Table 6.2 Work Items and Quantities for New and Planned Schemes

Kabupaten	Scheme	Scheme Area*(ha)	Intake (nos)	Weir Height (m)	Weir Length (m)	Main & Secondary Canal (km)	Aqueduct (m)	Supply Canal (km)
Tabalong	31.Sungai Kati	280	-	-	-	6.2	-	-
	32.Namun	64	1	2	5	2.5	-	-
	33.Kinarum	408	1	2	30	9.0	-	-
	34.Mihim	203	1	2	10	4.5	-	-
	35.Batupulut	225	-	-	-	5.0	-	-
	36.Bilas	643	2	2.5	10	14.1	-	-
	37.Banju Tajun	750	1	2.5	10	16.5	-	-
	Sub-totoal	2,573				57.8	-	-
H.S.U	38.Balangan	2,172	1	3	40	31.6	-	-
	39.Pitap	4,519	2	3	50	53.9	-	5.0
	Sub-total	6,691				85.5	-	5.0
H.S.T	40.Batang Alai	6,823	1	4	40	70.7	65	9.6
	41.Barabai	3,078	1	3	50	54.0	-	-
	Sub-total	9,901				124.7	65	9.6
H.S.S	42.Kayu Habang	347	1	1	10	7.6	-	-
	43.Amandit	6,432	2	4.5	57	66.0	-	0.6
	Sub-total	6,779				73.6	-	0.6
Tapin	44.Tapin	5,728	1	2.45	28	90.1	65	-
	45.Labuhan	300	1	2	10	6.6	-	-
	Sub-total	6,028				96.7	65	-
	Total	31,972				438.3	130	15.2

Kabupaten	Scheme	Scheme Area*(ha)	Main System (ha)	Tertiary System (ha)	Drain System (ha)	Remarks
Tabalong	31.Sungai Kati	280	280	280	280	Supplied by Jaro Bawah scheme
	32.Namun	64	64	64	64	
	33.Kinarum	408	408	408	408	
	34.Mihim	203	203	203	203	
	35.Batupulut	225	225	225	225	Supplied by Mihim scheme
	36.Bilas	643	643	643	643	
	37.Banju Tajun	750	750	750	750	
	Sub-totoal	2,573	2,573	2,573	2,573	
H.S.U	38.Balangan	2,172	2,172	2,172	2,172	
	39.Pitap	4,519	4,519	4,519	4,519	Including.Batu Mandi drainage scheme (785 ha)
	Sub-total	6,691	6,691	6,691	6,691	
H.S.T	40.Batang Alai	6,823	6,823	6,823	6,823	Including.Tg.Semanggi
	41.Barabai	3,078	3,078	3,078	3,078	Including.Tg.Jaranih Kambat drainage scheme (800ha)
	Sub-total	9,901	9,901	9,901	9,901	
H.S.S	42.Kayu Habang	347	347	347	347	
	43.Amandit	6,432	6,432	6,432	6,432	
	Sub-total	6,779	6,779	6,779	6,779	
Tapin	44.Tapin	5,728	5,728	5,728	5,728	Including.5bh Pintu Air drainage scheme (400ha)
	45.Labuhan	300	300	300	300	
	Sub-total	6,028	6,028	6,028	6,028	
	Total	31,972	31,972	31,972	31,972	

Remarks: *; Including drainage scheme areas with a possibility to receive irrigation water.

Table 7.1 List of Unit Price

(Unit : Rp)

	Items	Unit	Unit Price	Remarks
1.	Site clearing	m^2	195	
2.	Stripping of top soil	m^3	1,860	
3.	Excavation	m^3	6,330	weir site, common
			3,750	canal
			8,970	weathered rock
			15,660	rock
			36,000	tunnel
4.	Embankment	m^3	2,440	hauling within 50 m
			9,100	hauling within 1,000 m
			7,260	core
			17,220	random zone, hauling 5 km within 10 km
5.	Road metaling	m^2	6,200	
6.	Asphalt pavement	m^2	21,080	with base course
7.	Sodding	m^2	1,920	
8.	Masonry	m^3	86,500	
9.	Gabion mattress	m^3	75,700	
10.	Rip-rap	m^3	43,550	
11.	Plain concrete	m^3	118,480	
12.	Reinforced concrete	m^3	300,070	
13.	Form for concrete	m^2	32,530	

Table 7.2 Construction Cost for Existing Schemes

(Unit : million Rp.)

Kabupaten	Scheme	Scheme Area (ha)	Construction of Main System	Rehabilitation	Renewal of Structures	Construction of Main,Tertiary and Drain System	Land Acquisition	Total
Tabalong	1. Jaro	625	-	8	-	-	-	8
	2. Jaro Bawah	200	315	-	82	191	32	620
	3. Gumba	254	-	6	106	243	6	361
	Sub-Total	1,079	315	14	188	434	38	989
H.S.U	4. Paran	188	77	3	84	180	14	358
	5. Tundakan	233	-	2	138	223	6	369
	6. Suapin	116	-	1	93	110	3	207
	7. Lok Batu	116	-	21	220	110	4	355
	Sub-Total	653	77	27	535	623	27	1,289
H.S.T	8. Talong	165	-	5	158	158	5	326
	9. Tapuk	186	-	11	76	178	5	270
	10. Tamiyang	166	-	10	110	159	4	283
	11. Baruh Hawang	160	57	5	12	153	10	237
	12. Intangan	920	-	44	43	1,130	27	1,244
	13. Kahakan	633	-	4	121	606	15	746
	14. Mangunang	515	-	20	61	493	12	586
	15. Haruyan Dayak	1,486	-	4	158	1,422	35	1,619
	Sub-Total	4,231	57	103	739	4,299	113	5,311
H.S.S	16. Telaga Langsat	1,534	-	52	303	1,469	37	1,861
	17. Tayub	178	-	1	53	191	5	250
	18. Nunungin	36	-	1	95	157	4	257
	19. Kuanga	143	-	7	101	225	6	339
	20. Pamujaan	214	-	3	53	335	8	399
	21. Hawatu	71	403	-	104	246	41	794
	22. Taal	107	-	2	206	277	8	493
	23. Jarau	143	-	8	6	76	7	97
	Sub-Total	2,426	403	74	921	2,976	116	4,490
Tapin	24. Lok Paikat	392	294	1	67	375	41	778
	25. Pampain	392	-	3	161	375	10	549
	26. Nupadang	253	246	1	6	242	34	529
	27. Tatakan	99	-	2	75	94	3	174
	28. Pulau Pinang	270	-	2	-	259	6	267
	29. Rampanang	146	-	1	29	140	3	173
	30. Binuang	1,106	1,196	17	110	1,022	161	2,506
	Sub-Total	2,658	1,736	27	448	2,507	258	4,976
	Total	11,047	2,588	245	2,831	10,839	552	17,055

Table 7.3 Construction Cost for New Schemes

(Unit : Rp million)

Kabupaten	Scheme		Scheme Area (ha)	Head Works	Main System	Tertiary System	Drain System
Tabalong	31.	Sungai Kati	280	-	463	206	76
	32.	Namun	64	27	107	47	17
	33.	Kinarum	408	175	675	300	110
	34.	Mihim	203	87	336	149	55
	35.	Batupulut	225	-	372	165	61
	36.	Bilas	643	27	1,062	473	174
	37.	Banyu Tajun	750	322	1,292	551	202
		Sub-Total	2,573	638	4,307	1,891	695
H.S.U.	38.	Balangan	2,172	934	9,924	1,596	586
	39.	Pitap	4,519	1,942	23,892	3,321	1,220
		Sub-Total	6,691	2,876	33,816	4,917	1,806
H.S.T	40.	Batang.Alai	6,823	2,933	37,142	5,015	1,841
	41.	Barabai	3,078	1,323	14,064	2,262	831
		Sub-Total	9,901	4,256	51,206	7,277	2,672
H.S.S.	42.	Kayu Habang	347	149	574	255	94
	43.	Amandit	6,432	4,506	29,315	4,728	1,736
		Sub-Total	6,779	4,655	29,889	4,983	1,830
Tapin	44.	Tapin	5,728	3,577	27,004	4,210	1,546
	45.	Labuhan	300	129	496	221	81
		Sub-Total	6,028	3,706	27,500	4,431	1,627
		Total	31,972	16,131	146,718	23,499	8,630

Kabupaten	Scheme		Scheme Area (ha)	Supply Canal	Land Acquisition	Total Cost	Total Cost Excluding Water Supply Cost for Drainage Scheme
Tabalong	31.	Sungai Kati	280	-	45	790	790
	32.	Namun	64	-	10	207	208
	33.	Kinarum	408	-	65	1,325	1,325
	34.	Mihim	203	-	32	659	659
	35.	Batupulut	225	-	36	634	634
	36.	Bilas	643	-	103	2,089	2,089
	37.	Banyu Tajun	750	-	120	2,487	2,487
		Sub-Total	2,573	-	411	8,192	8,192
H.S.U.	38.	Balangan	2,172	-	348	13,388	13,388
	39.	Pitap	4,519	3,557	772	34,704	23,015
		Sub-Total	6,691	3,557	1,120	48,092	36,403
H.S.T	40.	Batang.Alai,	6,823	5,371	1,197	53,499	38,754
	41.	Barabai	3,078	-	492	18,972	14,041
		Sub-Total	9,801	5,371	1,689	72,471	52,795
H.S.S.	42.	Kayu Habang	347	-	56	1,128	1,128
	43.	Amandit	6,432	73	1,029	41,465	41,465
		Sub-Total	6,779	73	1,085	42,515	42,515
Tapin	44.	Tapin	5,728	-	917	37,254	34,960
	45.	Labuhan	399	-	48	975	975
		Sub-Total	6,028	-	965	38,229	35,935
		Total	31,972	39,001	5,270	209,499	175,840

Table 7.4 Additional Construction Cost for Alternative Water Supply

(Unit: Rp. million)

(1)	(2)	Additional Construction Cost (3)	(4)	(5)	(6)
39. Pitap	23,015	11,689	7,111	-	-
40. Batang Alai	38,754	14,745	8,415	12,574	-
41. Barabai	14,041	4,931	-	-	-
42. Amandit	41,387	-	2,939	4,469	12,512
43. Tapin	34,960	2,294	2,809	4,169	30,113
Total	152,157	33,659	21,274	21,212	42,625

Remarks:
(1) New Scheme
(2) Construction Cost
(3) Supply to Drainage Scheme
(4) Supplement to Irrigation Scheme
(5) Water Source Conversion of Irrigation Scheme
(6) Maximum Utilization of Water Source

Table 8.1 List of Evaluated and Relinquished Schemes

Kabupaten	Scheme	Scheme Area (ha)
Evaluated Schemes		
Tabalong	2. Jaro Bawah	200
	3. Gumba	254
	Sub-total	454
H.S.U.	4. Paran	188
	5. Tundakan	233
	6. Suapin	116
	Sub-total	537
H.S.T.	8. Talang	165
	9. Tapuk	186
	10. Tamiyang	166
	11. Baruh Hawang	160
	14. Mangunang	515
	Sub-total	1,192
H.S.S	17. Tayub	178
	20. Pamujaan	215
	Sub-total	393
Tapin	25. Pampain	392
	27. Tatakan	99
	28. Pulau Pinang	270
	Sub-total	761
Tabalong	31. Sungai Kati	280
	32. Namun	64
	33. Kinarum	408
	34. Mihim	203
	35. Batupulut	225
	36. Bilas	643
	37. Banju Tajun	750
	Sub-total	2,573
H.S.U.	38. Balangan	2,172
	39. Pitap	3,734
	Sub-total	5,906
H.S.T.	40. Batang Alai	6,223
	41. Barabai	3,078
	Sub-total	9,301
H.S.S.	42. Kayu Habang	347
	43. Amandit	6,432
	Sub-total	6,779
Tapin	44. Tapin	5,328
	45. Labuban	300
	Sub-total	5,628
	Total	33,524

Kabupaten	Scheme	Scheme Area (ha)
Relinquished Schemes		
Tabalong	1. Jaro	625
H.S.U.	7. Lok Batu	116
H.S.T.	12. Intangan	920
	13. Kahakan	633
	15. Haruyan Dayak	1,486
	Sub-total	3,039
H.S.S.	16. Telaga Langsat	1,534
	18. Nunungin	36
	19. Kuangun	143
	21. Hawatu	71
	22. Taal	107
	23. Jarau	143
	Sub-total	2,034
Tapin	24. Lok Paikat	392
	26. Nupadang	253
	29. Rampanang	146
	30. Binuang	1,106
	Sub-total	1,897
	Total	7,711

FIGURES

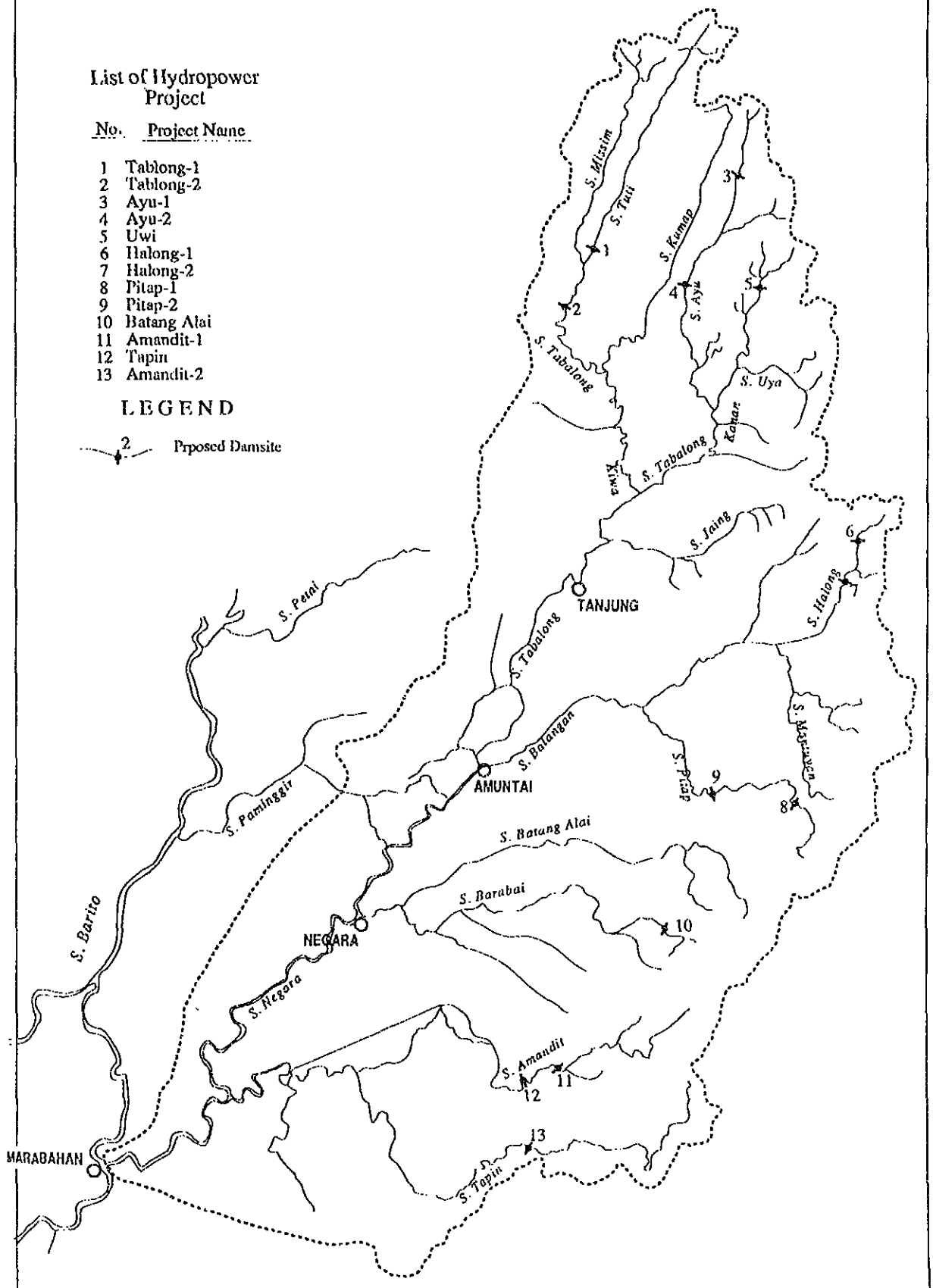

Figure 4.1 Location of Hydropower Project

REPUBLIC OF INDONESIA
DIRECTORATE GENERAL OF WATER RESOURCES DEVELOPMENT
NEGARA RIVER BASIN OVERALL IRRIGATION DEVELOPMENT PLAN STUDY
JAPAN INTERNATIONAL COOPERATION AGENCY

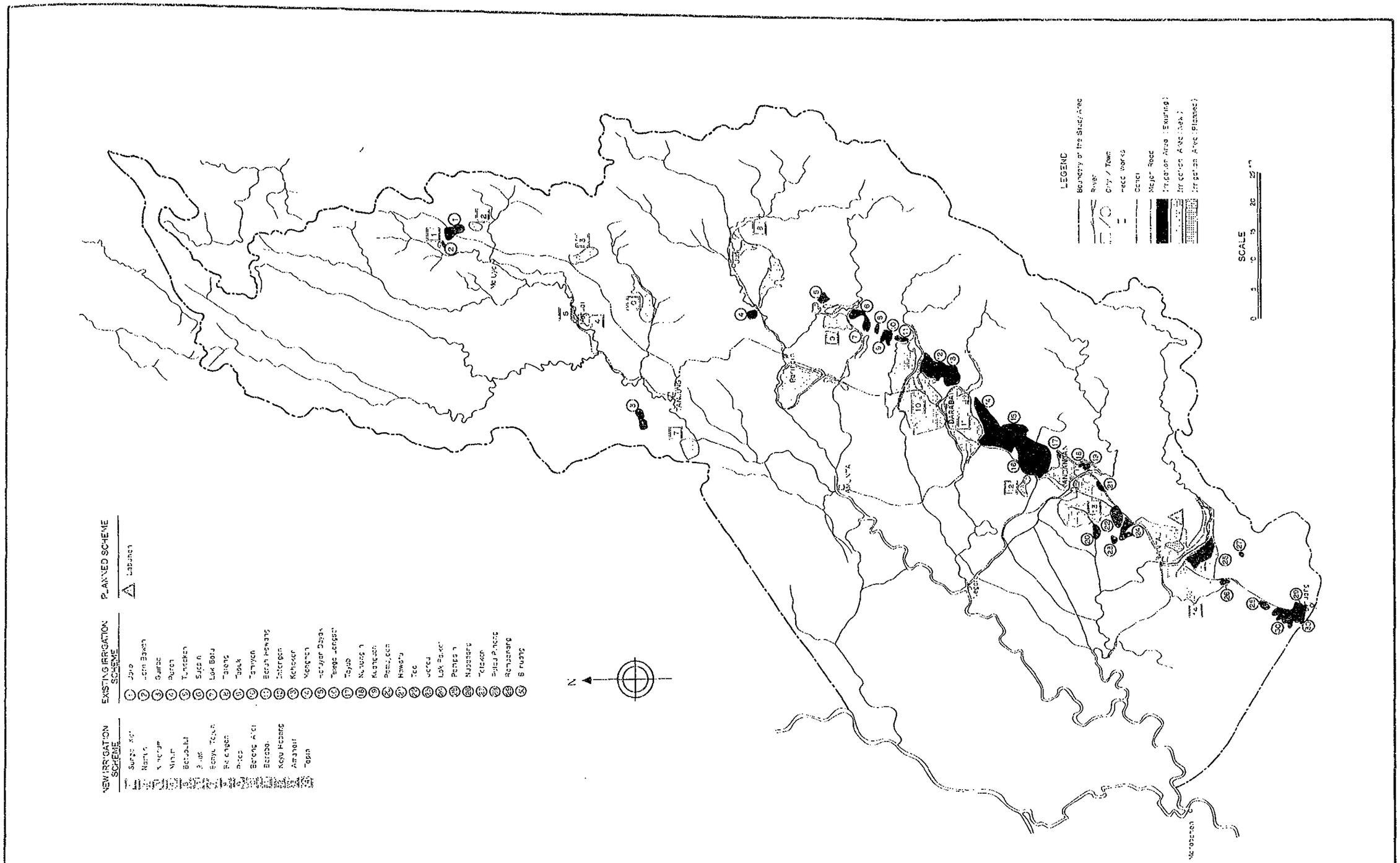

Figure 8.1 Location of Irrigation Schemes

REPUBLIC OF INDONESIA
DIRECTORATE GENERAL OF WATER RESOURCES DEVELOPMENT
NEGARA RIVER BASIN OVERALL IRRIGATION DEVELOPMENT PLAN STUDY
JAPAN INTERNATIONAL COOPERATION AGENCY

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F - 2	Proyek Pengairan Kalimantan Selatan Pelaksanaan Konstruksi (Under Construction) Perencanaan & Design (Under Design) (Project Location under Construction and under Design)	Aug.1987	DPU. Prop. Dati I Kal Sel
F - 3	Planning Irrigable Area in Negara River Basin		DPU. Prop. Dati I Kal Sel
F - 4	Pemanfaatan Daerah Pengairan Cabang Dinas P.U. Tabalong (Problems for Irrigation Project in Tabalong)	Jul.1987	Cabang Dinas P.U. Tabalong
F - 5	Pemanfaatan dan Permasalahan Daerah Pengairan Cabang Dinas Pekerjaan Umum Hulu Sungai Utara Amuntai (Problems for Irrigation Project in Hulu Sungai Utara)	Jul.1987	Cabang Dinas P.U. Hulu Sungai-Utara
F - 6	Makalah Tentang Pemanfaatan Daerah Pengairan dan Permasalahannya di Cabang Dinas P.U. Hulu Sungai Tengah (Problems for Irrigation Project in Hulu Sungai Tengah)	Jul.1987	Cabang Dinas P.U. Hulu Sungai-Tengah
F - 7	Pemanfaatan Pengairan di Kabupaten Hulu Sungai Selatan (Problems For Irrigation Project In - Hulu Sungai Selatan)	Jun.1987	Ir. Syamsuri Adenan Cabang Dinas P.U. Hulu Sungai-Selatan
F - 8	Pemanfaatan Daerah Pengairan Cabang Dinas P.U. Dati II Tapin (Problems For Irrigation Project In - Tapin)	Jun.1987	Cabang Dinas P.U. Dati II Tapin
F - 9	Basic Price Daftar Harga Satuan Bahan Bangunan dan Upah Kerja di Kalimantan Selatan (Basic Price)		Direktorat Jenderal Cipta-Karya- Dep. P.U.
F - 10	Unit Price Daftar Harga satuan Pekerjaan di Propinsi Kalimantan Selatan (Unit Price)		Direktorat Jenderal Cipta-Karya- Dep. P.U.

Number in Order	Title	Year Issued	Author/ Organization Issued
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F - 18	Peta Polder Alabio (Drawing For Polder Alabio)		
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Number in Order	Title	Year Issued	Author/ Organization Issued
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F - 25	Skema Daerah Irigasi 1) Telaga Langsat 2) Pamujaan 3) Kuangan 4) Nunungin 5) Tayub 6) Ta'al 7) Hawatu 8) Jaran (Schematic Diagram For Irrigation - System)	Aug.1987	Cabang Dinas P.U. Hulu Sungai-Tengah
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Number in Order	Title	Year Issued	Author/ Organization Issued
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F - 45	Laporan Penyelidikan Geologi Teknik pada Rencana Bendung Tapin (Report On Geology Survey For Tapin Weir Planning (Continued))	May.1975	D P M A
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F - 48	Hydropower Potentials Study (Hydropower Potential Study)	1982	Perusahaan Umum Listrik Negara
F - 49	Rencana Bendung Sei Uya Proyek Irigasi Sei Uya Kalimantan Selatan	1978	DPU. Prop. Dati I Kal Sel
F - 50	Peta Petak Proyek Irigasi Sederhana Namun Proyek Irigasi Sederhana Kinarum Proyek Irigasi Sederhana Mihim	-	DPU. Prop. Dati I Kal Sel
F - 51	Inventarisasi ; Daerah irigasi/ Reklamasi Diluar Pengelolaan PU Kabupaten H.S.T.	1987	Cabang Dinas PU. H.S.T.

Number in Order	Title	Year Issued	Author/ Organization Issued
F - 52	Daerah Pengairan Desa dan Tadah Hujan Non DPU. Kabupaten Dati II Hulu Sungai Selatan	-	Cabang Dinas PU. H.S.S.
F - 53	Kemampuan Penyediaan Sawah Pengairan Untuk : 1988/1989 (MH) Kabupaten : Tapin.	1988	Cabang Dinas PU. Tapin
F - 54	Daftar Peserta yang mendaftarkan diri di Daerah Irigasi Kab. H.S.U, H.S.T.	-	Cabang Dinas PU. H.S.T.
F - 55	Peta Situasi di Kahakan, Intangan, Haruyan Dayak, Tamiyang, Tapuk, Talang, Mangunang, Baruh Hawang	-	Cabang Dinas PU. H.S.T.
F - 55	Perencanaan Petak-petak D.I. Amandit Kal-Sel.	-	Cabang Dinas PU. H.S.S.
F - 56	Petak Tersier B Ka 1 kn, B Ka 2 Kn Daerah Irigasi Kayu Abang	-	Cabang Dinas PU. H.S.S.
F - 57	Daftar Inventarisasi Pos Hidrometri (Automatic Water Level Recorder). Propinsi Dati I Kalimantan Selatan	-	DPU. Prop. Dati I Kal Sel
F - 58	Laporan Akhir Penelitian Kebutuhan Air untuk Tanaman Padi pada Musim Hujan dan Haruyan Dayak	1983/84	Departemen Pendidikan dan Kebudayaan Fakultas Pertanian Universitas Pajajaran
F - 59	Design Note or Irrigation Water Requirement and Design Discharge of Irrigation Canal for Riam Kanan Irrigation Project	-	Nippon Koei Co, Ltd.

ANNEX G
DRAINAGE AND POLDER

ANNEX G DRAINAGE AND POLDER

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1. INTRODUCTION

The Negara sub-basin includes about 412,000 ha of swamps which account for 32% of the Study Area. Out of these, 398,680 ha lie in the midstream and downstream areas of the Negara sub-basin. The remaining 13,320 ha are dispersed along the upper reaches and the branches of the Negara river.

As shown in Figure 1.1, DPUP South Kalimantan divides these areas into such seven swamps as Tabalong, West Amuntai, East Amuntai, West Negara, East Negara, Tapin and North Muning. These seven swamps, according to the standard of Directorate of Swamp of DGWRD are all classified as inland swamps; they are little affected directly by the tide, but in part under the influence of tidal backwater.

At present, there exist 29 drainage improvement schemes and nine polder development schemes, both covering an area of 53,248 ha.

2. EXISTING DRAINAGE SCHEMES

2.1 Distribution and Classification of Schemes

Of the existing 29 drainage schemes with the total drainage area of 38,369 ha, construction works were already completed in five schemes and are ongoing in 24 schemes.

The following table shows the distribution of drainage schemes classified by the scale of scheme. The majority of schemes are in Kabupatens Hulu Sungai Selatan and Tapin, both located at the southern part of the Study Area. The scale of a drainage scheme averages about 500 ha in Kabupaten Tabalong and somewhere between 1,300 and 1,700 ha in the remaining 4 Kabupatens.

Kabupaten	Scheme (No.)	No. of Scheme by Scale				Total Area (ha)	Average Scheme Area (ha)
		500 ha or less	501 to 1000 ha	1001 to 2000 ha	2001 ha or more		
Tabalong	6	4	1	1		3,025	504
H.S.U.	2			2		3,355	1,678
H.S.T.	4	1	1	1	1	5,034	1,759
H.S.S.	7	2	2	1	2	10,705	1,529
Tapin	10	4	3	1	2	16,250	1,625
Total	29	11	7	6	5	38,369	1,323

Drainage areas, applied drainage systems and locations of 29 schemes are shown in Table 2.1.

2.2 Features of Schemes

The drainage improvement methods now being implemented by DPUP South Kalimantan in the Study Area are classified into five types as illustrated in Figure 2.1 by the Study Team based on a combination of drainage control methods and drainage facility types. The features of each type are summarized as follows:

Type A Independent drainage canal:
This is the simplest system having only excavated drainage canals. This method is not very effective in drainage control.

Type B Combination of a natural water course and gate (stop log):
This method aims at taking advantage of natural waterways, by providing a sluice at a conjunction of a natural waterway and the main stream so as to prevent reverse flow and secure adequate water level on paddy field during the growing period of paddy.

Type C Combination of a dike and gates (stop log):
In this method, a dike is constructed along the main stream to protect inflow of flood water. The dike is provided with a sluice, at an intersection of a natural waterway and the main stream, which is used for both intake and drainage of water.

Type D Combination of drainage canals and a gate (stop log):
This is a combination of newly-cut drainage canals and a gate, expecting more effective drainage control. A gate is provided at a conjunction of a drainage canal and the main stream of a river.

Type E Combination of drainage canals, gates, and a dike:
This is the ultimate system when natural drainage is a precondition. Drainage control is carried out by newly-cut drainage canals and gates. Gates are equipped at both the end-points of primary and secondary drainage canals. The dike is constructed along the main stream of a river for protecting flood and further functioning as inspection and access road.

The existing 29 drainage schemes can be classified by a type of drainage improvement system as follows:

Kabupaten	Scheme	Drainage System					Area by Drainage System (ha)				
		A	B	C	D	E	A	B	C	D	E
Tabalong	6	-	5	1	-	-	-	2,425	600	-	-
H.S.U.	2	2	-	-	-	-	3,355	-	-	-	-
H.S.T.	4	2	-	2	-	-	1,200	-	3,834	-	-
H.S.S.	7	4	-	3	-	-	7,600	-	3,105	-	-
Tapin	10	6	-	1	3	-	4,800	-	400	11,050	-
Total	29	14	5	7	3	-	16,955	2,425	7,939	11,050	-

2.3 Present Operation and Maintenance of Drainage Schemes

Many of the dikes and gates (stop logs) in the existing drainage schemes were built in 1940's as shown in Table 2.2. As a result, their obsolescence is hampering their intended drainage performance. In most of schemes with excavated drainage canals, heavy sedimentation has caused to lower discharging capacities of drainage canals.

Moreover, lacks of access roads to scheme sites have impeded to transport products and to secure labors needed for operation and maintenance. In some cases, conflict with inland fishery hampers operation and maintenance works of drainage facilities.

2.4 Constraints

Bottlenecks in drainage schemes are sedimentation, shortage of canals and waterways, damage of dikes and gates, shortage of access roads, and strong acid soils.

Table 2.3 shows these constraints by a scheme. It is to be noted, among others, that 16 schemes have drainage canals with sedimentation of more than 50 cm, causing the extremely poorest drainage functions. The estimated sedimentation volume is around 900,000 m^3 in these heavily sedimented canals with the total length of 160 km. Table 2.4 shows the current sedimentation situation in the problem drainage schemes.

3. EXISTING POLDER SCHEMES

3.1 Distribution and Classification of Schemes

There exist two polder schemes in Kabupaten Tabalong and seven in Kabupaten Hulu Sungai Utara, having the total area of 14,879 ha as shown in Table 3.1. At present, 13,703 ha are under paddy cultivation, while 1,176 ha have not been used. These polders are located in riverside areas with seasonal variation of water level.

3.2 Features of Schemes

The existing polder systems can be classified into technical polder system and simple polder system.

(1) Technical polder system

Technical polder system can be defined as the polder with artificial control system for irrigation and drainage. The existing system in the Study Area is Alabio polder only.

(2) Simple polder system

This system can protect reclaimed land by polder dykes and gates. The existing eight polders belong to this type. It is difficult to drain water when outside water level is high and to take water when it is low. Therefore, this system allows only dry-season farming.

As described in Section 3.1, these polders lie along the upper reaches of the Negara river. Owing to the above-mentioned characteristics, it is hard for the simple polder system to be located in any other areas within the Study Area.

3.3 Present Operation and Maintenance of Polder Schemes

Table 3.2 indicates a list of main structures installed for the existing polder schemes. Operation and maintenance works in polders are quite poor. Compared with the actual required cost for operation and maintenance works, amounts of less than one tenth are presently allocated every year as below:

Kabupaten	Scheme	Area (ha)	Allocated O&M Cost (Rp.1000)	Required O&M cost (Rp.1000)
Tabalong	Ampukung	418	} 2,290	8,360
	Tigaron	144		2,880
H.S.U.	Padang Gusti	468	1,840	9,360
	Bakar	2,344	8,045	46,880
	Pakacangan	1,694	2,368	33,880
	Kaludan	2,300	3,676	46,000
	Murung Bayur	1,737	2,412	34,740
	Simpang Empat	1,274	2,256	25,480
	Alabio	4,500	4,100	99,100

3.4 Constraints

The results of Study Team's field investigation show that a total of 13,703 ha is used for paddy cultivation during the dry season. However, there are many constraints as summarized below and thus cultivation becomes difficult in 9,004 ha as shown in Table 3.3.

1) Poor access roads along dikes make difficulty to transport agricultural products. In addition, there are many subsided places due to the insufficient foundation and compaction.

2) Inflow of flood water over dykes in the wet season often causes sedimentation in drainage canals.

3) Transportation by boat under these poor access roads condition is indispensable, but opening and closing of gates are not operated effectively. There are even some places where broken gates have been left without repairing works.

4. POSSIBILITIES OF FUTURE DEVELOPMENT

4.1 Swamp Area

Present land use patterns in the swamp areas of 412,000 ha are as follows:

(Unit: ha)

Land Use	Seven Swamps	Scattered Swamps	Total
Paddy field	78,510	12,964	91,474
Upland, etc.	13,944	-	13,944
Shifting cultivation	22,820	-	22,820
Grassland	47,018	356	47,374
Bush	74,217	-	74,217
Swamp forest	147,535	-	147,535
Water surface	5,254	-	5,254
Town/village	9,382	-	9,382
Total	398,680	13,320	412,000

Outlines of the seven swamps are as below:

(1) Tabalong Swamp

Area : 18,970 ha
Existing drainage scheme : nil
Existing polder scheme : 3 schemes with 2,256 ha

The Tabalong Swamp is sandwiched by the Tabalong and Balangan rivers. In this area, water level variation between the wet and dry seasons is large, and thus a polder-based drainage improvement is desirable.

There is a large natural swamp to the east of the existing Ampukung and Tigaron polder schemes. Topographically, it serves as a natural polder; the swamp is waterlogged when the external water level is high in the wet season and water is drained through the Liang

river to the Tabalong river during the dry season. Thus paddy cultivation becomes possible in an upper part of this swamp when its water level goes down. However, it is difficult to improve drainage condition drastically and economically by gravity means.

(2) West Amuntai Swamp

Area	:	66,790 ha
Existing drainage scheme	:	nil
Existing polder scheme	:	4 schemes with 9,429 ha

This West Amuntai Swamp is located along the right bank of upper reaches of the Negara river. Of the existing polder schemes, Alabio polder scheme covers 5,950 ha in gross including permanent open water space of 1,450 ha. The Harus river at the middle of this swamp flows into Danau Pangan, a lake to the north of Alabio polder, runs on the west side of Alabio polder, and then branches at Babarik into two rivers, one of which flows down to the Negara river and the other into the Barito river. Waterlogging is common throughout the year due to the existence of Danau Pangan and other small lakes.

(3) East Amuntai Swamp

Area	:	66,280 ha
Existing drainage scheme	:	4 schemes with 4,555 ha
Existing polder scheme	:	2 schemes with 4,644 ha

The East Amuntai Swamp extends over the left bank of the Negara river. The Batang Alai and Barabai rivers cut through this swamp. To the south of the swamp, there is a large lake, Danau Bangkau. Adjacent to this lake, there is a large waterlogged area created under the influence of Danau Bangkau. Because of this, drainage improvement in the wet season is considered to be difficult.

(4) West Negara Swamp

Area	:	126,210 ha
Existing drainage scheme	:	2 schemes with 1,000 ha
Existing polder scheme	:	nil

The West Negara Swamp is sandwiched by the Barito and Negara rivers. This swamp with the elevation of 1.0 to 3.0 m is divided into two parts during the dry season, and is flooded from the Barito river to the Negara river during the wet season. At the center of the swamp there extends an area with a thick peat layer which is more than 50 cm, hampering a large-scale development.

(5) East Negara Swamp

Area	:	53,960 ha
Existing drainage scheme	:	4 schemes with 7,450 ha
Existing polder scheme	:	nil

The East Negara Swamp is sandwiched by the Negara and Tapin rivers. The north area of the swamp is drained into the Negara river and the south area into the Tapin river. The majority of the existing drainage scheme areas are in the basin of the Tapin river, which is under the indirect influence of tidal action.

(6) Tapin Swamp

Area	:	17,500 ha
Existing drainage scheme	:	5 schemes with 4,550 ha
Existing polder scheme	:	nil

The Tapin Swamp lies along the Tapin river to the north of Rantau, and about 30% of the swamp is already under an existing drainage schemes. Drainage facilities, however, have not performed their intended functions due to sedimentation, lack of access roads and labor shortage.

(7) North Muning Swamp

Area	:	48,970 ha
Existing drainage scheme	:	1 scheme with 8,000 ha
Existing polder scheme	:	nil

The North Muning Swamp extends over the left bank of the lower reaches of the Tapin and Negara rivers. The existing Muning drainage scheme is indirectly affected by tidal action; if water level is controlled properly by means of gate operation in future, it is likely that the swamp will become cultivable.

4.2 Sectioning of Swamps (Drainage Block)

4.2.1 Basic procedure

The following procedure to section swamps is applied to evaluate their development potentiality for the agricultural use.

Point elevations are checked by referring to available topographical maps on the scale of 1/50,000 to know contour lines with 1-m intervals. Then, water-surface slopes of rivers running through swamp areas are calculated on average monthly water levels.

4.2.2 Sectioning of swamps

Through analysis of the above flow directions with seasonal variation and consideration of topographical and other factors, the seven swamps are further divided into 59 smaller drainage blocks as illustrated in Figures 4.1 to 4.3. The results of sectioning of seven swamps are as follows:

1) Tabalong Swamp:
Largely divided into three blocks (Block Nos. 1 to 3) by road.

2) West Amuntai Swamp:
Divided into 10 blocks; Block Nos. 4 to 9 surrounded by the existing polder and roads; Block Nos. 10 and 11 with flow into the Negara river; and Block Nos. 12 and 13 into the Barito river.

3) East Amuntai Swamp:
Divided into 18 blocks (Block Nos. 14 to 19, 20 to 27, and 28 to 31) by a road, a branch river flowing into the Batang Alai river and Danau Bangkau.

4) West Negara Swamp:
Divided into eight blocks; Block Nos. 32, 34, 36, 38 to 40 by a small tributary of the Negara river, and Block Nos. 33, 35, and 37 by a small tributary by the Barito river.

5) East Negara Swamp:
Divided into 10 blocks; Block Nos. 41, 42, and 44 to 47 with flow into the Negara river, and Block Nos. 43 and 48 to 50 into the Tapin river.

6) Tapin Swamp:
Divided into two blocks (Block Nos. 52 and 53) by the Tapin river.

7) North Muning Swamp:
Divided into six blocks; Block Nos. 57 to 59 with flow into the Negara river, and Block Nos. 54 to 56 into the Tapin river.

These drainage blocks are again distinguished into two groups: one consisting of villages, rivers, canals, lake water surface, rubber and coconut plantations and so on; and the other consisting of existing paddy fields, grasslands, swamp forests and so on. As shown in Table 4.1 and Figure 4.4, the total area of existing paddy fields, shifting cultivation area, swamp grasslands, bush and swamp forests within the 59 drainage blocks of the seven swamps is 370,100 ha.

4.3 Drainage Improvement

Drainage improvement in the swamp areas are categorized into the following three aspects;

- Rehabilitation and expansion of ongoing drainage schemes
- Review of drainage schemes in planning or designing stage by DPUP South Kalimantan
- Formulation of new drainage improvement schemes

(1) Rehabilitation and extension of ongoing drainage schemes

There are 29 existing drainage schemes with the improvement target area of 38,369 ha in total. At present, the cultivated area with paddy is 17,644 ha, and the drainage work progress is 46%. As pointed out in Section 2.4 and Table 2.3, required countermeasures to overcome the constraints in the presently cultivated areas are such rehabilitation works as removal of sediment in existing drainage canals and restoration of broken drainage facilities. These rehabilitation works are needed to be performed in 23 drainage scheme areas as shown in Table 4.2 and as summarized below.

Kabupaten	Cultivated Area (ha)	Rehabilitation Area (ha)	No. of Rehabilitation Scheme	No. of Schemes by Rehabilitation Work		
				Sediment Removal	Gate Improvement	Dike Improvement
Tabalong	1,640	865	4	0	4	0
H.S.U.	850	200	1	1	0	0
H.S.T.	1,310	1,310	4	2	2	2
H.S.S.	5,500	3,450	5	4	2	2
Tapin	8,344	7,944	9	9	1	0
Total	17,644	13,769	23	16	9	4

Transformation of the remaining 20,725 ha into paddy fields is possible in 24 drainage scheme areas, if drainage canal networks with related facilities are expanded to a necessary extent.

The benefitted area and name of these 24 schemes are listed in Table 2.1, column sixth "Area not cultivated" and summarized below.

Kabupaten	No. of Schemes	Expansion Area (ha)
Tabalong	6	1,385
H.S.U.	2	2,505
H.S.T.	4	3,724
H.S.S.	5	5,205
Tapin	7	7,906
Total	24	20,725

(2) Drainage schemes in planning or designing stage

In the Study Area, seven drainage schemes are in the planning or designing stage by DPUP South Kalimantan. The total area is 17,100 ha. As a result of technical review under the present Study, an area of 4,400 ha within the Pinang Kara scheme in the East Amuntai Swamp is excluded due to existence of thick peat layer of more than 50 cm as shown in Figure 4.5.

The following seven drainage schemes are taken up as planned schemes:

Swamp	Kabupaten	Scheme	Drainage Area(ha)
East Amuntai	H.S.U.	Pinang Kara	4,600
East Amuntai	H.S.T.	Bangkau II	600
East Amuntai	H.S.S.	Angkinang	1,500
East Negara	H.S.S.	Garis	1,500
East Negara	H.S.S.	Negara II	500
Tapin	Tapin	Bahanau	2,000
North Muning	Tapin	Muning II	2,000
Total			12,700

(3) New drainage improvement schemes

The possibility of drainage improvement is judged by the following four points.

- Any places with a 50 cm or thicker peat layer are unsuitable for agricultural land development.
- Potential drainage during the wet season except flood stage to let internal water on ground surface drain naturally into adjacent rivers is considered as the precondition.
- Sources of irrigation water
- Access roads to promote farming activities

Possibilities of new drainage improvement in the 59 drainage blocks are investigated as shown in Table 4.3 according to the above preconditions. As a result, the following eight new potential drainage improvement scheme areas of 16,280 ha are identified in eight drainage block.

Swamp Area	Block No.	Total Area (ha)	Potential Area (ha)
Tabalong	10	12,750	400
	1	9,810	280
East Amuntai	19	8,520	2,500
	21	4,300	3,800
	22	1,070	800
	26	2,800	1,500
East Negara	42	8,020	5,000
North Muning	54	22,860	2,000
Total			16,280

In addition, a possible area of drainage improvement amounting to 150 ha is identified in the scattered swamp areas in Kabupaten Tabalong.

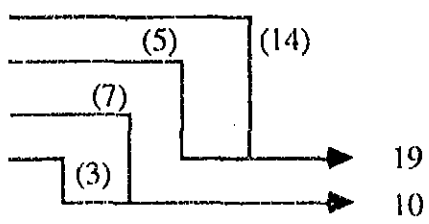
(4) Level of drainage improvement

As discussed in Section 2.2, the present drainage improvement works rely mostly on the Type A, B or C of drainage system. It is desirable that these drainage methods will be improved into higher levels in future providing with drainage canals and gates of Type D or E.

The initial and target levels of drainage improvement for the 16 planned and newly identified drainage schemes are defined in consideration of the improvement status of nearby ongoing drainage schemes. The initial and target levels of drainage improvement for each drainage scheme are shown in Table 8.2 to 8.4 and summarized below.

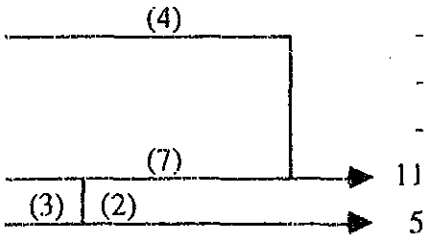
1) Ongoing Schemes

Type of Drainage System	No. of Drainage Scheme at Present	No. of Drainage Scheme in Future
Type A	14	
Type B	5	
Type C	7	
Type D	3	19
Type E	0	10
Total	29	29



2) Planned and Newly Identified Schemes

Type of Draiange System	No. of Drainage Scheme at Initial Level	No. of Drainage Scheme at Target Level
Type A	4	-
Type B	-	-
Type C	-	-
Type D	9	11
Type E	3	5
Total	16	16



4.4 Effect of Drainage Improvement

The upgrading effect of drainage system is preliminarily studied by estimating inundation duration, inundation area and inundation water depth on paddy field under the condition with 80% provable rainfalls. In this estimate, special attention is paid to such parameters as external water level, existence of hinterland and change in the type of drainage system. Of these parameters, hinterland means a catchment area extending over in alluvial plains to hills and having one or more rivers which directly flow from the catchment area into a drainage scheme area.

A total of 25 inundation cases is set up for evaluating upgrading effect of drainage system as shown in Table 4.4. Taking into account condition of the above parameters for each case, upgrading effect is evaluated for the existing 29 drainage schemes. As for the planned and newly identified schemes, effect of drainage improvement by step-wise implementation is analyzed. The results are given in Tables 4.5 and 4.5a.

4.5 Possibility of Polder Development

Polder development method in the Study Area for the period of coming 30 years should be the simple polder system as described in Section 3.2. However, possibility of polder development by introducing the technical polder system is also examined in this Study.

(1) Required conditions for simple polder system

This system is applied to only single-cropping during the dry season under the following conditions:

1) The area should have a peat layer with a thickness of less than 50 cm .
2) There should be sufficient water supplies during the paddy-planting season.
3) The area can be drained in the dry season.
4) Dry-season cropping should be possible.
5) There should be no aggravating influence upon inland water fishery.
6) The area should be highly accessible with high possibilities of future road construction.

As a result of potential evaluation on simple polder development in the 59 drainage blocks, only 2,800 ha in Lampihong of the East Amuntai Swamp and 600 ha in Kalumpang of the West Negara Swamp as shown in Table 4.6 and Figure 4.6 are identified as the area which can fulfil the above conditions.

(2) Possible area for technical polder system

A simple pump system with a relatively small area of 100 to 200 ha using a small-scale pump station will be introduced.

For double-cropping by using such a simple pump system in a polder, the following conditions are required.

1) The polder should have a peat layer with a thickness of less than 50 cm.
2) There should be sufficient water supplies during the paddy-cropping season.
3) There should be no adverse influence on inland water fishery.
4) The polder should be highly accessible with high possibilities of future road construction.

As shown in Table 4.7 and Figure 4.7, a total of 36,060 ha is identified in the Study area as suitable areas for introducing the simple pump system. This identified areas include the existing drainage and polder scheme areas of 17,174 ha.

4.6 Swamp Area Development Potential

(1) Development potential of existing schemes

Out of the existing 29 drainage schemes, only five schemes of 2,350 ha have achieved their targets as described in Section 4.3. The remaining 24 districts still have the unfinished area of 20,725 ha out of the target drainage improvement area of 36,019 ha in total. These low achievements are not resulted from technical reasons but mainly due to delay in allocating funds for these works.

With respect to the existing polder schemes, all polder construction works have been already completed. Due to defect of construction works, however, a total of 1,176 ha is not in practical use at present.

(2) Development potential of schemes in planning and designing stages

As described in Section 4.3, seven potential drainage schemes of 12,700 ha are delineated out of planned and designed areas of 17,100 ha by DPUP South Kalimantan.

(3) Development potential of new schemes

Newly designated potential development schemes include nine drainage improvement schemes of 16,430 ha and two polder development schemes of 3,400 ha as mentioned in Sections 4.3 and 4.4.

(4) Development potential of swamp area

The development potential of swamps in the Study Area is quantified from the engineering viewpoints as presented in Figure 4.8 and shown below.

Swamp Area	Drainage Improvement (ha)			Polder Development (ha)		Total (ha)
	Existing	Planned	New	Existing	New	
Tabalong	-	-	830	332	-	1,162
W. Amuntai	-	-	-	50	-	50
E. Amuntai	3,605	6,700	8,600	794	2,800	22,499
W. Negara	300	-	-	-	600	900
E. Negara	4,650	2,000	5,000	-	-	11,650
Tapin	2,150	2,000	-	-	-	4,150
N.Muning	4,400	2,000	2,000	-	-	8,400
Other swamps	5,620	-	-	-	-	5,620
Study Area	20,725	12,700	16,430	1,176	3,400	54,431

5. DRAINAGE IMPROVEMENT PLAN

5.1 Kabupaten Tabalong

(1) Existing schemes

There are six ongoing schemes in Kabupaten Tabalong (see Figure 5.1). The outline of upgrading plan for these schemes is shown below. Table 5.1 gives a summary of work items and quantities by scheme.

Scheme	Scheme Area (ha)	Upgrading of Drainage System		Rehabilitation Area (ha)	Expansion Area (ha)
		Existing	Target		
1. S. Gampa	1,500	B	D	0	812
2. S. Rampang	600	C	E	325	275
3. S. Paliat	475	B	D	352	123
4. S. Pimping	150	B	D	95	55
5. S. Bintoro	100	B	D	0	13
6. S. Nanti	200	B	D	93	107
Total	3,025			865	1,385

(2) New schemes

There are three new schemes in Kabupaten Tabalong (see Figure 5.1). The outline of drainage improvement target is summarized below. Table 5.3 shows a summary of work items and quantities.

Scheme	Target Drainage System	Improvement Area (ha)
37. R. Tamunti	E	150
38. Bankiling	E	400
39. Plaukuu	E	280
Total		830

5.2 Kabupaten Hulu Sungai Utara

(1) Existing schemes

There are two existing schemes in Kabupaten Hulu Sungai Utara (see Figure 5.1). The outline of upgrading plan for these schemes is indicated below. Table 5.1 presents a summary of work items and quantities by scheme.

Scheme	Scheme Area (ha)	Upgrading of Drainage System		Rehabilitation Area (ha)	Expansion Area (ha)
		Existing	Target		
7. S. Pinang Habang	1,995	A	D	200	1,795
8. R. Batu Mandi	1,360	A	D	0	710
Total	3,355				2,505

In the R. Batu Mandi drainage scheme, 785 ha out of the scheme area has a possibility to be provided with irrigation water for the dry season when the Pitap irrigation scheme is newly constructed.

(2) Schemes in planning and designing stages

There is a planned scheme in Kabupaten Hulu Sungai Utara (see Figure 5.1). The outline of drainage improvement target is shown below. Table 5.2 shows a summary of works items and quantities. Due to the distribution of peat layers, the scheme area is reduced to 4,600 ha from the original plan of 9,000 ha by DPUP South Kalimantan.

Scheme	Target Drainage System	Improvement Area (ha)
30. Pinang Kara	D	4,600
Total		4,600

5.3 Kabupaten Hulu Sungai Tengah

(1) Existing schemes

There are four ongoing schemes in Kabupaten Hulu Sungai Tengah (see Figure 5.1). The outline of upgrading plan for these schemes is as follow. Table 5.1 shows work items and quantities by scheme.

Scheme	Scheme Area (ha)	Upgrading of Drainage System		Rehabilitation Area (ha)	Expansion Area (ha)
		Existing	Target		
9. Tg. Jaranih	1,194	C	E	455	739
10. Tg. Semanggi	2,640	C	E	755	1,885
11. R. Taras	300	A	D	100	200
12. R. Bangkau	900	A	D	0	900
Total	5,034			1,310	3,724

There is a possibility to get irrigation water throughout the year for 800 ha in the Tg. Jaranih from the Barabai irrigation scheme and also for 600 ha in the Tg. Semanggi drainage scheme from the Batang Alai irrigation scheme, if these irrigation schemes are implemented.

(2) Schemes in planning and designing stages

There is a planned scheme in Kabupaten Hulu Sungai Tengah (see Figure 5.1). The outline of drainage improvement target is shown below. Table 5.2 indicates a summary of work items and quantities. This planned scheme is an extension of the existing R. Bangkau drainage scheme.

Scheme	Target Drainage System	Improvement Area (ha)
31. R. Bangkau II	D	600
Total		600

(3) New schemes

There are two drainage schemes newly identified in Kabupaten Hulu Sungai Tengah (see Figure 5.1). The outline of drainage improvement target is described below. Table 5.3 presents a summary of work items and quantities.

Scheme	Target Drainage System	Improvement Area (ha)
40. S. Sirung	D	2,500
41. S. Binjai	D	800
Total		3,300

5.4 Kabupaten Hulu Sungai Selatan

(1) Existing schemes

There are seven ongoing schemes in Kabupaten Hulu Sungai Selatan (see Figure 5.1). The outline of upgrading plan for these schemes is as below. Table 5.1 shows work items and quantities by scheme.

	Scheme	Scheme Area (ha)	Upgrading of Drainage System Existing	Target	Rehabilitation Area (ha)	Expansion Area (ha)
13.	Tg. Lungau	2,005	C	E	1,550	455
14.	Tg. Pengambau	500	C	E	500	0
15.	S. Kajang	1,500	A	D	700	800
16.	S. Tirta Bahalayung	600	C	E	400	200
17.	S. Taniran	300	A	D	300	0
18.	R. Negara	5,200	A	D	1,550	3,650
19.	S. Balum	600	A	D	500	100
	Total	10,705			5,500	5,205

(2) Schemes in planning and designing stages

There are three planned schemes in Kabupaten Hulu Sungai Selatan (see Figure 5.1). The outline of drainage improvement target is indicated below. Table 5.2 shows a summary of work items and quantities. Among these planned schemes, the R. Negara II scheme is an extension of the existing R. Negara drainage scheme.

	Scheme	Target Drainage System	Improvement Area (ha)
32.	R. Angkinang	D	1,500
33.	R. Garis	D	1,500
34.	R. Negara II	D	500
	Total		3,500

(3) New schemes

There are three schemes newly identified in Kabupaten Hulu Sungai Selatan (see Figure 5.1). The outline of drainage improvement target is given below. Table 5.3 shows a summary of work items and quantities.

	Scheme	Target Drainage System	Improvement Area (ha)
42.	S. Hadangan	D	3,800
43.	S. Batang Alai	D	1,500
44.	S. Tinjaulangit	D	5,000
	Total		10,300

5.5 Kabupaten Tapin

(1) Existing schemes

There are 10 ongoing schemes in Kabupaten Tapin (see Figure 5.1). The outline of upgrading plan for these schemes is described below. Table 5.1 presents work items and quantities by scheme.

	Scheme	Scheme Area (ha)	Upgrading of Drainage System		Rehabilitation Area (ha)	Expansion Area (ha)
			Existing	Target		
20.	5bh Pintu Air	400	C	E	400	0
21.	S. Udul	1,000	A	D	1,000	0
22.	R. Muning	8,000	D	E	3,600	4,400
23.	S. Garis Halat	1,000	A	D	300	700
24.	S. Tapin Gadung	1,000	A	D	400	600
25.	S. Pinang Babaris	300	D	E	250	50
26.	R. Belanti	2,750	D	E	1,594	1,156
27.	S. Damar	1,250	A	D	450	800
28.	S. Selai	400	A	D	200	200
29.	S. Masira	150	A	D	150	0
	Total	16,250			8,344	7,906

(2) Schemes in planning and designing stages

There are two planned schemes in Kabupaten Tapin (see Figure 5.1). The outline of drainage improvement target is shown below. Table 5.2 indicates a summary of work items and quantities. The R. Muning II scheme is an extension of the existing R. Negara scheme.

	Scheme	Target Drainage System	Improvement Area (ha)
35.	R. Bahanau	D	2,000
36.	R. Muning II	E	2,000
	Total		4,000

(3) New schemes

There is a newly identified scheme in Kabupaten Tapin (see Figure 5.1). The outline of

drainage improvement target is presented below. Table 5.3 shows a summary of work items and quantities.

Scheme	Target Drainage System	Improvement Area (ha)
45. R. Muning III	E	2,000
Total		2,000

This R. Muning III scheme is an extension of the existing R. Muning and planned R. Muning II schemes.

6. POLDER DEVELOPMENT

6.1 Kabupaten Hulu Sungai Utara

There exist 7 polders around the confluence of the Negara and Balangan rivers in Kabupaten Hulu Sungai Utara. Each polder needs rehabilitation as shown in Table 6.1.

A newly identified polder in Lampihong is situated in the East Amuntai Swamp, with an area of about 2,800 ha as shown in Figure 5.1. At present, this area is mostly covered with a swamp forest. In order to convert this area into a polder, therefore, undertaking of land clearing works is indispensable. Table 6.2 indicates a summary of work items and quantities.

As for implementation of the above schemes, top priority is given to rehabilitation of the existing schemes. It is desirable that the development of new polder schemes will be implemented at the final stage after drainage improvement is conducted from the viewpoint of required investment amount.

6.2 Kabupaten Hulu Sungai Selatan

Although there is no existing polder scheme in Kabupaten Hulu Sungai Selatan, a new polder scheme of 600 ha is identified in the West Negara Swamp as shown in Figure 5.1. This area is currently used for paddy cultivation without provision of drainage facilities. Table 6.2 indicates a summary of work items and quantities.

The first step toward development in this swamp should be drainage improvement. After confirming the effect of the drainage improvement in connection with the progress of river improvement works, the identified polder scheme will have to be implemented.

6.3 Technical Polder Development

Under the present circumstance, introduction of technical polder system into other swamp areas would be unrealistic from engineering point of view. In the long run, however, utilization of mechanical pump system will surely become desirable. In such case, a total of 36,060 ha is suitable for polder development by using a simple pump system in the Tabalong, West Amuntai, East Amuntai and West Negara Swamps.

7. IMPROVEMENT OF OPERATION AND MAINTENANCE SYSTEM

The operation and maintenance of drainage facilities should be practiced to realize the design capacity of individual facilities so that they can properly fulfil their functions. To do so, it is desirable that those facilities have to be operated and maintained by qualified staff taking into due consideration types, scales, structures and locations of facilities.

From this viewpoint, such staff should generally be technicians who are touched with those facilities by themselves. In the swamp areas, therefore, organizational structures and technical support systems need to be established mainly under the guidance of DPUP South Kalimantan for the effective operation and maintenance of drainage facilities.

Facilities to be constructed in drainage schemes include drainage canals, gates, dikes, access roads and bridges. For the operation and maintenance of these facilities, careful attention will be paid to the following points.

(1) Drainage canal

Most of drainage canals are earthen types, some of which are submerged in the flood season. In order to prevent collapse of canal slopes, sedimentation in canals and growth of waterweed, undertaking of periodic inspection and maintenance works are needed.

(2) Gate

The purpose of gates is to prevent reverse flow when the external water level becomes too high during the flood season, and to control water level so as to keep farmlands wet during the paddy planting period. Because of this, it is necessary to monitor internal and external water levels and cropping conditions, and to operate relevant gates accordingly. Especially in areas under the influence of tidal action near the Tapin river, careful attention will be given to timely gate operation.

(3) Dike

It is necessary to monitor the external water level during flood season and to maintain dike level at required elevation because overtopping during the flooding period could lead to the collapse of slopes.

(4) Access Road

Functions of access roads along drainage canals are deteriorated in process of time resulting in the cause of such problems as collapse of shoulders, subsidence of ground and obstruction to traffic. Therefore, it is desirable to inspect access roads periodically and repair them timely.

(5) Bridge

Periodic inspection is necessary to prevent bridge piers from damage by driftages during the flood season.

8. CONSTRUCTION SCHEDULE AND COST ESTIMATE

8.1 Drainage Facility Planning

As shown in Figure 8.1 drainage canal networks are classified into four models. These drainage canal network models are applied to each drainage scheme according to such factors as topography, rivers and canals, and the required facilities are planned accordingly. Planning concepts for each drainage canal network model is made as follows:

(1) Design precipitation

The total amount of 3-day consecutive rainfall with the probability of once per 5-year at four representative rainfall stations in the Study Area is used. These stations are located in Rantau, Negara, Pantai Hambawang and Kandangan

(2) Design drainage

The total amount of drainage under the design precipitation is expressed as follows:

If area ≤ 400 ha, $$Q = \frac{D_{(3)}}{3 \times 8640} \times A$$

If area ≤ 400 ha, $$Q = 1.62 \times \frac{D_{(3)}}{3 \times 8640} A^{0.92}$$

where,

Q : design drainage capacity (m^3/sec)
$D_{(3)}$: 5-year precipitation in consecutive three days (mm)
A : catchment area (ha)

(3) Determination of cross-section of drainage canal

- Minimum width of bottom: 0.6 m
- Relationship between width (w) and height (h):

Small canal $\frac{b}{h} = 1 \text{ to } 3$

Large canal $\frac{b}{h} > 3$

- Gradient of side slope:

Depth of canal (D)	D < 1	Side-slope m = 1
Depth of canal	1 < D ≤ 2	Side-slope m = 1.5
Depth of canal	D > 2	Side-slope m = 2

- Roughness (K value)

h > 1.5	K = 30 (n = 0.033)
h ≤ 1.5	K = 25 (n = 0.04)

- Gradient of ground: 1:10,000

8.2 Construction Cost

Required cost for drainage improvement and polder development is estimated as follows:

1) Unit prices are based on the Engineers' estimate used in the bid for the Riam Kanan Irrigation Project in 1988.

2) Above unit prices are increased by 20% in consideration of the transportation millages of construction materials.

3) Costs of miscellaneous works (10%), general items (15%) and value added tax (10%) are taken into consideration.

Table 8.1 gives unit prices of work items. Based on the unit prices as shown in Table 8.1 and the work quantities presented in Tables 5.1 to 5.3 for drainage improvement schemes and in Tables 6.1 and 6.2 for polder development schemes, construction costs are calculated. The required costs are indicated in Tables 8.2 to 8.4 for the drainage schemes and in Table 8.5 for the polder schemes. The summary of construction cost is below.

(Unit: Rp. million)

Scheme	Drainage	Polder	Total
Existing			
Rehabilitation	5,848	14,328	20,176
Expansion	4,228	0	4,228
Upgrading	47,612	0	47,612
Sub-total	57,688	14,328	72,016
Planned	31,454	0	31,454
New	38,589	32,124	70,713
Total	127,731	46,452	174,183

In respect to operation and maintenance costs, unit prices are fixed to be Rp.20,000/ha for both drainage and polder schemes.

9. IMPLEMENTATION SCHEDULE

The results of project evaluation study compiled in Annex J reveals that 38 drainage schemes and five polder schemes are economically viable and the remaining seven drainage schemes and six polder schemes are excluded from the investment plan for the next 30 years due to low economic feasibility.

The proposed implementation schedule is made based on the result of fund allocation analysis. Table 9.1 shows the list of schemes to be implemented for each Repelita period. With regard to the said 13 schemes with low economic feasibility as shown in Table 9.2, it can be considered as recommendable measures that the following actions are further taken by DPUP South Kalimantan.

1) Sungai Gumpa existing drainage scheme in Kabupaten Tabalong: Additional investment for extension of canals is recommendable to command an area of 812 ha with no drainage facilities at present. Required cost is estimated to be Rp. 241 million.

2) R. Bangkau existing and R. Bangkau II planned drainage schemes in Kabupaten Hulu Sungai Tengah: On the assumption that river courses as the main drain are to be constantly maintained, additional investment is recommendable to provide with drainage canals of Type A for the both scheme areas of 1,500 ha. Required cost is estimated to be Rp. 300 million.

3) S. Balum existing drainage scheme in Kabupaten Hulu Sungai Selatan and S. Salai existing drainage scheme in Kabupaten Tapin: Both schemes have similar conditions to the above Sungai Gumpa. Required costs are estimated to be Rp. 364 million for 100 ha in the S. Balum scheme and Rp. 39 million for 200 ha in the S. Salai scheme.

4) The other two existing drainage schemes, 5bh Pintu Air and S. Masira in Kabupaten Tapin, will have to be intensively maintained by allocating operation and maintenance funds to keep the present level of drainage capability.

5) Tigaron, Padang Gusti and Pakacangan existing polder schemes in Kabupaten Tabalong: It is recommendable to make efforts to carry out operation and maintenance works for the present paddy cultivation areas of 2,027 ha by obtaining required amount of operation and maintenance cost as mentioned in Section 3.3.

6) At present, no merit of investment to new polder schemes, Lampihong in Kabupaten Hulu Sungai Utara and Kalumpan in Kabupaten Hulu Sungai Selatan, can be identified. It is recommendable that these two potential areas will be kept in the condition as it is.

10. RECOMMENDATION

(1) In the present Study, drainage systems in the swamp areas are reviewed on the basis of topographic maps on the scale of 1/50,000 from which point elevation data are obtained. It is therefore important to check those elevation data and the river water level records against nearest bench-marks from time to time according to the progress of the planned drainage schemes.

(2) If proper watershed management is not performed in hinterlands, sedimentation in drainage canals is expected to become more serious problems. Therefore, periodic removal of sediments is important within the framework of the operation and maintenance of drainage systems. Many drainage canals and rivers are interconnected for navigation, and sediment accumulation and inundation occur on the lower reaches of these canals and rivers. So, in future, it is desirable to rearrange these canals either for the drainage or navigation purpose.

(3) With the progress of swamp development and construction of roads and communities, it is likely that drainage systems and inundation patterns will change considerably. This will necessitate improving water level control systems and giving proper instructions to farmers, keeping pace with the progress of the development.

TABLES

Table 2.1 Inventory of Existing Drainage Schemes

(Unit: ha)

Kabupaten	Scheme	Swamp	Drainage System	Cultivated Paddy Field	Area not Cultivated	Total Scheme Area
Tabalong	1. S. Gampa	8	B	688	812	1,500
	2. S. Rampang	8	C	325	275	600
	3. S. Paliat	8	B	352	123	475
	4. S. Pimping	8	B	95	55	150
	5. S. Binitoro	8	B	87	13	100
	6. S. Nanti	8	B	93	107	200
	Sub-total			1,640	1,385	3,025
Hulu Sungai Utara	7. S. Pinang Habang	3	A	200	1,795	1,995
	8. R. Batu Mandi	3	A	650	710	1,360
	Sub-total			850	2,505	3,355
Hulu Sungai Tengah	9. Tg. Jaranih	8	C	455	739	1,194
	10. Tg. Semanggi Kambat	8	C	755	1,885	2,640
	11. R. Taras	3	A	100	200	300
	12. R. Bangkau	3	A	0	900	900
	Sub-total			1,310	3,724	5,034
Hulu Sungai Scalatan	13. Tg. Lungau	8	C	1,550	455	2,005
	14. Tg. Pengambau	8	C	500	0	500
	15. S. Kajang	5	A	700	800	1,500
	16. S. Tirtabahalayung	5	C	400	200	600
	17. S. Taniran	8	A	300	0	300
	18. R. Negara	5	A	1,550	3,650	5,200
	19. S. Balum	4	A	500	100	600
	Sub-total			5,500	5,205	10,705
Tapin	20. Sbh Pintu Air	8	C	400	0	400
	21. S. Udul	6	A	1,000	0	1,000
	22. R. Muning	7	D	3,600	4,400	8,000
	23. S. Garis Halat	6	A	300	700	1,000
	24. S. Tapin Gadung	6	A	400	600	1,000
	25. S. Pinang Babaris	6	D	250	50	300
	26. R. Belanti	8	D	1,594	1,156	2,750
	27. S. Damar	6	A	450	800	1,250
	28. S. Selai	4	A	200	200	400
	29. S. Masera	5	A	150	0	150
	Sub-total			8,344	7,906	16,250
	Total			17,644	20,725	38,369

Remarks: Swamp 1; Tabalong
2; West Amuntai
3; East Amuntai
4; West Negara
5; East Negara
6; Tapin
7; North Muning
8; Other scattered swamps

Drainage System A; Drainage canal
B; Natural water course + Gate (Stop log)
C; Dyke + Gate (Stop log)
D; Drainage canal + Gate (Stop log)
E; Drainage canal + Gate + Dyke

Source: DPUP South Kalimantan Province

Table 2.2 Main Structures of Existing Drainage Scheme

Kabupaten	Scheme	Scheme Area [ha]	Construction Period		Main Structures		
			Start	Complete	Canal [km]	Gate [nos]	Dyke [km]
Tabalong	1. S.Gampa	1,500	before 1945			1	
	2. S.Rampang	600	before 1945			1	0.2
	3. S.Paliat	475	before 1945			1	
	4. S.Pimping	150	before 1945			1	
	5. S.Bintro	100	before 1945			1	
	6. S.Nanti	200	1984	1985		1	
	Sub-Total	3,025			0.0	6	0.2
H.S.U	7. S.Pinang Habang	1,995	1983	1985	7.5		7.5
	8. R.Batu Mandi	1,360	1982	1983	6.5		
	Sub-Total	3,355			14.0	0	7.5
H.S.T	9. Tg.Jaranih	1,194	before 1945			13	14.2
	10. Tg.Semmangi Kambat	2,640	before 1945			6	14.2
	11. R.Taras	300	1976	1976	5.5		
	12. R.Bangkau	900	1985	1986	11.3		
	Sub-Total	5,034			16.8	19	28.4
H.S.S	13. Tg.Lungau	2,005	before 1945			9	7.0
	14. Tg.Pengaubau	500	1959			1	0.1
	15. S.Kajang	1,500	1975	1985	42.0		
	16. S.Tirtabahalayung	600	1972		7.0		7.0
	17. S.Taniran	300		1955	6.0		
	18. R.Negara	5,200	1975	1985	145.0		
	19. S.Bulum	600	1981	1981	9.0		
	Sub-Total	10,705			209.0	10	14.1
Tapin	20. 5 bh Pintu Air	400	1981	1981		5	
	21. S.Udul	1,000	1980	1983	13.0		
	22. R.Muning	8,000	1978		274.0		
	23. S.Garis Halat	1,000	1974	1976	17.5		
	24. S.Tapin Gading	1,000	1981	1984	20.5	2	
	25. S.Pinang Babaris	300	1981	1981	1.9	1	
	26. R.Belanti	2,750	1978	1982	66.5	11	
	27. S.Damar	1,250	1978	1978	19.5		
	28. S.Selai	400	1982	1982	2.0		
	29. S.Masura	150	1981	1981	1.9		
	Sub-Total	16,250			416.8	19	0.0

Source: DPUP Kabupaten Office

Table 2.3 Operation and Maintenance Problems in Existing Drainage Schemes

Kabupaten		Scheme	Sedimen-tation	Short of Canal	Short of Access	Broken Gate	Broken Dyke	Acid Soil
Tabalong	1.	S. Gampa						
	2.	S. Rampang				o		
	3.	S. Paliat				o		
	4.	S. Pimping				o		
	5.	S. Binitoro						
	6.	S. Nanti				o		
Hulu Sungai Utara	7.	S. Pinang Habang	o	o				
	8.	R. Batu Mandi		o				
Hulu Sungai Tengah	9.	Tg. Jaranih				o	o	
	10.	Tg. Semanggi Kambat				o	o	
	11.	R. Taras	o		o			o
	12.	R. Bangkau	o					o
Hulu Sungai Sealatan	13.	Tg. Lungau						
	14.	Tg. Pengambau				o	o	
	15.	S. Kajang	o		o			o
	16.	S. Tirtabahalayung	o			o	o	
	17.	S. Taniran	o					
	18.	R. Negara	o					o
	19.	S. Balum		o	o			
Tapin	20.	5bh Pintu Air						
	21.	S. Udul	o		o			
	22.	R. Muning	o					
	23.	S. Garis Halat	o		o			
	24.	S. Tapin Gadung	o		o			
	25.	S. Pinang Babaris	o	o				
	26.	R. Belanti	o			o		
	27.	S. Damar	o		o			
	28.	S. Salai	o	o	o			
	29.	S. Masera	o	o	o			

Source: DPUP Kabupaten Office

Table 2.4 Canal Length by Sedimentation Depth in Problem Drainage Scheme Areas

Kabupaten	Scheme	Canal Length by Sedimentation Depth (km)				Sedimentation Volume (m3) (Depth>0.5m)
		0 - 0.5 m	0.5 - 1.0 m	>1.0m	Total	
Hulu sungai Utara	Pinang-Habang	4.0	3.5	0.0	7.5	31,500
	Batu Mandi	6.5	0.0	0.0	6.5	0
Hulu Sungai Tengah	Rawa Taras	2.5	3.0	0.0	5.5	3,375
	Rawa Bangkau	6.5	4.8	0.0	11.3	27,750
Hulu Sungai Scalatan	Rawa Negara	91.0	52.1	11.9	155.0	409,200
	S. Kajang	30.6	1.0	0.0	31.6	4,875
	S. Tirtabahalayung	4.0	3.0	0.0	7.0	30,375
	S. Taniran	3.0	2.0	1.0	6.0	12,000
	S. Balum	9.0	0.0	0.0	9.0	0
Tapin	S. Udul	11.0	2.0	0.0	13.0	15,000
	R. Muning	245.0	25.0	4.0	274.0	107,625
	S. Garis Hallat	10.5	7.0	0.0	17.5	26,250
	S. Tapin Gradung	10.0	7.5	3.0	20.5	81,000
	S. Pinang Babaris	0.0	1.9	0.0	1.9	7,125
	Rawa Belanti	44.5	13.0	9.0	66.5	111,300
	S. Damar	17.5	2.0	0.0	19.5	15,000
	S. Selai	0.0	2.0	0.0	2.0	6,750
	S. Masera	0.0	1.8	0.0	1.8	6,750
	Total	495.6	131.6	28.9	656.1	895,875

Source: DPUP Kabupaten Office

Table 3.1 Inventory of Existing Polder Schemes

(Unit: ha)

Kabupaten	Scheme	Scheme Area [I]	Scheme Area [T]	Cultivated Area	Uncultivated Area
Tabalong	Ampukung	418	418	365	53
	Tigaron	144	144	115	29
H.S.U	Padang Gusti	468	468	468	0
	Bakar	2,344	2,344	2,050	294
	Pakacangan	1,694	1,694	1,444	250
	Kaludan	2,300	2,300	1,800	500
	Murung Bayur	1,737	1,737	1,687	50
	Simpang Empat	1,274	1,274	1,274	0
	Alabio	5,950	4,500	4,500	0
	Total	16,329	14,879	13,703	1,176

[I] : DPUP South Kalimantan
[T]: Study Team

Source: DPUP South Kalimantan Province

Table 3.2 Main Structures of Existing Polder Schemes

Kabupaten	Scheme	Construction Period Start	Construction Period End	Main Structures Dyke (km)	Gate (nos.)	Canal (km)	Bridge (nos.)	Others
Tabalong	Ampukung	1929	1936	14.0	1	2.5	-	
	Tigaron	1929	1936	3.0	2	2.0	1	
H.S.U	Padang Gusti	1942	1945	11.0	2	2.0		
	Bakar	1942	1945	16.0	6	8.8	6	
	Pakacangan	1942	1945	30.0	6	6.3	1	
	Kaludan	1942	1945	17.3	5	17.0	-	
	Murung Bayur	1942	1945	14.0	4	4.0	-	
	Simpang Empat	1942	1945	16.0	7	6.0	-	
	Alabio	1929	1952	45.0	12	121.6	-	2 pump stations
Total				166.3	45	170.05	8	

Source: DPUP South Kalimantan Province

Table 3.3 Problems in Existing Polder Schemes

Kabupaten	Scheme	Dike	Gate	Bridge	Canal	Pump	Influenced Area (ha) by Trouble	
Tabalong	Ampukung	O	Δ		Δ		418	a+b*
	Tigaron		Δ		Δ		144	a+b
H.S.U.	Padang Gusti	Δ	O		O		213	b
	Bakar	Δ	Δ	O			2,344	a+b
	Pakacangan	Δ	Δ		O		339	b
	Kaludan	O	Δ		O		500	a
	Murung Bayur	O			O			
	Simpang Empat	O	Δ	Δ	O		546	b
	Alabio	Δ	O		Δ	O	4,500	a+b
							9,004	

Remarks: O; problem but not so serious
Δ; serious trouble
*a; planting impossible
b; production decrease

Source: DPUP South Kalimantan Province

Table 4.1 Area and Ground Level of Drainage Blocks

Swamp Area	Block No.	Area (km2) A	B	Total	Ground Level (m) Lowest	Highest
Tabalong	1	54.0	44.1	98.1	4.0	21.0
	2	21.7	16.1	37.8	15.0	21.0
	3	24.0	29.8	53.8	2.0	3.0
Sub-total		99.7	90.0	189.7		
West Amuntal	4	6.9	11.6	18.5	4.0	4.0
	5	19.9	2.0	21.9	3.0	4.0
	6	6.5	6.9	13.4	3.0	3.0
	7	4.7	0.4	5.1	2.0	3.0
	8	12.7	14.3	27.0	2.0	3.0
	9	59.5	10.2	69.7	2.0	3.0
	10	120.7	6.8	127.5	3.0	6.0
	11	128.1	16.6	144.7	1.5	4.0
	12	144.3	7.3	151.6	2.0	3.0
	13	83.5	5.0	88.5	2.0	3.0
Sub-total		586.8	81.1	667.9		
East Amuntal	14	56.7	27.7	84.4	2.0	12.0
	15	47.5	14.5	62.0	2.0	4.0
	16	24.9	1.2	26.1	2.0	4.0
	17	72.0	3.4	75.4	2.0	2.0
	18	23.4	0.0	23.4	2.0	3.0
	19	77.4	7.8	85.2	2.0	3.0
	20	65.3	14.3	79.6	1.5	2.0
	21	42.5	0.5	43.0	1.5	2.0
	22	8.9	1.8	10.7	2.0	2.0
	23	13.3	1.0	14.3	1.5	2.0
	24	15.3	4.2	19.5	1.0	2.0
	25	6.2	0.4	6.6	1.0	1.5
	26	27.9	0.1	28.0	1.5	2.0
	27	23.6	5.6	29.2	1.0	2.0
	28	25.5	1.8	27.3	1.0	2.0
	29	11.9	0.0	11.9	1.0	2.0
	30	11.2	0.0	11.2	1.0	2.0
	31	24.9	0.1	25.0	1.0	2.0
Sub-total		578.4	84.4	662.8		
West Negara	32	182.7	7.0	189.7	2.0	2.0
	33	241.6	0.7	242.3	2.0	2.0
	34	205.8	0.9	206.7	2.0	2.0
	35	219.5	0.0	219.5	1.0	2.0
	36	165.6	0.0	165.6	1.0	3.0
	37	150.3	0.0	150.3	1.0	3.0
	38	25.9	0.0	25.9	2.0	3.0
	39	34.4	0.0	34.4	2.0	3.0
	40	27.7	0.0	27.7	2.0	3.0
Sub-total		1,253.5	8.6	1,262.1		
East Negara	41	28.6	0.4	29.0	1.0	2.0
	42	79.3	0.9	80.2	2.0	2.0
	43	92.0	1.5	93.5	2.0	4.0
	44	48.5	0.0	48.5	2.0	4.0
	45	47.7	0.0	47.7	2.0	3.0
	46	24.3	0.0	24.3	2.0	3.0
	47	63.8	0.1	63.9	2.0	3.0
	48	44.2	0.0	44.2	2.0	4.0
	49	28.5	0.0	28.5	2.0	3.0
	50	51.3	0.0	51.3	2.0	3.0
	51	28.5	0.0	28.5	2.0	2.0
Sub-total		536.7	2.9	539.6		
Tapin	52	79.3	12.2	91.5	3.0	6.0
	53	78.5	5.0	83.5	2.0	4.0
Sub-total		157.8	17.2	175.0		
North Muning	54	227.0	1.6	228.6	2.0	4.0
	55	25.6	0.0	25.6	2.0	2.0
	56	132.4	0.0	132.4	2.0	3.0
	57	36.8	0.0	36.8	2.0	3.0
	58	21.2	0.0	21.2	2.0	3.0
	59	45.1	0.0	45.1	2.0	3.0
Sub-total		488.1	1.6	489.7		
Total		3,701.0	285.8	3,986.8		

Remarks: A; Paddy field, shifting cultivation area, grassland, bush, forest
B; Village, water surface, free crop area

Table 4.2 Required Rehabilitation Works

Scheme	Area (ha)	Rehabilitation Area (ha)	Rehabilitation Work		
			Sedimentation	Gate	Dyke
1. S. Rampang	600	325		O	
2. S. Paliat	475	352		O	
3. S. Pimping	150	95		O	
4. S. Nanti	200	93		O	
5. S. Pinang Habang	1,995	200	O		
6. Tg. Taranih	1,194	455		O	O
7. Tg. Semanggi Kambat	2,640	755		O	O
8. R. Taras	300	100	O		
9. R. Bangkan	900	0	O		
10. Tg. Penigamban	500	500		O	O
11. S. Kajang	1,500	700	O		
12. S. Tirtabahalayung	600	400	O	O	O
13. S. Taniran	300	300	O		
14. R. Negara	5,200	1,550	O		
15. S. Udul	1,000	1,000	O		
16. R. Muning	8,000	3,600	O		
17. S. Garis Halat	1,000	300	O		
18. S. Tapin Gadung	1,000	400	O		
19. S. Pinang Babaris	300	250	O		
20. R. Belanti	2,750	1,594	O	O	
21. S. Damar	1,250	450	O		
22. S. Selai	400	200	O		
23. S. Masera	150	150	O		

Source: DPUP South Kalimantan Province

Table 4.3 Evaluation Results of Drainage Improvement Potential

Drainage Block No.	Evaluation Item P	D	W	A	Remarks
1	o	o	x	o	Existing Polder
2	o	o	x	o	
3					Existing Polder
4					
5					Existing Polder
6					
7					Existing Polder
8					Existing Polder
9					Existing Polder
10	x				
11	x				
12	x				
13	x				
14	o	x	o	o	Pinang Kara Scheme
15	o	x	o	o	Pinang Kara and Batu Mandi Schemes
16	x				Pinang Kara Scheme
17	x				Pinang Kara Scheme
18	o	x	o	o	Pinang Habang Scheme
19	o	o	o	o	Taras Scheme and New Scheme
20	o	o	x	o	
21	o	o	o	o	New Scheme
22	o	o	o	o	New Scheme
23	o	x	x	x	
24	o	o	x	x	
25	o	o	x	x	
26	o	o	o	o	New Scheme
27	o	o	x	o	
28	o	x	o	o	Bangkau Scheme
29	o	x	o	o	Bangkau Scheme
30	o	x	o	o	Angkinang Scheme
31	o	x	o	o	Angkinang Scheme
32	Δ	x	o	x	
33	x				
34	Δ	x	o	x	S. Balum Scheme
35	x				
36	x				
37	x				
38	o	o	x	x	
39	o	o	x	x	Selai Scheme
40	o	o	x	x	
41	Δ	o	o	o	Garis and Tirtabahalayung Schemes
42	Δ	o	o	o	New Scheme
43	Δ	o	o	o	Negara and Kajang Schemes
44	o	o	x	x	
45	o	o	x	x	
46	o	o	x	x	
47	o	o	x	x	
48	o	o	x	x	Negara Scheme
49	o	o	x	x	Negara Scheme
50	o	o	x	x	
51	o	o	x	x	Masira Scheme
52	o	o	o	o	Halat, Udul, Gadung and Babaris Schemes
53	o	o	x	o	Tapin Damar Scheme
54	Δ	o	o	o	Muning Sheme and New Scheme
55	x				
56	o	o	x	x	
57	o	o	x	x	
58	o	o	x	x	
59	o	o	x	x	

Remarks: P; Peat Depth — o ... <50 cm, x ... ≥51 cm, Δ ... partly >51cm
D; Drainage Control — o ... possible, x ... difficult
W; Water Supply — o ... possible, x ... difficult
A; Access Road — o ... exist, x ... none

Table 4.4 Inundation Pattern

Condition of Water Level in River	Drainage System		Inundation Pattern	Duration of Flood Over 20 cm in Depth (hr)	Flood Area Over 20 cm in Depth (%)
Water level affected by the tide	Type	A-1	1-1-1	78	39
		A-2	1-1-2	62	35
		B,C	1-1-3	No case	-
		D	1-1-4	14	28
		E	1-1-5	14	27
Difference of water levels (1 m)	Type	A-1	1-2-1	58	42
		A-2	1-2-2	44	39
		B,C	1-2-3	72	46
		D	1-2-4	24	34
		E	1-2-5	23	33
Difference of water levels (3 m)	Type	A-1	1-3-1	No case	-
		A-2	1-3-2	No case	-
		B,C	1-3-3	80	54
		D	1-3-4	26	46
		E	1-3-5	25	42
Water level affected by the tide	Type	A-1	2-1-1	No case	-
		A-2	2-1-2	54	25
		B,C	2-1-3	No case	-
		D	2-1-4	10	20
		E	2-1-5	10	19
Difference of water levels (1 m)	Type	A-1	2-2-1	No case	-
		A-2	2-2-2	36	31
		B,C	2-2-3	55	34
		D	2-2-4	20	26
		E	2-2-5	20	25

Remarks: Drainage System

Type A-1	Main drainage canal
Type A-2	Main and secondary drainage canals
Type B	Natural water course + gate (stoplog)
Type C	Dyke + gate (stoplog)
Type D	Drainage canal + gate (stoplog)
Type E	Drainage canal + gate + dyke

Table 4.5 Drainage Control Effect under Existing Schemes

Kabupaten	Scheme	Present Condition	Upgraded	
			First Step	Second Step
Tabalong	1. S. Gampa	1-3-3		1-3-4
	2. S. Rampany	1-3-3		1-3-4
	3. S. Pallat	1-3-3		1-3-4
	4. S. Pimping	1-3-3		1-3-4
	5. S. Bintoro	1-3-3		1-3-4
	6. S. Nantl	1-3-3		1-3-4
H.S.U.	7. S. Pinany Habang	1-2-1		1-2-4
	8. R. Batu Mandl	1-2-1	1-2-4	1-2-5
H.S.T.	9. Tg. Jaranih	2-2-3		2-2-5
	10. Tg. Semanggl Kambat	2-2-3		2-2-5
	11. R. Taras	1-2-2		1-2-4
	12. R. Bangkau	1-2-2	1-2-4	1-2-5
H.S.S.	13. Tg. Lungau	1-2-3		1-2-5
	14. Tg. Pangambau	2-2-3		2-2-5
	15. S. Kajang	2-2-2	2-2-4	2-2-5
	16. S. Tirtabahalayung	1-2-3		1-2-5
	17. S. Tanirau	2-2-2	2-2-4	2-2-5
	18. R. Negara	1-2-2	1-2-4	1-2-5
	19. S. Balum	1-1-1		1-1-4
Tapin	20. Sbh Pintu Air	2-2-3		2-2-5
	21. S. Udul	1-1-2	1-1-4	1-1-5
	22. S. Huning	1-1-4		1-1-5
	23. S. Garis Halat	1-1-2	1-1-4	1-1-5
	24. S. Tapin Gadung	2-1-2	2-1-4	2-1-5
	25. S. Pinang Babaris	1-1-4		1-1-5
	26. R. Belanti	1-2-4		1-2-5
	27. S. Damar	2-1-2	2-1-4	2-1-5
	28. S. Selal	1-1-1		1-1-4
	29. S. Mapsira	1-1-1		1-1-4

Table 4.5a Drainage Control Target under Planned and New Schemes

Kabupaten	Scheme	Target Level		
		First Step	Second Step	Third Step
Planned				
H.S.U.	30. Pinang Kara	1-2-2	1-2-4	1-2-5
H.S.T.	31. R. Bangkau II	1-2-2	1-2-4	1-2-5
H.S.S.	32. R. Angkinang	1-2-2	1-2-4	1-2-5
	33. R. Garis	1-2-2	1-2-4	1-2-5
	34. R. Negara II	1-2-2	1-2-4	1-2-5
Tapin	35. R. Bahanau	1-1-2	1-1-4	1-1-5
	36. R. Muning II	1-1-2	1-1-4	1-1-5
New				
Tabalong	37. R. Tamunti	1-3-4		1-3-5
	38. Bangkiling	1-3-4		1-3-5
	39. Pulau Kuu	1-3-4		1-3-5
H.S.T.	40. S. Sirung	1-2-2	1-2-4	1-2-5
	41. S. Binjai	1-2-2	1-2-4	1-2-5
H.S.S.	42. S. Hadangan	1-1-2	1-1-4	1-1-5
	43. S. Batang Alai	1-1-2	1-1-4	1-1-5
	44. S. Tinjaulangit	1-1-2	1-1-4	1-1-5
Tapin	45. R. Muning III	1-1-2	1-1-4	1-1-5

Table 4.6 Evaluation of Suitability for New Polder System in Simple Stage

Drainage Block	River Basin	A	B	C	D	E	F	G	Area (km2)	Potential Area (km2)
1.	9	1	1	1	-1				54.0	
2.	9	1	-1	-1	-1				21.7	
3.	9	exist polder			1				24.0	
4.	9	1	1	1	-1				6.9	
5.	15	exist polder			1				19.9	
6.	15	1	1	1	-1				6.5	
7.	15	exist polder			0				4.7	
8.	15	exist polder			1				12.7	
9.	15	exist polder			1				59.5	
10.	9	0	1	1	0	0	1	1	120.7	
11.	15	0	0	1	1	-1	1	1	128.1	
12.	BARITO	0	0	0	0	0	0	-1	144.3	
13.	BARITO	0	0	0	0	0	0	-1	83.5	
14.	14	1	1	0	1	1	1	1	56.7	28.0
15.	14	1	0	-1	-1				47.5	
16.	14	-1	0	-1	1	-1	1	1	24.9	
17.	19	exist polder							72.0	
18.	19	1	0	0	0	0	0	0	23.4	
19.	19	1	0	0	0	0	0	-1	77.4	
20.	19	1	0	1	1	1	0	1	65.3	
21.	15	1	0	1	0	1	0	0	42.5	6.0
22.	19	1	1	0	-1				8.9	
23.	19	1	-1	0	-1				13.3	
24.	19	1	0	1	0	-1	-1	-1	15.3	
25.	19	1	0	1	0	-1	-1	-1	6.2	
26.	19	1	0	1	0	-1	0	1	27.9	
27.	18	1	0	1	0	-1	-1	-1	23.6	
28.	17	1	0	0	-1				25.5	
29.	17	1	0	0	-1				11.9	
30.	18	1	0	0	-1				11.2	
31.	18	1	0	0	-1				24.9	
32.	20	1	0	1	0	0	0	0	182.7	
33.	BARITO	0	0	0	1	0	0	-1	241.6	
34.	20	0	-1	-1	0	1	0	-1	205.8	
35.	BARITO	0	0	0	0	0	0	-1	219.5	
36.	20	0	0	-1	-1	0	0	-1	165.6	
37.	BARITO	0	0	0	-1				150.3	
38.	20	1	0	0	-1				25.9	
39.	20	1	0	0	-1				34.4	
40.	20	1	0	0	-1				27.7	
41.	23	0	0	1	-1				28.6	
42.	23	1	0	1	-1				79.3	
43.	23	0	0	-1	-1				92.0	
44.	23	1	-1	-1	-1				48.5	
45.		1	-1	0	-1				47.7	
46.		1	-1	0	-1	0	0	-1	24.3	
47.		1	-1	-1	-1	0	0	-1	63.8	
48.		1	-1	0	-1				44.2	
49.		1	-1	0	-1				28.5	
50.		1	0	-1	-1	0	-1	-1	51.3	
51.		1	0	-1	-1	0	-1	-1	28.5	
52.		1	-1	-1	-1	0	0	1	79.3	
53.		1	-1	-1	-1	0	0	1	78.5	
54.		0	-1	-1	-1	0	0	1	227.0	
55.		1	-1	-1	-1	0	0	1	25.6	
56.		1	-1	-1	-1				132.4	
57.		1	-1	-1	-1				36.8	
58.		1	-1	-1	-1				21.2	
59.		1	-1	-1	-1				45.1	
Total									3701.0	34.0

Remarks:
A; Peat Depth<0.50m
B; Possibility of supply to demand water for planting
C; dry-seasons crops
D; Flood
E: Drainability in dry season
F: Limit by fish
G: Accessibility(including possibility of construction of new road)
1; good condition
0; no good condition
-1; bad condition

Table 4.7 Evaluation of Suitability for Polder System in Technical Stage

No.	A	B	C	D	E	F	G	Area (km2)	Potential area (km2)
1.	1	1	1	-1				54	5.6
2.	1	-1	-1	-1				22	
3.	exist polder			1				24	23.4
4.	1	1	1	-1				7	
5.	exist polder			1				20	17.4
6.	1	1	1	-1				7	
7.	exist polder			0				5	4.7
8.	exist polder			1				13	12.7
9.	exist polder (ALABIO)			1				60	45.0
10.	0	1	1	0	0	1	1	121	7.0
11.	0	0	1	1	-1	1	1	128	19.0
12.	0	0	0	0	0	0	-1	144	
13.	0	0	0	0	0	0	-1	84	
14.	1	1	0	1	1	1	1	57	28.0
15.	1	0	-1	-1				48	
16.	-1	0	-1	1	1	1	1	25	
17.	exist polder							72	23.0
18.	1	0	0	0	0	0	0	23	10.0
19.	1	0	0	0	0	0	-1	77	15.0
20.	1	0	1	1	1	0	1	65	65.3
21.	1	0	1	0	1	0	0	43	42.5
22.	1	1	0	-1				9	
23.	1	-1	0	-1				13	
24.	1	0	1	0	-1	-1	-1	15	
25.	1	0	1	0	-1	-1	-1	6	
26.	1	0	1	0	-1	0	1	28	14.0
27.	1	0	1	0	-1	-1	-1	24	
28.	1	0	0	-1				26	
29.	1	0	0	-1				12	
30.	1	0	0	-1				11	
31.	1	0	0	-1				25	
32.	1	0	1	0	0	0	0	183	28.0
33.	0	0	0	1	0	0	-1	242	
34.	0	-1	-1	0	1	0	-1	206	
35.	0	0	0	0	0	0	-1	220	
36.	0	0	-1	-1	0	0	-1	166	
37.	0	0	0	-1				150	
38.	1	0	0	-1				26	
39.	1	0	0	-1				34	
40.	1	0	0	-1				28	
41.	0	0	1	-1				29	
42.	1	0	1	-1				79	
43.	0	0	-1	-1				92	
44.	1	-1	-1	-1				49	
45.	1	-1	0	-1				48	
46.	1	-1	0	-1	0	0	-1	24	
47.	1	-1	-1	-1	0	0	-1	64	
48.	1	-1	0	-1				44	
49.	1	-1	0	-1				29	
50.	1	0	-1	-1	0	-1	-1	51	
51.	1	0	-1	-1	0	-1	-1	29	
52.	1	-1	-1	-1	0	0	1	79	
53.	1	-1	-1	-1	0	0	1	79	
54.	0	-1	-1	-1	0	0	1	227	
55.	1	-1	-1	-1	0	0	1	26	
56.	1	-1	-1	-1				132	
57.	1	-1	-1	-1				37	
58.	1	-1	-1	-1				21	
59.	1	-1	-1	-1				45	
Total								3,701	360.6

Remarks:
A; Peat Depth<0.50m
B; Possibility of supply to demand water for planting
C; dry-seasons crops
D; Flood
E: Drainability in dry season
F: Limit by fish
G: Accessibility(including possibility of construction of new road)
1; good condition
0; no good condition
-1; bad condition

Table 5.1 (1/2) Work Items and Quantities of Existing Drainage Schemes

Kabupaten	Scheme	Area (ha)	Rehabilitation: Gate (m2) (L)	Gate (m2) (S)	Bridge (nos.) (L)	Bridge (nos.) (S)	Road Embankment (m3)	Road Metalling (m2)	Dyke (m)	Dredging (m3)	Extension Canal (m3)
Tabalong	1. S. Gampa	1,500	-	-	-	-	-	-	-	-	48,700
	2. S. Rampang	600	12.0	-	1	-	-	-	-	-	16,500
	3. S. Paliat	475	10.5	-	1	-	-	-	-	-	7,400
	4. S. Pimping	150	-	0.8	-	1	-	-	-	-	2,100
	5. S. Bintoro	100	-	-	-	-	-	-	-	-	600
	6. S. Nanti	200	-	7.5	-	1	-	-	-	-	4,400
	Sub total	3,025	22.5	8.3	2	2	-	-	-	-	79,700
H.S.U.	7. S. Pg. Habang	1,995	-	-	-	3	16,875	22,500	-	31,500	107,700
	8. R. Batu Mandi	1,360	-	-	-	-	-	-	-	-	42,400
	Sub-total	3,355	-	-	-	3	16,875	22,500	-	31,500	150,100
H.S.T.	9. Tg. Jaranih	1,194	-	9.0	-	-	-	-	500	-	40,400
	10. Tg. Semmangi Kambat	2,640	-	4.5	-	-	-	-	125	-	240,600
	11. R. Taras	300	-	-	-	-	-	-	-	3,375	7,500
	12. R. Bangkau	900	-	-	-	-	-	-	-	27,750	36,600
	Sub-total	5,034	-	13.5	-	-	-	-	625	31,125	324,900
H.S.S.	13. Tg. Lungau	2,005	-	-	-	-	-	-	-	-	47,800
	14. Tg. Penganbau	500	-	1.0	-	-	-	-	100	-	-
	15. S Kajang	1,500	-	-	-	-	-	-	-	4,875	-
	16. S. Tirtabahalayung	600	-	10.5	-	-	-	-	70	30,375	19,800
	17. S. Tanitan	300	-	-	-	-	-	-	-	12,000	-
	18. R Negara	5,200	-	-	-	-	-	-	-	409,200	-
	19. S. Balum	600	-	-	-	-	-	-	-	-	5,900
	Sub-total	10,705	-	11.5	-	-	-	-	170	456,450	73,500
Tapin	20. Sbh Pintu Air	400	-	-	-	-	-	-	-	-	-
	21. S. Udul	1,000	-	-	-	-	-	-	-	15,000	-
	22. R. Muning	8,000	-	-	-	-	-	-	-	107,625	131,800
	23. S. Garis Halat	1,000	-	-	-	-	-	-	-	26,250	28,000
	24. S. Tapin Gadang	1,000	-	-	-	-	-	-	-	81,000	23,800
	25. S. Pg. Babaris	300	-	-	-	-	-	-	-	7,125	2,600
	26. R. Belanti	2,750	160.0	-	-	-	-	-	-	111,300	-
	27. S. Damar	1,250	-	-	-	-	-	-	-	15,000	31,900
	28. S. Selai	400	-	-	-	-	-	-	-	6,750	7,900
	29. S. Masira	150	-	-	-	-	-	-	-	6,750	-
	Sub-total	16,250	160.0	-	-	-	-	-	-	376,800	225,400
	Total	38,369	182.5	33.3	2	5	16,875	22,500	795	895,875	853,600

Table 5.1 (2/2) Work Items and Quantities of Existing Drainage Schemes

Kabupaten	Scheme	Area (ha)	Rehabilitation: Canal (m3)	Gate (m2) (L)	Gate (m2) (S)	Bridge (nos.) (L)	Bridge (nos.) (S)	Road Embankment (m3)	Road Metalling (m2)	Dyke (m)
Tabalong	1. S. Gampa	1,500	119,200	125.0	180.0	10	36	75,000	45,000	-
	2. S. Rampang	600	26,600	28.0	48.0	1	10	18,000	10,800	-
	3. S. Paliat	475	23,800	34.5	38.0	1	8	14,000	8,400	-
	4. S. Pimping	150	7,800	7.5	18.0	-	4	10,200	6,100	-
	5. S. Bintoro	100	5,900	5.0	12.0	-	3	4,000	2,400	-
	6. S. Nanti	200	6,900	-	24.0	1	5	9,000	5,400	
	Sub-total	3,025	190,200	200.0	320.0	13	66	130,200	78,100	-
H.S.U.	7. S. Pg. Habang	1,995	11,100	145.6	159.6	4	32	52,000	31,200	-
	8. R. Batu Mandi	1,360	33,100	99.3	108.8	3	22	35,000	21,000	-
	Sub-total	3,355	44,200	244.9	268.4	7	54	87,000	52,200	-
H.S.T.	9. Tg. Jaranih	1,194	27,400	74.0	81.0	2	19	9,000	5,400	
	10. Tg. Semmangi Kambat	2,640	69,200	96.0	106.0	5	42	47,450	28,470	-
	11. R. Taras	300	3,900	45.0	36.0	2	12	23,000	13,800	-
	12. R. Bangkau	900	-	64.5	108.0	3	27	42,600	25,600	
	Sub-total	5,034	100,500	279.5	331.0	12	100	122,050	73,270	-
H.S.S.	13. Tg. Lungau	2,005	141,800	146.4	160.4	4	32	40,000	24,000	-
	14. Tg. Penganbau	500	69,100	36.5	40.0	2	8	17,000	10,200	500
	15. S Kajang	1,500	-	110.0	120.0	3	24	61,000	36,600	-
	16. S. Tirtabahalayung	600	39,100	43.8	48.0	2	10	22,700	13,600	-
	17. S. Taniran	300	11,900	15.0	36.0	2	7	27,600	16,600	-
	18. R Negara	5,200	-	210.0	260.0	10	83	136,000	81,700	-
	19. S. Balum	600	30,000	43.8	48.0	2	10	22,700	13,600	-
	Sub-total	10,705	291,900	605.5	712.4	25	174	327,000	196,300	500
Tapin	20. Sbh Pintu Air	400	45,500	-	48.0	-	10	6,800	4,100	-
	21. S. Udul	1,000	40,000	52.5	80.0	3	16	39,000	23,400	-
	22. R. Muning	8,000	107,500	336.0	512.0	16	128	175,000	105,000	4,500
	23. S. Garis Halat	1,000	11,900	52.5	80.0	3	16	39,000	23,400	-
	24. S. Tapin Gadang	1,000	16,200	52.5	80.0	3	16	39,000	23,400	-
	25. S. Pg. Babaris	300	10,000	12.0	36.0	1	7	21,000	12,600	-
	26. R. Belanti	2,750	-	40.0	147.4	5	44	36,000	21,700	2,000
	27. S. Damar	1,250	18,000	65.6	100.0	3	20	50,000	30,000	-
	28. S. Selai	400	8,000	29.2	32.0	1	7	15,500	9,300	
	29. S. Masira	150	6,000	6.8	18.0	1	4	9,300	5,600	-
	Sub-total	16,250	263,100	647.1	1,133.4	36	268	430,600	258,500	6,500
	Total	38,369	889,900	1,977.0	2,765.2	93	662	1,096,850	658,370	7,000

Table 5.2 Work Items and Quantities for Planning Drainage Schemes

Kabupaten	Scheme	Area (ha)	Canal (m3)	Gate (m2) (L)	Gate (m2) (S)	Bridge (nos.) (L)	Bridge (nos.) (S)	Road Embankment (m3)	Road Metalling (m2)	Dyke (m)
H.S.U.	30. Pinang Kara	4,600	907,600	-	-	-	-	-	-	-
	Sub-total	4,600	907,600	-	-	-	-	-	-	-
H.S.T.	31. R. Bangkau II	600	99,400	43.8	48.0	2	16	33,750	20,280	-
	Sub-total	600	99,400	43.8	48.0	2	16	33,750	20,280	-
H.S.S.	32. R. Angkinang	1,500	254,900	111.4	120.0	6	40	87,750	54,060	-
	33. R. Garis	1,500	254,900	111.4	120.0	6	40	87,750	54,060	-
	34. R. Negara II	500	67,000	36.5	40.0	2	13	28,150	16,900	-
	Sub-total	3,500	576,800	259.3	280.0	14	93	203,650	125,020	-
Tapin	35. R. Bahanau	2,000	233,900	109.0	160.0	7	53	114,750	69,840	-
	36. R. Muning II	2,000	232,600	109.0	158.5	8	53	114,750	69,840	
	Sub-total	4,000	466,500	218.0	318.5	15	106	229,500	139,680	-
	Total	12,700	2,050,300	521.1	646.5	31	215	466,900	284,980	-

Kabupaten	Scheme	Area (ha)	Canal (m3)	Gate (m2) (L)	Gate (m2) (S)	Bridge (nos.) (L)	Bridge (nos.) (S)	Road Embankment (m3)	Road Metalling (m2)	Dyke (m)
H.S.U.	30. Pinang Kara	4,600	-	371.8	368.0	17	123	318,980	186,980	-
	Sub-total	4,600	-	371.8	368.0	17	123	318,980	186,980	-
H.S.T.	31. R. Bangkau II	600	-	-	-	-	-	-		-
	Sub-total	600	-	-	-	-	-	-	-	-
H.S.S.	32. R. Angkinang	1,500	-	-	-	-	-	-	-	-
	33. R. Garis	1,500	-	-	-	-	-	-	-	-
	34. R. Negara II	500	-	-	-	-	-	-	-	-
	Sub-total	3,500	-	-	-	-	-	-	-	-
Tapin	35. R. Bahanau	2,000	-	-	-	-	-	-	-	-
	36. R. Muning II	2,000	-	-	-	-	-	-	-	3,000
	Sub-total	4,000	-	-	-	-	-	-	-	3,000
	Total	12,700	-	371.8	368.0	17	123	318,980	186,980	3,000

Table 5.3 Work Items and Quantities for New Drainage Schemes

Kabupaten	Scheme	Area (ha)	Canal (m3)	Gate (m2) (L)	Gate (m2) (S)	Bridge (nos.) (L)	Bridge (nos.) (S)	Road Embankment (m3)	Road Metalling (m2)	Dyke (m)
Tabalong	37. R. Tamunti	150	18,750	7.5	18.0	-	8	16,875	11,250	200
	38. Bangkiling	400	50,000	20.0	48.0	-	20	45,000	30,000	400
	39. Pulau Kuu	280	35,000	14.0	33.6	-	14	31,500	21,000	300
	Sub-total	830	103,750	41.5	99.6	-	42	93,375	62,250	900
H.S.T.	40. S. Sirung	2,500	415,000	182.5	200.0	8	67	140,750	84,500	-
	41. S. Binjai	800	132,800	58.4	64.0	3	21	45,040	27,040	-
	Sub-total	3,300	547,800	240.9	264.0	11	88	185,790	111,540	-
H.S.S.	42. S. Hadangan	3,800	509,200	-	-	-	-	-	-	
	43. S. Batang Alai	1,500	201,000	-	-	-	-	-	-	-
	44. S. Tinjaulangit	5,000	670,100	-	-	-	-	-	-	-
	Sub-total	10,300	1,380,300	-	-	-	-	-	-	-
Tapin	45. R. Muning III	2,000	230,000	105.0	160.0	7	53	112,600	67,600	-
	Sub-total	2,000	230,000	105.0	160.0	7	53	112,600	67,600	-
	Total	16,430	2,261,850	387.4	523.6	18	183	391,765	241,390	900

Kabupaten	Scheme	Area (ha)	Canal (m3)	Gate (m2) (L)	Gate (m2) (S)	Bridge (nos.) (L)	Bridge (nos.) (S)	Road Embankment (m3)	Road Metalling (m2)	Dyke (m)
Tabalong	37. R. Tamunti	150	-	-	-	-	-	-	-	
	38. Bangkiling	400	-	-	-	-	-	-	-	
	39. Pulau Kuu	280	-	-	-	-	-	-	-	-
	Sub-total	830	-	-	-	-	-	-	-	-
H.S.T.	40. S. Sirung	2,500	-	-	-	-	-	-	-	-
	41. S. Binjai	800	-	-	-	-	-	-	-	-
	Sub total	3,300	-	-	-	-	-	-	-	-
H.S.S.	42. S. Hadangan	3,800	-	277.4	304.0	13	101	213,940	128,440	-
	43. S. Batang Alai	1,500	-	109.5	120.0	5	40	84,450	50,700	-
	44. S. Tinjaulangit	5,000	-	365.0	400.0	17	133	281,600	169,000	-
	Sub-total	10,300	-	751.9	824.0	35	274	579,990	348,140	-
Tapin	45. R. Muning III	2,000	-	-	-	-	-	-	-	3,000
	Sub-total	2,000	-	-	-	-	-	-	-	3,000
	Total	16,430	-	751.9	824.0	35	274	579,990	348,140	3,000

Table 6.1 Work Items and Quantities of Rehabilitation of Existing Polder Schemes

Scheme	Area (ha)		Dyke (km)			Gate (nos)			Bridge (nos)			Canal (km)			Remark
			Trouble		Rehabili-	Trouble		Rehabili-	Trouble		Rehabili-	Trouble		Rehabili-	
	Plan	Exist	Light	Heavy	tation	Light	Heavy	tation	Light	Heavy	tation	Light	Heavy	tation	
Ampukung	418	365	12.0				1	1					2.5	2.5	
Tigaron	144	115					1	1					2.0	2.0	
Padan Gusti	468	468		5.0	5.0	2						2.0			
Bakar	2,344	2,050	5.0	5.0	5.0	1	5	5	6						
Pakacangan	1,694	1,444	5.9	0.1	6.0		3	3				3.0			
Kaludan	2,300	1,800	3.0			2	1	1				7.0			
Murung Bayur	1,737	1,687	1.0									1.0			
Simpang Empat	1,274	1,274	6.0				3	3				6.0			
Alabio	4,500	4,500	11.6	2.5	12.0	6		6	5	1	6	17.1	7.9	25.0	2 [illegible]
Total	14,879	13,703	44.5	12.6	28	11	14	20	11	1	6	36.08	12.4	29.5	?

Table 6.2 Work Items and Quantities for New Polder Schemes

Kabupaten	Scheme	Scheme Area (ha)	Main Structures			
			Dyke (km)	Gate (nos)	Canal (km)	Bridge (nos)
H.S.U.	Lampihong	2,800	29.0	8	26.5	5
H.S.S.	Kalumpang	600	11	4		1
	Total	3,400	40	12	26.5	6

Table 8.1 Unit Price

No.	Items	Unit	Unit Price (Rp.)	Remarks
1.	Site clearing	m2	195	
2.	Striping of top soil	m3	1,860	
3.	Excavation	m3	6,330	weir site, common
4.	Excavation	m3	3,750	canal
5.	Excavation	m3	3,390	dredging
6.	Embankment	m3	2,440	hauling within 50 m
7.	Embankment	m3	9,100	hauling within 1,000 m
8.	Embankment (new)	m3	30,480	hauling within 20,000 m
9.	Embankment (rehabilitation)	m3	28,680	hauling within 20,000 m
10.	Road metalling	m2	6,200	
11.	Asphalt pavement	m2	21,080	with base course
12.	Sodding	m2	1,920	
13.	Masonry	m3	86,500	
14.	Gabion mattera	m3	75,700	
15.	Rip-rap	m3	43,550	
16.	Plain concrete	m3	118,480	
17.	Rainforced concrete	m3	300,070	
18.	Stop log	m3	670,000	
19.	Gate (wood)	nos	18,000,000	main canal
20.	Gate (wood)	nos	9,000,000	secondary canal
21.	Gate (wood)	m2	2,400	
22.	Gate (wood)	m2	3,600	
23.	Bridge (wood)	nos	10,000,000	main canal
24.	Bridge (wood)	nos	6,000,000	secondary canal
25.	Dyke	m	477,000	
26.	Dyke	m	225,000	
27.	Canal	m	88,000	

Table 8.2 Construction Cost for Existing Drainage Schemes

Kabupaten	Project Name	Scheme Area [ha]	Drainage System		Cost (Rp. million)			
			Existing	Grade up	Rehabil-tation	Extention	Grade up	Total
Tabalong	1. S.Gampa	1,500	B	D		241	3,112	3,353
	2. S.Rampang	600	C	E	57	82	747	886
	3. S.Paliat	475	B	D	51	37	649	737
	4. S.Pimping	150	B	D	13	10	286	309
	5. S.Bintoro	100	B	D		3	172	175
	6. S.Nanti	200	B	D	48	22	300	370
	Sub-Total	3,025			169	395	5,266	5,830
H.S.U.	7. S.Pinang Habang	1,995	A	D	446	533	2,212	3,191
	8. R.Batu Mandi	1,360	A	D		210	1,636	1,846
	Sub-Total	3,355			446	743	3,848	5,037
H.S.T.	9. Tg.Jaranih	1,194	C	E	212	200	1,098	1,510
	10. Tg.Semmanggi Kambat	2,640	C	E	65	1,192	2,105	3,362
	11. R.Taras	300	A	D	17	39	708	764
	12. R.Bangkau	900	A	D	137	178	1,458	1,773
	Sub-Total	5,034			431	1,609	5,369	7,409
H.S.S.	13. Tg.Lungau	2,005	C	E		237	2,758	2,995
	14. Tg.Pengambau	500	C	E	38		1,097	1,135
	15. S.Kajang	1,500	A	D	24		1,820	1,844
	16. S.Tirtabahalayung	600	C	E	229	98	921	1,248
	17. S.Taniran	300	A	D	59		640	699
	18. R.Negara	5,200	A	D	2,027		4,202	6,229
	19. S.Balum	600	A	D		29	876	905
	Sub-Total	10,705			2,377	364	12,314	15,055
Tapin	20. 5 bh Pintu Air	400	C	E			627	627
	21. S.Udul	1,000	A	D	74		1,338	1,412
	22. R.Muning	8,000	D	E	533	653	10,470	11,656
	23. S.Garis Halat	1,000	A	D	130	139	1,199	1,468
	24. S.Tapin Gadung	1,000	A	D	401	118	1,220	1,739
	25. S.Pinang Babaris	300	D	E	35	10	546	591
	26. R.Belanti	2,750	D	E	1,112		3,093	4,205
	27. S.Damar	1,250	A	D	74	158	1,514	1,746
	28. S.Selai	400	A	D	33	39	526	598
	29. S.Masera	150	A	D	33		282	315
	Sub-Total	16,250			2,425	1,117	20,815	24,357
Total		38,369			5,848	4,228	47,612	57,688

Source: Riam Kanan Project in 1988

Table 8.3 Construction Cost for Planned Drainage Schemes

(Unit: Rp. million)

Kabupaten		Scheme	Scheme Area [ha]	Drainage System		Construction Cost		
				First Stage	Grade Up	First Stage	Grade Up	Total
H.S.U.	30.	Pinang Kara	4,600	A	D	4,495	7,397	11,892
H.S.T.	31.	R.Bangkau II	600	D		1,372		1,372
H.S.S.	32.	R.Angkinang	1,500	D		3,525		3,525
	33.	R.Garis	1,500	D		3,525		3,525
	34.	R.Negara II	500	D		1,067		1,067
Tapin	35.	R.Bahanau	2,000	D		3,991		3,991
	36.	R.Muning II	2,000	D	E	3,991	2,091	6,082
Total			12,700			21,966	9,488	31,454

Table 8.4 Construction Cost for New Drainage Schemes

(Unit: Rp. million)

Kabupaten		Scheme	Scheme Area [ha]	Drainage System		Construction Cost		
				First Stage	Grade Up	First Stage	Grade Up	Total
Tabalong	37.	R.Tamunti	150	E		585		585
	38.	Bangkiling	400	E		1,457		1,457
	39.	Pulau'Kuu	280	E		1,033		1,033
H.S.T.	40.	S.Sirung	2,500	D		5,719		5,719
	41.	S.Binjai	800	D		1,833		1,833
H.S.S.	42.	S.Hdangan	3,800	A	D	2,522	5,573	8,095
	43.	S.Batang Alai	1,500	A	D	996	2,199	3,195
	44.	S.Tinjaulangit	5,000	A	D	3,319	7,333	10,652
Tapin	45.	R.Muning III	2,000	D	E	3,929	2,091	6,020
Total			16,430			21,393	17,196	38,589

Table 8.5 Construction Cost for Polder Schemes

Kabupaten	Scheme	Scheme Area (ha)	Construction Cost (1000 Rp)	Remarks
Tabalong	Ampukung	418	347,718	rehabilitation
	Tigaron	144	283,434	rehabilitation
	Sub-total		631,152	
H.S.U.	Padang Gusti	468	1,643,625	rehabilitation
	Bakar	2,344	1,722,519	rehabilitation
	Pakacangan	1,694	2,048,614	rehabilitation
	Kaludan	2,300	26,298	rehabilitation
	Murung Bayur	1,737	0	
	Simpang Empat	1,274	39,447	rehabilitation
	Alabio	4,500	8,216,664	rehabilitation
	Lampihong	2,800	24,391,395	new construction
	Sub-total		38,088,562	
H.S.S.	Kalumpang	600	7,733,073	new construction
	Total	18,279	46,452,787	

Table 9.1 List of Schemes Implemented

Kabupaten	Scheme	Stage	Area (ha)
(1) Drainage Scheme			
Tabalong	2. S. RampanG	Existing	600
	3. S. Paliat	Existing	475
	4. S. Pimping	Existing	150
	5. S. Bintoro	Existing	100
	6. S. Nanti	Existing	200
	37. R. Tamunti	New	150
	38. Bangkiling	New	400
	39. Pulau Kuu	New	280
H.S.U.	7. S. Pinang Habang	Existing	1,995
	8. R. Batu Mandi	Existing	1,360
	30. Pinang Kara	Planned	4,600
H.S.T.	9. Tg. Jaranih	Existing	1,194
	10. Tg. Semanggi Kambat	Existing	2,640
	11. R. Taras	Existing	300
	40. S. Sirung	New	2,500
	41. S. Binjai	New	800
H.S.S.	13. Tg. Lungau	Existing	2,005
	14. Tg. Pengambau	Existing	500
	15. S. Kajang	Existing	1,500
	16. S. Tirtabaralayung	Existing	600
	17. S. Taniran	Existing	300
	18. R. Negara	Existing	5,200
	32. R. Angkinang	Planned	1,500
	33. R. Garis	Planned	1,500
	34. R. Negara II	Planned	500
	42. S. Hadangan	New	3,800
	43. S. Batang Alai	New	1,500
	44. S. Tinjau Langti	New	5,000
Tapin	21. S. Udul	Existing	1,000
	22. R. Muning	Existing	8,000
	23. S. Garis Malat	Existing	1,000
	24. S. Tapin Gadung	Existing	1,000
	25. S. Pinang Babaris	Existing	300
	26. R. Belanti	Existing	2,750
	27. S. Damar	Existing	1,250
	35. R. Bahanau	Planned	2,000
	36. R Muning II	Planned	2,000
	45. R. Muning III	New	2,000
Total			62,949
(2) Polder Scheme			
Tabalong	1. Ampukung	Existing	418
H.S.U.	4. Bakar	Existing	2,344
	6. Kaludan	Existing	2,300
	7. Murung Bayur	Existing	1,737
	8. Simpang Empat	Existing	1,274
	9. Alabio	Existing	4,500
Total			12,573

Table 9.2 List of Schemes Screened Out

Kabupaten	Scheme	Stage	Area (ha)
(1) Drainage Scheme			
Tabalong	1. S. Gumpa	Existing	1,500
H.S.T.	12. R. Bangkau	Existing	900
	31. R. Bangkau II	Planned	600
H.S.S.	19. Balum	Existing	600
Tapin	20. 5bh Pintu Air	Existing	400
	28. S. Selai	Existing	400
	29. S. Masera	Existing	150
Total			4,550
(2) Polder Scheme			
Tabalong	2. Tigaron	Existing	144
H.S.U.	3. Padang Gusti	Existing	468
	5. Pakacangan	Existing	1,694
	10. Lampihong	New	2,800
H.S.S.	11. Kalumpang	New	600
Total			5,706

FIGURES

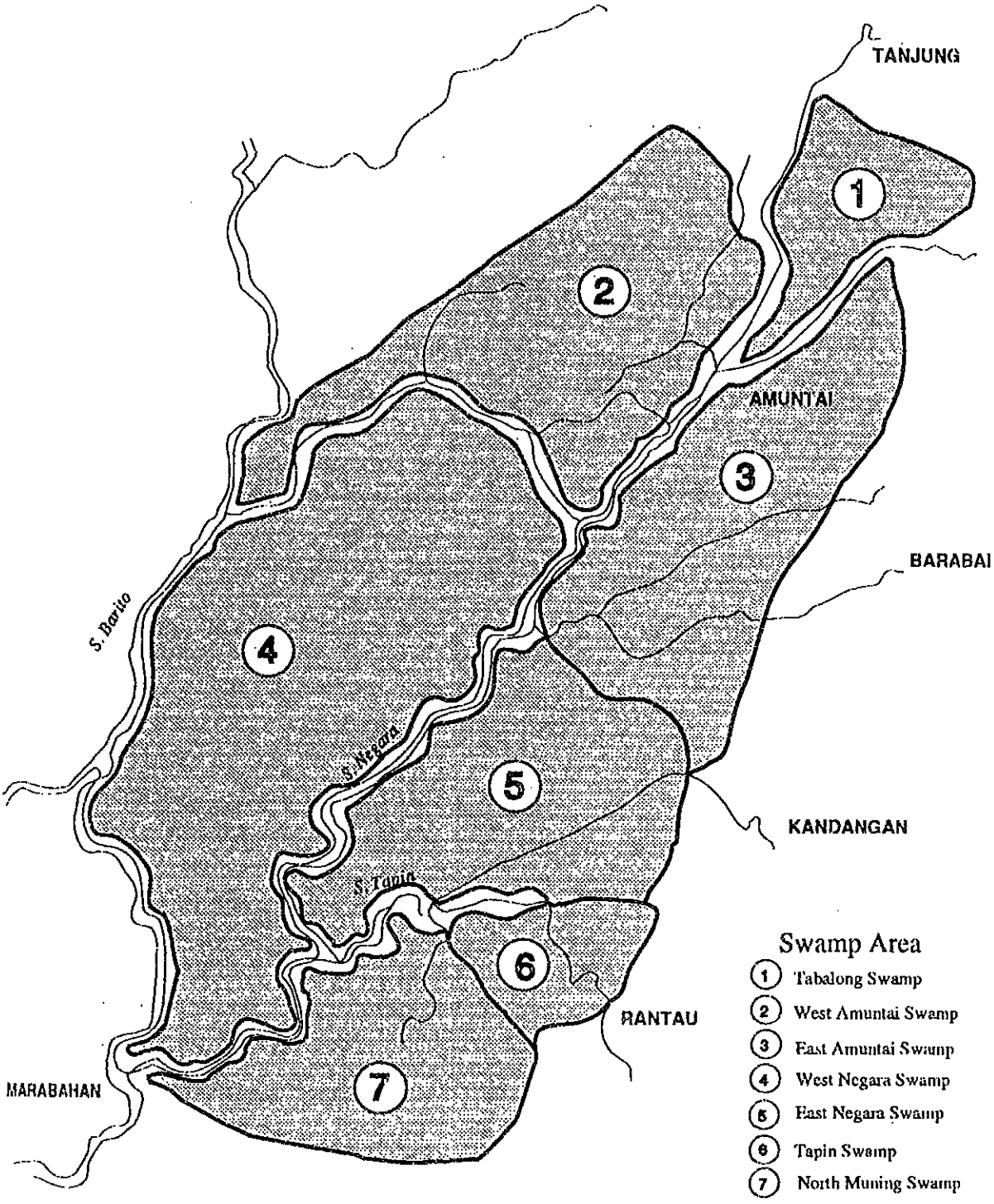


Figure 1.1 Location of Seven Swamp Areas

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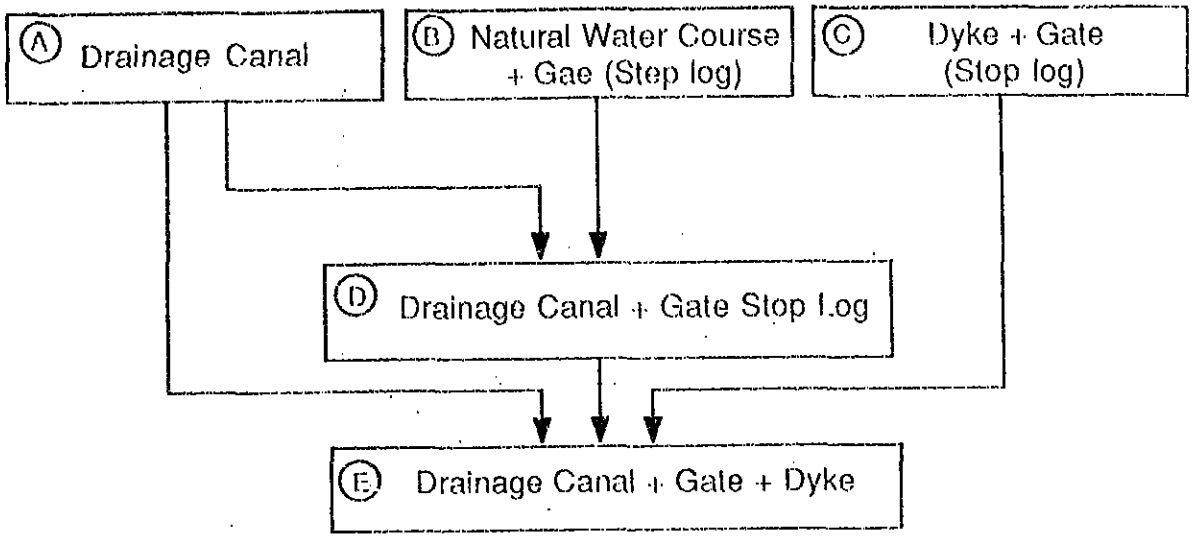
NEGARA RIVER BASIN OVERALL IRRIGATION DEVELOPMENT PLAN STUDY
JAPAN INTERNATIONAL COOPERATION AGENCY

Type of Drainage System



Type of Drainage System

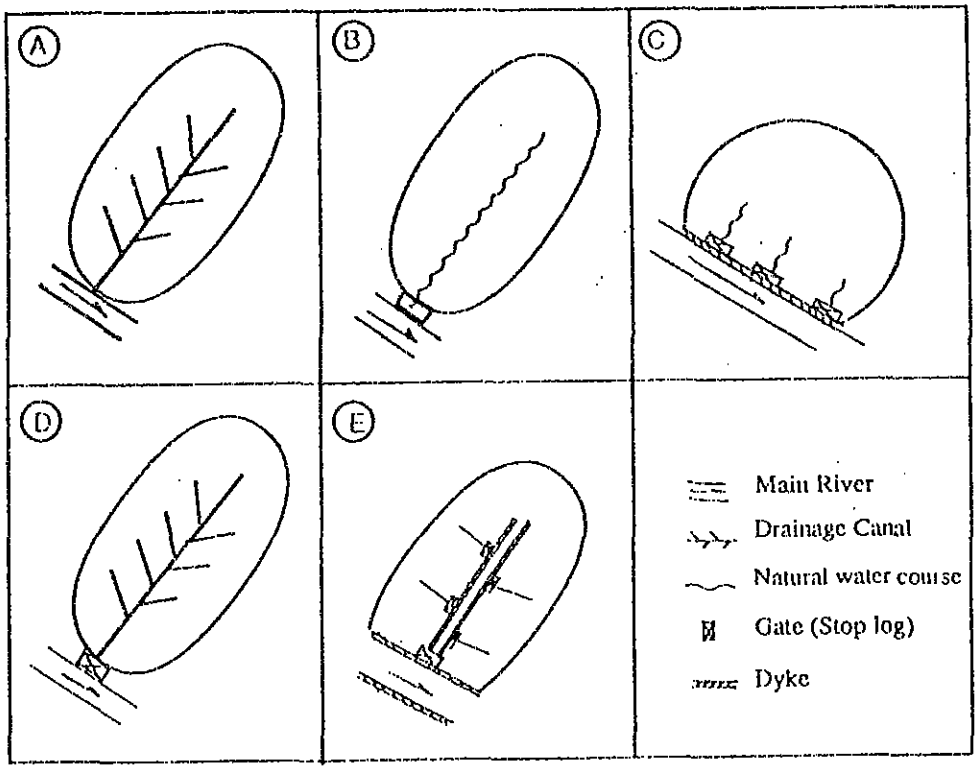


Figure 2.1 Drainage Improvement Step

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NEGARA RIVER BASIN OVERALL IRRIGATION DEVELOPMENT PLAN STUDY
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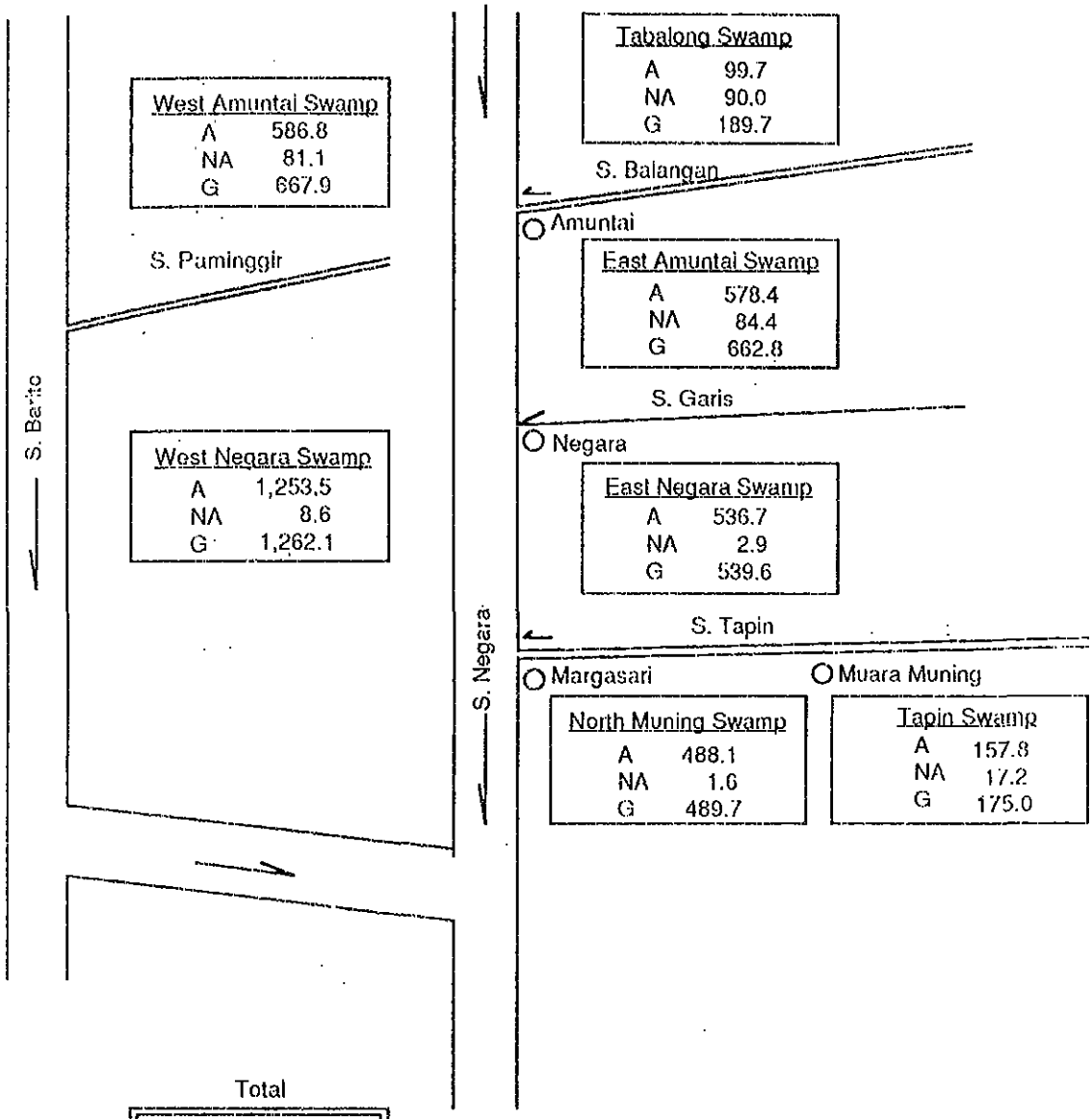

Figure 4.1 Schematic Chart Seven Swamp Areas

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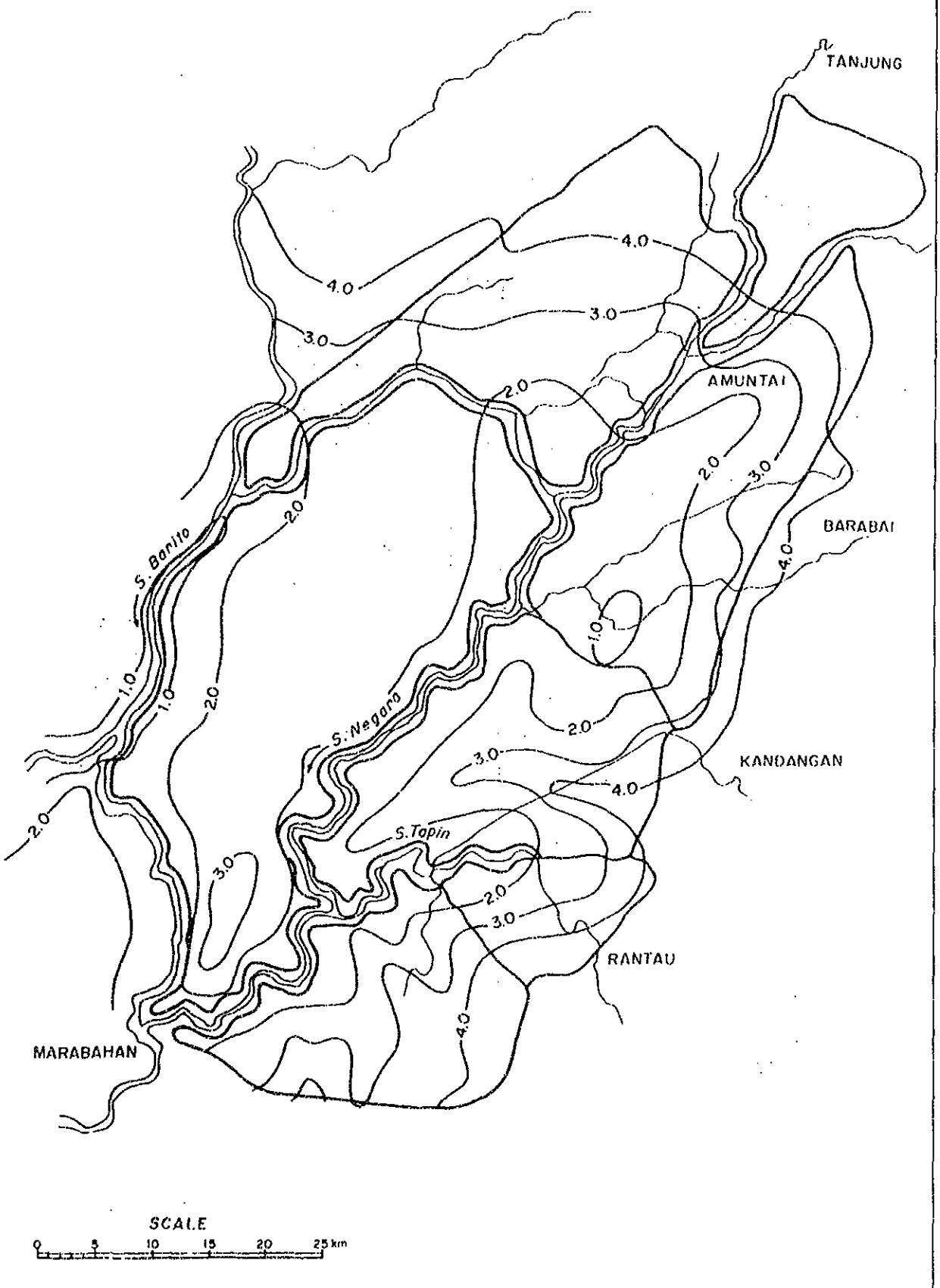

Figure 4.2 *Provisional Contour Line*

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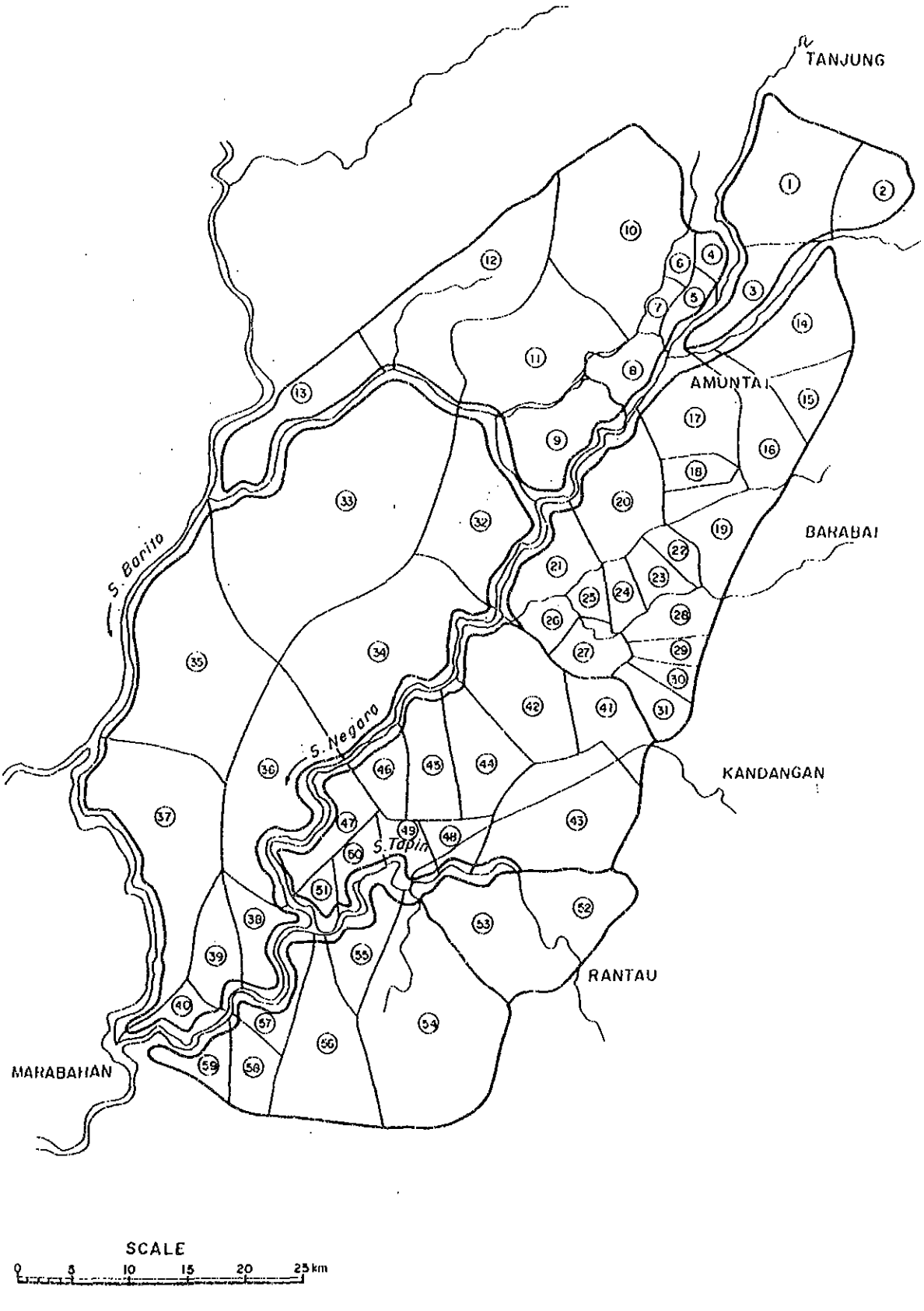

Figure 4.3 Location of Drainage Blocks

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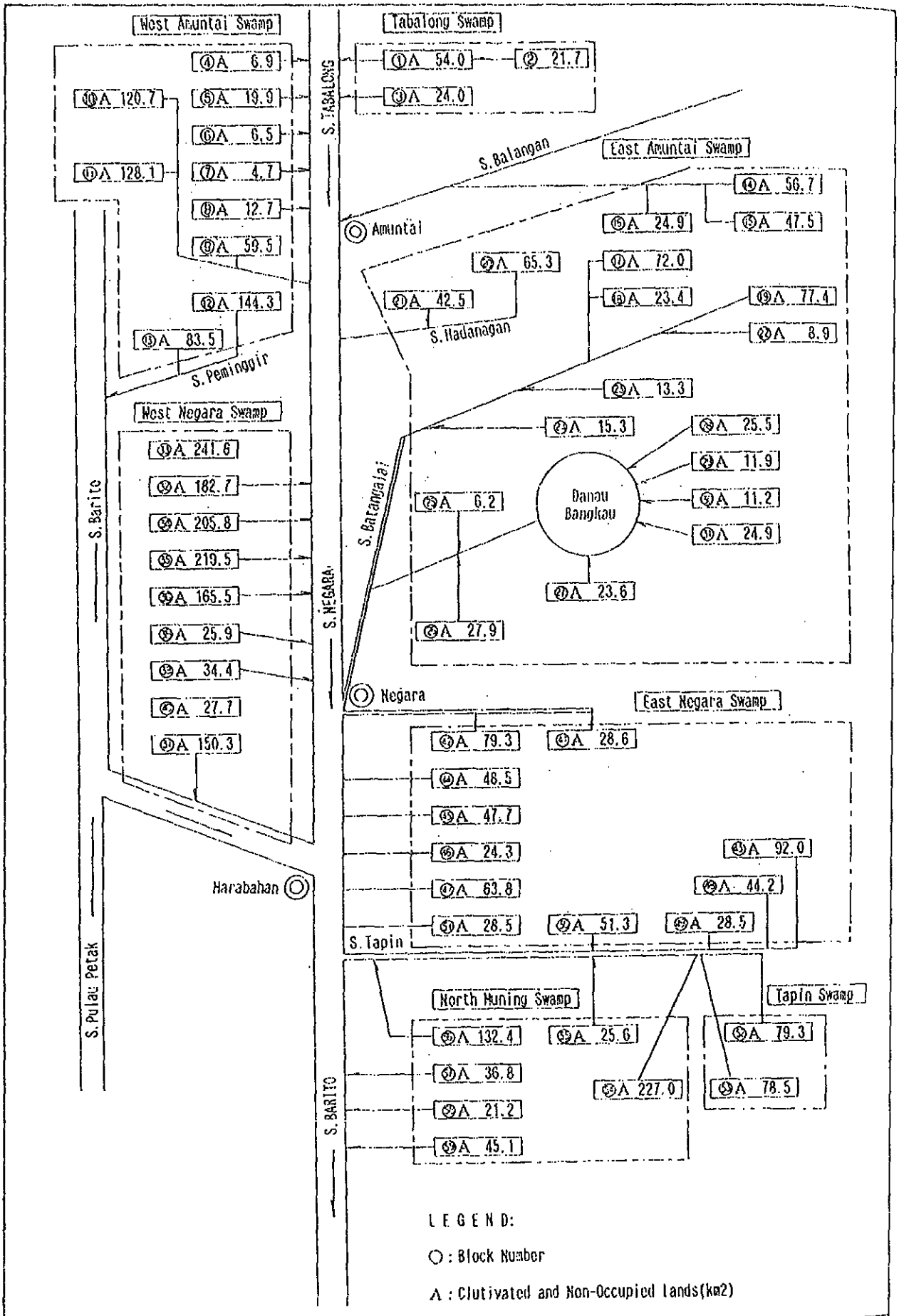

Figure 4.4 Drainage Network in Swamp Area

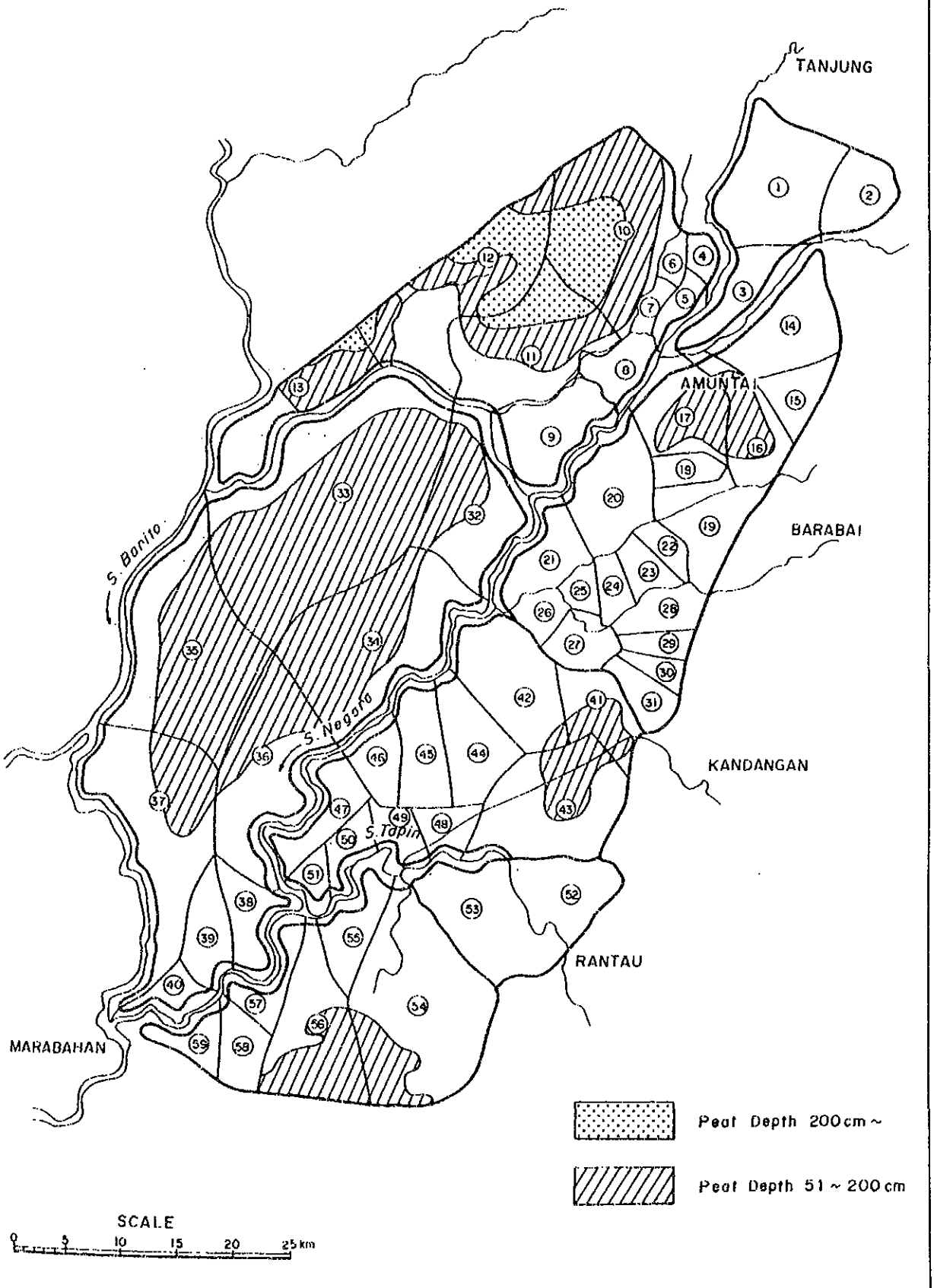

Figure 4.5 Distribution of Peat Layer

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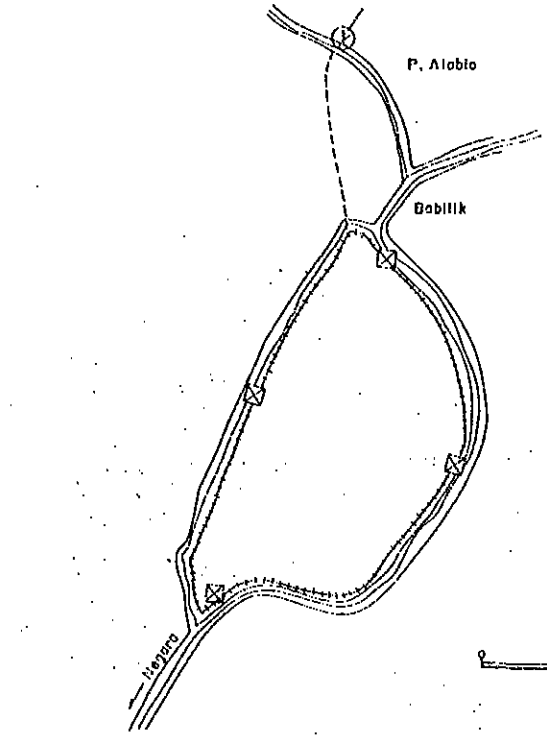
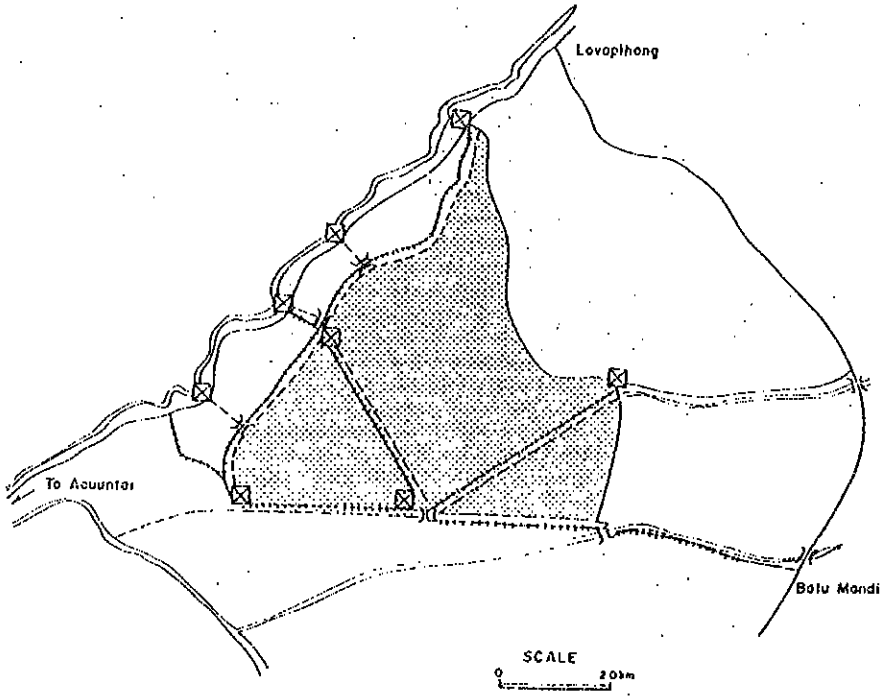


Kalumpang Scheme

SCALE
0 1.0 2.0 2.5



SCALE
0 2.0km

Lamplhong Scheme

LEGEND

- Bridge (plan)
- Gate (plan)
- Dyke (plan)
- Dyke (exist)
- Canal (plan)
- Canal (plan)
- Benifit Area

Figure 4.6 New Polder Schemes

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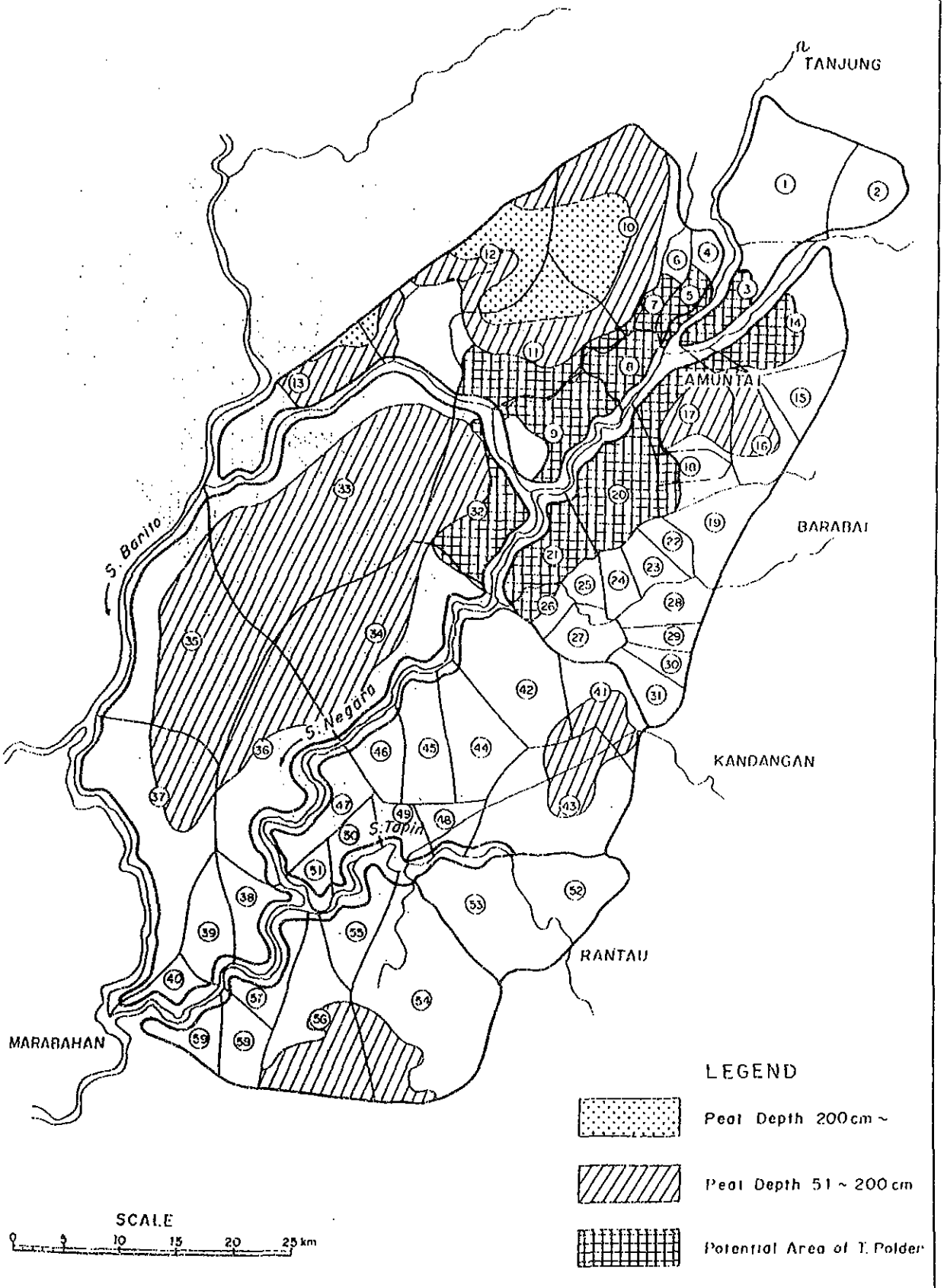

Figure 4.7 Potential Area of Technical Polder

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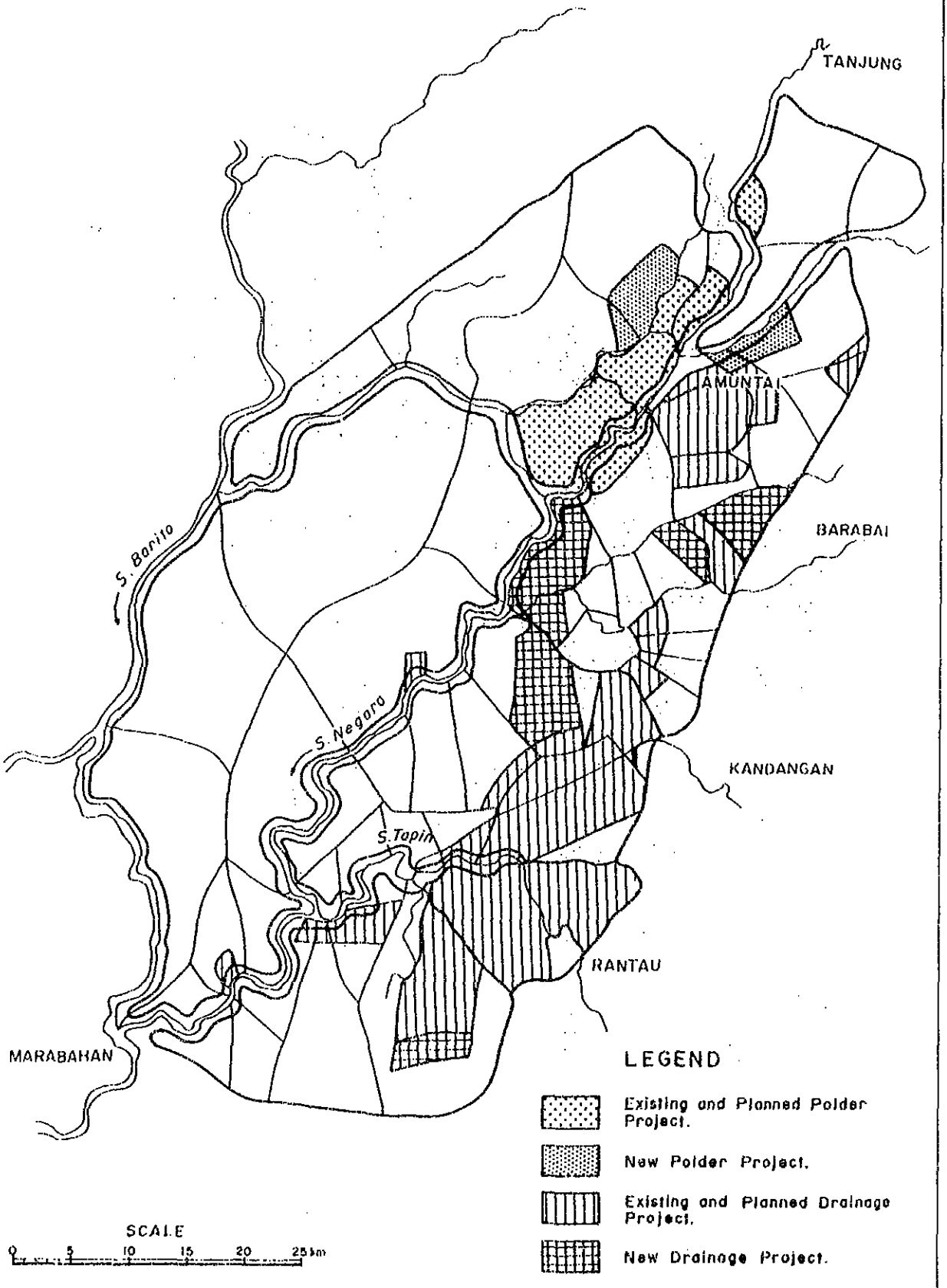

Figure 4.8 Location Map of Swamp Development Schemes

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DIRECTORATE GENERAL OF WATER RESOURCES DEVELOPMENT
NEGARA RIVER BASIN OVERALL IRRIGATION DEVELOPMENT PLAN STUDY
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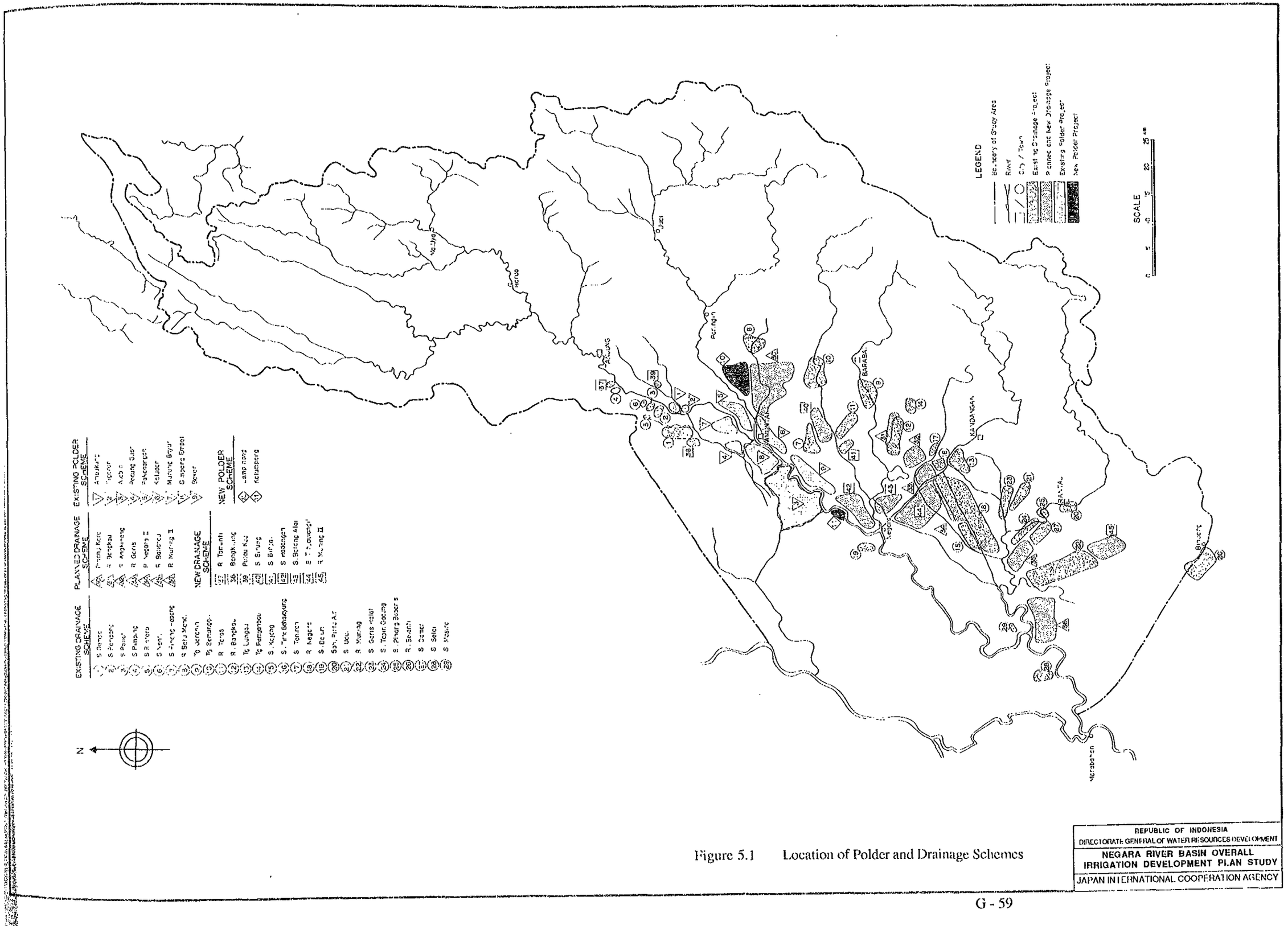

Figure 5.1 Location of Polder and Drainage Schemes

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NEGARA RIVER BASIN OVERALL IRRIGATION DEVELOPMENT PLAN STUDY
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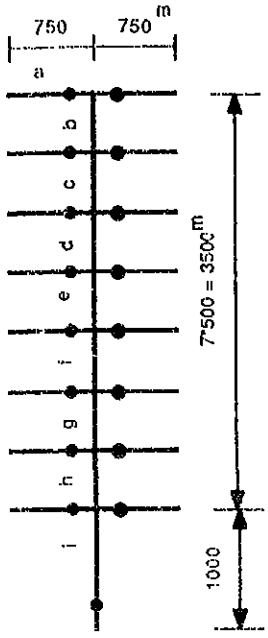
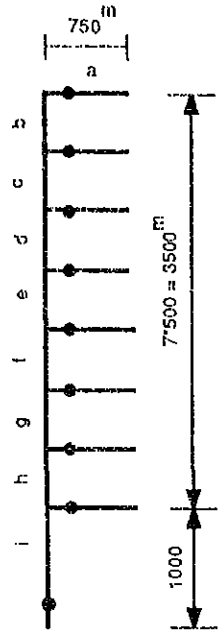
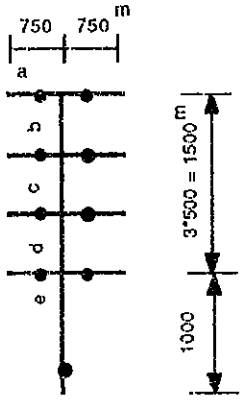


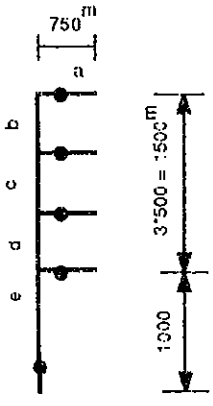
A = 600 ha



A = 300 ha



A = 200 ha



A = 100 ha

LEGEND

DRAINAGE CANAL

GATE

Figure 8.1 Typical Drainage Network Model

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DIRECTORATE GENERAL OF WATER RESOURCES DEVELOPMENT
NEGARA RIVER BASIN OVERALL IRRIGATION DEVELOPMENT PLAN STUDY
JAPAN INTERNATIONAL COOPERATION AGENCY

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G -02	Perencanaan Jaringan Saluran Drainage Rawa Muning (Sei Jepang) 25.000 HA Dati II Tapin KAL-SEL (Drainage and Canal Net Planning of MUNING Swamp Area)	1982	P.T. Survey and Design Jalan A.Yani 434 Lantai II Banjarmasin
G - 03	Perencanaan Jaringan Saluran Drainage Rawa Muning (Sei Jepang) 2.000 HA Dati II Tapin KAL-SEL (Drainage and Canal Net Planning of MUNING Swamp Area)	1983	P.T. Survey and Design Jalan A.Yani 434 Lantai II Banjarmasin
G - 04	Design Jaringan Drainage Rawa Bangkau 1.500 HA Dati II H.S.T (Design report of Drainage Canal of BANGKAU Swamp Area)	1983	P.T. AIRSTAN Cabang Banjarmasin
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G - 08	Daftar : Pelaksanaan proyek Pengembangan Daerah Rawa Kalimantan Selatan (Polder Alabio) H.S.U (List of Facilities of Polder Alabio Project)	1984	D.P.U H.S.U
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Number in Order	Title	Year Issued	Author/ Organization Issued
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G - 11	Peta : Proyek Perencanaan Tata Ruang Dan Wilayah Kalimantan Selatan (Kabupaten Tapin) (Map : Project Area and District in Kalimantan Selatan)		D.P.U. Tapin
G - 12	Peta : Proyek Perencanaan Tata Ruang Dan Wilayah (Kabupaten H.S.S) (Map : Project Area and District in Hulu Sungai Selatan)		D.P.U. H.S.S
G - 13	Final Report Perencanaan Jaringan Saluran Drainage Rawa Angkinang 1500 HA Dati II H.S.S (Drainage and Canal Net Planning of Angkinang Swamp Area)	1985	P.T. Survey And Design Engineering Consultant
G - 14	Laporan Akhir Design Jaringan Saluran Drainage Rawa Garis 1500 HA Dati II H.S.S (Drainage and Canal Net Planning of Garis Swamp Area)	1986	P.T.Adiya Widyajasa Konsultan Arsitek & Insinyur
G - 15	Final Report Design Jaringan Saluran Drainage Rawa Ampukung Dan Tigaron Seluas 600 HA Dati II Kabupaten Tabalong (Drainage and Canal Net Planning of Ampukung and Tigaron Swamp Area)	1985	P.T.Multi Gama Consultant Cabang Kal-Sel
G - 16	Laporan Tahunan Proyek Ekploitasi Dan Pemeliharaan Pengairan Kal-Sel (Yearly Report : Project explritation and Maintenance of Irrigation Project	1987	Pemerintah Propinsi Daerah Tingkat I Kal - Sel D.P.U Sub Dinas Pengairan
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ANNEX H
RURAL INFRASTRUCTURE

ANNEX H RURAL INFRASTRUCTURE

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1. INTRODUCTION

This Annex H presents the survey and study results on rural infrastructures involving domestic water supply, public road and electric power supply in the Study Area as well as the mini-hydropower development potentials.

The main objectives of the infrastructure study consist of:

- To clarify the present condition on domestic water supply, public road and electric power supply in the Study Area, and the development needs in the study period up to 2018;
- To identify the mini-hydropower potential sites and to examine economic viability thereof

To attain the above objectives, the data and information related to the infrastructures were collected from various governmental organizations concerned as summarized below.

Item	Governmental organization
Domestic water supply	Cipta Karya Office in Jakarta, Water Supply Extension Project (PPSAB) Office and Health Department Office in Banjarmasin and Regional Corporation Office of Water Supply in major towns of the Study Area
Public road	Bina Marga Offices in Jakarta and Banjarmasin (Wilayah)
Electric power supply and mini-hydropower development	National Power Corporation (PLN) Offices in Jakarta and Banjarmasin (Wilayah)

Besides the said data collection, the site inspections for piped water supply facilities and public road networks were conducted so as to grasp their present condition and development needs through discussion with the responsible persons in the regional offices. While, the site reconnaissance to the mini-hydropower potential sites identified on 1 to 50,000 scaled maps also was performed to confirm the site condition including accessibility thereto, topographical and geological conditions, distance to power consuming area and so on.

Regarding the long-term development plan on domestic water supply covering the study period, no definite plan could be obtained from the said governmental organization, though it is informed that the investigation on water supply in the Study Area be commenced by Cipta Karya in line with Integrated Urban Infrastructure Development Programme (IUIDP).

In this Study, the development need of domestic water supply facilities is measured by applying the latest IUIDP's Guidelines to the population forecast in principle.

As for the road development, the first priority is put on rehabilitation of national and provincial roads, and rural roads as the Government's policy. While, construction of new road is quite limited due to the recent downturn in the economy prevailing in Indonesia. Under the circumstance, Bina Marga has not established the long-term road development plan in the Study Area yet. Hence, the present Study on public road is made by focussing on development of new access road and improvement of existing one to the new irrigation schemes identified.

The Study on electric power supply is made on the condition that the presently isolated power system in the Study Area be coordinated with the neighbouring power systems comprising that in Banjarmasin, taking into account the long-term span of the study period. The power demand in the coordinated power system for the study period is made by referring to the latest one therefor.

2. MINI-HYDROPOWER DEVELOPMENT POTENTIALS

2.1 Mini-hydropower Development Sites Identified

The climate in the Study Area is characterized by typical tropical monsoon climate. The wet season usually lasts for November to April influenced by the northwest monsoon, while the dry season continues between May and October by influence of the southeast monsoon. Average annual rainfall in the Study Area generally varies from 2,000 to 2,500 mm.

Topography in the Study Area comprises three categories, namely inland swamp, alluvial plain, and hilly and mountainous areas. The mountainous area forming the northeastern and eastern boundaries of the Study Area is of steep slopes of more than 40%, while the swamp area and alluvial plains are mostly of rather gentle slope.

Thus, the northeastern and eastern mountainous areas are prospective as the mini-hydropower development site from the topographical condition, although the annual rainfall is abundant in the whole Study Area, exceeding 2,000 mm.

At present, there exists a mini-hydropower plant lying on the Haruyan river, around 14 km northeast of Kandangan. An installed capacity is around 200 kW. Around 2 m high masonry intake weir is constructed to take the irrigation water for the downstream wet paddy field. The powerhouse is situated just downstream from the intake weir utilizing a head between the pond water level raised up thereby and the downstream water level. However, the power plant is not operated due to a failure in generation of the designed rated power output. It is conceived that this mini-hydropower plant is suggestive of a typical one in contemplating it at other sites in the Study Area.

The mini-hydropower potential sites are identified using topographic maps at 1/50,000 scale. Taking into consideration the accessibility, distance to the power demand area and size of catchment area, 24 mini-hydropower sites are selected to be promising as shown in Table 2.1 and Figure 2.1.

2.2 Development Type of Mini-hydropower Scheme

To assess the economic viability of 24 mini-hydropower schemes discussed in Section 2.1, the cost and benefit are roughly estimated at the master planning study level. The procedures applied for estimation thereof and the their results are explained below.

As for the mini-hydropower sites identified, the following three different development types are conceivable in compliance with river slope thereat and the necessity of afterbay weir for the upstream high dam for the purpose of hydroelectric development.

(1) Type-1: Intake weir only

A head required for power generation in this development type is gained by raising up the intake weir crest level. A 6 m high intake weir is planned to be constructed at the scheme site. A powerhouse is laid out just downstream from the intake weir. This type is similar to the existing mini-hydropower plant on the Haruyan river in the Kabupaten Hulu Sungai Tengah.

(2) Type-2: Intake weir with headrace structure

In case of this type, a horizontal headrace channel or tunnel will be built to effectively utilize the potential head of the river course. Thus, this type is planned for the mini-hydropower sites where the river gradient is considerably steep.

(3) Type-3: Afterbay weir

In case that the multipurpose dam scheme inclusive of irrigation and hydropower development is planned for the said hydropower potential sites, the middle to large scale hydropower plants shall bear the peak load of the power system. In such a case, an afterbay weir has to be constructed to regulate the tail water used for peak power operation for the purpose of diverting it into irrigation channel constantly throughout a day. By utilizing a head created by construction of afterbay weir, mini-hydropower plant will be planned to be installed.

This type is expected to generate stable energy even in the dry season as compared with the said Type-1 and Type-2 of which the power dependability is dependent on the inflow condition without the regulating pond.

The most desirable development type for the respective mini-hydropower schemes is determined based on the topographic condition as shown in Table 2.1. The Pitap-1 and

Batang Alai-1 schemes are planned to be of the Type-2, while the remaining 22 schemes are of the Type-1. On the other hand, PLN has no implementation plan to develop the high dam scheme in the Study Area. Since it is unforeseeable to develop a high dam in the Study Area for the time being, thus, the Type-3 is not taken up in the present Study.

2.3 Installed Capacity and Energy Output

For the purpose of grasping runoff condition in the Study Area, a flow duration curve is constructed for mean daily runoffs observed at the streamflow stations. In principle, the flow duration curve has to be set up applying the daily runoff data for the complete years only. However, the available data periods at the streamflow stations are generally much limited, having the frequent interruptions of observation since it's commencement. Taking into consideration the available data period and size of catchment area at streamflow station as well as the data quality, the following three streamflow stations are selected as the key station.

- A7 on the Amandit river (C.A. = 491 km^2)
- A9 on the Batang Alai river (C.A. = 318 km^2)
- A10 on the Barabai river (C.A. = 81 km^2)

A flow duration curve for the mean daily runoff per 100 km^2 at each of the above three streamflow stations is established. In succession, the flow duration curve at the respective mini-hydropower sites is derived through transposition of that at the nearest one among the three key stations in proportion to their catchment area ratio.

In general, the firm discharge in the run-of-river type hydropower plant is defined to be a mean daily discharge of 95% firmness on the flow duration curve. The peak power output which can be guaranteed with the firm discharge is the dependable peak. Usually, the installed capacity is determined to be over the dependable peak so as to efficiently utilize the inflow discharge for power generation. Since the efficiency of the power plants in the dry period decreases with expansion of installed capacity to a considerable extent, however, the installed capacity should be limited to avoid such an inefficient power generation. From this viewpoint, an installed capacity of each mini-hydropower scheme is determined based on a criteria that the rated power discharge is equal to two times the firm discharge as shown below.

$$P = f_c \times g \ (2 \times Q_{95}) \times He$$

where,

P	:	Installed capacity in kW
f_c	:	Combined efficiency of generator and turbine
g	:	Acceleration of gravity (= 9.8 m/sec^2)
Q_{95}	:	Firm discharge (mean daily discharge of 95% firmness) in m^3/sec
He	:	Effective head in m

The estimated installed capacity of each mini-hydropower scheme is summarized in Table 2.2 together with the annual energy output, which is calculated based on the flow duration curve.

2.4 Evaluation

(1) Cost

To estimate the cost at the master planning study level, the cost formulae are prepared by each work item by referring to those and unit cost applied to the similar schemes. The cost formulae which are expressed as a function of structural dimensions, head, discharge, installed capacity and so on are shown in Table 2.3.

By adding the engineering service and the physical contingency costs to the direct cost, the initial investment cost is estimated by scheme as shown in Table 2.2. Besides, the annual operation and maintenance cost are estimated to be 0.5% of the civil work cost and 2.5% of generating equipment and metal work cost.

(2) Benefit

The benefit is measured by cost of the most competitive alternative thermal plant. Taking into account the following conditions in the Study Area and Wilayah VI of PLN, a 200 kW class diesel plant is selected as the least cost alternative one.

1) The mini-hydropower plants, whose installed capacities are mostly as small as less than 200 kW, is planned to be operated with high plant factor. Judging from these factors, a small scale diesel plant is considered to be the most suitable alternative one among various kinds of thermal plants such as gas turbine, diesel and oil/coal-fired steam ones.

2) The existing power plants in the Study Area are wholly of diesel one. Further, PLN is going to install a lot of diesel power plants with an installed capacity of 200 to 500 kW in the Wilayah IV power system so as to cope with the future power demand.

The alternative thermal cost consists of capital cost for constructing the alternative plant and fuel cost for operating it. The capital cost per kW and fuel cost per kWh of 200 kW class diesel plant are US$1,500 and US$0.0726, respectively. The benefit estimated with these values is summarized in Table 2.2.

(3) Evaluation

The economic viability of the mini-hydropower schemes is assessed based on a benefit-cost ratio (B/C). To estimate the B/C ratio, a cash flow table is prepared for each of cost and benefit, from which the present worth cost and benefit are derived at a discount rate of 12%.

The B/C ratio for each mini-hydropower scheme is summarized in Table 2.2. The B/C ratio is less than 1.0 for the whole schemes. Thus, there is no mini-hydropower development site which shows the high economic viability.

2.5 Possibility of Development of Micro-hydropower Plant Utilizing Irrigation Intake Facilities

As discussed in Annex E, Irrigation, 13 new irrigation water source development sites are identified throughout the Study Area. The proposed type of water resource facilities to be constructed these 13 new sites is composed of a diversion weir. The diversion weirs are situated on the Tapin, Amandit, Kayu Habang, Barabai, Batang Alai, Pitap, Balangan, Tabalong and Tabalong Kanan rivers.

The proposed diversion intake weir sites are located downstream from the said mini-hydropower plants in the whole rivers having the mini-hydropower development potential. There is a possibility to install a micro-hydropower plant at a location just downstream from the diversion weir on the irrigation channel, if a head between the upstream pond and downstream irrigation channel water levels can be available. Since the proposed diversion sites are commonly located in the comparatively wide valley, it would be not preferable to secure the required power head by raising up the diversion weir for this purpose only. Accordingly, it is considered that 1 to 2 m may be developed as the power head with construction of 3 to 4 m high diversion weir, if the irrigation channel with gravity flow can be economically laid out.

Based on the above conditions, it is preliminary estimated that installed capacities of these micro-hydropower schemes which will be developed in the maximum are approximately in a range of 1 to 20 kW, depending on the intake discharge. Thus, the potential power output of these micro-hydropower plants is somewhat small as compared with those of the said mini-hydropower and diesel plants. Accordingly, the generated power will be consumed mainly for the station use including lighting and gate operation, and domestic use in the nearby small area.

As a result of the field reconnaissance and examination thereon based on the available topographic maps, it appears that there are no potentials exploitable economically as the micro-hydropower sites regarding the irrigation schemes identified in the present Study, since their diversion weir sites are located at the places where the slope is rather gentle. It is recommended that further study be carried out in the successive study stage when the detailed topographic maps with 1 m contour interval be available for preparing the comprehensive layout plan of the irrigation facilities.

3. DOMESTIC WATER SUPPLY

3.1 Organization

Directorate Air Bersih (DAB) under the Directorate General Cipta Karya (Cipta Karya) of Ministry of Public Works is institutionally responsible for planning water supply programs, identifying water supply projects and financing thereof. The construction of water supply schemes in the Study Area is executed under the supervision of Extension Water Supply Project Office (PPSAB) in Banjarmasin after completion of their planning and financing. Water supply facilities once constructed by the Central Government are turned over to Regional Corporation of Water Supply (PDAM) of the local governments for operation and maintenance under a certain condition of the capital expense repayment to the Central Government.

At present, there exists a PDAM office in a capital town of each Kabupaten in the Study Area, and expansion of the piped water supply systems is underway by the said governmental organization concerned.

The existing water supply systems in the Study Area are largely classified into the following two groups by type of supply facility:

- Piped water supply facility with more than 2.5 liter/sec in capacity in major towns, and

- Isolated simple water supply facility in rural areas consisting of hand/electric pump, water tank and so on.

The above simple water supply facility in rural areas was installed by the Department of Health.

3.2 Present Condition

(1) Standard of water quality

Table 3.1 shows the standards on quality of drinking water which are adopted in Indonesia. According to laboratory of the Department of Health in Banjarmasin, the river water in Kalimantan island in general contains much iron, from time to time exceeding the allowable standard. Concerning the river water of the Study Area, the quality is generally within the allowable range. However, the worse condition is observed in the swamp area where the local inhabitants are subject to shortage of clean drinking water.

(2) Piped water supply system

According to the statistics in 1985, the average daily water supply amount in the Study Area was as low as 19 liters in comparison of the national average of 41 liters as shown below.

Region	Volume Supplied ('000 m^3)	No. of Family ('000 m^3)	Average Supply per Family (lit/day)
Study Area	1,447	211	19
- Tapin	192	29	18
- H.S.S.	296	46	18
- H.S.T.	389	49	22
- H.S.U.	420	56	20
- Tabalong	151	31	13
South Kalimantan Province	9,899	533	51
Indonesia	531,000	35,889	41

On the other hand, the efforts for diffusing the piped water supply facilities over the Study Area have been made by Cipta Karya since then. Consequently, the existing and planned piped water supply facilities in the Study Area total 23 as shown in Table 3.2 and their supply capacity including the systems under planning and construction reaches to 175 liter/sec as a whole of the Study Area. According to PDAM office in Banjarmasin, the target unit supply volume was planned to be 60 liters per capita per day (lcd) though the new guideline has been established as explained hereinafter.

The number of population who can be covered with these existing and planned piped water supply facilities in the Study Area is approximated by the following formula.

$$N = \frac{Q \times 24 \times 3600 \times (1 - R3) \times R4}{P \times R1 \times R2}$$

Where,

N : Population
Q : Rated water production rate of water supply facility (lit/sec)
R1 : Ratio of daily maximum water demand to daily mean during plant operation (= 1.15)
R2 : Ratio of raw water requirement to daily maximum water demand (= 1.07)
R3 : Ratio of unaccounted-for water (= 0.25)
R4 : Plant factor (= 0.75)
P : Planned unit consumption rate (= 60 lcd)

Consequently, it is roughly estimated that the existing and under-construction/planned water supply facilities have a capacity to supply domestic water to population of around 120,000 at the unit consumption rate in the maximum.

It deems, however, that the planned unit consumption rate of 60 lcd is rather small in comparison of the standard rate of 150 to 200 lcd in urban areas of the country, even though it cannot be said that the major towns in the Study Area are urbanized. According to PPSAB office in Banjarmasin, in reality, a lot of people in the piped water supply area are hoping for water supply of more than 100 lpd. In addition, there was a policy regarding a

new development of the piped water supply facilities that it be installed for a town having a population of more than 3,000.

Thus, the domestic water supply plan in the existing area needs to be worked out taking into account growth of unit consumption rate in future which usually increases with urbanization. Accordingly, the expansion plan of the existing piped water supply system requires to be prepared in compliance with the latest Government's policy therefor.

As the Government's policy, the water supply target was formulated in the Guidelines for Integrated Urban Infrastructure Development Programme Preparation 1988 to 1989 as to be described in the succeeding Section 3.3. The development program of water supply system is largely divided into the following two different supply levels.

- Basic Need Approach (BNA) level for urbanized area
- Ibu Kota Kecamatan (IKK) level for semi-urbanized or rural areas

The BNA and IKK levels of water supply are applied to the cities exceeding and less than 20,000 persons, respectively.

The capacities of the piped water supply facilities installed in capital towns of the Kabupatens in the Study Area and water sources are shown below.

Kabupaten	Capital Town	Water Supply Capacity (liter/sec)	Source of Water
Tabalong	Tanjung	10	Tabalong river
H.S.U.	Amuntai	45	Balangan river
H.S.T.	Barabai	20	Barabai river
H.S.S.	Kandangan	20	Amandit river
Tapin	Rantau	20	Tapin river

As seen in the above, sources of piped water are of the river water concerning the major water supply facilities in the Study Area. These water supply facilities are equipped with treatment facilities. In particular, the treatment facility in Amuntai, which is made of concrete, is superior to other ones in purification of water.

Unaccounted-for water is defined as the balance between the total quantity of water supplied or treatment plant output and the total quantity of water metered, which comprises the followings:

- Leakage from distribution tanks, and pipes and operation losses,
- Losses due to metering inefficiency, and
- Unauthorized connection.

Unaccounted-for water ratio is defined as unaccounted-for water divided by treatment plant output. The water volume supplied and metered in these piped water supply systems in 1987 are summarized below together with their unaccounted-for water ratio.

Item	Rantau	Kandangan	Barabai	Amuntai	Tanjung
Supplied Volume ('000 m^3)	449.6	500.1	469.0	740.9	303.3
Metered Volume ('000 m^3)	320.8	369.0	343.4	584.0	223.7
Unaccounted-for water Ratio (%)	29	26	27	21	26

Unaccounted-for water loss ratios in the above major piped water systems are in a range of 21% to 29%.

(3) Simple water supply facility

In the rural area, the following simple water supply facilities are installed by the Department of Health for the cooperative use.

No.	Water Supply Facility	Source of Water	Supply Capacity (Person/set)
1.	Water tank (PMA)	Spring	500
2.	Water tank (PAH)	Rainfall	15
3.	Hand pump with 12 m deep suction pipe (SPTDK)	Ground water	50
4.	Hand pump with 30 m deep suction pipe (SPTDI)	Ground water	50
5.	Well (SGL)	Ground water	50
6.	Electric pump (SA)	Ground water	500
7.	Piped water supply facility (PP)	Spring or river	1,000

The installation of the simple water supply facilities was gone on between 1974/75 and 1986/87 under the Government's grant. Thereafter, no facilities were installed in the Study Area due to the budget constraint of the Government.

The numbers of the respective water supply facilities installed up to 1986/1987 are summarized below by Kabupaten.

No.	Simple Water Supply Facility	Kabupaten					
		Tapin	H.S.S.	H.S.T.	H.S.U.	Tabalong	Total
1.	P M A	5	3	8	2	11	29
2.	P A H	58	32	69	16	99	334
3.	S P T D K	1,110	800	1,255	698	945	4,808
4.	S P T D I	127	47	70	57	51	353
5.	S G L	273	164	163	216	234	1,071
6.	S A	1	0	0	0	0	1
7.	P P	0	4	3	0	1	8
Supply capacity in persons		79,920	56,530	82,935	50,740	69,485	339,610

As shown in the above, the simple water supply facilities installed in the Study Area have a capacity to supply water for population of around 340,000.

In the swamp area, on the other hand, river water is commonly used for drinking purposes by local inhabitants who are living in villages nearby swamp areas and along the main stream of the Negara river. During the dry season when the stream flow velocity becomes almost nil, they are compelled to use preserved water in containers and often suffering from shortage of domestic water sources. In addition, water in the swamp area is affected by the organic material of peat. Accordingly, the piped water supply systems with treatment facility are required to be installed in the swamp area where population is expected to be rapidly increased from now on.

3.3 Development Plan of Domestic Water Supply System

As clarified in Section 3.2, a piped water supply system is installed or planned in each of 23 Kecamatans of the Study Area. Water sources of these piped water supply systems are of river water. Therefore, it is conceived that water utilized for the newly developed piped water supply systems as well as extension of the existing ones will rely on river flow in the Study Area.

The development of the pipe water supply system consists of extension of the above existing ones and new installation thereof in the Kecamatan which is not provided yet.

To set up the development plan of water supply facilities in the Study Area, the population forecast is made by Kecamatan based on the various kinds of statistic data and information collected from the organizations concerned as shown in Table 3.2.

The domestic water supply target for the Repelita IV was to provide for service to 75% of the urban population at 60 l/c/d in the minimum. Further, the policy on installation of new piped water supply systems is to install it for a town with more than a population of 3,000 for Kecamatan capitals (Ibu Kota Kecamatan or IKK). According to the Guidelines for Integrated Urban Infrastructure Development Programme Preparation 1988 to 1989, on the

other hand, the water supply targets are formulated based on analysis of minimum requirements for cities of different size classes and domestic/non-domestic demand as follows:

City Size Category (person)				Water Supply Targets (l/c/d) Domestic	Non-domestic	Total
	>	1,000,000		60	60	120
500,000	-	1,000,000		60	40	100
100,000	-	500,000		60	30	90
20,000	-	100,000		45	15	60
3,000	-	20,000	(IKK level)	30	15	45
	<	3,000	(IKK level)	20	10	30

Population of IKKs in the Study Area which are unprovided with a water supply system is forecast to be less than 10,000 in the year 2018. As for the IKK with a population of less than 10,000, the Guideline presents the criteria for selecting towns for which a water supply system is to be installed is shown below:

Health Condition	Programme
Good	None
Poor	Rural water supply

On the other hand, it is considered as desirable that a piped water supply system be installed for towns in the swamp area with a population over 3,000 in consideration of the unhealthful drinking water utilized during the dry season.

From the above considerations, new installation and extension plans of water supply systems are established based on the following criteria and policy.

1) A piped water supply system, in principle, is to be installed/extended in accordance with the said IUIDP's guideline.

2) Regarding the towns where the river water is quite inferior in quality, a piped water supply system with treatment facility is to be installed for those with a population of more than 3,000.

3) As for other rural areas, simple water supply facilities consisting of hand/electric pump, water tank and so on are to be installed.

The new installation/extension plans of piped water supply systems which are constructed based on the above criteria/policy and population growth forecast are shown below:

Kabupaten	Kecamatan/City	Capacity of Facility to be installed (lit/sec)
Tapin	Tapin Tengah	2.5
	Candi Laras Utara	2.5
	Rantau	10.0
H. S. T.	Labuan Amas Utara	2.5

The investment cost of the above new piped water supply systems is estimated based on the data on those under construction in the Study Area. The cost comprises the direct cost for civil, metal and electrical works, land acquisition cost, administration cost of executive agency and physical contingency. According to the data obtained from PDAM offices in the Study Area, the direct costs of 2.5 and 10 liter/sec class piped water supply facilities being under construction are estimated to be around US$80,000 and 150,000, respectively, excluding erection cost in metal and electrical works.

Therefore, the total investment costs of 2.5 and 10 liter/sec class water supply facilities are estimated to be approximately US$1.0 and 1.9 million, respectively, by adding other costs than the direct cost. Consequently, the total investment costs required for development of piped water supply systems total around US$5.0 million concerning the whole of the new development. In addition, it is estimated that it takes around three years to complete the construction.

4. PUBLIC ROAD AND INLAND NAVIGATION

4.1 Public Road

4.1.1 Organization and national policy on road development

(1) Organization

The Directorate General of Highways (Bina Marga) belonging to the Ministry of Public Works is a responsible agency for development of road networks in Indonesia. Bina Marga is divided into six Directorates as shown below.

Directorate of Planning,
Directorate of Urban Road Development,
Directorate of Western Region,
Directorate of Central Region,
Directorate of Eastern Region, and
Directorate of Equipment.

The Directorate of Western Region manages public roads in Sumatra and Kalimantan islands. Thus, the road networks in the Study Area are under jurisdiction of the Directorate of Western Region, while the technical planning, development and maintenance of the road networks are entrusted to the local governments. Most of the public roads are administratively classified into national, provincial and Kabupaten roads, among which national roads are developed and maintained by Bina Marga. While, provincial and Kabupaten roads are handled by local government's responsible agencies which are institutionally controlled by Ministry of Home Affairs and assisted technically by Wilayah (Region) of Bina Marga.

(2) National policy on road development

During the 1970's, the demand for transport, especially in the road subsector, brought about remarkable increase with the rapid economic development. At that time, the existing road networks in this country were, in general, unable to meet the demands increasing at around 15% per annum because of the poor road condition, although they were mostly adequate in road density. Most of the roads had fallen into disrepair and their pavements had exceeded their design life. Accordingly, in the Government's First and Second Five-Year Development Plans (Repelita I and II), the primary emphasis was to improve the national and provincial road networks, and in particular those links which served major population centers, access to ports and centers of production. While, new construction was limited to providing access to remote areas with development potential and alleviating traffic congestion in urban area.

The current development plan in Repelita IV also places the significance on road improvement and rehabilitation. Due to the recent downturn in the economy, on the other hand, funds are now only allocated for improvement or new construction if the roads are under on-going projects externally assisted.

Under the circumstances mentioned above, the priority on the road development is put as follows:

Priority	Classification
I	Rehabilitation of national and provincial roads, and rural (Kabupaten) roads
II	Betterment of on-going projects, and new projects with high traffic volume
III	New construction of pioneering roads for regional development, and tollroads

4.1.2 Present condition

(1) National and provincial road

The Study Area has a relatively well maintained networks of the national and provincial roads. But these networks are maldistributed in the swamp area. There are insufficient access roads to the existing drainage and polder schemes in the swamp area.

The existing national and provincial roads in the South Kalimantan Province are shown in Figure 4.1 and Table 4.1. The total distance of the national and provincial roads in South Kalimantan is 1,236.4 km at present, and around 66% of those roads are paved with asphalt and maintained under the good condition. There is the trunk national road connecting between Banjarmasin, a commercial center in and the capital of the South Kalimantan Province, and such towns in the Study Area as Rantau, Kandagan, Hambawan, Amuntai, Kelua, Tanjung and Muara Uya from south to north. A total distance of the national road from Banjarmasin to Muara Uya is 275.5 km.

On the way from Kandagan to Amuntai, the national/provincial road running from Hambawan to Batu Babi through Barabai and Paringin branches off the national road. The provincial road extends to the East Kalimantan Province. These national and provincial roads are linked by the provincial one for sections between Amuntai and Paringin/Mantimin via Lampihong and between Tanjung and Daha/Mabuun. Further, the provincial roads to such towns in the Study Area as Margasari, Negara and Halong branch off the said roads.

The length of the national and provincial roads is summarized below by the surface type to compare with the average one in Indonesia.

	Type of Surface				Total	Per Capita Length
	Asphalt (km)	Gravel (km)	Earth (km)	Other (km)	(km)	(m)
Study Area	425	104	6	0	535	601
(% of total)	(79.4)	(19.4)	(1.1)	(0.0)	(100.0)	
- Tapin	72	0	0	0	72	474
- H.S.S	62	14	0	0	76	273
- H.S.T	83	0	0	0	83	221
- H.S.U	78	25	0	0	103	518
- Tabalong	130	65	6	0	201	479
Indonesia	30,445	10,026	5,645	857	46,973	286
(% of total)	(64.8)	(21.3)	(12.0)	(1.8)	(100.0)	

As shown in the above, the total length of the national and provincial roads in the Study Area is 535 km corresponding to about 50% of that in the South Kalimantan Province. The road density is 44 m/km^2 in the Study Area. This is more than the provincial average of 30 m/km^2 and the national average of 24 m/km^2. The per capita road length is 600 m in the Study Area. This is longer than the provincial level of 475 m and the national level of 290

m. As for the road pavement condition, 80% of these roads are paved with asphalt. This condition is higher than the provincial average of 70% and the national average of 65%.

Thus, it can be said that the Study Area is much blessed with the networks of the national and provincial roads as compared with the national average.

According to Bina Marga's investigation, the condition of bridges built on the national and provincial roads is as follows:

Status	Nos. of Bridge	Nos. of Bridges Passable
National	146	92
Provincial	681	393
Total	827	485

Thus, 41% of the existing bridges on the national/provincial roads are damaged so that Bina Marga places the priority on improvement/betterment and replacement of the existing road and bridges.

As explained Subsection 4.1 (2), the first priority is placed on rehabilitation of the existing national and provincial roads as well as replacement of above damaged bridges in the Study Area.

(2) Kabupaten road

In the Study Area, Kabupaten roads have functions developed as the rural service roads. The total length and density of the Kabupaten roads are summarized below:

Kabupaten	Area (km^2)	Total length (km)	Density (m/ha)
Tapin	270,062	295	1.1
H. S. S.	189,261	431	2.3
H. S. T.	147,200	343	2.3
H. S. U.	359,178	251	0.7
Tabalong	394,600	434	1.1
Study Area	1,360,301	1,754	1.3
Indonesia	191,944,300	92,038	0.48

The above shows that the road density in Kabupatens Tapin, Hulu Sungai Utara and Tabalong is low as compared with that in Kabupatens Hulu Sungai Selatan and Hulu Sungai Tengah. In particular, the Kabupaten Hulu Sungai Utara has the lowest density among 5 Kabupatens in the Study Area. This shows that existing Kabupaten roads in the Study Area are less in the swamp area. Thus, in the Study Area, the Kabupaten road is more

maldistributed than the said national and provincial road. The road network in the swamp area which is linked with the national/provincial and Kabupaten roads are required for development of polder and drainage schemes planned under the present Study in view of their favorable operation and maintenance.

The density of Kabupaten roads in the Study Area is derived to be 1.3 m/ha as shown in the above. The value is much higher than the provincial average of 0.77 m/ha and the national average of 0.48 m/ha.

The proportion of surface type of the Kabupaten roads in the Study Area is shown below.

	Distance (km)	Type of Surface	
		Asphalt (%)	Others (%)
Study Area	1,754	12.0	88.0
Tapin	295	29.2	70.8
H.S.S.	431	6.3	93.7
H.S.T.	343	5.0	95.0
H.S.U.	251	19.9	80.1
Tabalong	434	6.9	93.1
Indonesia	92,038	26.0	74.0

In the Study Area, the proportion of Kabupaten roads paved with asphalt is considerably less in comparison with the national average. Among 5 Kabupatens in the Study Area, the proportion in Kabupaten Tapin only exceeds the national one. Most of road surfaces in the Study Area are built mainly with low grade material such as gravel, stone, earth and so on.

The surface condition of Kabupaten roads in the Study Area is summarized below.

Kabupaten	Total length of kabupaten road (km)	Ratio of poor and bad road to total length (%)
Tapin	295	31.5
H. S. S.	431	32.0
H. S. T.	343	34.1
H. S. U.	251	48.6
Tabalong	434	69.8
Study Area	1,754	44.1
Indonesia	191,944,300	34.7

The above exhibits that around 44% of Kabupaten roads in the Study Area has suffered deterioration of road surface. This ratio exceeds the national average of around 35%. Among 5 Kabupatens in the Study Area, Kabupatens Hulu Sungai Utara and Tabalong are

in the worse condition than the national average. In particular, ratio of deterioration in the Kabupaten Tabalong is outstanding.

The number of existing bridges on Kabupaten roads in the Study Area totals some 860, and those of less than 5 m in span length account for the major part. In addition, they are mostly of timber types and generally in poor condition as well as road surface.

As a conclusion, Kabupaten roads in the Study Area still remains at a low level in view of the road grade and surface condition as compared with their national averages, although they are densely developed as a whole. Accordingly, rehabilitation and improvement of existing Kabupaten roads are keenly necessary for the regional development including the agricultural development. On the other hand, the improvement scheme for Kabupaten roads including those in the Study Area is just commenced in 1989. Accordingly, the road networks are expected to be rather qualitatively improved from now on.

4.1.3 Rural road development plan

As described in Subsection 4.1, the Study Area is comparatively blessed with the public roads in view of density of their networks, and the improvement and rehabilitation of national, provincial and Kabupaten roads are to be implemented in accordance with the Government's development policy. Regarding the irrigation and drainage/polder schemes identified in the present Study, on the other hand, the road network linked with national and/or provincial roads is indispensable from the viewpoint of their favorable operation and maintenance. In the present Study, accordingly, the road development plan is set up by placing it's emphasis on the rural road development.

In the present Study, new irrigation, drainage and polder schemes are identified to be promising. With respect to these agricultural development, the road development plan is established based on the following criteria.

- Only access road for linking the scheme area with the nearby public road is considered in the present rural road development plan.

- Road networks in the irrigation area which are used for maintenance and operation of the schemes are planned in the framework of irrigation or drainage/polder schemes.

(1) Development need of new access road for new irrigation schemes

In the present Study, 15 new irrigation schemes are identified as described in Annex E. The development scale of new irrigation area is optimized to be 29,387 ha in total. The development of new access roads required for each of these irrigation schemes is measured based on 1/50,000 scaled maps and site reconnaissance results.

The present condition of existing road networks and the development need are explained described below for each of the new irrigation schemes.

Kabupaten Tabalong

There exist seven new irrigation schemes in Kabupaten Tabalong, i.e. Sungai Kati, Namun, Kinarum, Mihim, Batupulut, and Bilas and Banju Tajun schemes. These irrigation areas are located comparatively close to the existing provincial road connecting Tanjung and Batu Babi.

As for the Namun, Kinarum and Bilas schemes, no new access road needs to be developed as Kabupaten road branching off the provincial road passes through these irrigation areas. While, the Mihim scheme needs to construct a new access road of around 0.5 km so as to link the irrigation area with the provincial road running between Halong and Muara Uya.

Kabupaten Hulu Sungai Utara

In Kabupaten Hulu Sungai Utara, there are two irrigation schemes newly identified in the present Study, i.e. Balangan and Pitap schemes. These are geographically subdivided into four zones, being isolated each other. Among these, the Balangan scheme only requires to develop a new access road of around 0.8 km so as to connect the irrigation area and the Kabupaten road running along the Balangan river from Paringin.

Kabupaten Hulu Sungai Tengah

In the Kabupaten Hulu Sungai Tengah, two new irrigation schemes, Batang Alai and Barabai, are selected as the promising one.

These irrigation areas extends around Barabai, a capital town of the Kabupaten, and the national/provincial and Kabupaten roads crossing these scheme areas are developed. Hence, no access road is required to be developed to link these scheme areas with the trunk road.

Kabupaten Hulu Sungai Selatan

There exist two new irrigation schemes in Kabupaten Hulu Sungai Selatan, i.e. Kayu Habang and Amandit schemes.

The irrigation area of Amandit scheme extends centering around Kandangan, a capital town of this Kabupaten, and it is crossed by the national road connecting such major towns in the Study Area as Rantau, Kandangan and Barabai and many Kabupaten roads branching off it.

On the other hand, the irrigation area of Kayu Habang scheme is situated around 2 km northwest of Ankinang on the said national road and is linked therewith by Kabupaten roads.

Taking into account the above circumstances of these scheme areas with respect to the accessibility, no new access road is required to be developed in connection with the irrigation development.

Kabupaten Tapin

The Tapin and Labuhan schemes are selected as the promising irrigation scheme in the Kabupaten Tapin. Most of the irrigation area extends in the south of Rantau, and the national road connecting Banjarmasin and Rantau passes through the irrigation areas. Accordingly, no access road for connecting these irrigation areas and the existing public road is required to be developed.

(2) Development needs of new access road for new drainage and polder schemes

In the swamp area, poor road networks hamper the agricultural development in a sense. The road construction requires rather higher cost than that in the alluvial plain due to the costly foundation treatment. Although the Government's budget for new construction of road is quite limited under the recent severe economic condition prevailing in Indonesia, the available fund resources are allocated mainly for rehabilitation and improvement of the existing road networks as explained in Section 4.1. The Government's policy is considered to be sustained from now on, especially in the Study Area where road networks are densely distributed in comparison with the national average. However, road networks in the swamp area would have to be well distributed and maintained so as to promote the swamp development for the agricultural purpose.

(3) Estimate of construction cost of new access road

The length of new access road required for development of the irrigation schemes identified in the present Study, which is discussed in Section 4.1.3, totals 1.3 km as summarized below.

Kabupaten	Irrigation Schemes	Length of New Access Road (km)
Tabalong	Mihim	0.5
H.S.U.	Balangan	0.8

Thus, the access road length to be constructed in connection with the irrigation development is less than 1 km for each scheme. In addition to the new access road, the improvement works for the existing access road are required to be carried out for the respective irrigation schemes. In the present Study, it is assumed that the improvement works be conducted under the Government's budget in line with the current Government's policy.

Taking into account the traffic volume on these new access roads, it is conceived that the design standards equivalent to the Kabupaten road are to be applied to the design thereof.

The effective road width is 4.5 m, having a 1.5 m wide shoulder on both sides, and it's pavement structure is composed of 2 cm thick asphalt, 10 cm thick base course and 15 cm thick sub-base course. The unit cost of the access road is estimated to be around US$105,000/km. Consequently, the total construction cost for the access road is derived to be approximately US$140,000. Thus, the cost required for construction and improvement of access roads is very small against the total cost of each scheme, since the new development area is selected in the region where the road networks are well distributed.

4.2 Inland Navigation

Through the present Study, no serious problems on the inland navigation activity are identified in a sense of physical traffic constraints.

According to statistical data of the Regional Office of Inland Transport South Kalimantan, the total number of river transportation facilities in the whole Province increased at an annual rate of 12.3% between 1983 and 1986 as shown below:

Type of Facilities	No. of Facilities		Increasing Rate (% p.a.)
	1983	1986	
Side motor	225	305	10.7
Speed boat	417	601	12.9
Raft motor	7,113	10,892	15.3
Motor boat	2,566	2,857	3.6
Tug boat	106	240	32.9
Barge	533	669	7.9
Total	10,990	15,573	12.3

Since roads in the swamp area have not been well networked, inland navigation by passenger's and cargo boats has been the most common transportation measures. The wooden boat of 3 to 5 tons with inboard engine is popular and about 20 passengers can be on board. As the draft depth of these boats is usually as shallow as under 0.5 m, there are no barriers in the Negara main stream.

The Negara river is functioning as one of the major inland transportation routes linking the Study Area to Banjarmasin, the center of South Kalimantan. Regular boat services in the Negara main stream are conducted in between the core towns such as Tanjung, Amuntai, Babirik, Negara and Margasari in order from the upstream and also for connecting these towns to Banjarmasin through the main inland navigation route. Beside the above relatively long distance navigation, adjacent trips among the river side villages along and across the rivers are routinely carried out by the local people using their own small canoes with or without engine. It is noteworthy that presently the navigation is only one access method to Banjarmasin or the east side capital towns for the people living in the west side villages of the Negara down stream areas.

The major goods on inland navigation are agricultural products, fresh and dried fishes and daily commodities. Timber is also transported in the Negara river, but its amount is very few as compared with that in the Barito river. The fish carrier boats from Danau Panggang to Banjarmasin usually take a route through the Barito river.

In the swamp areas of the middle and downstream parts of the Negara sub-basin, an artificial water courses have been extended for a long time. However, these water courses are insufficient in width and depth. Improvement of the existing inland navigation networks is expected by rural inhabitants in the swamp area. There exists only one provincial road connecting Kandagan and Negara across the swamp area in the Study Area. At present, small rivers, artificial water courses and drainage canals play very important role in inland navigation system for the rural inhabitants.

5. ELECTRIC POWER SUPPLY

5.1 Existing Power Supply and Transmission Systems

PLN is responsible for electric power supply in the whole Indonesia. The Central, East and South Kalimantan Provinces are under jurisdiction of Wilayah (Region) VI of PLN as shown in Figure 5.1. The PLN Wilayah VI is administratively divided into the following 5 subregions called "Cabang".

No.	Cabang	Province
1.	Banjarmasin	South Kalimantan
2.	Barabai	South Kalimantan
3.	Palangka Raya	Central Kalimantan
4.	Balikpapan	East Kalimantan
5.	Samarinda	East Kalimantan

At present, the power supply systems of these subregions are isolated each other. The Cabang Barabai which involves most part of the Study Area is further divided into 8 "Ranting", i.e. Tanjung, Amuntai, Kandangan, Daha, Rantau, Binuang, Kelua and Paringin.

A 20 kV transmission line connecting major towns in the Cabang Barabai is scheduled to be completed at the end of 1988. On the other hand, there exists a 70 kV transmission line in South Kalimantan called "Barito System", which links the Ir. Nur (Riam Kanan) hydropower station and major cities/towns in the Cabang Banjarmasin such as Banjarmasin, Cempaka, Trisakti, and so on.

As to be discussed in the succeeding Section 5.2, the presently isolated Barabai system is forecasted to be interconnected and coordinated with other systems of PLN Wilayah VI until year 2018.

The existing power plants in the Cabang Barabai are wholly of diesel one and their total installed capacity amounts to around 15 MW as shown in Table 5.1.

The existing power plants in the whole Wilayah VI of PLN are summarized in Table 5.2. Power supply in other power systems than the Barabai system also relies on diesel power plants, except for the Riam Kanan Hydropower plants with an installed capacity of 30 MW in the Barito System.

5.2 Power Statistics

The peak load in the Cabang Barabai was recorded between 1985/86 and 1987/88 as listed below.

Fiscal year	1985/86	1986/87	1987/88
Peak load (MW)	5.9	6.9	8.7
Increase ratio (%)		17	26

As shown in the above, the peak load in the Cabang Barabai has increased at an annual rate of 21% for the period from 1985/86 to 1987/88. The peak load in the whole Wilayah VI of PLN reached to 43.6 MW in 1987/88 as shown in Table 5.3.

The energy production, sales and loss ratio in the Cabang Barabai are summarized below and those data for the whole Wilayah VI are listed in Table 5.3.

Fiscal year	1985/86	1986/87	1987/88
Energy Production (GWh)	16.6	20.4	25.9
Energy Sale (GWh)	13.7	17.9	22.1
Energy Loss Ratio (%)	17.5	12.5	14.6

An annual increase ratio of energy production in the Cabang Barabai was recorded to be 25% for the period from 1985/86 to 1987/88. The yearly load factor was 34.1% in 198788. In 1986/87, the domestic sector accounted for around 80% of the yearly energy sale as shown below.

	Consumer Sector			Public & Station Use	Total
	Domestic	Commercial	Industrial		
Energy sale (GWh)	14.11	0.59	0.33	2.82	17.95

5.3 Extension Plan of Power Transmission System

According to the PLN's expansion plan of power transmission system in the Wilayah VI of PLN, the Palangka Raya power system in Central Kalimantan is planned to be connected with the Barito System in South Kalimantan by 2000. In East Kalimantan, the Samarinda and Balikpapan power systems are scheduled to be linked by 1993.

According to the feasibility study report on the Riam Kiwa Hydro Electric Development Project whose site is situated around 40 km east of Rantau, it was planned to connect the Barito system and the Cabang Barabai system by constructing 150/70 kV transmission lines via the Riam Kiwa power station. Due to the difficulties in resettlement of inhabitants in the reservoir area, however, the implementation of the Project has been postponed from the original schedule in which the power plants are planned to be put in service in 1992/93.

Since PLN has an intention to implement the Riam Kiwa Project in an appropriate time after the resettlement problem be satisfactorily solved, it is expected that the power system of the Cabang Barabai will be interconnected with the Barito system through it's realization.

Further, PLN is going to commence the feasibility study on the development of coal-fired power plants in South Kalimantan, utilizing coal resources therein. It would be prospective that the Cabang Barabai system will be interconnected with the Barito system, following introduction of a large-scale coal-fired power plant. In consideration of the long-term time span of the present Study up to 2018, thus, it is considered that the Study Area would be absorbed in the Barito System.

As explained above, the timing of interconnection between the Barito and Barabai systems would depend on implementation schedule of the Riam Kiwa Project as well as the said coal-fired power development project. In the Report on 21 Hydroelectric Power Development Projects which involves the Amandit project located in an eastern part of the Study Area, on the other hand, the interconnection plan of subregions in the Wilayah VI of PLN is proposed as follows.

Power Systems Interconnected	Year Scheduled
Barito - Barabai	1998
Barito - Balikpapan & Samarinda	2003

Although the interconnection plan is under examination by PLN and is subject to change, they will be tentatively applied to the present Study in consideration of the said long-term time span.

5.4 Hydropower Potentials in and around Study Area

PLN carried out the Hydropower Potentials Study (HPPS) for identifying hydropower potential sites throughout the country. The study report was completed in 1983. The identified schemes in the Study Area was 13. The locations of these schemes are shown in Figure 5.2, and those installed capacity and energy output are summarized in Table 5.4.

The scheme sites are located in mountainous ranges in the eastern and northern parts of the Study Area where limestone distributes in a wide range. The sites are located on the Tabalong Kiwa, Kumap and Ayu rivers.

On the other hand, the damsites in the eastern part of the Study Area seem not to be generally composed of the limestone, although the limestone extends in the downstream area therefrom. These damsites consist mainly of the volcanic intrusives which enable to construct the high dam except Amandit 1 on the Amandit river. Pitap 1 and Pitap 2 sites are located on the Pitap river, Batang Alai site on the Batang Alai river, Amandit 1 site on the Amandit river, and Tapin site on the Tapin river. According to the geological investigation for the Prefeasibility Study on 21 Hydro Electric Power Development Project which was undertaken as a continuation study of HPPS, the Amandit 1 damsite consists mainly of the diorite which also enables to construct the high dam. However, reservoir capacities of these dams are much limited due to the topographic condition.

According to the said prefeasibility study, on the other hand, the Amandit project which was selected as one of the prospective projects out of the hydropower projects in the Study Area exhibited the lower economic viability of less than 12% in an economic internal rate of return. Consequently, there are no hydropower schemes in the Study Area.

Around the Study Area, following hydropower projects are planned to be developed by PLN Wilayah VI to meet the increasing power demand in South Kalimantan.

No.	Name of Project	Installed Capacity (MW)	Starting Year of Operation
1.	Riam Kiwa	42 (21 x 2)	1992/93
2.	Kusan	30	1999/2000

Regarding the Riam Kiwa project, the detailed design was completed in 1987. However, the commencement of its construction is postponed due to the reason described in Section 5.3. Consequently, commencement year of operation is expected to be rather delayed from the original schedule in the above.

The Kusan project being under feasibility study was originally identified in HPPS. The Kusan river basin faces to the Riam Kiwas is comparatively close to the Study area. Accordingly, the power generated by this project is expected to be supplied to the Barabai system after interconnection of the Barabai and Barito systems.

5.5 Power Demand Forecast and Installation Plan

Table 5.5 shows the power and demand forecast of the Wilayah VI in the course of the said 21 Pre-F/S Study completed in February 1987. The forecast is made on the Cabang basis by each of residential, commercial, public and industrial sectors, covering a period up to the year 2006/2007.

These power and energy demand forecasts are considered to be applicable to the present Study, since there is no large difference between the forecast and recorded values for the whole Wilayah VI. The energy and power demands between 2006/2007 and 2017/2018 are estimated by extrapolating the growth rates for the latter 5 years and assuming that the load factor will be constant at 70% after 2006/2007.

After interconnection of power systems in PLN Wilayah VI in accordance with the schedule in Section 5.3, a total of power demand is forecast to reach to around 913 MW in 2018/19.

To meet the increasing demand, PLN Wilayah VI plans to develop power plants listed in Table 5.6. Those power plants are summarized below by type of power plants.

Plant Type	Installed Capacity (MW)
PLTD (Diesel)	278.46
PLTU (Oil Fired)	100.00
PLTA (Hydro)	72.00
PLTM (Minihydro)	0.35
Total	450.81

Diesel power plants account for around 62% of the total installed capacities of the power plants. These power plants are scheduled to be installed in the region by 2000/2001. Therefore, a total installed capacity is expected to be augmented up to around 680 MW in the beginning of the coming century. Nevertheless, it is forecast that PLN Wilayah VI will be subject to the power shortage thereafter, even though these power plants are wholly installed on schedule.

On the other hand, PLN is going to commence the feasibility study on coal-fired power plants for the power system. Hence, the power demand in the PLN Wilayah VI is forecast to be met by a large scale of steam power plants inclusive of coal-fired power plants.

According to the latest plan of PLN Head Office in Jakarta, the following large scale of power plants are nominated to cope with the future power demand in the power system of the PLN Wilayah VI.

- Steam power plant,	natural gas in Balikpapan		:	100 MW
	coal fired	- do -	:	100 MW
	coal fired	- do -	:	75 MW
- Gas turbine in Balikpapan			:	75 MW

It is foreseen that the power demand in the PLN Wilayah VI power system will be able to be met through a series of installation of the above large scale of thermal power plants as well as those planned by PLN Wilayah VI office.

6. RECOMMENDATION

6.1 Mini-hydropower Development

It is clarified through the present Study that there are no mini-hydropower schemes with high economic viability exceeding EIRR 12%. Among the 24 mini-hydropower scheme sites, promising ones are generally in the eastern mountainous area where access roads thereto are insufficient. Thus, the low economic viability of these schemes is judged to be attributable mainly to the insufficient accessibility. Accordingly, it is recommended that their development plans be reexamined after improvement of access roads are realized through development of other sectors than the mini-hydropower. From the viewpoint of promoting the rural electrification, the mini-hydropower schemes are recommended to be developed as long as they are able to be competitive to diesel power power plants in terms of the investment, operation and maintenance costs.

Regarding the micro-hydropower plant utilizing irrigation intake facilities, it appears that favourable sites are scarce in new irrigation schemes identified in the present Study as their scheme sites are selected in comparatively flat areas. While, it is judged to be not beneficial to gain a head required for power generation by means of raising up crest elevation of a diversion weir for this purpose only. Provided that an available head therefor is found out in the course of laying out the irrigation channel in the successive study stage when more detail topographic maps become available, introduction of the micro-hydropower plants should be examined taking into consideration its need in ad around the Study Area.

6.2 Domestic Water Supply

Water supply systems in the Study Area consist of piped water supply facilities in major towns and simple ones in the rural area. These have a capacity to supply domestic water to

approximately 50% of population in 1987 in a total of piped and simple water supply facilities including planned and under construction.

However, capacity of piped water supply facilities is still at low level, although much efforts are being made by Cipta Karya and other related governmental organizations so as to expand it over the Study Area. In the present Study, the piped water supply facilities are recommended to be newly or additionally installed in four towns of the Study Area based on the population forecast as described in Chapter 3. It is considered that this lesser development needs result from the low population growth. It appears that more accurate data on population and area in each of villages and towns have to be arranged by the Provincial government to work out the most economically desirable distribution plan on a piped water system.

On the other hand, most of piped water systems are utilized for the domestic use and water consuming type industry is not expected to be developed in the Study Area under the latest low economic growth in the country. Provided that change in the present economic and/or industrial circumstances is forecast to occur in the Study Area, a development plan needs to be modified based on refined basic data related to water demand.

Simple water supply facilities provided by the Department of Health are popular as the equipment for obtaining drinking water in rural areas. It is considered that domestic water in rural area with sparse population density which occupies a large part of the Study Area should be supplied with the simple ones, unless distribution pipe of piped water supply facility in the nearby town is economically connected to the rural area. However, supply of simple ones was stopped since 1987 due to budget constraint of the Government. In a view of improvement of rural infrastructure, it is strongly recommended to diffuse with more intensity simple water supply systems in the rural areas, in which inhabitants cannot get the clean drinking water easily.

In particular, inhabitants in the swamp area are subject to shortage of clean drinking water in the dry season when water velocity becomes almost zero and unsuitable for the drinking purpose in quality. Further, water in the swamp area is in general affected by organic matters in peat. Thus, the water quality is required to be clarified more clearly through biological and chemical analyses. Based on the results, countermeasures should be set up. One of the countermeasures is to take water from the deep portion of underground unaffected by the surface water by constructing deep well or a hand pump with longer underground pipe than usual. In order to settle inhabitants in the swamp areas development for irrigation purpose, a domestic water supply system has to be improved as well as other infrastructures such as road, electricity and so on.

6.3 Public Road

The Study Area is bless with densely distributed public roads such as national, provincial and Kabupaten roads. However, these roads are maldistributed, concentratedly allocated in the flat alluvial plains. In the Study Area, insufficient conditions of public roads are