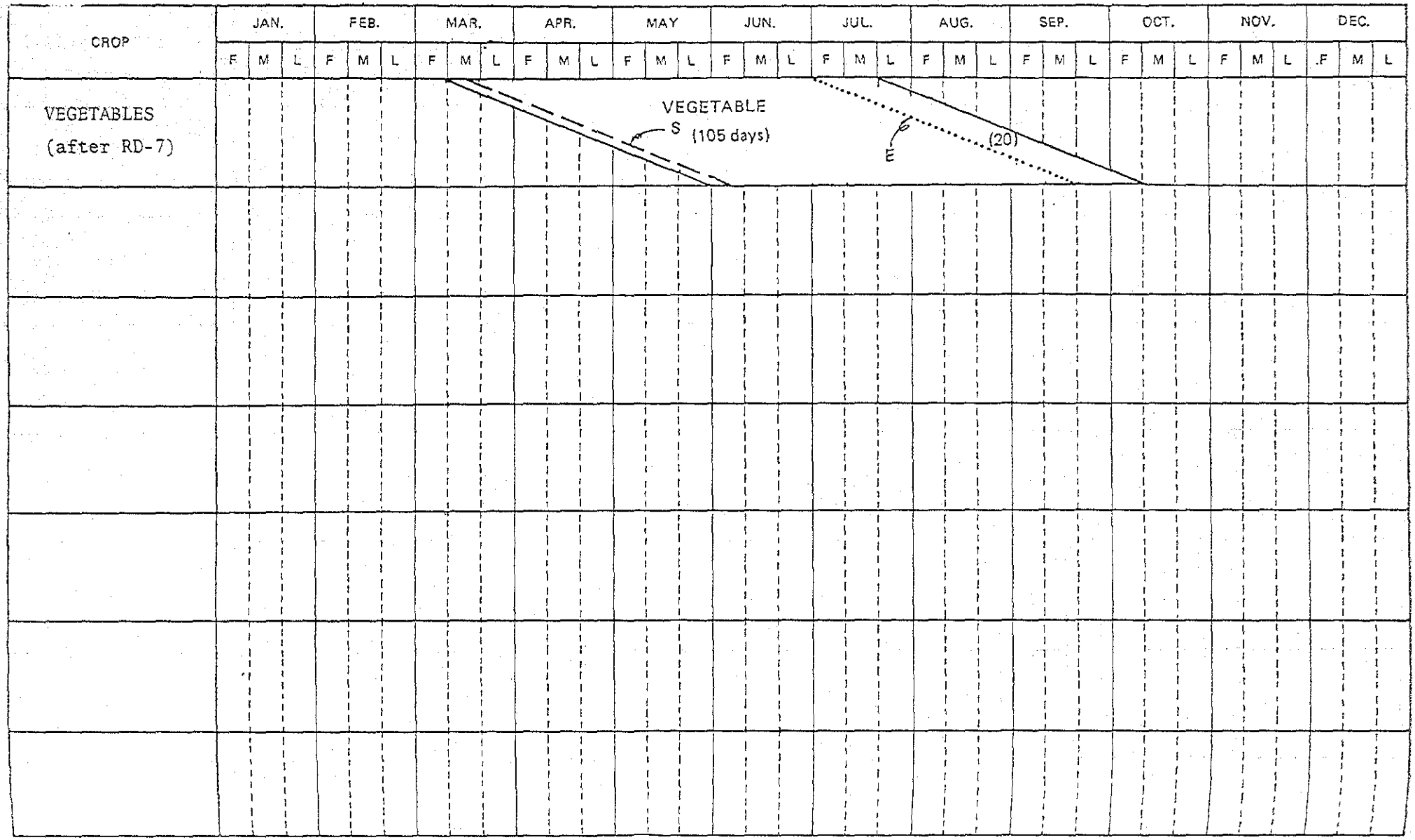
(2 of 3)



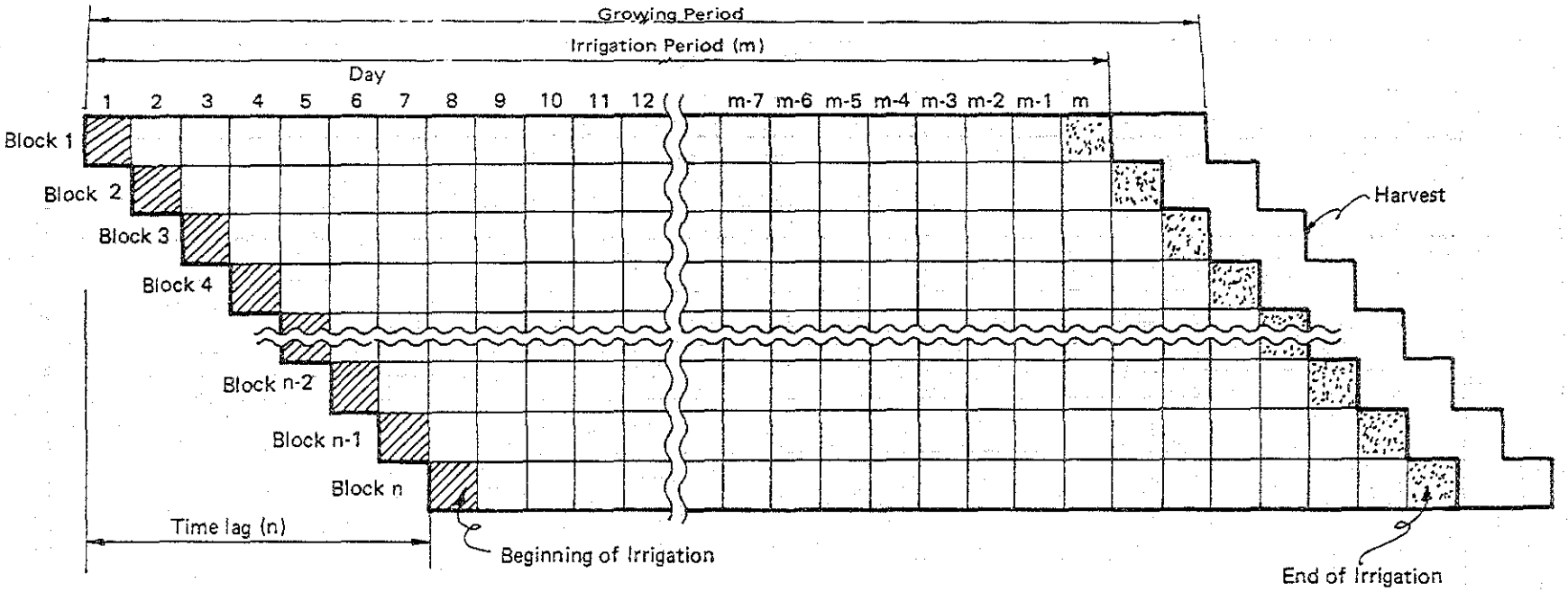
Note: P = Plowing H = Harrowing TP = Transplanting E = End of Irrigation HA = Harvesting N = Nursery

FIGURE VIII–2–3. CROPPING CALENDAR

(3 of 3)



Note: P = Plowing H = Harrowing TP = Transplanting E = End of Irrigation HA = Harvesting N = Nursery

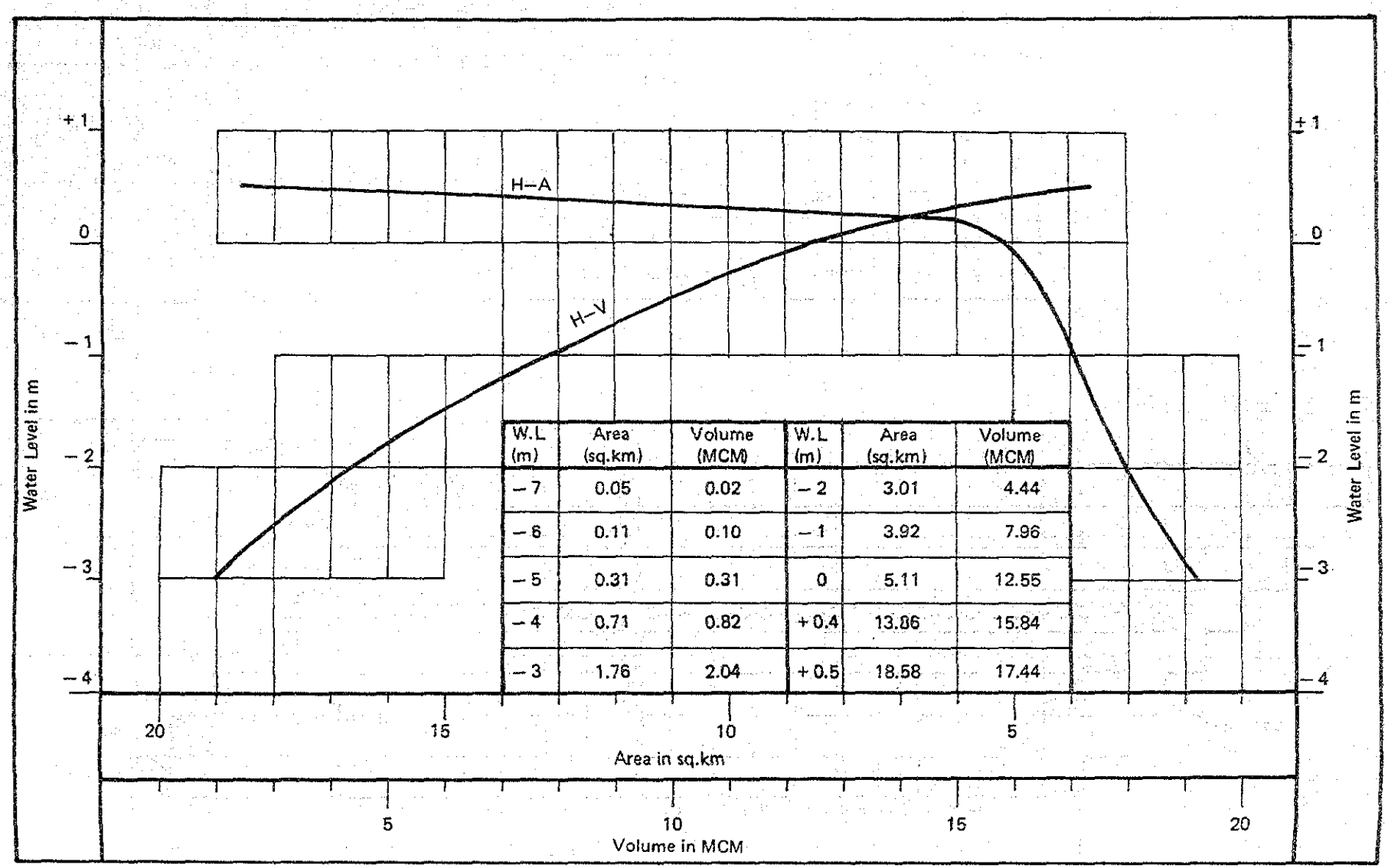


Block No. 1	Block No. 2	Block No. 3		Block No. n-8	Block No. n-7	Block No. n-6
Block No. 4	Block No. 5	Block No. 6		Block No. n-5	Block No. n-4	Block No. n-3
Block No. 7	Block No. 8	Block No. 9		Block No. n-2	Block No. n-1	Block No. n

Irrigation Area

FIGURE VIII-2-4. BASIC CONCEPT OF IRRIGATION

FIGURE VIII-2-5. H-A AND H-V OF BANG NARA WATER STORAGE



W.L (m)	Area (sq.km)	Volume (MCM)	W.L (m)	Area (sq.km)	Volume (MCM)
-7	0.05	0.02	-2	3.01	4.44
-6	0.11	0.10	-1	3.92	7.96
-5	0.31	0.31	0	5.11	12.55
-4	0.71	0.82	+0.4	13.86	15.84
-3	1.76	2.04	+0.5	18.58	17.44

FIGURE VIII-2-6 RESULT OF WATER BALANCE ANALYSIS (1961)

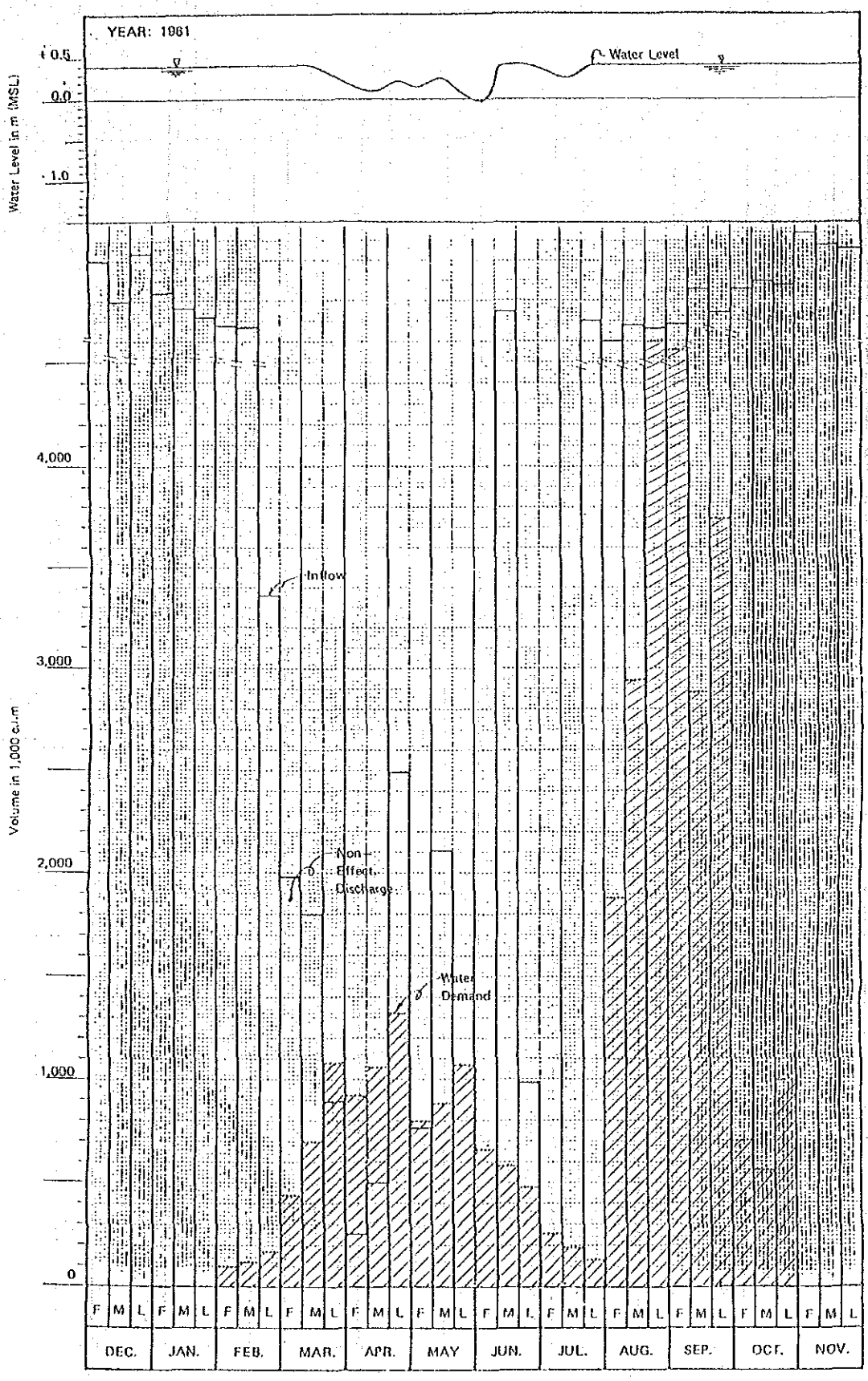


FIGURE VIII-2-7

RESULTS OF WATER BALANCE ANALYSIS OF BANG NARA WATER STORAGE

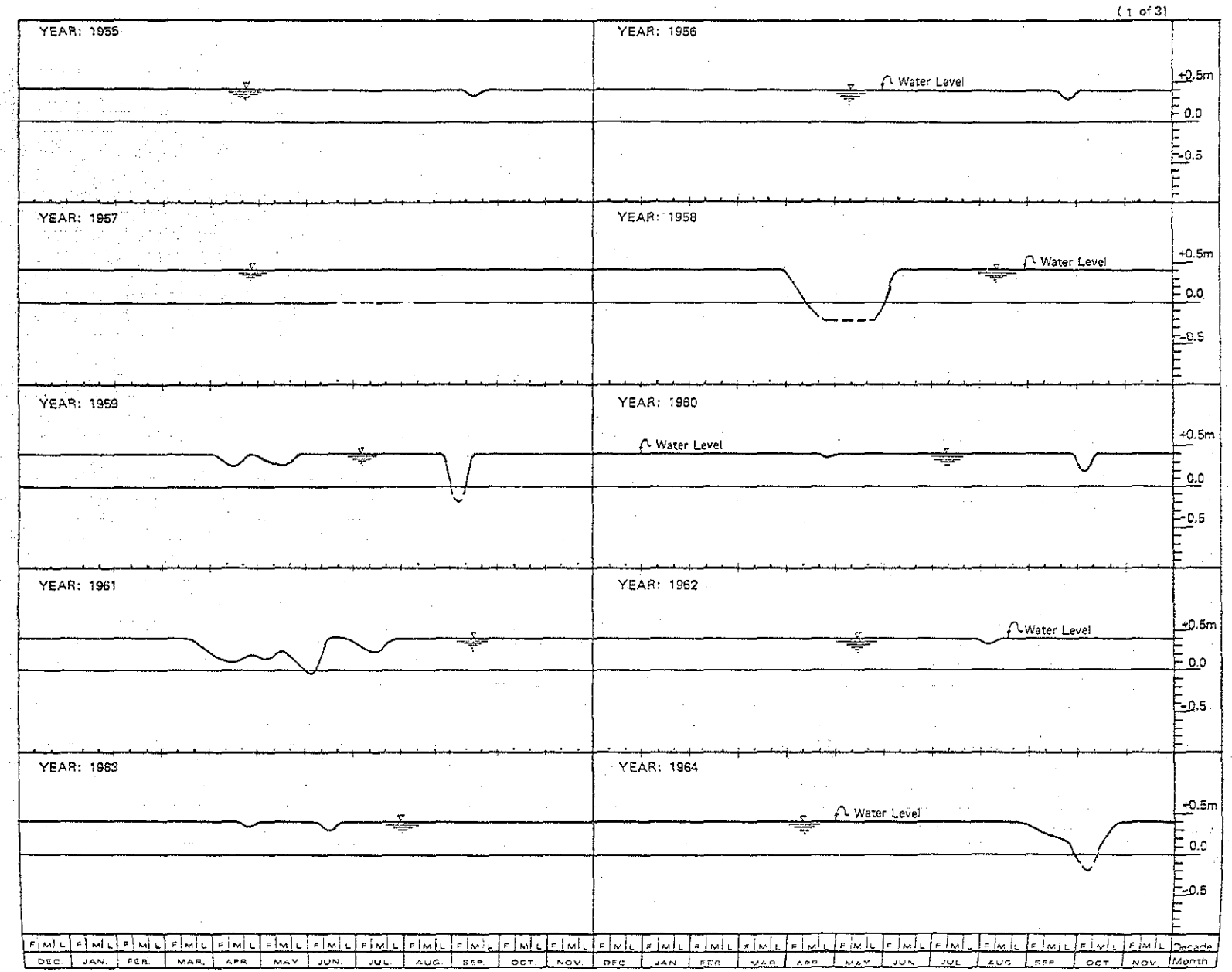


FIGURE VIII-2-7 RESULTS OF WATER BALANCE ANALYSIS OF SANG NARA WATER STORAGE

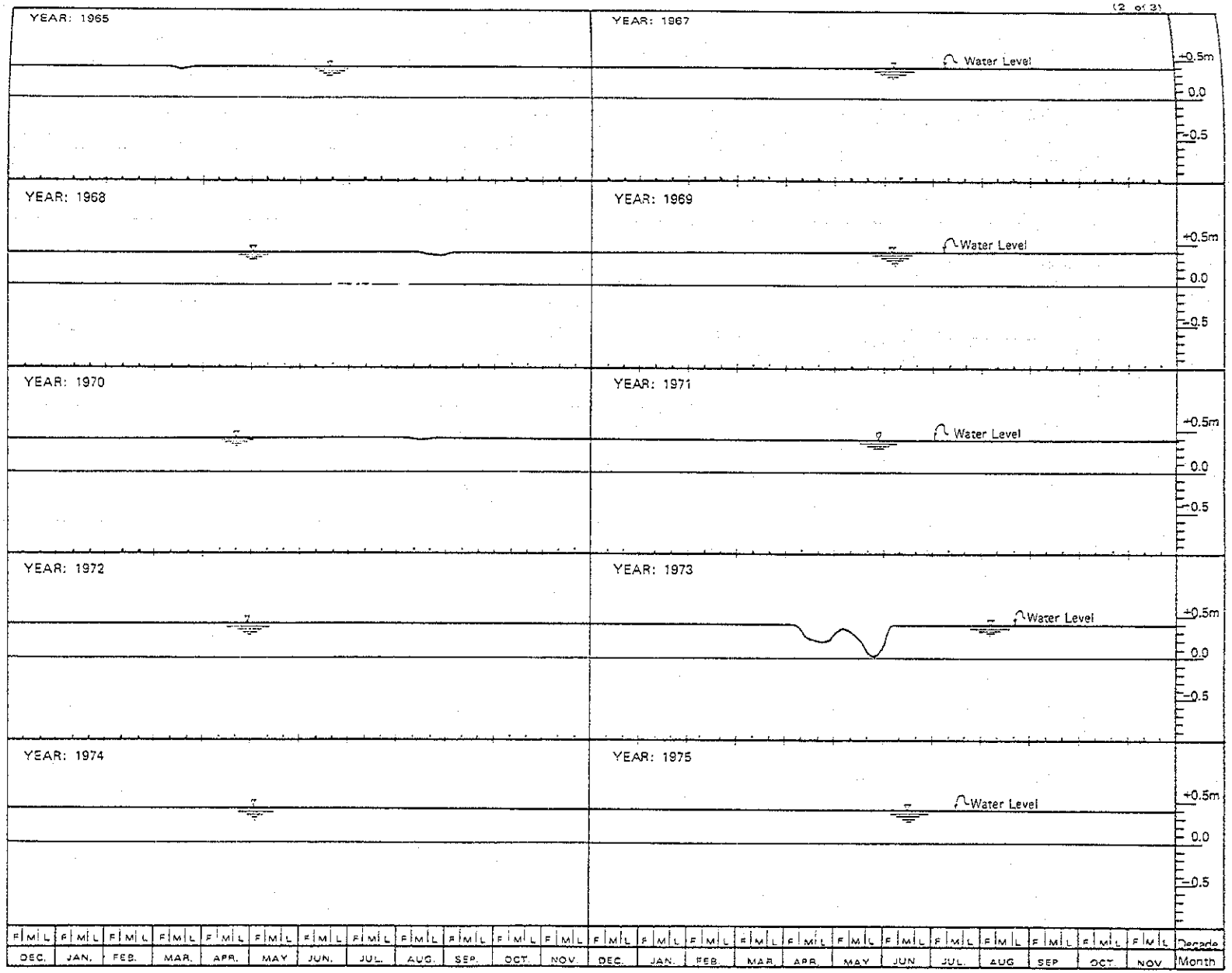


FIGURE VIII-2-7

RESULTS OF WATER BALANCE ANALYSIS OF BANG NARA WATER STORAGE

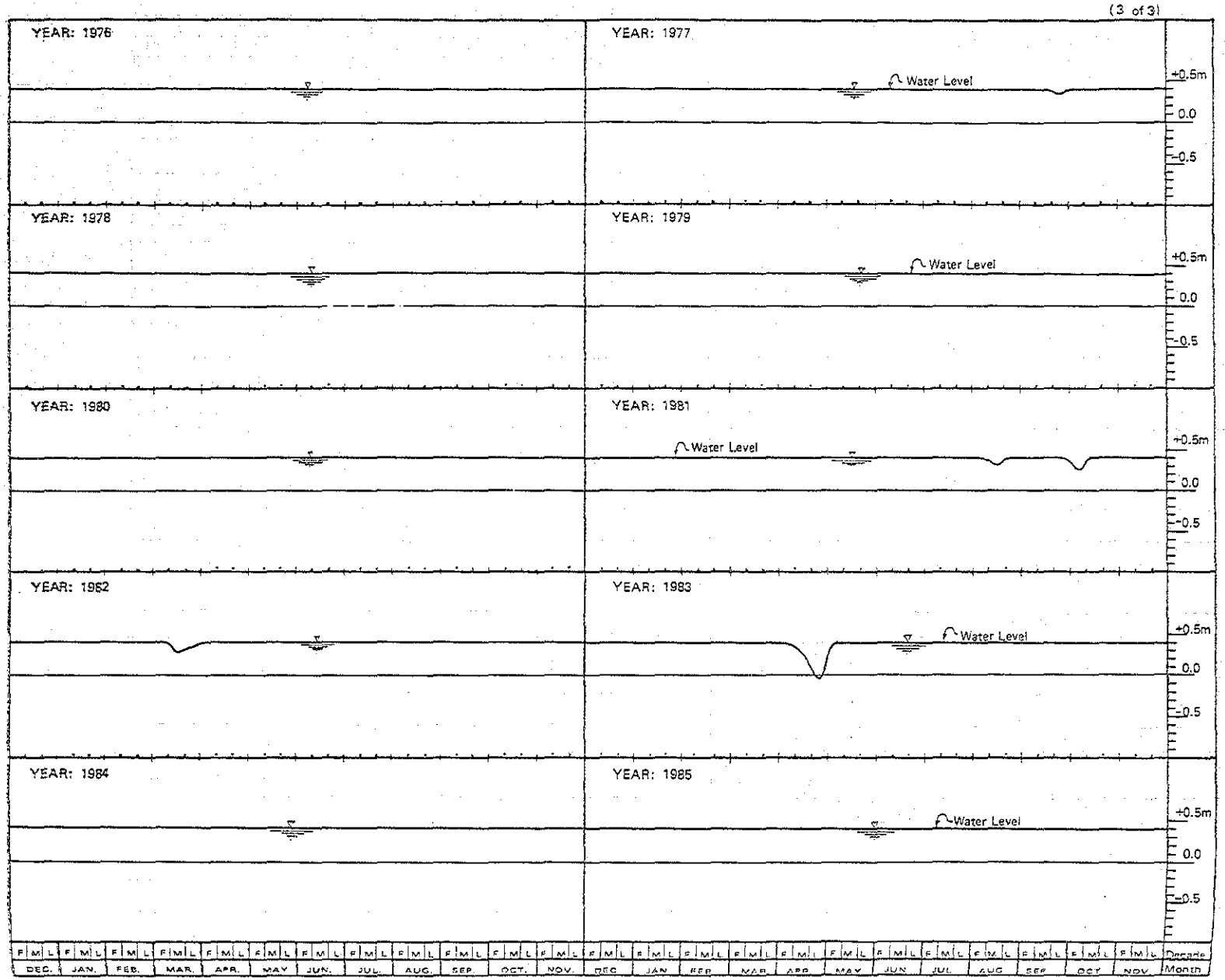


TABLE VIII-2-12 CALCULATION OF EVAPOTRANSPIRATION
(by Penman method)

(Unit: mm/day)

Mon.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
1951	4.9	5.4	6.3	6.3	5.5	4.8	4.9	4.8	4.8	4.5	4.1	4.1
1952	5.6	6.1	5.7	6.3	5.4	5.4	4.6	5.3	5.9	5.1	3.9	4.5
1953	5.3	5.0	6.3	6.2	5.3	5.1	5.1	5.9	5.1	5.5	4.5	4.7
1954	5.2	7.0	6.8	7.2	5.6	5.7	6.0	5.6	5.0	4.5	3.8	5.5
1955	5.8	5.9	6.7	6.3	6.1	5.2	5.9	4.9	6.0	4.8	4.6	4.7
1956	5.7	6.1	6.5	6.7	5.5	5.8	5.6	5.8	5.6	4.9	5.2	4.3
1957	5.7	7.0	6.5	7.0	4.8	5.1	4.6	4.7	4.1	4.4	4.8	4.6
1958	5.6	6.2	6.8	7.6	6.1	4.7	4.4	4.3	4.3	3.8	3.3	4.2
1959	5.0	5.4	5.3	5.7	4.5	4.2	4.2	3.8	4.1	3.5	3.2	3.5
1960	3.9	4.9	5.1	5.2	4.2	3.9	4.0	3.8	4.1	4.0	3.1	3.5
1961	4.2	4.6	5.2	4.8	4.1	3.9	3.8	3.7	3.8	3.4	2.8	3.0
1962	4.0	4.7	4.6	4.8	4.0	3.9	3.6	3.6	3.6	3.4	3.2	3.4
1963	3.6	4.7	4.9	5.4	4.6	4.1	4.0	3.8	3.9	3.6	3.3	3.5
1964	3.9	5.5	5.2	5.1	4.8	4.0	3.9	4.0	4.1	3.8	3.3	3.4
1965	3.8	4.6	5.0	4.9	4.1	3.9	4.1	4.0	4.1	3.6	3.0	2.9
1966	3.8	4.4	4.8	5.2	4.4	3.8	3.7	3.7	4.0	3.5	3.1	3.2
1967	4.2	5.2	5.3	5.5	4.5	4.4	4.0	3.9	4.1	3.6	3.4	4.1
1968	4.0	6.2	6.4	6.2	4.8	4.5	4.5	4.8	4.2	3.7	3.9	3.3
1969	4.3	5.4	6.1	6.3	4.6	4.1	4.0	4.2	4.3	3.9	3.1	3.5
1970	4.5	4.7	5.2	5.0	4.7	4.0	4.2	4.1	4.3	3.8	3.3	3.4
1971	4.6	4.9	4.9	5.6	4.5	4.6	4.5	4.0	4.3	3.9	3.3	3.6
1972	4.3	4.9	5.5	5.2	4.7	4.1	4.3	4.2	4.0	3.8	3.3	3.9
1973	4.5	5.3	5.1	5.4	4.5	4.4	4.4	4.3	4.0	3.8	3.3	3.2
1974	3.9	5.1	5.2	5.3	4.6	4.1	4.3	4.5	4.2	4.0	3.5	3.6
1975	4.0	4.8	4.9	5.2	4.1	3.8	4.3	4.2	4.0	3.8	3.3	4.0
1976	3.9	4.8	5.2	5.3	3.9	3.7	3.7	3.6	3.7	3.4	2.8	4.0
1977	3.7	4.6	5.1	4.9	4.3	3.8	3.6	3.8	3.8	3.4	3.0	3.3
1978	4.2	4.7	4.7	4.8	3.9	3.8	3.9	3.7	3.6	3.3	3.0	3.5
1979	4.0	4.5	4.8	4.6	4.0	3.7	3.7	3.7	3.6	3.4	2.9	3.3
1980	3.9	4.9	4.9	4.9	4.1	3.6	3.7	3.9	4.1	3.8	3.0	3.0
1981	3.8	4.3	4.9	4.7	3.9	3.9	3.8	3.9	3.9	3.4	3.0	3.4
1982	3.6	4.3	4.6	4.7	4.1	3.6	3.5	3.5	3.6	3.4	3.0	3.6
1983	3.9	4.4	4.6	4.8	4.2	3.9	3.7	3.6	3.6	3.4	3.1	3.2
1984	3.5	4.2	4.3	4.4	3.6	3.5	3.5	3.6	3.5	3.5	3.0	3.0
1985	3.8	4.2	4.6	4.6	3.8	3.9	3.7	3.5	3.7	3.6	3.1	3.4
Mean	4.4	5.1	5.4	5.5	4.6	4.3	4.2	4.2	4.2	3.9	3.4	3.7
Mean*	4.0	4.8	5.0	5.1	4.3	4.0	3.9	3.9	3.9	3.6	3.2	3.4

Note: * - mean values from 1960 to 1985

TABLE VIII-2-13 OBSERVED PERCOLATION RATE

Soil Type	No.	Date (1986)	Time	Value (cm/day)	Mean Value (cm/day)	Acreage (in ha)
Ta-ly	1	Jan. 18	14:00	5.40 - 5.25 = 0.15		
(Tak Bai Loamy)	2	Jan. 19	11:14	1.38 - 1.34 = 0.04	0.10	2,090
	3	Jan. 18	10:54	2.80 - 2.68 = 0.12		
Ta-fc	13	Jan. 18	9:21	5.18 - 5.15 = 0.03		
(Tak Bai Fine Clay)	14	Jan. 19	9:08	5.88 - 5.88 = 0.00	0.02	90
	15	Jan. 18	10:10	2.92 - 2.90 = 0.02		
Ra-ly	4	Jan. 18	13:24	6.02 - 5.94 = 0.08	0.08	2,310
Ra-O (Rangae)	17	Jan. 20	11:19	5.18 - 5.18 = 0.00	0.00	770
Mu-ly (Mu No)	7	Jan. 18	15:49	8.14 - 7.78 = 0.36	0.36	980
Ba-ly	9	Jan. 19	12:55	4.20 - 4.20 = 0.00		
(Bang Nara)	10	Jan. 18	14:53	3.86 - 3.66 = 0.20*		3,020
	11	Jan. 19	12:30	8.52 - 7.80 = 0.72*	0.06	
	12	Jan. 19	10:23	0.66 - 0.64 = 0.04		
Ba/Tsl-ly	16	Jan. 19	10:51	5.40 - 5.36 = 0.04	0.04	1,050
Ba/Ptl	18	Jan. 19	(:50	7.40 - 6.75 = 0.29	0.29	450
Pit-ly	6	Jan. 20	13:10	1.52 - 1.52 = 0.00	0.00	870
Weighted average					0.094 (say 1.0 mm/day)	11,630

Note: The value with * mark is omitted due to an abnormal value.

TABLE VIII-2-14 IRRIGATION REQUIREMENT OF UPLAND CROPS

		MAR.			APR.			MAY			JUN.			JUL.			AUG.	
		F	M	L	F	M	L	F	M	L	F	M	L	F	M	L	F	M
Evapotranspiration mm/day		----	4.8	---	----	5.0	---	----	5.1	---	----	4.3	---	----	4.0	---	-	3.9 -
MUNGBEAN after ILV	kc	-	-	-	0.41	0.47	0.65	0.87	0.94	0.96	0.96	0.94	0.91	0.85	-	-	-	-
	IR	-	-	-	4.5	5.2	7.2	8.1	8.8	9.0	8.3	8.2	7.9	7.2	-	-	-	-
MUNGBEAN after RD-13	kc	-	-	0.41	0.47	0.65	0.87	0.94	0.96	0.96	0.94	0.91	0.85	-	-	-	-	-
	IR	-	-	4.5	5.2	7.2	9.6	8.8	9.0	9.0	8.2	7.9	7.4	-	-	-	-	-
MUNGBEAN after RD-7	kc	-	-	-	-	-	-	0.41	0.47	0.65	0.87	0.94	0.96	0.96	0.94	0.91	0.85	-
	IR	-	-	-	-	-	-	3.8	4.4	6.1	7.6	8.2	8.3	8.1	8.0	7.7	7.2	-
SWEETCORN after ILV	kc	-	-	-	-	-	0.41	0.45	0.56	0.81	1.03	1.05	1.05	1.03	0.95	-	-	-
	IR	-	-	-	-	-	4.5	4.2	5.2	7.6	9.0	9.1	9.1	8.7	8.1	-	-	-
SWEETCORN after RD-13	kc	-	-	-	0.41	0.45	0.56	0.81	1.03	1.05	1.05	1.03	0.95	-	-	-	-	-
	IR	-	-	-	4.5	5.0	6.2	7.6	9.6	9.8	9.1	9.0	8.3	-	-	-	-	-
SWEETCORN after RD-7	kc	-	-	-	-	-	-	-	0.41	0.45	0.56	0.81	1.03	1.05	1.05	1.03	0.95	-
	IR	-	-	-	-	-	-	-	3.8	4.2	4.9	7.0	9.0	8.9	8.9	8.7	8.1	-
GROUNDNUT after ILV	kc	-	-	-	0.42	0.47	0.63	0.88	1.05	1.06	1.05	0.89	0.78	0.55	-	-	-	-
	IR	-	-	-	4.7	5.2	7.0	8.2	9.8	9.9	9.1	7.7	6.8	4.7	-	-	-	-
GROUNDNUT after RD-13	kc	-	-	0.42	0.47	0.63	0.88	1.05	1.06	1.05	0.89	0.78	0.55	-	-	-	-	-
	IR	-	-	4.6	5.2	7.0	9.8	9.8	9.9	9.8	7.7	6.8	4.8	-	-	-	-	-
GROUNDNUT after RD-7	kc	-	-	-	-	-	0.42	0.47	0.63	0.88	1.05	1.06	1.05	0.89	0.78	0.55	-	-
	IR	-	-	-	-	-	4.7	4.4	5.9	8.2	9.1	9.2	9.1	7.5	6.6	4.7	-	-

(cont'd)

Note : IR (Irrigation requirement) = ETo x kc / 0.46
0.46 --- Irrigation efficiency, ETo --- Evapotranspiration in mm/day

TABLE VIII-2-15 IRRIGATION REQUIREMENT OF UPLAND CROPS (cont'd)

		MAR.			APR.			MAY			JUN.			JUL.			AUG.	
		F	M	L	F	M	L	F	M	L	F	M	L	F	M	L	F	M
Evapotranspiration mm/day		----	4.8	---	----	5.0	---	----	5.1	---	----	4.3	---	----	4.0	---	-	3.9 -
VEGETABLES after ILV	kc	-	-	-	0.39	0.44	0.53	0.81	1.07	1.16	1.17	1.17	1.12	0.93	0.60	-	-	-
	IR	-	-	-	4.3	4.9	5.9	7.6	10.0	10.8	10.2	10.2	9.7	7.9	5.1	-	-	-
VEGETABLES after RD-13	kc	-	0.39	0.44	0.53	0.81	1.07	1.16	1.17	1.17	1.12	0.93	0.60	-	-	-	-	-
	IR	-	4.2	4.8	5.9	9.0	11.9	10.8	10.9	10.9	9.7	8.1	6.2	-	-	-	-	-
VEGETABLES after RD-7	kc	-	-	-	-	-	0.39	0.44	0.53	0.81	1.07	1.16	1.17	1.17	1.12	0.93	0.60	-
	IR	-	-	-	-	-	4.4	4.1	5.0	7.6	9.3	10.1	10.2	9.9	9.5	7.9	5.1	-
Mean IR	mm/day	-	0.4	1.2	2.9	3.6	5.9	6.5	7.7	8.6	8.5	8.5	7.9	5.2	3.7	2.0	1.8	-
Mean IR after LV only	mm/day	-	-	-	3.4	3.8	6.2	7.0	8.5	9.3	9.2	8.8	8.4	7.1	3.3	-	-	-

Note : IR (Irrigation requirement) = ETo x kc / 0.46
0.46 --- Irrigation efficiency, ETo --- Evapotranspiration in mm/day

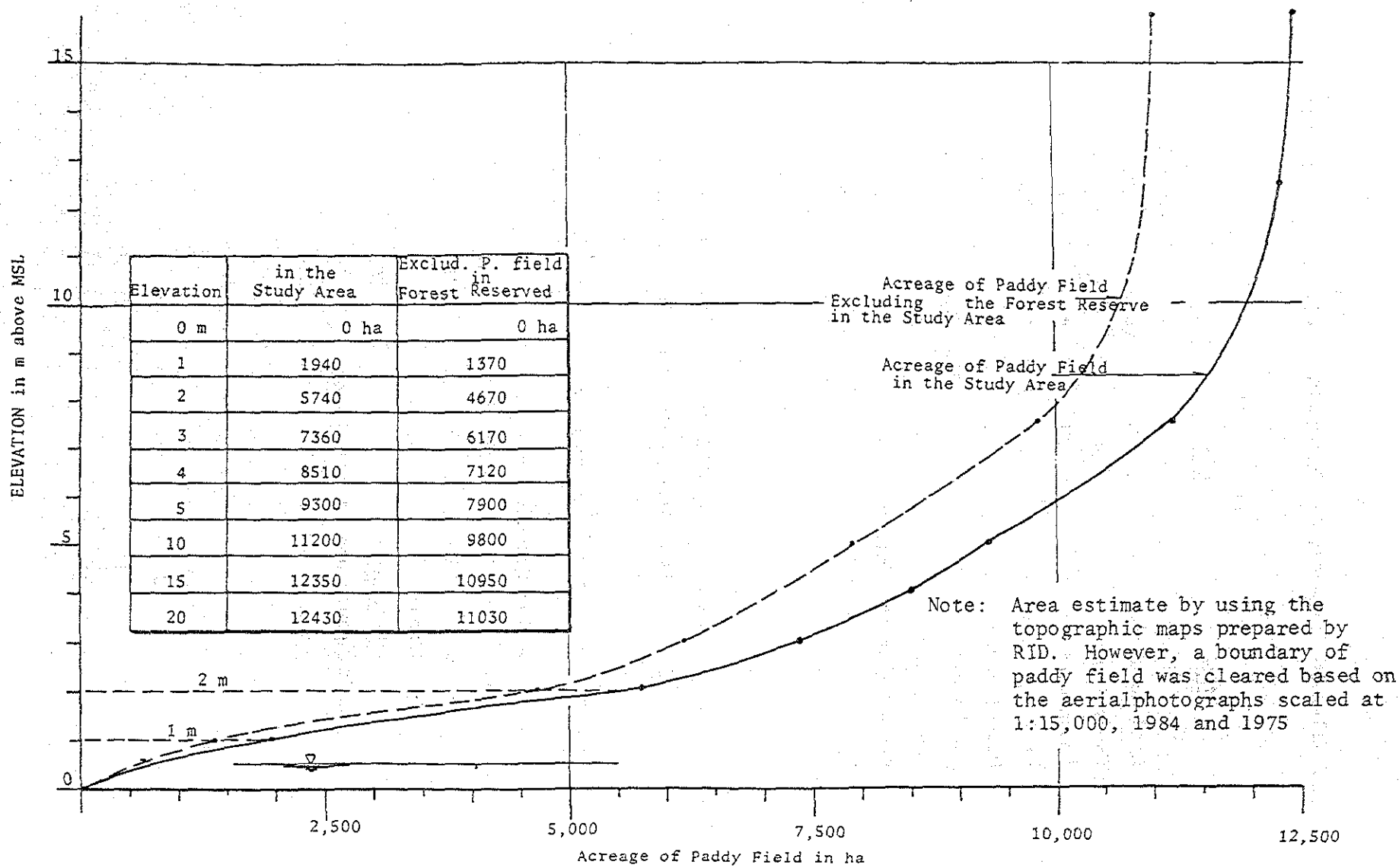
TABLE III-2-16 SUMMARY OF CONSTRUCTION COST OF LOW EMBANKMENT DIKE

Item	Quant'y	Unit	Cost (1,000 ฿)
Land Acquisition	620	rai	12.4
Excavation	202	10^3 cum	2.9
Embankment	346	"	11.0
Drainage Sluice	12	pls	36.0
Miscellaneous	1	LS	6.2
Sub-Total			68.6
Contingency	20	%	13.7
D/D & Goverm't Admi. Fee			12.3
Total			94.6

TABLE III-2-17 SUMMARY OF CONSTRUCTION COST OF INTAKE FACILITY
(Collecting Conduit at Mae Nam Yakang)

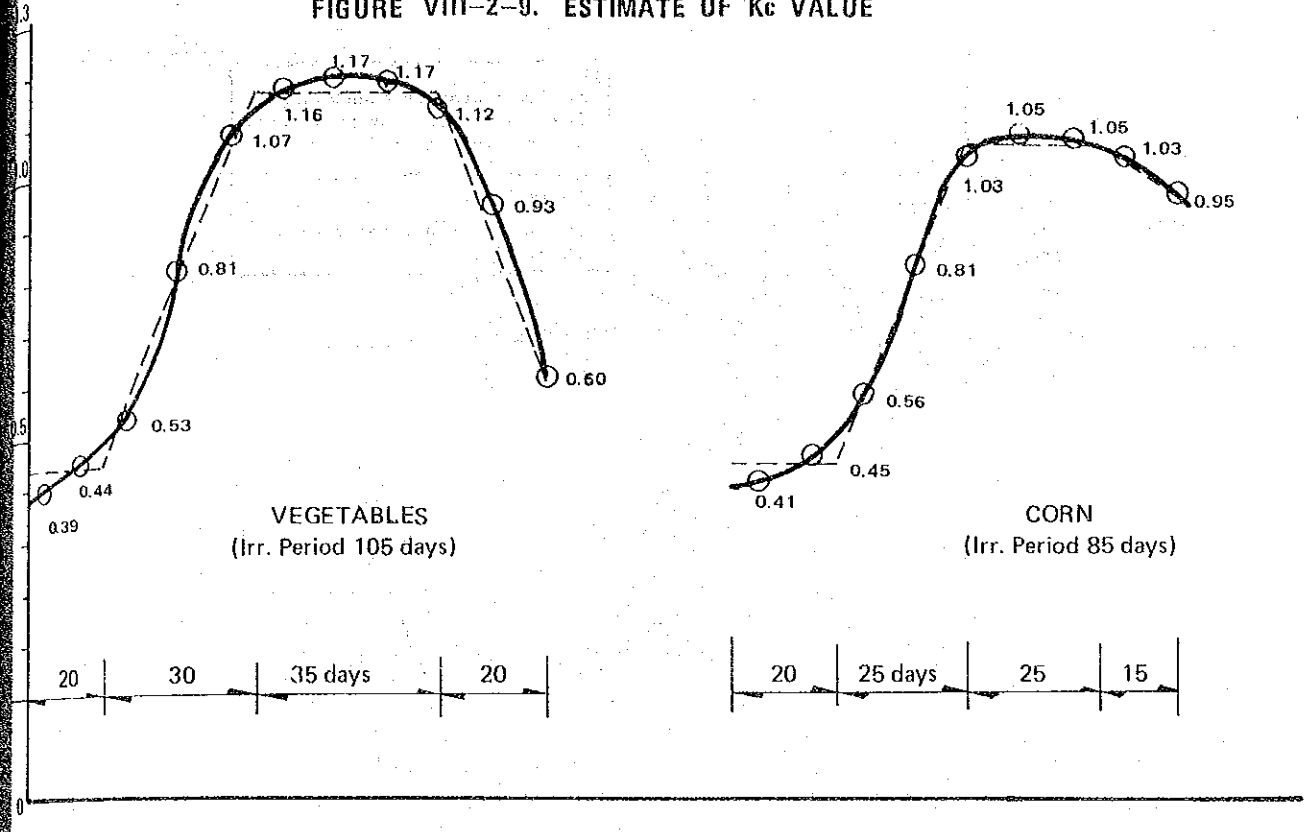
Item		Cost (million ฿)
Collecting Conduit	L=1.3 km	11
Intake Facility	L=340 m	12
Conveyance Pipe	L= 13 km	182
Open Canal	L= 5 km	3
Sub-Total		208
Contingency and others (20 %)		42
Total		250

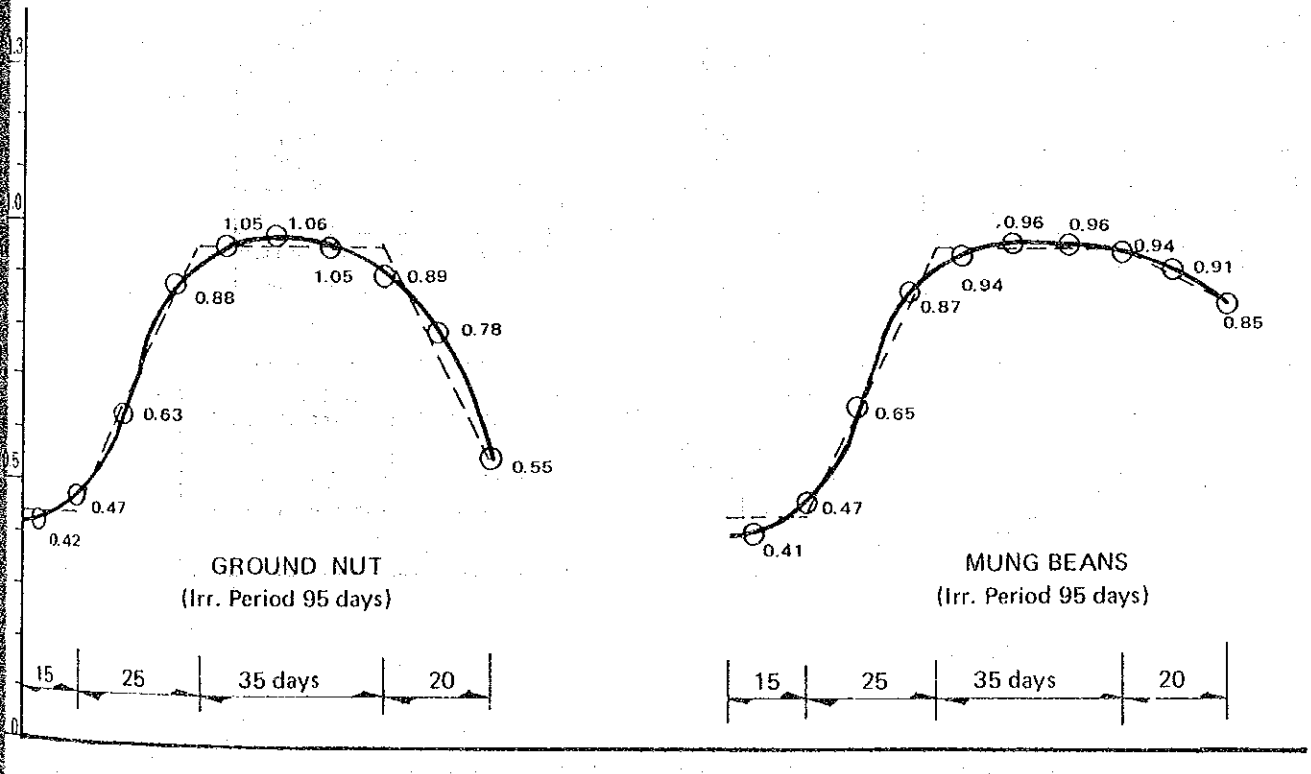
FIGURE VIII-2-8 PADDY FIELD DISTRIBUTION BY ELEVATION



Elevation	in the Study Area	Exclud. P. field in Forest Reserved
0 m	0 ha	0 ha
1	1940	1370
2	5740	4670
3	7360	6170
4	8510	7120
5	9300	7900
10	11200	9800
15	12350	10950
20	12430	11030

FIGURE VIII-2-9. ESTIMATE OF Kc VALUE





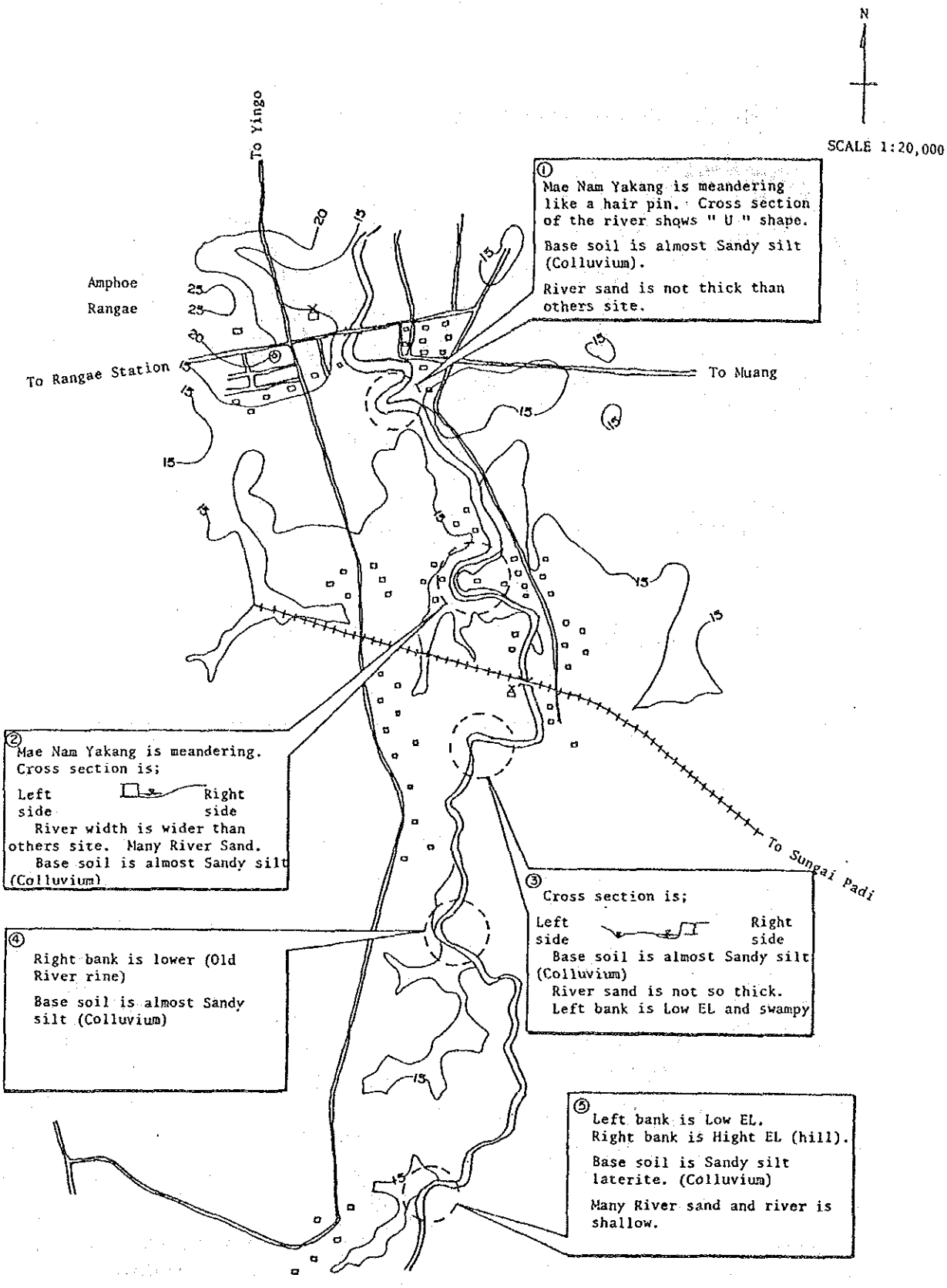


FIGURE VIII-2-10 GEOLOGICAL CONDITION ALONG MAE NAM YAKANG

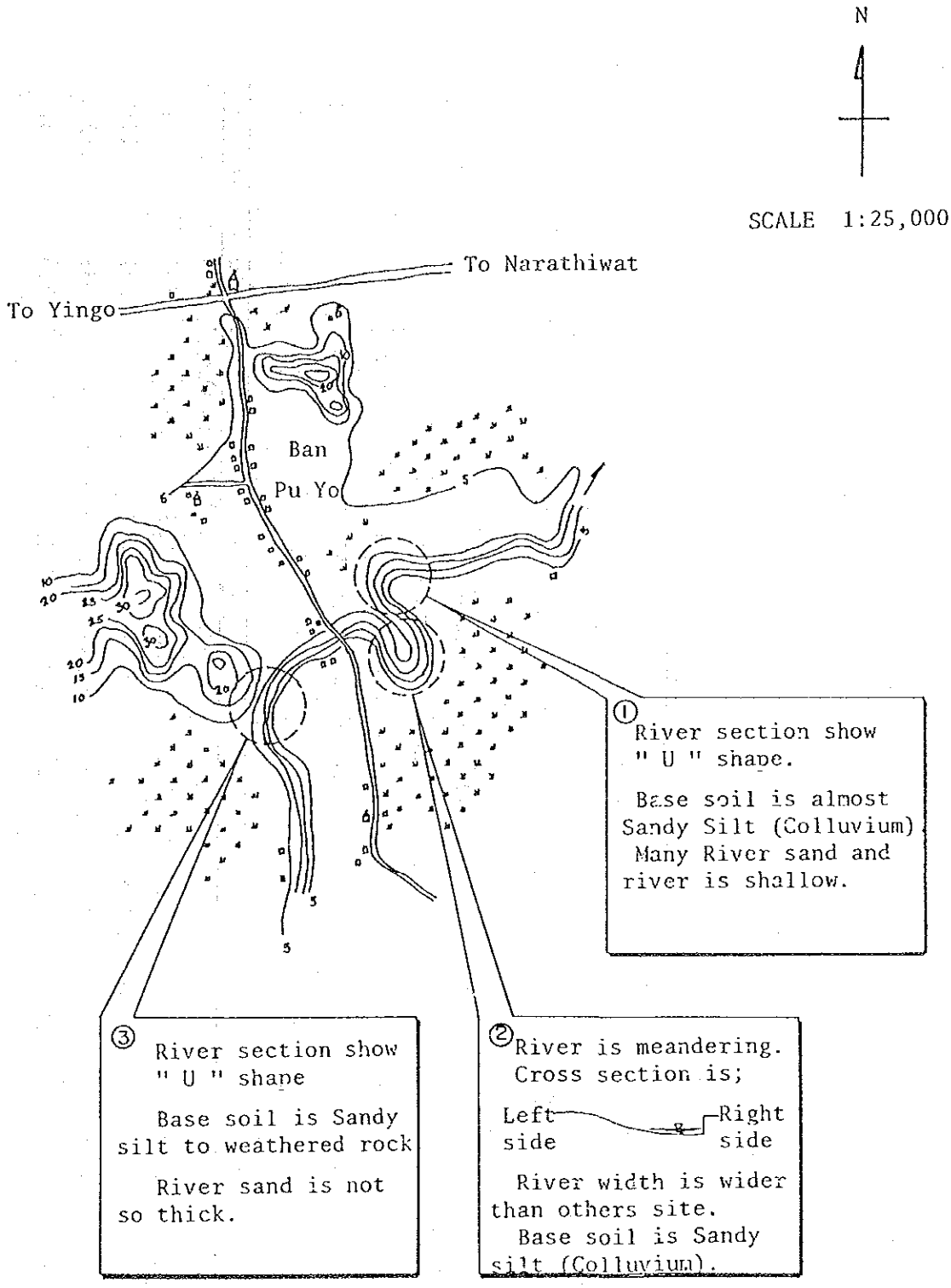
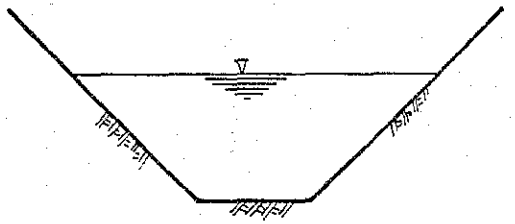


FIGURE VIII-2-11 GEOLOGICAL CONDITION ALONG MAE NAM YAKANG

TABLE VIII-2-18 RATING CURVE OF FARM DITCH



b : Canal bed width in m

d : Water depth in m

A : Flow area in sq.m = (b + d) * d

P : Wetted perimeter in m = b + 2 * 1.414 * d

R : Hydraulic radius = A/P

I : Hydraulic gradient

n : Roughness coefficient = 0.030

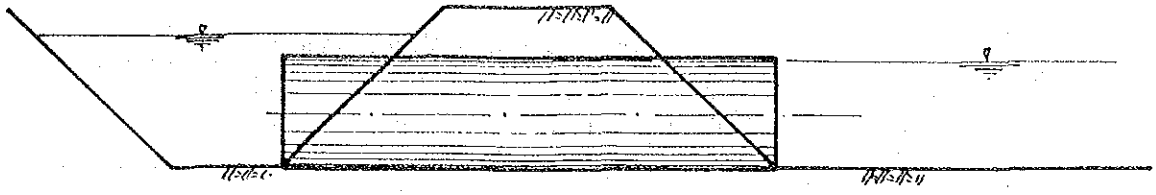
V : Mean velocity in m/sec = $R^{(2/3)} * I^{(1/2)} / n$

Q : Discharge in cu.m/sec = V * A

Type	b	d	A	P	R	I=1/100		I=10,000		I	
						V	Q	V	Q	V=0.3m/s	V=1.0m/s
	(m)	(m)	(sq.m)	(m)		(m/sec)	(cu.m/s)	(m/sec)	(cu.m/s)	(1/)	(1/)
A	0.30	0.25	0.138	1.007	0.137	0.884	0.122	0.088	0.012	868	78
B	0.30	0.35	0.228	1.290	0.176	1.048	0.239	0.105	0.024	1221	110
C	0.40	0.35	0.263	1.390	0.189	1.097	0.288	0.110	0.029	1338	120
D	0.40	0.45	0.383	1.673	0.229	1.247	0.477	0.125	0.047	1726	155

Note : Free board of 5 cm is taken at the maximum discharge.

Table VIII-2-19 Design of Farm Inlet



Farm Ditch　　Paddy Field

$$dH = Vo^2 + 0.6 \times Vp^2/2g + f\,L/D \times Vp^2/2g + ((Vp-V_2)/2g)^2$$

where;

Vo : mean velocity of water in a farm ditch (0.4 m/sec)

Vp : mean velocity of water in the pipe (0.95 m/sec)

f : coefficient of friction $f=124.6 \times n^2/D^{(1/3)}$

n : roughness coefficient (0.015)

D : diameter of the pipe (0.2m)

V_2 : mean velocity on a field (0.2 m/sec)

Therefore;

$$f = 124.6 \times 0.015^2/0.2^{(1/3)} = 0.048$$

$$dH = 0.4^2/2 \times 9.8 + 0.6 \times 0.95^2/2 \times 9.8 + 0.048 \times 1.0/0.2 \times (0.95^2/2 \times 9.8) + ((0.95 - 0.2)/2 \times 9.8)^2$$

$$= 0.048 \text{ (say } 0.05\text{m)}$$

The loss head from a farm ditch to a field is taken at 5 cm. A diameter of 20 cm of a RC pipe for the farm inlet is enough to convey irrigation water to a field.

TABLE VIII-2-20 ACREAGE AND QUANTITY IN NARATHIWAT SAMPLE AREA

Acreage : Total = 134.87 ha (843.0 rai)

R.U. No.	Rotation Block No. (ha)					
	1	2	3	4	5	6
1	2.16	1.83	1.68	1.49	2.20	0.78
2	1.22	2.21	1.27	2.26	2.33	0.89
3	2.25	2.01	1.37	1.46	2.21	1.76
4	1.23	2.41	3.24	2.08	2.33	2.55
5	2.40	2.08	2.30	1.73	1.31	2.40
6	2.36	1.47	2.06	2.04	2.23	1.71
7	2.19	3.78	2.13	1.80	1.66	1.82
8		1.70	2.20	1.88	2.13	2.04
9		2.16	1.98	2.13	1.18	2.19
10		2.25	1.79	2.12	2.22	1.49
11			2.39	1.93	1.81	2.04
12			2.06	1.91	2.21	2.25
13			2.15		2.12	1.85
Total	13.81	21.90	26.62	22.83	25.94	23.77

Quantity

R.B. No.	Acreage		Farm Ditch (m)						FIT No.
	ha	Rai	FD-1	FD-2	FD-3	FD-4	FD-5	Total	
1	13.81	86.3	605	124	-	-	-	729	7
2	21.90	136.9	1,435	272	-	-	-	1,707	11
3	26.62	166.4	1,055	455	255	15	100	1,880	15
4	22.83	142.7	1,374	45	23	-	-	1,442	12
5	25.94	162.1	880	585	408	25	-	1,898	13
6	23.77	148.6	1,605	120	-	-	-	1,725	13
Total	134.87	843.0						9,381	71

Note: R.U. No. ... Rotation unit No.
R.B. No. ... Rotation block No.
FIT ..... Farm inlet

TABLE VIII-2-21 LIST OF APPURTENANT STRUCTURES

Area : Narathiwat Sample Area

Acreage : 134.87 ha (843.0 rai)

ITEMS	Rotation No. 1	2	3	4	5	6	Total
1. Potable Pump ϕ100 mm	1	1	1	1	1	1	6
2. Road Crossing (pls)							
RC ϕ600 L=4.0m	1	3	2	1	-	1	8
" L=8.0m	-	-	-	-	-	-	-
" L=20.0m	-	-	-	-	-	-	-
3. Division Box (pls)	1	1	3	2	2	1	10
4. Curve Protection Works (pls)	8	41	16	13	22	39	139
5. Check (pls)	4	7	8	8	8	9	44
6. Concrete Lining at High Embankment Portion (m)	-	160	280	175	-	-	615
7. Drainage Crossing (pls)	1	3	3	1	3	3	14
8. Foot Bridge (pls)	2	3	4	3	4	3	19
9. Farm Drain (m)							
FDR-1							1,687
FDR-2							220
FDR-3							255
Total							2,162
10. Drainage Crossing (pls)							3

TABLE VIII-2-22 ACREAGE AND QUANTITY IN RANGAE SAMPLE AREA

Acreage : Total = 87.56 ha (547.2 rai)

R.U. No.	Rotation Block No. (ha)				
	1	2	3	4	5
1	2.01	2.28	2.10	2.00	2.01
2	2.09	2.33	1.51	1.45	1.81
3	2.08	2.30	1.47	1.26	1.01
4	2.27	2.22	1.87	2.08	1.08
5	2.24	1.79	2.15	1.46	1.53
6	2.20	2.15		1.48	1.71
7	1.49	1.81		1.49	1.85
8	1.99	2.28		2.05	1.57
9	1.79	2.14		2.04	1.48
10		1.89		2.34	1.57
11				1.54	
12				2.30	
13				2.00	
Total	18.16	21.19	9.10	23.49	15.62

Quantity

R.B. No.	Acreage		Farm Ditch (m)						FIT No.
	ha	Rai	FD-1	FD-2	FD-3	FD-4	FD-5	Total	
1	18.16	113.5	795	245	370	-	-	1,410	9
2	21.19	132.4	702	418	-	-	-	1,120	10
3	9.10	56.9	573	22	-	-	-	595	5
4	23.49	146.8	850	200	-	-	-	1,050	13
5	15.62	97.6	785	420	174	85	-	1,464	10
Total	87.56	547.2						5,639	47

Note: R.U. No. ... Rotation unit No.
R.B. No. ... Rotation block No.
FIT ..... Farm inlet

TABLE VIII-2-23 LIST OF APPURTENANT STRUCTURES

Area : Rangae Sample Area

Acreage : 87.56 ha (547.2 rai)

I T E M S	Rotation No. 1	2	3	4	5	Total
1. Road Crossing (pls)						
RC ϕ600 L=4.0m	1	-	-	3	2	6
" L=8.0m	-	-	-	-	-	-
" L=20.0m	-	-	-	-	-	-
2. Division Box (pls)	2	1	1	1	2	7
3. Curve Protection Works (pls)	29	-	8	8	24	69
4. Check (pls)	6	8	2	10	5	31
5. Concrete Lining at High Embankment Portion (m)	-	-	-	-	-	-
6. Drainage Crossing (pls)	-	-	1	-	2	3
7. Foot Bridge (pls)	3	3	1	2	3	12
8. Farm Drain (m)						-
9. Drainage Crossing (pls)						-

TABLE VIII-2-24 ACREAGE AND QUANTITY IN TAK BAI SAMPLE AREA

Acreage : Total = 132.01 ha (825.4 rai)

R.U. No.	Rotation Block No. (ha)					
	1	2	3	4	5	6
1	1.66	1.67	1.57	1.35	1.75	2.03
2	1.69	2.04	1.90	1.89	1.33	2.05
3	1.81	1.94	1.87	1.92	2.09	2.40
4	1.59	1.52	1.68	2.08	1.84	2.29
5	1.69	1.27	1.80	1.88	2.40	2.52
6	1.69	1.34	0.97	1.95	2.11	2.20
7	1.94	2.16	1.54	1.73	1.14	1.75
8	1.71	1.86	1.03	1.51	1.47	2.25
9	1.66	1.98	1.64	1.98	2.34	1.57
10	1.99	1.93	1.05	1.99	1.93	2.00
11	1.80	2.03	1.05	1.54	2.09	1.87
12	1.59		1.73	2.22		
13			2.17	1.74		
14			1.93	2.32		
Total	20.82	19.74	21.93	26.10	20.49	22.93

Quantity

R.B. No.	Acreage		Farm Ditch (m)						FIT No.
	ha	Rai	FD-1	FD-2	FD-3	FD-4	FD-5	Total	
1	20.82	130.1	738	346	157	-	-	1,241	12
2	19.74	123.4	860	225	60	-	-	1,145	11
3	21.93	137.1	160	486	300	630	90	1,666	14
4	26.10	163.4	855	743	282	88	-	1,968	16
5	20.49	128.1	698	415	248	-	-	1,361	10
6	22.93	143.3	805	692	-	-	-	1,497	12
Total	132.01	825.4						8,878	75

Note: R.U. No. ... Rotation unit No.
R.B. No. ... Rotation block No.
FIT ..... Farm inlet

TABLE VIII-2-25 LIST OF APPURTENANT STRUCTURES

Area : Tak Bai Sample Area

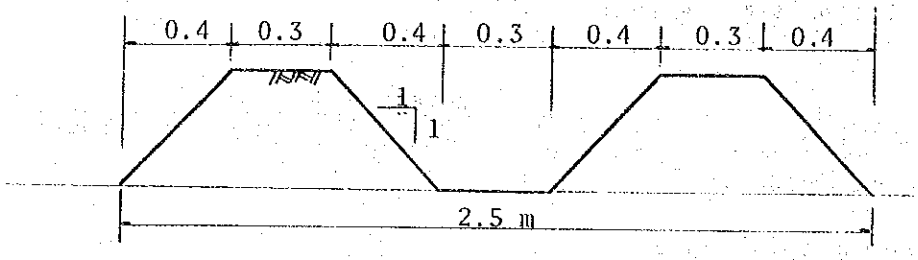
Acreage : 132.01 ha (825.4 rai)

ITEMS	Rotation No. 1	2	3	4	5	6	Total
1. Portable Pump ϕ100 mm	1	1	1	1	1	1	6
2. Road Crossing (pls)							
RC ϕ600 L=4.0m	-	1	3	-	-	-	4
" L=8.0m	-	-	-	-	-	-	-
" . L=20.0m	-	-	-	-	1	-	1
3. Division Box (pls)	2	2	4	3	1	1	13
4. Curve Protection Works (pls)	8	10	18	13	5	9	63
5. Check (pls)	7	7	7	11	8	10	50
6. Concrete Lining at High Embankment Portion (m)	340	340	250	-	210	-	1,140
7. Drainage Crossing (pls)	2	2	2	5	3	3	17
8. Foot Bridge (pls)	3	2	3	4	3	3	18
9. Farm Drain (m)							
FDR-1							1,369
FDR-2							780
FDR-3							768
Total							2,917
10. Drainage Crossing (pls) L=20.0m							2

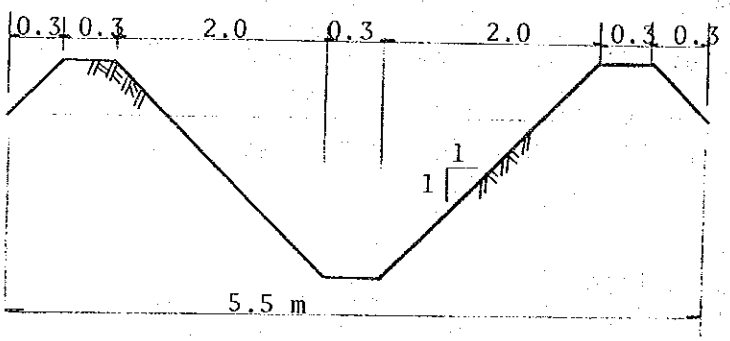
TABLE VIII-2-26 RIGHT OF WAY FOR FACILITIES

1. Right of Way for On-Farm Facilities

1.1 Typical Cross Section of Farm Ditch



1.2 Typical Cross section of Farm Drain



1.3 Right of Way for On-Farm Facilities

Item	Sample Area			Total
	Narathiwat	Rangae	Tak Bai	
1 Gross area (ha)	138.41	88.97	135.83	363.21
2 Net area (ha)	134.87	87.56	132.01	354.44
3 Length of Farm Ditch (m)	9,381	5,639	8,878	23,898
4 ROW for Farm Ditch (ha)	2.35	1.41	2.22	5.98
5 Length of Farm Drain (m)	2,162	-	2,917	5,079
6 ROW for Farm Drain (ha)	1.19	-	1.60	2.79
7 Total of ROW (ha)	3.54	1.41	3.82	8.77

1.4 Ratio of Right of Way to the Net Area

8.77 / 354.44 = 2.4 %

1.5 Total Acreage of Right of Way for On-Farm Facilities

9,980 / (1.00 - 0.024) - 9,980 = 245 ha

2. Right of Way for Irr. & Drainage Facilities

2.1 Total Acreage of Right of Way for Irr. Facilities

23.5 + 32.6 = 56.1 ha (say 56 ha)

(refer to Table VIII-2-28)

2.2 Total Acreage of Right of Way for Drainage Facilities

33.1 + 3.8 = 36.9 ha (say 37 ha)

(refer to Table VIII-2-27)

3. Total Acreage of Right of Way for Irr. and Drainage Facilities

245 + 56 + 37 = 338 ha (say 340 ha)

TABLE VIII-2-27 LAND ACQUISITION FOR DRAINAGE IMPROVEMENT FACILITIES

(unit : ha)

Drainage Canal	Length (km)		Land Acquisition		Right-of-Way in Paddy Field	
	Improvement	New construction	Improvement	New construction	Improvement	New construction
A.1 Ban La Mo	-	2.5 (1.0)	-	2.8	-	1.1
A.2 Kh. Ku Pa Po	9.0 (1.7)	0.8 (-)	9.3	1.0	1.8	-
A.3 Kh. Na Ko	4.9 (3.8)	- (-)	7.2	-	5.6	-
A.4 Khlong To Che						
A.4.1 To Che	5.6 (3.7)	- (-)	12.0	-	7.9	-
A.4.2 Lu Bo Manang	10.0 (4.1)	2.5 (-)	15.6	3.1	6.4	-
A.4.3 Khok Niang	5.5 (1.1)	-	6.7	-	1.3	-
A.5 Kh. Chang						
A.5.1 Chang	9.8 (1.3)	0.8 (-)	15.2	1.1	2.0	-
A.5.2 Ba Nao Du Dong	10.5 (-)	- (-)	17.5	-	-	-
A.5.3 Ku Rong Ya Ma	4.7 (1.6)	- (-)	6.9	-	2.2	-
A.6 Kh. Sala Pradu	- (-)	1.1 (0.5)	-	1.4	-	0.6
A.7 Kh. Sala Mai	5.0 (5.0)	1.7 (1.7)	5.9	2.1	5.9	2.1
Total	65.0 (22.3)	9.4 (3.2)	96.3	11.5	33.1	3.8

Note: The figure in parenthesis means the total length of drainage canals passed in the paddy field.

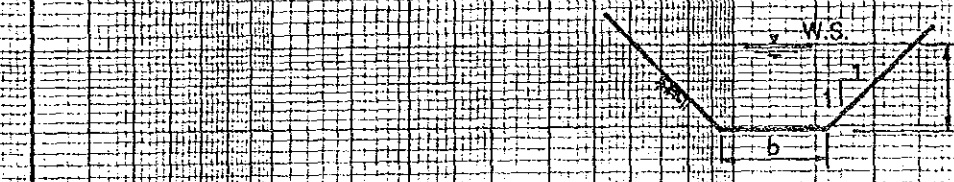
TABLE VIII-2-28 LAND ACQUISITION FOR IRRIGATION FACILITIES
(Main and Lateral Canals)

(unit : ha)

RID Pumping Station	Length (km)		Land Acquisition		Right of Way in Paddy Field	
	Main Canal	Lateral Canal	Main Canal	Lateral Canal	Main Canal	Lateral Canal
No.1 Pu Ta PS	1.7 (-)	3.4 (1.1)	2.1	3.5	-	1.1
No.2 Khao Kong PS	8.8 (1.6)	8.1 (1.9)	13.0	8.6	2.4	2.0
No.3 Du Song PS	7.2 (2.0)	12.8 (4.5)	10.5	13.2	2.9	4.6
No.4 Tan Yong Mat PS	4.8 (4.8)	14.1 (11.3)	6.9	14.6	6.9	11.7
No.5 Khok Ti Te PS	15.6 (4.6)	17.1 (4.8)	21.5	17.4	6.3	4.9
No.6 Maru Bo PS	4.1 (0.2)	5.3 (5.3)	5.7	5.4	0.3	5.4
No.7 Sala Mai PS	4.4 (0.6)	7.4 (0.8)	6.1	7.5	0.8	0.8
No.8 Ko Sawat PS	5.3 (1.8)	9.7 (0.2)	8.7	9.9	3.0	0.2
No.9 Phru Kap Daeng PS	3.0 (0.5)	11.3 (1.8)	5.1	11.6	0.9	1.8
No.10 Ku Cham PS	5.1 (-)	2.7 (0.1)	8.1	2.6	-	0.1
Total	60.0 (16.1)	91.9 (31.8)	87.7	94.3	23.5	32.6

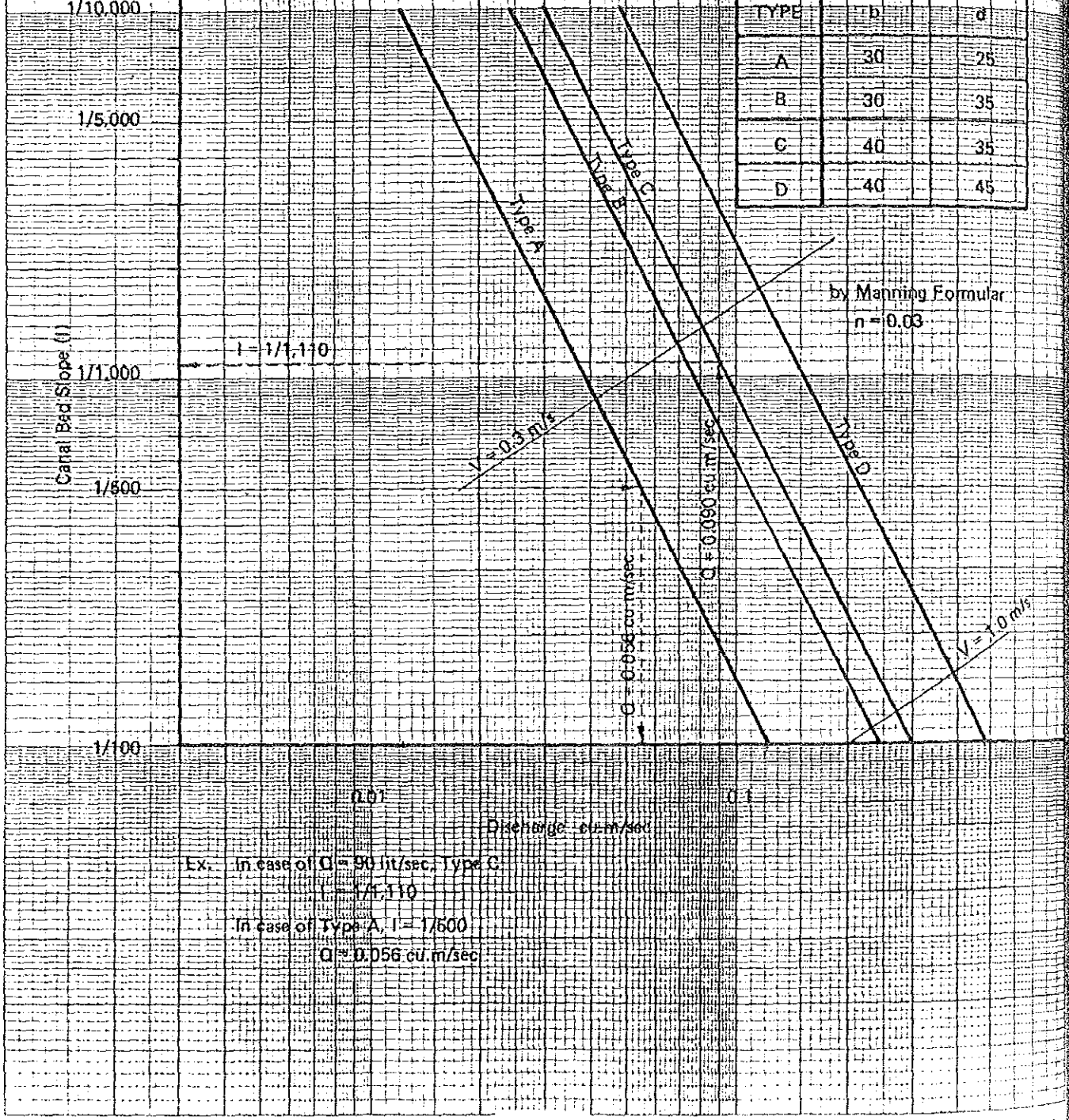
Note: The figure in parenthesis means the total length of irrigation canals passed in the paddy field.

FIGURE VIII 2-12 RATING CURVE OF FARM DITCH



Dimension (cm)

TYPE	b	d
A	30	25
B	30	35
C	40	35
D	40	45



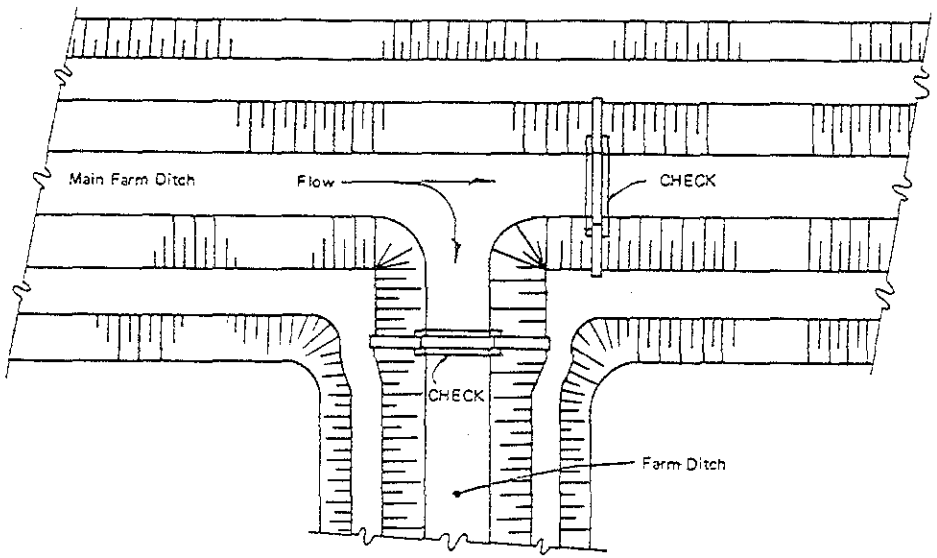
Ex. In case of Q = 90 lit/sec, Type C

I = 1/1,110

In case of Type A, I = 1/500

Q = 0.056 cu.m/sec

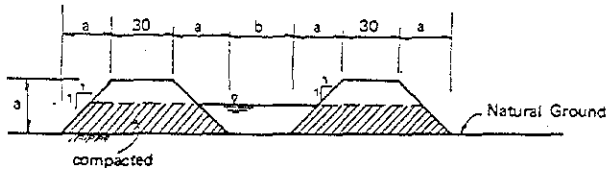
FIGURE VIII-2-13 TYPICAL DRAWINGS OF FARM DITCH AND DIVISION BOX



PLAN

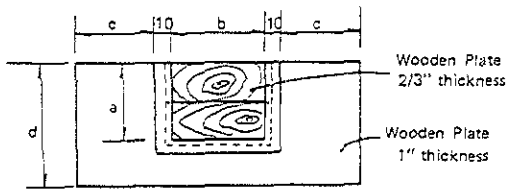
TYPICAL DRAWING OF DIVISION BOX

TYPICAL CROSS SECTION
OF FARM DITCH

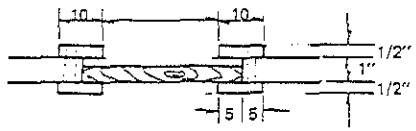


DIMENSION (cm)

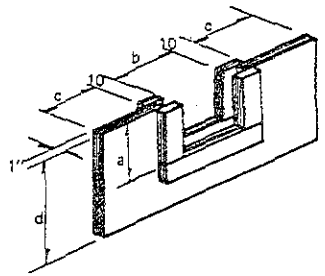
Type	a	b	c	d
A	30	30	45	50
B	40	30	55	60
C	40	40	55	60
D	50	40	65	70



SECTIONAL ELEVATION FOR CHECK



DETAIL OF STOP LOG



ISOMETRIC VIEW OF CHECK

Note: All dimension are shown in cm
except thickness of timber

TABLE VIII-3-1 PROBABLE RAINFALL BY IWAI METHOD
(STATION: YINGO)

(unit: mm)

No.	Daily Rain	Consecutive Rainfall 2-day Rain	3-day Rain	4-day Rain	5-day Rain	6-day Rain	7-day Rain
1	316.3	603.4	845.0	900.4	916.5	949.9	964.2
2	308.3	445.3	590.6	640.4	647.1	647.1	699.6
3	285.9	444.6	564.0	618.2	627.1	634.5	648.8
4	221.5	355.3	401.5	516.8	555.3	613.7	619.8
5	217.8	336.2	399.6	486.2	510.5	547.8	580.5
6	211.5	315.2	388.3	455.9	493.1	540.4	549.7
7	190.6	310.7	383.8	434.9	470.8	517.9	539.3
8	190.5	248.9	348.3	405.2	455.1	515.9	537.5
9	190.0	248.6	319.5	369.5	436.8	495.3	527.4
10	186.5	232.1	294.4	359.9	407.4	407.4	429.7
11	180.7	231.2	281.2	318.3	386.8	393.2	407.4
12	180.4	228.2	275.3	290.3	324.0	374.3	374.3
13	180.4	226.0	260.6	281.2	296.9	335.1	358.6
14	177.7	224.8	253.4	277.4	296.5	323.2	353.5
15	177.2	224.0	248.9	269.5	291.9	311.4	323.2
16	158.9	223.1	245.6	265.0	290.5	298.3	321.1
17	146.4	204.8	243.7	263.1	281.2	290.5	319.5
18	122.5	202.9	239.6	260.4	272.5	288.9	311.6
19	118.5	197.8	208.8	253.2	263.1	281.9	298.3
20	117.6	181.1	202.4	235.0	261.5	281.2	290.5
21	114.5	175.2	197.8	232.8	261.0	263.1	281.2
22	113.1	162.0	186.7	221.1	254.1	255.2	272.7
23	111.2	147.1	177.6	220.0	234.8	243.1	256.2
24	109.3	136.2	169.9	206.7	227.8	237.7	248.7
25	98.4	135.7	164.9	195.3	226.6	226.6	226.6
26	97.8	133.9	145.4	159.4	188.9	191.2	216.4
27	95.3	123.7	138.0	156.6	181.7	188.9	202.7
28	86.0	122.8	135.7	151.2	174.4	181.7	194.4
29	75.2	89.0	123.7	141.0	147.7	159.1	181.7
30	66.6	86.0	113.6	132.9	141.0	141.0	141.0
31	10.5	14.7	18.8	22.5	29.4	29.4	34.8
Ave.	156.6	226.1	276.3	314.2	340.3	360.1	377.7

R.P	Daily Rain	Probable Consecutive Rainfall 2-day Rain	3-day Rain	4-day Rain	5-day Rain	6-day Rain	7-day Rain
2	146.5	200.4	232.3	265.8	299.8	319.6	337.4
5	213.8	318.8	406.5	461.0	478.9	505.6	527.4
10	256.6	402.9	544.6	614.8	608.2	637.0	660.3
20	296.5	487.4	693.4	779.8	739.2	768.2	792.3
25	309.0	514.9	743.9	835.7	782.2	810.9	835.1
30	319.1	537.8	786.5	882.8	817.8	846.2	870.5
50	347.1	602.2	909.9	1,019.0	918.9	945.8	970.0
100	348.5	692.5	1,090.8	1,218.0	1,061.4	1,084.9	1,108.5
200	421.7	786.2	1,287.5	1,433.9	1,210.4	1,229.1	1,251.5

Note: R.P ... Return Period in year

TABLE VIII-3-2 PROBABLE RAINFALL BY IWAI METHOD
(STATION: MUANG NARATHIWAT)

(unit: mm)

No.	Daily Rain	Consecutive Rainfall 2-day Rain	3-day Rain	4-day Rain	5-day Rain	6-day Rain	7-day Rain
1	424.6	693.1	808.7	906.2	926.7	973.7	1,053.0
2	366.1	621.5	790.9	847.9	902.4	919.4	921.0
3	312.1	517.4	565.9	586.8	614.5	667.9	716.4
4	244.4	372.5	510.8	565.5	577.8	640.8	676.7
5	238.4	337.3	489.3	536.9	559.6	618.8	658.5
6	236.6	321.7	445.0	511.1	552.7	572.0	631.0
7	233.2	312.8	400.5	509.8	543.6	550.0	597.6
8	224.8	301.3	385.7	458.9	528.2	542.8	576.5
9	224.7	298.1	373.5	415.7	496.2	540.9	552.8
10	177.2	273.2	368.6	406.7	467.0	487.0	495.7
11	176.5	271.5	326.8	396.8	438.7	453.4	474.9
12	172.4	253.1	316.2	377.4	385.0	447.5	473.5
13	154.2	245.8	310.7	354.1	381.5	445.7	451.4
14	152.7	241.5	308.5	351.0	369.0	391.5	398.9
15	144.9	226.5	275.2	328.0	366.1	382.8	395.7
16	141.4	224.2	261.6	313.9	334.0	341.9	382.3
17	136.9	219.2	260.9	265.2	296.3	323.7	366.3
18	135.6	207.4	250.8	262.2	287.2	311.4	327.9
19	133.2	185.3	225.1	259.9	286.2	311.0	313.0
20	129.4	174.3	205.0	241.3	276.9	292.0	298.1
21	126.4	173.6	196.2	218.6	275.0	277.3	283.5
22	124.4	171.4	187.8	217.6	271.3	274.6	279.2
23	120.5	168.7	182.1	205.1	227.8	274.2	278.4
24	120.3	167.5	178.0	204.0	216.6	251.1	260.1
25	119.8	160.1	176.2	195.3	210.7	247.3	256.1
26	111.9	159.1	174.3	188.4	203.2	239.1	250.2
27	111.9	157.9	169.9	179.9	200.7	214.7	229.2
28	105.2	153.5	161.0	172.1	193.0	206.4	221.4
29	105.0	149.3	157.2	168.7	178.9	204.1	214.4
30	77.7	106.3	149.7	162.5	177.7	178.6	178.8
31	74.9	105.3	126.0	142.4	151.4	157.7	174.5
Ave.	172.8	257.1	314.1	353.2	383.7	410.9	431.8

R.P	Daily Rain	Probable Consecutive Rainfall 2-day Rain	3-day Rain	4-day Rain	5-day Rain	6-day Rain	7-day Rain
2	158.0	230.8	277.4	311.8	341.7	368.3	386.4
5	224.3	337.6	419.4	473.8	513.1	547.6	575.9
10	269.3	411.8	520.5	589.6	634.6	673.7	709.6
20	313.3	485.3	622.2	706.4	756.3	799.6	843.1
25	327.4	509.1	655.4	744.5	796.0	840.4	886.5
30	339.0	528.7	682.9	776.2	828.8	874.3	922.4
50	371.5	583.8	760.5	865.6	921.4	969.5	1,023.5
100	416.1	660.4	869.5	991.3	1,051.1	1,102.4	1,164.9
200	461.7	739.2	982.8	1,122.2	1,185.7	1,239.9	1,311.2

Note: R.P ... Return Period in year

TABLE VIII-3-3 PROBABLE RAINFALL BY IWAI METHOD
(STATION: RANGAE)

(unit: mm)

No.	Daily Rain	Consecutive Rainfall 2-day Rain	3-day Rain	4-day Rain	5-day Rain	6-day Rain	7-day Rain
1	306.3	540.5	647.7	751.9	814.2	819.8	839.0
2	291.6	430.7	557.0	672.4	714.9	741.1	762.2
3	250.5	293.6	373.1	445.3	460.5	486.9	515.1
4	185.4	250.0	334.0	409.0	414.0	414.0	425.0
5	165.0	249.0	268.4	328.6	349.0	391.0	408.2
6	140.0	240.0	266.0	296.0	324.0	389.4	407.0
7	128.0	214.0	250.0	281.0	305.0	324.8	359.4
8	110.9	208.0	237.0	272.0	297.3	324.0	324.0
9	110.1	149.5	177.9	196.7	225.0	258.8	283.0
10	106.0	148.0	174.0	191.0	221.0	241.0	242.3
11	100.9	134.0	168.6	189.2	206.9	233.3	233.3
12	96.0	133.7	155.8	182.0	202.2	206.9	220.8
13	93.7	130.7	150.9	182.0	193.2	198.9	208.6
14	92.6	120.0	150.9	168.6	182.0	193.2	206.9
15	91.1	110.9	148.0	161.1	161.1	189.9	201.1
16	85.0	106.9	130.6	143.7	154.9	182.0	198.9
17	75.0	100.8	127.9	140.3	154.8	174.7	193.2
18	52.2	91.4	112.4	137.4	152.6	161.1	182.0
19	48.3	80.2	109.0	113.3	140.2	145.7	162.5
20	42.3	79.2	100.8	109.6	124.2	140.2	140.2
21	42.2	78.8	100.6	100.8	114.9	121.9	133.6
22	40.0	69.3	92.0	98.4	109.7	112.6	130.2
23	38.9	63.3	80.1	96.9	109.6	110.0	119.1
24	35.1	58.6	77.8	87.3	95.9	109.6	109.6
25	33.2	50.9	63.3	81.1	87.3	105.5	105.5
26	32.8	45.0	59.6	64.3	77.3	86.9	98.3
27	22.1	35.2	51.2	60.2	73.3	85.9	86.9
28	20.5	35.0	47.8	59.2	63.4	72.9	76.7
29	20.0	35.0	40.4	51.2	51.2	61.4	74.3
30	18.3	27.2	34.8	34.8	38.7	38.7	45.6
31	18.2	20.0	26.0	26.0	26.0	26.0	29.0
Ave.	93.2	139.6	171.4	197.7	214.3	230.5	242.6

R.P	Daily Rain	Probable Consecutive Rainfall 2-day Rain	3-day Rain	4-day Rain	5-day Rain	6-day Rain	7-day Rain
2	67.9	102.4	127.9	145.3	160.5	176.0	185.5
5	136.1	202.8	247.1	285.4	310.2	335.3	352.4
10	195.7	289.8	348.6	406.1	436.7	467.8	492.7
20	264.2	389.2	463.2	543.4	578.7	615.1	649.7
25	288.4	424.1	503.2	591.5	628.0	666.0	704.2
30	309.0	453.9	537.2	632.5	670.0	709.3	750.6
50	370.4	542.3	637.8	754.1	793.8	836.1	887.0
100	463.9	676.6	789.4	938.4	979.9	1,025.6	1,091.6
200	570.1	828.5	959.4	1,146.1	1,187.8	1,236.0	1,319.9

Note: R.P ... Return Period in year

TABLE VIII-3-4 PROBABLE RAINFALL BY IWAI METHOD
(STATION: TAK BAI)

(unit: mm)

No.	Daily Rain	Consecutive Rainfall 2-day Rain	3-day Rain	4-day Rain	5-day Rain	6-day Rain	7-day Rain
1	427.8	786.4	1,030.7	1,066.8	1,153.6	1,153.6	1,153.6
2	415.2	550.0	734.3	820.6	898.2	926.4	971.2
3	284.7	518.6	663.4	754.0	785.0	812.4	881.9
4	273.5	500.6	649.8	677.9	677.9	708.5	710.8
5	206.7	343.5	459.8	619.4	656.1	674.1	708.5
6	200.3	328.2	452.2	518.7	548.4	557.2	557.2
7	189.5	318.2	442.9	495.4	524.6	535.2	537.1
8	186.2	316.1	409.8	427.1	471.1	474.6	503.6
9	184.5	297.7	373.0	417.9	439.5	458.3	502.2
10	182.4	286.5	356.3	363.0	421.6	439.5	477.8
11	178.6	280.9	332.8	351.1	373.6	438.8	458.3
12	173.4	277.6	330.0	342.8	351.1	431.0	438.8
13	172.6	243.2	309.4	326.2	350.9	392.3	438.6
14	162.9	242.0	273.2	299.8	345.7	388.7	403.5
15	157.3	228.3	266.7	292.6	342.8	366.4	403.2
16	152.4	222.1	244.3	286.4	313.7	343.8	402.4
17	148.0	211.0	228.9	284.6	309.8	338.8	371.4
18	138.4	210.5	228.3	279.9	302.3	329.6	354.7
19	130.0	184.2	225.9	255.6	297.4	319.1	329.6
20	122.3	179.4	224.0	233.9	289.3	297.4	299.7
21	121.7	178.6	214.0	228.3	255.6	273.5	289.8
22	118.7	175.8	211.0	225.9	245.3	272.2	272.2
23	117.5	168.8	201.4	225.4	241.4	246.2	360.7
24	117.3	167.3	192.0	225.3	229.6	231.7	253.9
25	115.2	158.8	184.2	196.8	228.3	228.3	241.7
26	111.9	153.5	183.3	190.5	198.8	211.1	229.1
27	106.3	142.6	174.4	184.2	190.5	202.6	227.6
28	94.7	136.0	153.4	164.2	168.3	190.4	207.6
29	72.8	86.5	86.5	86.5	93.0	93.0	125.6
Ave.	174.5	272.1	339.1	373.8	403.5	425.4	448.7

R.P	Daily Rain	Probable Consecutive Rainfall 2-day Rain	3-day Rain	4-day Rain	5-day Rain	6-day Rain	7-day Rain
2	160.2	241.9	293.3	322.4	349.7	371.3	397.0
5	224.7	361.5	459.6	510.3	550.9	581.6	604.6
10	268.2	445.9	581.3	648.7	698.5	735.4	753.3
20	310.4	530.4	705.8	790.9	849.9	892.6	903.3
25	323.9	557.8	746.8	837.8	899.8	944.4	952.4
30	335.0	580.6	780.9	877.0	941.4	987.6	933.1
50	365.8	644.6	878.0	988.5	1,059.7	1,110.1	1,108.2
100	408.2	734.2	1,015.5	1,147.0	1,227.8	1,283.8	1,270.0
200	451.3	827.0	1,160.2	1,314.2	1,404.7	1,466.5	1,438.6

Note: R.P ... Return Period in year