Table 6.1.1 Current Condition of Water Supply

Province	Kotamadya/ kabupaten	Area (km2)	Population (person)	Treatment Capacity (l/sec)	Service Population (person)	(*1) Service Ratio (%)	Non-Service Population (person)	(*2) System S.R. (%)	(*3) System Capacity (l/head/day)	Distribution Loss (%)
Jambi		53,436	2,018,463	492.50	239,882	11.88%	1,778,581	38.54%	68.37	N.A.
	Kerinci	4,200	280,017	35.00	17,740	6.34%	262,277	22.81%	38.88	27.79%
	Bungo-Tebo	13,500	360,402	40.00	24,880	6.90%	335,522	39.93%	55.47	N.A.
	Sarolangun Bangko	14,200	350,095	37.50	25,567	7.30%	324,528	45.53%	57.70	N.A.
	Batang Hari	11,130	325,783	22.50	16,345	5.02%	309,438	35.62%	42.36	N.A.
	Tanjung Jabung	10,200	362,380	47.50	19,448	5.37%	342,932	37.24%	78.59	46.53%
	Kota Jambi	206	339,786	310.00	135,902	40.00%	203,884	44.00%	86.72	N.A.
South-Sumatra		109,234	6,276,482	2180.00	755,903	12.04%	5,520,579	42.44%	105.75	37.44%
	Ogan Komering Ulu	10,408	963,794	100.00	47,424	4.92%	916,370	35.98%	65.55	35.35%
	Ogan Komering Iril	21,658	771,463	42.50	16,615	2.15%	754,848	21.54%	47.60	28.29%
	Muara Enim	9,575	586,075	90.00	64,433	10.99%	521,642	46.95%	56.66	28.00%
	Lahat	4,034	599,347	85.00	42,808	7.14%	556,539	25.15%	43.15	28.76%
	Musi Rawas	21,513	512,077	80.00	25,853	5.05%	486,224	42.00%	112.29	35.00%
	Musi Banyuasin	25,644	883,719	50.00	23,699	2.68%	860,020	42.02%	76.60	28.40%
	Bangka	11,614	513,946	62.50	19,769	3.85%	494,177	26.50%	72.39	37.88%
	Belitung	4,532	192,972	45.00	19,335	10.02%	173,637	29.53%	59.38	32.33%
	Kota. Palembang	224	1,139,926	1,550.00	479,747	42.09%	660,179	53.00%	147.95	40.00%
	Kota. Pangkal Pinang	32	113,163	75.00	16,220	14.33%	96,943	16.00%	63.92	25.00%
Bengkulu		19,709	1,179,122	290.00	90,161	7.65%	1,088,961	28.43%	79.01	N.A.
	Bengkulu Selatan	5,969	2948,214	40.00	16,799	5.63%	281,415	45.82%	94.26	N.A.
	Rejang Lebong	4,110	367,9480	95.00	34,457	9.36%	333,523	29.32%	69.84	N.A.
	Bengkulu Utara	9,612	342,601	55.00	18,626	5.44%	323,975	45.70%	116.59	N.A.
	Kota. Bengkulu	18	170,327	100.00	20,279	11.91%	150,048	16.60%	70.73	N.A.
Lampung		35,422	6,017,573	484.00	121,008	2.01%	5,896,564	26.70%	82.27	N.A.
	Lampung Selatan	6,694	1,824,162	70.00	28,874	1.58%	1,795,288	29.56%	61.92	32.56%
	Lampung Tengah	9,190	1,901,630	54.00	23,551	1.24%	1,878,079	30.25%	59.93	N.A.
	Lampung Utara	19,369	1,655,075	60.00	28,959	1.75%	1,626,116	36.27%	64.93	35.50%
	Kota.Bandar Lampung	169	636,706	300.00	39,625	6.22%	597,081	20.00%	130.83	48.00%
Total		217,801	15,491,640	3446.50	1,206,955	7.79%	14,284,685	N.A.	N.A.	N.A.

*Sources : Hasil Pembangunan S/D Perita IV, Cipta Karya, PU

*Note : (*1) Service ratio is calculated service population devided by the population of Kotamadya or Kabupaten.
(*2)System service ration is calculated service population devided by the population within the service area.
(*3) System capacity is calculated treatment capacity devided by service population.

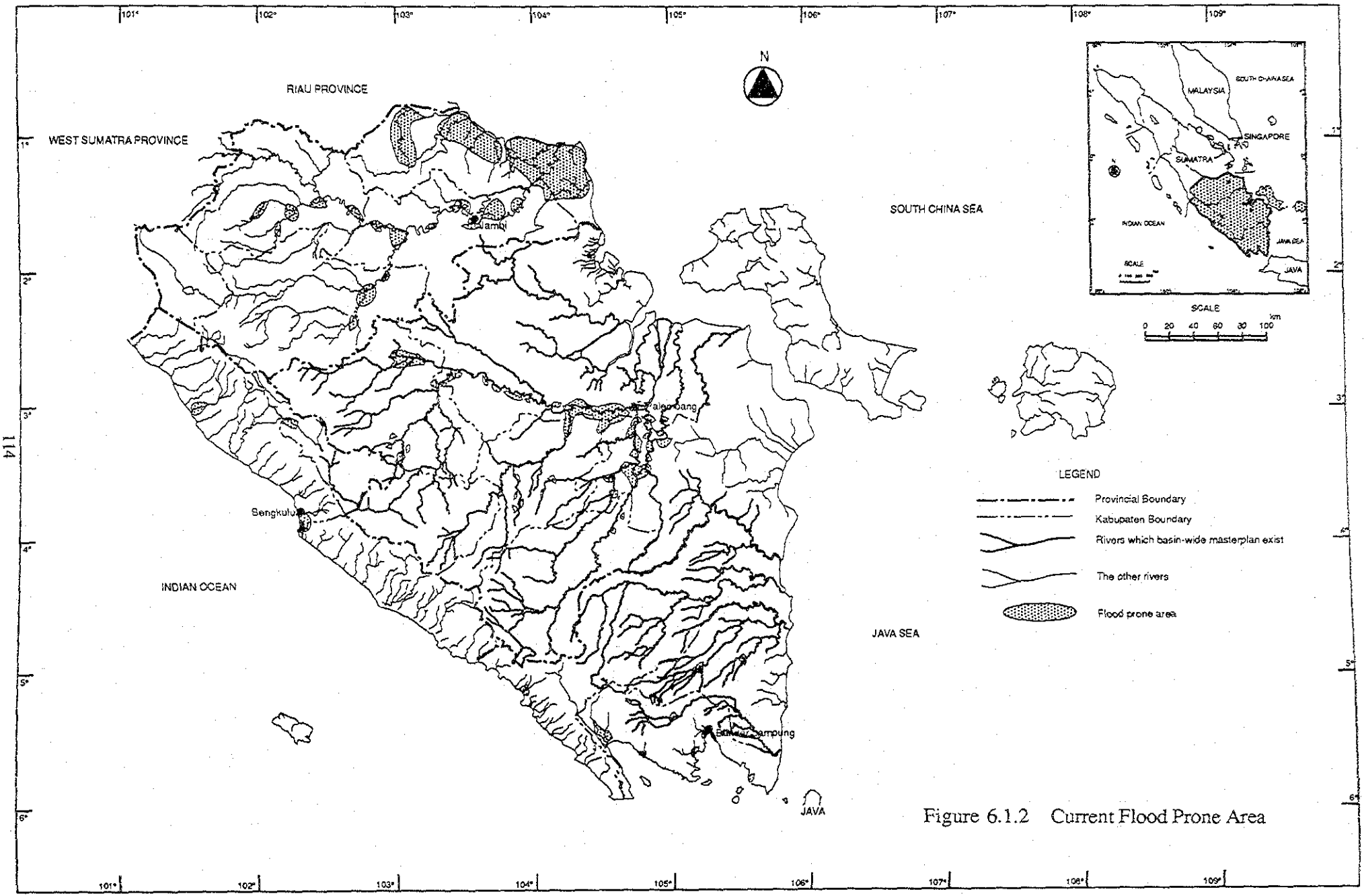


Figure 6.1.2 Current Flood Prone Area

flood prone area. The way of production in the area also reflects the natural river condition, applying "Lebak" or "Pasang Surut", which are the traditional paddy farming methods for swamp, or inundation area. Inland fishery activity is also found in the area using the deep swamp. The road network newly constructed in the area is also generally elevated by dyking to avoid the transportation damage due to flood.

The recent flood is however becoming serious because of expansion of residual area in the flood prone area and degradation of water holding capacity in the upstream basin. In January 1992, the severe flooding attacked the eastern low land area of Sumatra Island, particularly Jambi City along the Batang Hari River. The flooding of the Batang Hari River destroyed hundreds hectares of crops, inundated at least 200 villages, and claimed the life of ten persons. Major economic activities of the city force to close down for a week due to inundation of infrastructures, factories, markets and so on.

6.1.4 Irrigation Development

Figure 6.1.3 shows the location of existing and further expected irrigation schemes, revealed that past major development activities were made in Lampung Province and the fringe of Bukit Barisan Range. Large scale irrigation development is found in Kabupatens Lampung Tengah and Ogan Komering Ulu which are situated rice supply base for the Region and Indonesia. Large impact, creating job opportunity for local people and transmigrants is another contribution of the large scale irrigation development. On the other hand, irrigation schemes on mountain edges are mainly medium and small scale with simple river structures contribute to the improvement of local farmers' living by to maintaining self-sufficiency of rice within the village.

Further development potential is mainly found in Kabupatens Lampung Utara, Ogan Komering Ulu, Musi Rawas and Sarolangun Bangko, in view of both land and water availability. Detail figures of present and further irrigation conditions are summarized in Table 6.1.2, and the list of project ideas is shown in Table 6.1.3.

6.1.5 Swamp Reclamation

More than 8 million hectares of tidal or non-tidal swamp area spread in the Region, particularly in South Sumatra and Jambi Provinces. Major part of the area is not yet developed and the reclamation can be helpful to enhance agriculture production for the regional economic development. The swamp area began being used by local people in the beginning of this century without infrastructure development. The traditional paddy farming method called "Pasang Surut" and "Lebak" were applied for rice production and the swamp area is now becoming major rice supply field for the Region and Indonesia.

Enhancement of the existing swamp reclamation area was carried out by Indonesian government in recent years, aims at increasing the efficiency of agriculture production and encouraging resettlement people from the crowded inner islands to the swamp reclamation area. Table 6.1.4 shows existing and on-going swamp reclamation area distributed by Kabupatens, and the further project ideas together with development potentials are shown in Table 6.1.5. A total of 609,818 ha of swamp area has developed with 75 schemes and 168,165 families live in the area. The development activities are mainly found along eastern coast of the Region as referred to Figure 6.1.3, showing the swamp area near Palembang and Jambi cities is concentrated to be developed. The problems still remain that most of the developed area is isolated by road and telecommunications networks.

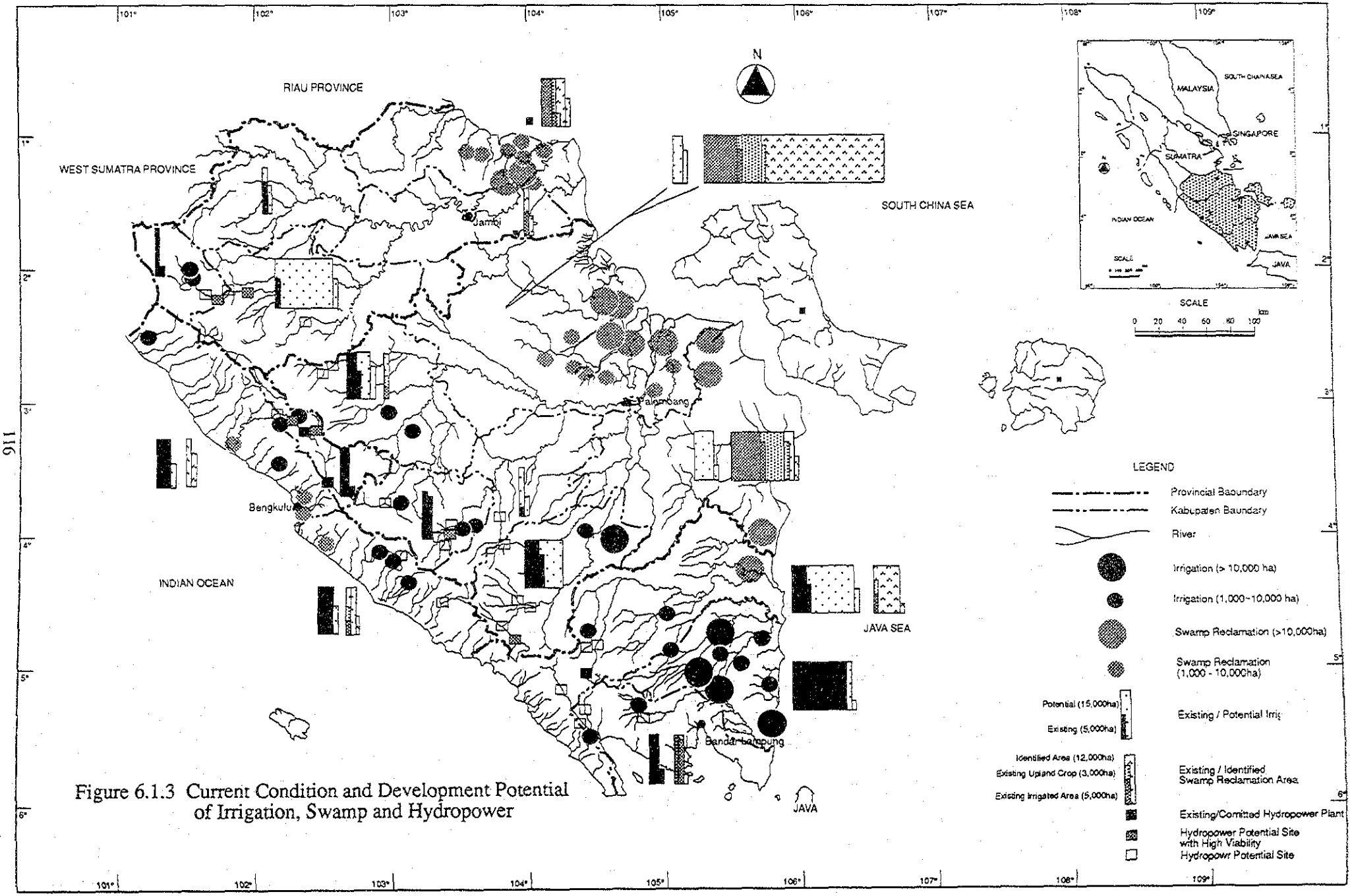


Figure 6.1.3 Current Condition and Development Potential of Irrigation, Swamp and Hydropower

Table 6.1.2 Existing/Further Irrigation development in the Region

Province/ Kabupaten	Existing Irrigation Scheme (*1)								On-going/ Committed	Idea Schemes(*2)	
	Technical		Semi-Tech		Simple		Total				
	(Nos)	(ha)	(Nos)	(ha)	(Nos)	(ha)	(Nos)	(ha)	(ha)	(Nos)	(ha)
JAMBI	2	499	63	14,176	49	824	114	15,499	11,271	8	134,529
Kerinci	0	0	26	9,277	8	604	34	9,881	2,023	0	0
Bungo Tebo	2	499	16	1,616	16	205	34	2,320	4,373	2	8,346
Sarko	0	0	19	1,616	16	15	35	1,631	3,402	6	126,183
Batang Hari	0	0	1	1,637	7	0	8	1,637	282	0	0
Tanjung Jabung	0	0	1	30	2	0	3	30	1,191	0	0
SOUTH SUMATRA	2	26,782	55	16,908	29	4,135	86	47,825	16,587	26	153,700
OKU	1	18,691	13	1,992	12	2,766	26	23,449	4,328	5	42,155
OKI	-	-	-	-	-	-	-	-	-	7	42,574
Muara Enim	0	0	6	458	5	246	11	704	909	3	11,070
Lahat	0	0	19	9,564	10	1,073	29	10,637	3,912	0	0
MURA	1	8,091	13	4,464	1	0	15	12,555	6,306	5	31,200
MUBA	-	-	1	1,240	-	-	-	-	380	6	26,701
Bangka	0	0	2	330	0	0	2	330	751	0	0
Belitung	0	0	2	100	1	50	3	150	381	0	0
BENGKULU	24	17,432	168	21,364	122	7,521	314	46,317	25,187	2	10,514
B. Salatan	2	4,043	61	8,844	55	4,939	118	17,826	8,913	1	5,600
Rejang Lebong	11	7,311	75	10,797	13	527	99	18,635	1,900	0	0
B. Utara	11	6,078	32	1,723	54	2,055	97	9,856	14,374	1	4,914
LAMPUNG	19	70,388	59	13,315	29	2,550	107	86,253	68,703	14	110,455
L. Selatan	8	5,635	44	9,592	1	500	53	15,727	4,056	0	0
L. Tengah	8	60,961	15	3,723	0	0	23	64,684	34,555	2	11,750
L. Utara	3	3,792	0	0	28	2,050	31	5,842	30,092	12	98,705

Sources : (*1) Pekapitulasi Inventarisasi Daerah Irigasi, PU 1989.
(*2) by hearing survey from respective Provincal government.

Table 6.1.3 List of Project Ideas for Irrigation Development

No.	Project Name	Kabupaten	River	Irrigation Area(ha)	Remarks
JAMBI				**134,529**	
1	Batang Bungo	Bungo-Tebo	Bt.Bungo	7,400	D/D
2	Kuamang Kuning	Bungo-Tebo	S.Pelepat	946	D/D
3	Batang Tabir	Sarko	Bt.Tabir	50,000	Identified by ADCA,1990
4	Batang Merangin	Sarko	Bt.Merangin	60,000	Idea Level
5	Batang Asai	Sarko	Bt.Asai	7,000	D/D
6	Batang Limun	Sarko	Bt.Limun	2,468	D/D
7	Batang Reban	Sarko	Bt.Reban	2,285	D/D
8	Batang Singkut	Sarko	Bt.Singkut	4,430	D/D
SOUTH SUMATRA				**153,699**	
9	Belitang 1,2,3	OKU	A.Komering	20,600	Upper Komering Scheme
10	Belitang 4	OKU	A.Komering	8,750	ditto
11	Tanjung Raya	OKU	A.Komering	1,875	ditto
12	Way Hitam Kiri	OKU	A.Komering	3,830	ditto
13	Muncak Kabau	OKU	A.Komering	7,100	ditto
14	Lempuing	OKI	A.Komering	13,100	Lower Komering Scheme
15	Sungai Rotan	OKI	A.Komering	5,080	ditto
16	Lebak Bungur	OKI	A.Komering	6,594	ditto
17	Lebak Palas 1,2	OKI	A.Komering	8,750	ditto
18	Tanjung Balai	OKI	A.Komering	1,750	ditto
19	Dangku Kiri	Muara Enim	A.Enim	3,820	
20	Dangku Kanan	Muara Enim	A.Enim	3,750	
21	Modong	Muara Enim	A.Enim	3,500	
22	Sekayu/Lumpatan	MUBA	A.Musi	5,800	Batanghari Leko Scheme
23	Danau Calah	MUBA	A.Musi	2,800	ditto
24	Batanghari Leko	MUBA	A.Musi	4,400	ditto
25	Lebak Semendawai	OKI	A.Ogan	5,300	
26	Lebak Air Daros	OKI	A.Ogan	2,000	
27	Air Malus 2	MURA	-	1,500	
28	Air Baal	MURA	-	5,500	
29	Air Kati	MURA	-	1,500	
30	Rupit	MURA	A.Rupit	11,100	Upper Musi Scheme
31	Air Rawas	MURA	A.Rawas	10,000	ditto
32	Lakitan	MURA	A.Lakitan	11,600	ditto
33	Talang Niur	MUBA	A.Musi	2,500	
34	Babat Toman	MUBA	A.Musi	1,200	
BENGKULU				**14,719**	
35	Muko-Muko Kanan	B.Utara	A.Manjuto	4,919	D/D
36	Air Selagan	B.Utara	A.Selagan	4,200	F/S by JICA
37	Air Alas	B.Selatan	A.Alas	5,600	F/S
LAMPUNG				**136,955**	
38	Way Abung	L.Utara	W.Abung	13,000	
39	Way Pedada	L.Utara	W.Pedada	13,500	
40	Way Giham	L.Utara	W.Giham	5,000	
41	Way Bahuga	L.Utara	W.Bahuga	5,000	
42	Way Pisang	L.Utara	W.Pisang	330	
43	Way Besai	L.Utara	W.Besai	40,000	
44	Wai Bawang	L.Utara	W.Bawang	40,000	
45	Way Kampar	L.Utara	W.Kampar	750	
46	Way Tangguh	L.Utara	W.Tangguh	650	
47	Way Bambang	L.Utara	W.BAmbang	100	
48	Way Pontan	L.Utara	W.Pintau	100	
49	Ngaras	L.Utara	W.Ngaras	275	
50	Ngambur	L.Utara	W.Ngambur	2,500	
51	Way Biha	L.Utara	W.Biha	4,000	
52	Rumbia	L.Tengah	W.Sekampung	3,750	
53	Way Bekri	L.Tengah	W.Bekri	8,000	
	TOTAL OF THE REGION			**439,902**	

SOURCES : Musi River Basin Study, DGWRD, PU, 1989
Master Plan Study for Mesuji and Tulangbawan River Basins, DGWRD,PU,1989
Hearing survey from local government

Table 6.1.4 Existing / On-going Swamp Reclamation Schemes

Province / Kabupaten	Total Schemes (Nos.)	(A) Identified Area (ha)	Existing Area				(B)	Existing Farmars (families)	(A)-(B) Un-developed Area (ha)
			Paddy (ha)	Up-land (ha)	Tree crops (ha)	Others (ha)	Total (ha)		
JAMBI	17	71,008	29,267	5,614	2,311	2,346	39,538	16,844	31,470
Kerinci	1	384	200	72	0	0	272	200	112
Sarko	1	567	130	11	0	0	141	141	426
Batanghari	4	13,950	5,050	185	220	97	5,552	2,305	8,398
Tanjung Jabung	10	56,002	23,819	5,326	2,086	2,237	33,468	14,138	22,534
Bungo-tebo	1	105	68	20	5	12	105	60	0
Kota.Jambi	0	0	0	0	0	0	0	0	0
SOUTH-SUMATRA	47	471,060	149,510	59,134	32,102	16,718	257,464	124,431	213,596
Ogan Komering Ulu	1	1,200	680	480	0	40	1,200	800	0
Ogan Komering Ilir	16	135,202	68,010	30,740	5,410	14,245	118,405	62,435	16,797
Muara Enim	0	0	0	0	0	0	0	0	0
Lahat	1	500	280	120	20	80	500	334	0
Musi Rawas	8	10,300	3,200	5,000	40	260	8,500	5,668	1,800
Musi Banyuasin	18	323,121	77,050	22,574	26,602	1,896	128,122	54,738	194,999
Bangka	1	500	160	220	0	120	500	300	0
Belitung	0	0	0	0	0	0	0	0	0
Kota.Palembang	2	237	130	0	30	77	237	156	0
Kota.Pangkalpinang	0	0	0	0	0	0	0	0	0
BENGKULU	5	15,700	3,590	3,150	0	50	6,790	4,057	8,910
Bengkulu Selatan	3	14,400	3,040	2,950	0	50	6,040	3,407	8,360
Rejang Lebong	0	0	0	0	0	0	0	0	0
Bengkulu Utara	2	1,300	550	200	0	0	750	650	550
Kota.Bengkulu	0	0	0	0	0	0	0	0	0
LAMPUNG	6	52,050	22,996	1,750	0	1,205	25,951	22,833	26,099
Lampung Selatan	2	22,050	18,936	100	0	265	19,301	16,233	2,749
Lampung Tengah	0	0	0	0	0	0	0	0	0
Lampung Utara	4	30,000	4,060	1,650	0	940	6,650	6,600	23,350
Kota.Bandarlampung	0	0	0	0	0	0	0	0	0
TOTAL	75	609,818	205,363	69,648	34,413	20,319	329,743	168,165	280,075

Source : Inventarisasi Luas Pemanfaatan Lahan Rawa Pasang Surut dan Rawa Non pasang Surut (P2TRPDR,DGWRD, PU, August,1989)

Table 6.1.5 Potential for Swamp Reclamation

Province	Scheme	Kabupaten	Area (ha)	Source
Current Condition of Swamp Reclamation				P2TPDR,PU
JAMBI				
	Total Swamp Area		1,902,301	
	Suitable Area		384,740	
	Developed Area		71,003	
	Potential Area		313,737	
SOUTH SUMATRA				
	Total Swamp Area		5,679,174	
	Suitable Area		3,007,139	
	Developed Area		471,060	
	Potential Area		2,536,079	
BENGKULU				
	Total Swamp Area		267,232	
	Suitable Area		121,703	
	Developed Area		15,700	
	Potential Area		106,003	
LAMPUNG				
	Total Swamp Area		348,062	
	Potential Area		108,517	
	Developed Area		52,050	
	Remaining Area		56,467	
SOUTHERN SUMATRA				
	Total Swamp Area		8,196,769	
	Potential Area		3,622,099	
	Developed Area		609,813	
	Remaining Area		3,012,286	

Note :

1) P2TPDR : Proyek Perencanaan Teknis Pengembangan Daerah Rawa

6.1.6 Hydropower Development

Power supply system in the Region is so far isolated by major energy consumption area, where power generation is generally depended on diesel generators. Isolated power system rises many problems such as low efficiency and the difficulty of the effective maintenance. The existing transmission line is found only two lines Pelembang - Bukit Asam and Tes - Curup, Bengkulu, however, PLN, state electric company plans to interconnect power supply system within the Region and further to expand whole Sumatra Island aiming at attaining stable power supply and effective operation of the system.

Tes-1 hydropower station is currently one and only major hydropower plant with 16 MW of installed capacity located downstream of Lake Tes in Kabupaten Rejang Lebong of Bengkulu Province for generating power mainly to Bengkulu City. The other two hydropower projects are so far under detailed design, Besai-1 with 90 MW in Lampung Utara and Musi-1 with 111 MW in Rejang Lebong for further interconnection of transmission to Palembang and Bandar Lampung cities.

Previous studies revealed abundant hydropower development potential in the Region. Thirty five potential schemes are identified in four provinces expected to 8,280 GWh of annual energy output with 1,650 MW of total installed capacity. Development potential is shown in Figure 6.1.3, and Table 6.1.6.

6.2 DEVELOPMENT CONCEPT 2010

Figures 6.2.1 and 6.2.2 show water resources development contrasting between 1990 and 2010, and the general development concept is as follows:

6.2.1 Water Supply

Expansions of water supply system will be mainly focused within the sector, particularly for major cities in the view of population density and the impact of the project. Table 6.2.1 summarizes the long-term water supply program for respective provincial capital cities.

Long-term water supply plan with the period between 20 and 25 years was provided for respective Provincial capital except Jambi City. It is generally required such long term water supply plan for the provincial capital cities to encourage smooth economic growth and social welfare. According to the long term master plan, the water supply service ratio to the population is expected more or less 70% in 2010, contrasting the current average service ratio is 29.5% for the provincial capital cities.

The planning horizon of the towns along the major river basins also required expansion of water supply program with the long-term view as the components of frame work plan for the basin-wide water resources development and management. Expansion of water supply system for the other cities, towns and villages will be required under the mid-term development with the period of 5 or 10 years, together with detailed financial plan and institutional arrangement.

Table 6.1.6 Major Hydropower Potential in The Region

No.	Project Name	River	Province	Catchment Area (km2)	Firm Discharge (m3/s)	Installed Capacity (MW)	Energy Output (GWh/yr)	Phase	Remarks
1	Merangin-1	Merangin	Jambi	-	-	22.4	98.1	HPPS'83	*1
2	Merangin-2	Merangin	Jambi	-	-	340.0	1136.0	F/S'91	*7
3	Merangin-3	Merangin	Jambi	-	-	57.4	251.4	HPPS'83	*1
4	Merangin-5	Merangin	Jambi	2,597	24.5	24.0	155.5	Pre F/S'87	*2
5	Asai-4	Asai	Jambi	-	-	41.9	200.1	HPPS'83	*1
6	Ranau	Selabung	S.Sumatra	508	14.5	60.0	145.9	F/S'87	*1
7	Selabung-2	Selabung	S.Sumatra	1,005	31.5	73.0	443.7	HPPS'83	*1
8	Selabung-3	Selabung	S.Sumatra	1,155	40.3	20.8	184.0	HPPS'83	*1
9	Enim-3	Enim	S.Sumatra	468	21.8	47.0	300.9	HPPS'83	*1
10	Lematang-4	Lematang	S.Sumatra	1,148	46.3	83.2	676.4	Pre F/S'87	*2
11	Musi-1	Musi	S.Sumatra	610	14.0	69.2	582.5	D/D'91-	*1
12	Kutu	Kutu	S.Sumatra	246	9.3	39.6	266.4	HPPS'83	*1
13	Buluh	Lematang	S.Sumatra	1,350	8.0	12.2	105.5	Pre F/s'81	*4
14	Tanjung Pula	Ogan	S.Sumatra	360	5.3	26.7	116.0	Pre F/s'81	*4
15	Kota Agung	Selabung	S.Sumatra	1,250	15.8	37.2	163.0	Pre F/s'81	*4
16	Sejemput	Lematang	S.Sumatra	1,800	34.6	100.0	43.0	Pre F/s'81	*4
17	Sula	Kutu/Rawas	S.Sumatra	235	8.2	12.8	56.0	Pre F/s'81	*4
18	Muara Lintang	Musi	S.Sumatra	2,940	48.4	20.9	92.0	Pre F/s'81	*4
19	Panjung	Lematang	S.Sumatra	280	31.4	22.0	100.0	Pre F/s'81	*4
20	Baru	Selabung	S.Sumatra	1,110	14.3	35.0	153.0	Pre F/s'81	*4
21	Luas-3	Luas	Bengkulu	616	25.8	32.2	200.0	HPPS'83	*1
22	Manna-1	Manna	Bengkulu	460	20.8	77.2	629.6	HPPS'83	*1
23	Ketahun-1	Ketahun	Bengkulu	314	10.4	19.8	128.7	HPPS'83	*1
24	Ketahun-4	Ketahun	Bengkulu	1,091	50.4	40.8	216.7	HPPS'83	*1
25	Besai-1	Besai	Lampung	420	9.3	61.6	380.3	D/D'90	*1
26	Batutegi	Sekampung	Lampung	424	-	24.0	105.1	F/S'78	*6
27	Besai Gedongbatin	Besai	Lampung	686	31.2	-	-	Pre F/S'89	*5
28	Giham Pungkan	Giham	Lampung	52	-	40.0	212.5	Pre F/S'89	*5
29	Upper Semangka-1	Semangka	Lampung	290	12.5	26.8	143.0	Pre F/s'92	*8
30	Upper Semangka-2	Semangka	Lampung	383	29.8	23.2	123.0	Pre F/s'92	*8
31	Upper Semangka-3	Semangka	Lampung	416	32.3	28.2	151.0	Pre F/s'92	*8
32	Lower Semangka-1	Semangka	Lampung	799	50.3	35.5	182.0	Pre F/s'92	*8
33	Lower Semangka-2	Semangka	Lampung	840	52.9	40.4	209.0	Pre F/s'92	*8
34	Semung-1	Semung	Lampung	312	19.7	23.8	123.0	Pre F/s'92	*8
35	Semung-2	Semung	Lampung	320	20.2	38.7	202.0	Pre F/s'92	*8

Sources:
*1 : Hydro Power Potential Study, 1983, Nippon Koei Co, Ltd (IBRD)
*2 : Pre Feasibility Study on 21 Hydropower Project, 1987, Nippon Koei Co.,Ltd. (IBRD)
*3 : Feasibility Study for Ranau Hydropower Project, 1987, JICA
*4 : Musi River Basin Study, 1989, BCEOM (EC)
*5 : Tulangbawang and Mesuji River Basin Master Plan Study, 1989, Binnie and Partners
*6 : Lanpung Water Resources Development Project, 1978, UK
*7: Feasibility Study for Merangin-2 Hydropower Project, 1990, Wiratman (IBRD)
*8: Pre-F/S carried out by the Study (LTA-129) in 1992 based on the PLN data.

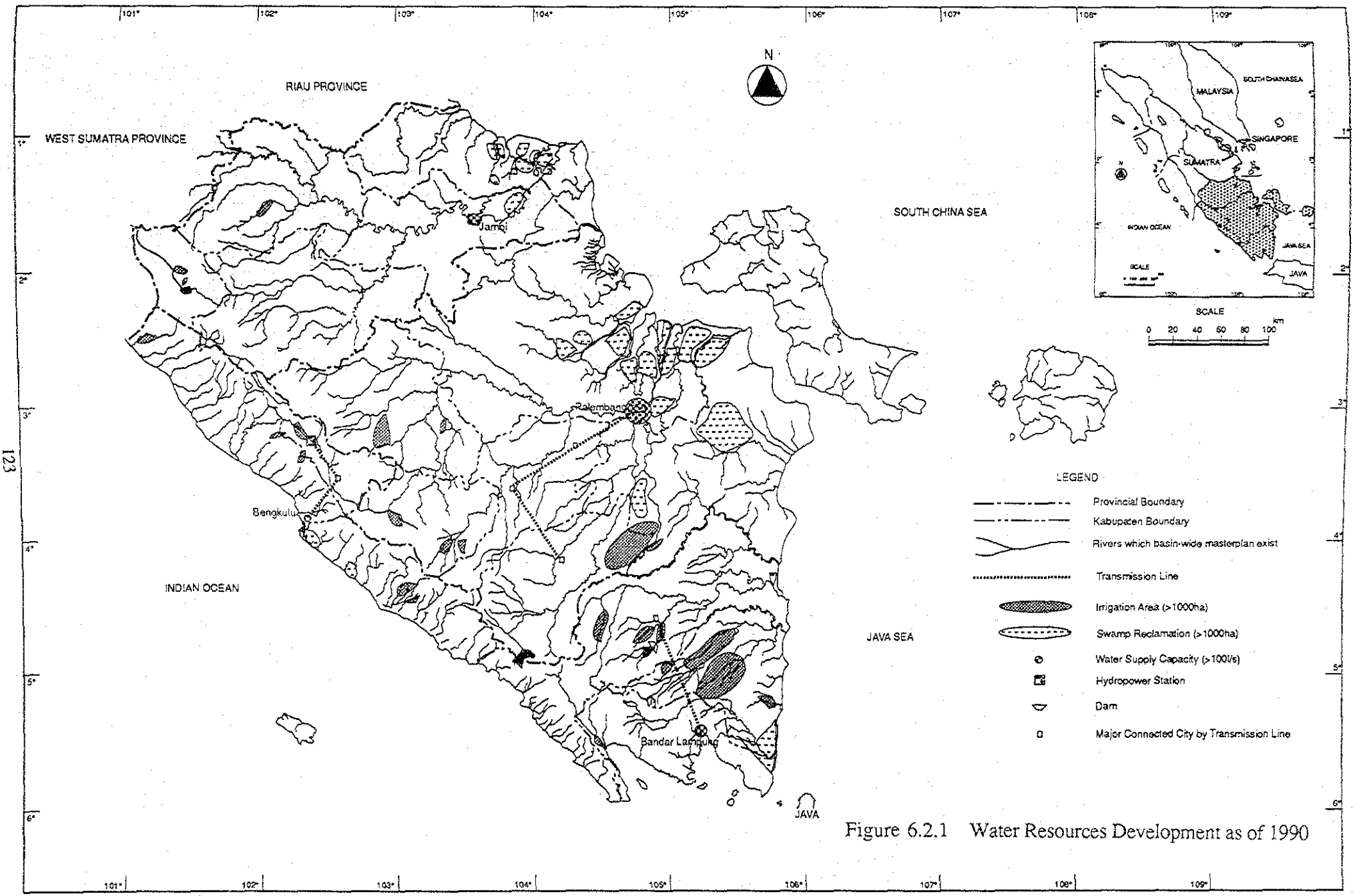


Figure 6.2.1 Water Resources Development as of 1990

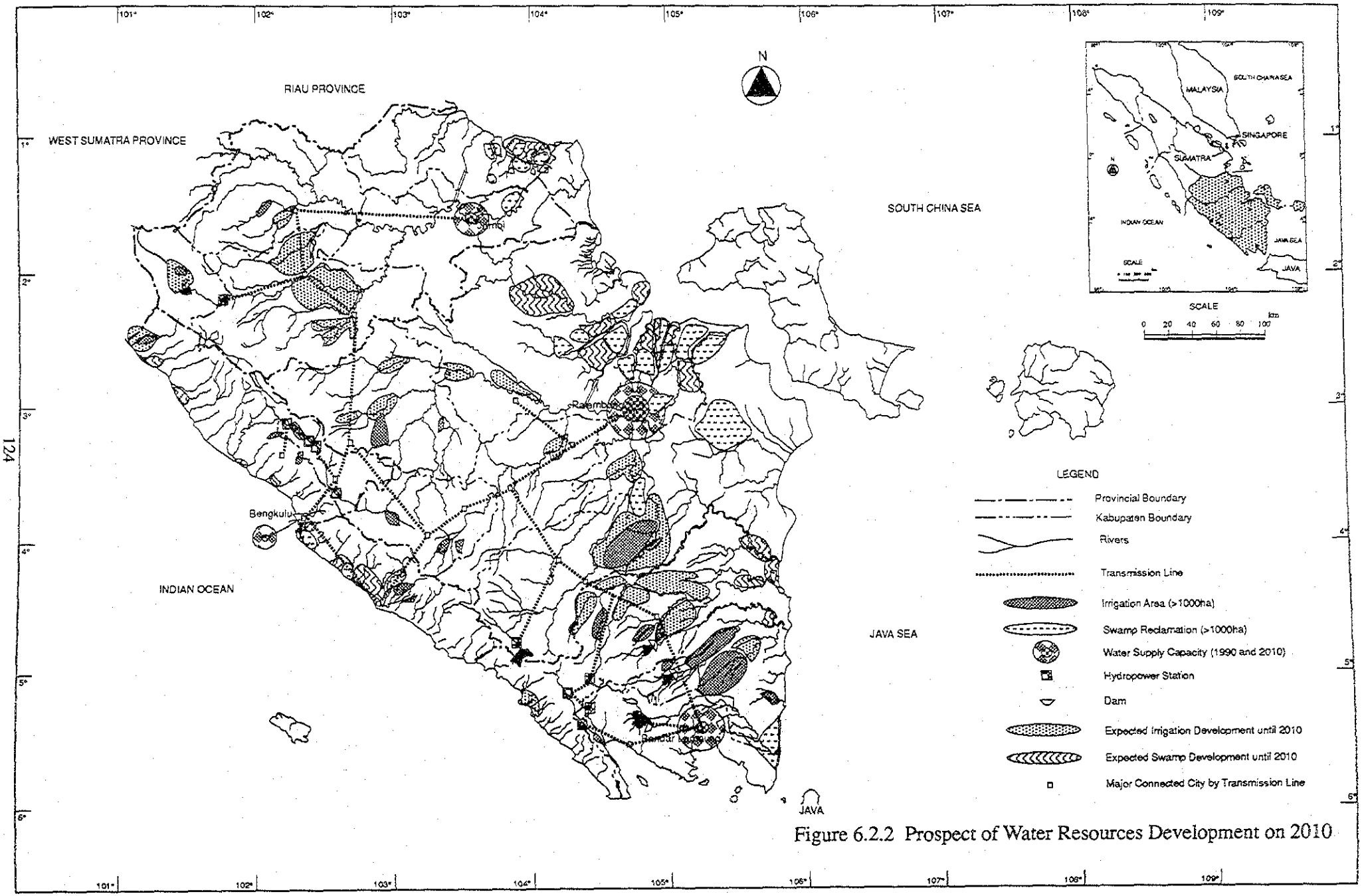


Figure 6.2.2 Prospect of Water Resources Development on 2010

Table 6.2.1 Long-Term Water Supply Program for Major Cities

	Jambi (Jambi)	Palembang (S. Sumatra)	Bengkulu (Bengkulu)	Bandar Lampung (Lampung)
1. Current Condition				
(1) Population	339,786	1,139,926	170,327	636,706
(2) Area	206.0 km2	224.0 km2	144.5 km2	169.2 km2
(3) Population in Service Area	-	-	-	198,125
(4) Several % of Population Served	135,902	479,747	20,279	139,625
(5) Service Ratio to Administrative Population	40.0%	42.1%	11.9%	6.2%
(6) Raw Water Intake Capacity	-	-	-	570 l/Sec
(7) Treatment Capacity	310 l/Sec	1.550 l/Sec	100 l/Sec	300 l/Sec
(8) Major Water Resources	Batang Hari	Air. Musi	Air Bengkulu	Way Kuripan
(9) Coverage Period Within The Existing Facilities	-	Upto 1995	Upto 1994	Upto 1995
2. Further Water Supply Program				
(1) Water Supply Master Plan	None	1991	1991	1986
(2) Supporting Agency		ADB (IUIDP)	German	AIDAB (Australia)
(3) Coverage Period		1995 - 2015	1995 - 2015	1985 - 2010
(4) Estimated Population on Target Year		2,391,000 (2015)	489,950] (2014)	1,479,000 (2010)
(5) Expected Service Population on Target Year		1,919,000 (2015)	-	1,087,000 (2010)
(6) Overall % to Population Served		79.8%	-	73.4%
(7) Required Raw Water Resources		8,430 l/S	1,250 l/Sec	4,475 l/Sec
(8) Target Per Capita Consumption		1951 l/head/day	-	182 l/head/day
(9) Estimated Treatment Capacity		7,330 l/S	1,200 l/Sec	4,341 l/Sec
(10) Major Water Resources		Air Musi 6,830 l/S Air Ogan 1,600 l/S	Air Bengkulu Air Nelas	Way Kuripan 780 l/S Way Sabu 2,150 l/S Ketibung G/W 1,000 l/S Others 220 l/S Way Sekampung 2,000 l/S

Sources : Masterplan Study for Palembang Water Supply Project, (IUIDP,1991)
Bengkulu Water Supply Project, 1991
Masterplan Study for Bandarlampung Water Supply Project (AIDAB, 1986)

6.2.2 Flood and Sedimentation

As mentioned in Section 6.1, the existing flood and sediment damages can be classified the following two types, flood and debris flow damages at the fringe of mountains, and flood and sediment damages at major cities in low land area. It is required to consider the different approaches as shown below.

A number of medium and small towns, and villages are located on the fringe of Bukit Barisan Range, which are seriously damages to human lives and the river structures such as the irrigation intakes, the bridges and so on, due to the violence of flood and debris flow. The required countermeasures are mainly aiming at energy dissipation of the flood and the

debris flow. Debris flow control is particularly important for the areas because the volcanic activities by Trans Sumatra Fault Zone are remarkable and the geological condition is brittle.

The urgent countermeasures, such as construction of Sabo dams, protection of land erosion and also river dyking, are generally done by the local government in the view of social welfare. However, it is still necessary to continue the sabo activities particularly in Kerinci and Lampung Selatan, in where the current population density is relatively high and the habitual debris flow disaster is occurred. The long term sabo master plan is required considering the technical and financial assistance from the foreign countries in such major damaged area.

On the other hand, the flood and sediment damages in the eastern low land area is required the different approach. Because the rivers located in the area have the larger watershed, the longer river length and the gentle gradient. The flood characteristics are, therefore, long lag time , dull peak and long flood duration, and the damages are mainly not to human lives and the destroy of the infrastructures but decrease the validity of commodities by inundation, and being affected the economic activities due to the inundation of commercial zone and road network with longer period. The excess sediment deposition in the river channel is accelerate the flood damages due to decreased river capacity, and also damaged to the river transportation activities.

The integrated basin wide approach is proposed to tackle the issues aiming at the both of minimizing the flood damage and maximizing the economic development with the long term view. Because the huge flood prone area is spread in low land area, where is so far unused and functioning as the natural flood retarding basins for the downstream major cities, however, having higher potential for the future development as the hinterland of the cities. On the other hand, flood protection plan with pre-supposing the upstream development would be very costly for the major cities in low land area. The integrated basin wide approach should be therefore composed of the following considerable items;

- Basin environmental management,
- Partially river dyking and widening,
- Flood way channel,
- Basin land use plan with flood retarding basin plan,
- Dam and reservoir,
- Flood forecasting and warning system,
- Flood insurance system.

6.2.3 Irrigation Development and Swamp Reclamation

It is reported that national self-sufficiency of rice was attained in 1983 by great deal of effort for extensive irrigation development. After that, the sectoral priority was put on intensification of the existing paddy field to improve the efficiency of rice production particularly in Java and Sumatra Islands. According to Repelita V, area extension with 100,000ha per year of irrigation development is also required whole in Indonesia to maintain national self-sufficiency of rice taking into account the further population growth.

On the other hand, the regional policy was revealed that maintaining self-sufficiency of rice in the Region is put priority among the regional development activities, and it was found that the regional government is still interested in extensive irrigation development. Lampung and South Sumatra Provinces are particularly expected to develop large scale irrigation schemes because the provinces are situated rice granary in the view of maintaining national self-sufficiency of rice. Current major rice supply base in the Region are Kabupatens Lampung Tengah, OKI, MUBA, and Tanjung Jabung. All those Kabupatens mainly produce rice in huge swamp area except Kabupaten Lampung Tengah.

Irrigation development is generally expected higher land productivity and the production stability with less affected by the climate condition, however, the capital investment is relatively higher than the swamp land paddy farming. In the case of on going Komering Irrigation Project in OKU, the estimated investment cost is more or less US$10,000/ha, is as 10 to 20 times as of capital investment for swamp land development with US$500 - 1,000/ha.

The paddy farming by "Pasang Surut" or "Lebak", which are found in South Sumatra and Jambi Provinces, are main production activity in the swamp reclamation area and becomes the dominant rice granary of the Region. However, the productivity appears much lower than the paddy farming by irrigated wetland in lowland area. Tree crops such as coconuts, rubber and oil palm can be considered as attractive alternatives to swamp paddy farming to enhance the economic activity in the swamp area. However, still more investment is required to reach the same output level as the plantation in inland has. Past experience of swamp development in the Region however seems to be unsatisfactory by various unexpected difficulties. The problem to be identified in the existing swamp reclamation area are as follows:

1) Low production efficiency,
2) Poor communication system (include road network),
3) Bad quality of groundwater and lack of water supply system,
4) Prevalent poverty among new settlers.

The further policy for swamp reclamation to be recommended therefore to improve the existing swamp reclamation area in the view of infrastructures and institution set-up for pursuit better production efficiency rather than to extend swamp reclamation area except the area where the land development is strongly required with effective economic viability.

6.2.4 Hydropower Development

Although the regional power supply system is currently separated from the major energy consumption centers, the system is expected to be linked in future as shown in Figure 6.2.2. Together with the expansion of transmission line network, hydropower development will be attractive for the regional power supply. Implementation plan of transmission expansion is shown in Table 6.2.2.

Table 6.2.2 Plan of Transmission Expansion in the Region

From - To	Voltage Level (kv)	No.of Circuit (Nos.)	Length	Target Year (Year)	Remarks
Bukit Asam - Palembang	150	2	-	-	Existing
Tes - Curup	70	2	40	1990	Existing
Curup - Bengkulu	70	2	60	1990	Existing
Bukit Asam - Baturaja	150	2	90	1991	Existing
Katabumi - Tarahan	150	1	135	1991	Existing
Lahat - Pagar Alam	70	2	40	1993	Committed
Baturaja- Kotabumi	150	1	60	1993	Committed
Lahat-Lubuk Linggau	150	1	100	1995	Committed
Lubuk Linggau - Curup	150	2	60	1995	Committed

* Source: Feasibility Study for Merangin - 2 HPP, March 1990 PLU

Furthermore, interconnection of PLN Region III, which covers West Sumatra and Riau Provinces, and IV covering four provinces in the Region, by 275 kv through Bangko has been recommended for implementation within the period 1993 to 1998 in the Long Range Power Development Study of Sumatra. The further policy of Power Supply within the Region is that the base load will be supplied by coal thermal plants in Bukit Asam, and the peak load by various hydropower stations in Bukit Barisan Range for all the major cities in the Region. Several major hydropower projects have been identified in the Region as shown in Table 6.2.3.

Table 6.2.3 Major Hydropower Project in the Region

Scheme	Province	Kabupaten	Target year (year)	Installed Capacity (MW)	Annual Energy Output (GWh/yr)	Current condition
Tes-1	Bengkulu	Rejang Lebong	1991	16	-	operation
Besai-1	Lampung	L. Utara	1996	90	380.3	D/D completed
Musi-1	Bengkulu	Rejang Lebong	1998	111	582.5	D/D on-going
Merangin-2	Jambi	Kerinci	2001	340	1136.0	F/S completed
Katahun-1	Bengkulu	Rejang Lebong	2003	84	175.0	F/S completed
Ranau	S. Sumatra	OKU	-	60	145.9	F/S completed
Tes-2	Bengkulu	Rejang Lebong	-	17	-	waiting F/S
Merangin-5	Jambi	Sarko	-	24	155.5	waiting F/S

Source: PLN, Feasibility Study for Merangin-2 Hydropower Project, 1990

Micro hydropower development applied to mountain streams and artificial irrigation canals with simple structures seem to be attractive for rural electrification particularly in Bengkulu and Lampung Provinces. Considering the further expansion of power supply system, special program for rural electrification is required since the many isolated villages in the Region will still remain without access to the system.

6.3 ISSUES AND STRATEGY

6.3.1 Water Supply and Sewerage Treatment

(1) Urban Water Supply and Sewerage Treatment

Most of the urbanized area in the region has generally abundant water resources for water supply, however ensuring raw water resources for water supply of Bandar Lampung City is urgently required. Because the present water resources is almost limited in the view of water quantity and the Way Sekampung River, which is expected as the further water resources for the city, is fully used for irrigation, and no more water to be allocated for Bandar Lampung city under the present condition. Reassessment of water allocation and construction of Batutegi multi purpose dam and reservoir are recommended together with the research of the other new water resources in and around the city.

Long-term water supply plan has been almost completed for the urban water supply. However, the institutional arrangement for the implementation work and the operation

and maintenance for the system seem to be insufficient. Strengthening of water supply agency is necessary for smooth implementation of the further expansion of water supply system. Detail assessment of institutional set-up including tariff system and staff increasing and training shall be carried out together with long-term water supply program particularly for PDAM in major cities.

Sewerage treatment condition is remarkably poor compared with the water supply capacity. Water pollution will become more serious together with expansion of water supply capacity, because the expansion of water supply system is generally to increase water consumption and resulting increase of waste water. In the view of sustainable environmental condition, the further water supply program should be linked with the sewerage treatment with adequate capacity.

(2) Rural Water Supply

Rural water supply is gradually expanding the Region without priority area under the equity policy. However, it is recommended to consider the availability of spring, river flow, and groundwater for respective village to reveal the priority areas. The villages located in eastern coastal swamp generally suffer from bad quality of groundwater, no adequate alternatives to rural water supply by treated water, where is strongly required to supply potable water.

6.3.2 Flood and Sedimentation

(1) Urgent Flood Control, Sabo, and Drainage

In some places, the urgent countermeasures are required for the flood control, sabo and urban drainage issues in view of the social stability and basic human needs. The most of the identified area has already made countermeasures by the regional government, but still required the technical and financial assistance. The following area have identified to be required urgent action;

- Jambi City (flood control and urban drainage)
- Batang Suliti River in Kerinci (debris flow control)
- Lake Kerinci Basin in Kerinci (flood control)
- Palembang City (drainage)
- Allied rivers flow to Semangka Bay in Lampung Selatan (flood control and sabo)

(2) Basin Wide Approach

Together with the urgent flood control works where the serious flood damage occurs, comprehensive basin-wide flood management plan is required, which should be a components of basin-wide water resources development master plan because the respective flood control works can influence other areas within the basin. Particularly, flood control works in the Musi and the Batanghari River Basins are required within the basin-wide approach.

"Musi River Basin Study" has completed in 1989, which is a comprehensive study including water resources development, flood control plan, irrigation and swamp development and environmental management with the basin-wide long-term view. Flood control and urban drainage for Palembang City, which require urgent actions shall be carried out pre-supporting the results of the master-plan study.

On the other hand, there is no comprehensive river basin study for the Batanghari River in spite of the flood and sediment issues as summarized below:

1) Forest degradation in Kerinci Seblat National Park
2) Flood damage in Lake Kerinci Basin
3) Debris flow damage in Batang Suliti Basin
4) Bank erosion of Batang Hari river
5) Flood and inundation damages in Jambi City
6) Influence river transportation due to excess sediment deposition

It is noted that the above problems are not independent but strongly related to each other. Therefore, it is required to tackle the issues with the basin-wide view.

6.3.3 Irrigation Development

(1) Continue the on-going large scale irrigation schemes

Two large-scale irrigation schemes, that is, Way Rarem Irrigation scheme with 22,000 ha in Lampung Utara and Upper Komering Irrigation scheme with 42,155 ha in Ogan Komering Ulu, should be put top priority in the view of national and regional requirements to yield surplus production of rice within the Region. The both projects are currently under construction and Way Rarem is expected to complete in the early 1990's and Upper Komering in the later 1990's.

Intensification of Way Sekampung Irrigation scheme together with construction of Batutegi dam and reservoir in Lampung Utara is also put priority in the sectoral view point. Construction of Batutegi dam and reservoir will be expected not only for irrigation purpose but also for industrial and potable water supply purposes for Bandar Lampung City and the industrial area. Therefore, the detailed assessment of water allocation among irrigation, industrial and potable water supply for Bandar Lampung City should be done before the project commencement.

(2) Feasibility Study for the identified irrigation schemes

The other major irrigation development in Kabupatens Lampung Utara, Ogan Komering Ilir, Musi Banyuasin, Musi Rawas, Bengkulu Utara and Sarolangun Bangko are also expected to be developed however presupposing long-term demand forecasting of rice consumption with national level is required to encourage implementation of the projects . The priority among the projects listed in Table 6.1.3 shall be considered following to the national level of long-term rice consumption in Indonesia and the transmigration program.

(3) Development of small scale irrigation schemes

The medium and small scale irrigation development can directly contribute to the improvement of the smallholders' well-being and therefore is recommended in the view of the national equity policy and the regional stability. There are some programs to encourage the improvement of the small scale schemes such as Provincial Irrigated Agriculture Development Project (PIADP), and Small Scale Irrigation Management Project (SSIMP).

PIADP financed by IBRD aims at improvement of the existing small-scale irrigation projects with the provincial view, including structure rehabilitation, institutional arrangement and modification of cropping pattern and so on. The project is currently carried out for Bengkulu Province and expected a great deal of impact for improvement of rural development. On the other hand, SSIMP financed by USAID and Japanese OECF aims at encouraging implementation of the identified small-scale irrigation projects which are trapped for various reasons such as technical, institutional and financial constraints. The project is currently carried out in Eastern Indonesia but it is expected to apply such kind of approach to the Region.

Table 6.3.1 Present Condition of The Southern Part of Sumatra

Province	Kabupaten	Administrative Area (km2)	Population as of 1990 (thousand)	GRDP (Rp. billion)	GRDP per Capita (Rp. million)	Irrigation Area (ha)	Wetland Area (ha)	Paddy Production (ton)	Producton Yield (ton/ha)	Production per Capita (kg/person)	Remarks
Jambi		53,436	2,015	756	0.375	27,729	145,214	475,243	3.27	235.85	
	Kerinci	4,200	279	61	0.219	11,412	21,128	76,353	3.61	273.67	KR
	Bungo Tebo	13,500	361	114	0.316	5,059	12,285	36,764	2.99	101.84	BT
	Sarorangun Banko	14,200	350	119	0.340	8,995	5,324	17,149	3.22	49.00	SB
	Barang Hari	11,130	324	133	0.410	1,095	19,599	55,916	2.85	172.58	BH
	Tanjung Jabung	10,200	361	128	0.355	1,168	86,878	289,061	3.33	800.72	TJ
	Kota.Jambi	206	340	201							
South Sumatra		109,234	6,276	4,002	0.638	58,478	352,801	1,202,060	3.41	191.53	
	Ogan Komering Ulu	10,408	964	324	0.336	22,464	68,989	261,045	3.78	270.79	OKU
	Ogan Komering Iril	21,638	771	276	0.358	3,326	95,294	300,205	3.15	389.37	OKI
	Muara Enim	9,575	582	244	0.419	4,103	21,517	68,115	3.17	117.04	ME
	Lahat	4,034	602	248	0.412	20,914	31,062	130,366	4.20	216.55	LHT
	Musi Rawas	21,513	512	216	0.422	6,608	23,820	85,911	3.61	167.79	MR
	Musi Banyuasin	25,664	884	729	0.825	1,063	112,119	356,418	3.18	403.19	MB
	Bangka	11,614	514	428							
	Belitung	4,532	193	124							
	Kota. Palembang	224	1,141	1345							
	Kota. Pangkal Pinang	32	113	68							
Bengkulu		19,789	1,171	454	0.388	45,669	65,933	234,082	3.55	199.90	
	Bengkulu Selatan	5,949	298	102	0.342	14,997	27,354	101,012	3.69	338.97	BS
	Rejang Rebong	4,110	360	152	0.422	17,810	19,175	68,055	3.55	189.04	RR
	Bengkulu Utara	9,585	343	109	0.318	12,862	19,404	65,015	3.35	189.55	BU
	Kota. Bengkulu	145	170	91							
Lampung		35,377	6,006	1,939	0.323	135,292	264,062	1,113,402	4.22	185.38	
	Lampung Selatan	6,649	1,825	514	0.282	26,786	98,637	434,493	4.40	238.08	LS
	Lampung Tengah	9,190	1,901	591	0.311	86,305	116,684	478,476	4.10	251.70	LT
	Lampung Utara	14,418	1,335	359	0.260	22,201	48,741	197,277	4.05	147.77	LU
	Lampung Barat	4,951	308	68							
	Kota. Bandar Lampung	169	637	407				3,156			
Southern Sumatra		217,836	15,468	7,151	0.462		828,010	3,024,787	3.65	195.55	

Sources: kantor Statistik, Jambi, South Sumatra, Bengkulu and Lampung Provinces

(4) Conducting Integrated Agriculture Development Approach

It was revealed that the previous irrigation development in the region has contributed to the regional economic growth, but not directly to contribute to the improvement of the average farmers income. Correlation analysis was made to be clear the impact of irrigation development using the statistic data of all kabupatens in the region.

Figure 6.3.1 shows the correlation between irrigation ratio and production yield of paddy. The figure indicates there is strong relationship between the irrigation ratio and the production yield of paddy. Accordingly, irrigation development has effect on the increase the production yield of paddy.

Increase of production yield of paddy is however not contribute to the growth of per capita GRDP as shown in Figure 6.3.2. In the case of the region, eastern lowland area such as Batang Hari and OKI is the lower production yield of paddy between 2.7 ton/ha and 3.2 ton/ha, and Lampung Province has the higher production yield of paddy with more than 4.0 ton/ha due to great deal of investment for irrigation development. However, the per capita GRDP is almost same level in the both area. This figure may suggest the irrigation development is not directly contribute to the farmers income growth.

Figure 6.3.3 is the correlation between population density and production yield of paddy, showing strong relationship. The figure suggest that the irrigation development has an effect to increase of migrants from outside of the project area. Consequently, irrigation development can contribute to the regional economic growth due to the increase of labor receipt capability, and accelerate of migration from the outside poorer villages. However, it is still required to improve the income level for the farmers in the project area, and some countermeasures should be considered for the further irrigation development project.

6.3.4 Swamp Reclamation

(1) Improvement of The Existing Swamp Reclamation Area

Improvement of the existing swamp reclamation area is firstly recommended as the priority action. The main objective is to eliminate the serious poverty in the swamp reclamation areas by upgrading infrastructures, research alternative production activity and so on. The recommended procedure of improvement is as follows:

1) Upgrading communication network (rural road, telecommunication)
2) Provide water supply system and electricity
3) Upgrading drainage system with gated structures
4) Strengthening agricultural extension service
5) Development social structures such as school, mosques, and so on
6) Institutional set-up

For the research of new production activity as alternative to swamp paddy farming, three pilot projects are recommended as follows:

1) Pumping irrigation development pilot-project in Kabupaten Musi Banyuasin of South Sumatra Province.
2) Small agro-industry using coconuts and coconuts shells in Kabupaten Tanjung Jabung of Jambi Province
3) Inland fishery improvement in Kabubaten Tanjung Jabun of Jambi Province.

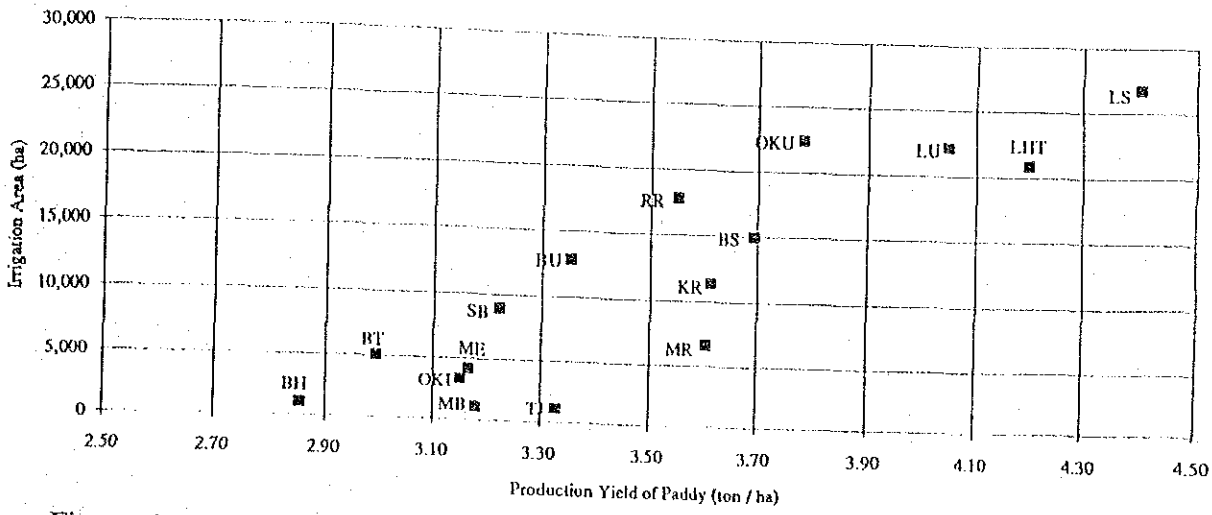


Figure 6.3.1 Relationship between Irrigation Area and Production Yield of Paddy

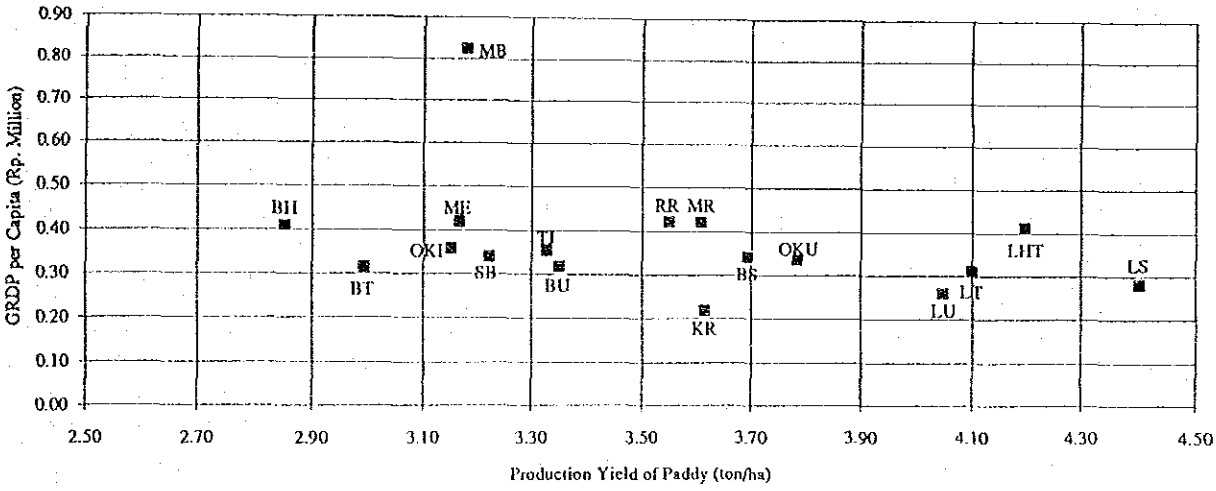


Figure 6.3.2 Relationship between GRDP per Capita and Production Yield of Paddy

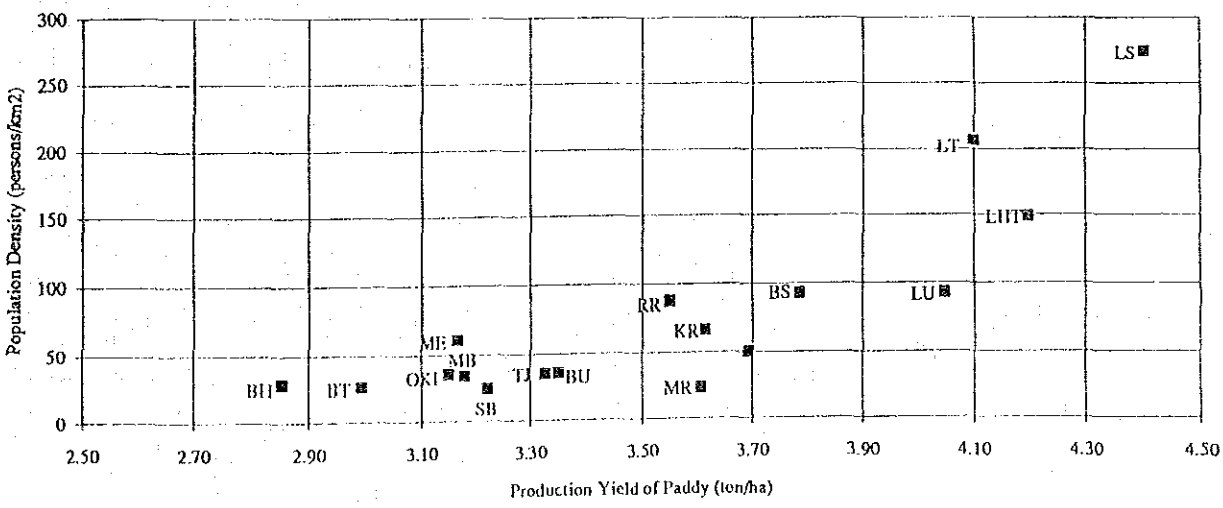


Figure 6.3.3 Relationship between Population Density and Production Yield of Paddy

Location advantage can be considered in the view of marketing further prospect of the existing swamp reclamation area as the gateway to the Growth Triangle, which is composed of Singapore, Batam and Johor. Kabupaten Tanjung Jabung in Jambi Province is particularly expected further development as the hinterland of the Growth Triangle. The second priority therefore shall be intensive development of enhancement agricultural production aiming at the Growth Triangle. The long-term marketing research is required to realize the intensive swamp development for Kabupaten Tanjung Jabung.

(2) Extensive Swamp Reclamation in Bengkulu Province

Another requirement to extend swamp reclamation area is found in Bengkulu Province, which has limited land for development and expects extensive development particularly for agro-based industry. The huge swamp area is located in Kabupaten Bengkulu Selatan along the western coast between Bengkulu City and Manna. The transportation advantage is confirmed because of closeness to Bengkulu Port and on-going new road network to Bandar Lampung city. There are three swamp reclamation schemes as the components of the recommended development plan:

1)	Rawa Peninjauan	10,600 ha	on-going
2)	Rawa Penago	3,800 ha	on-going
3)	Rawa Alas	6,500 ha	New

6.3.5 Hydropower Development

(1) Realize On-going and Committed Hydropower Schemes

Insufficient of the electric power supply for the Region is focused, and power supply shortage is forecasted in 1995/96. The installation of additional power generation facilities is one of the urgent matters, and there are two hydropower development projects, Besai-1 and Musi-1 schemes, are on-going or committed to realize. Implementation of the projects should be priority to satisfy the electric power demand by 2000.

Following to the schemes, two other hydropower schemes are scheduled to be installed, Merangin-2 on 2000/01, and Ketahun-1 on 2003/04. Since the feasibility study for the both schemes have completed with adequate economic viability, it is urgently required to carry out the detailed design to realize as scheduled.

(2) Provide the Power Supply Program after 2003/04

The existing power supply program for the Region covers until 2003/04, and the further power supply program is required, taking into account the inter connection to Northern Sumatra and also Java. For the further power supply program, the feasibility study for the other identified schemes in the Region such as Way Semangka schemes in Lampung Selatan, Manna-1 scheme in Bengkulu Selatan and Merangin-5 scheme in Kerinci are proposed, which are assumed rather attractive than the other identified schemes. Among them, Way Semangka schemes are assessed in the Study with pre-F/S level. The detailed are shown in Volume 4.

(3) Micro Hydropower Development for the Isolated Area

Micro hydropower development is expected as an alternative to isolated diesel power plant particularly in Kabupatens Bengkulu Utara, Bengkulu Selatan and Lampung Barat. These areas are not covered by the current expansion plan of transmission network but various potential sites for micro hydropower development might exist. It is recommended to research micro-hydropower development potential as the component of small rivers development for the rural development by small water resources development with local government initiative.

6.3.6 Basin Wide Water Resources Development

Water resources is one of the important economic and environmental assets of the Region. Considering development of water resources, it is strongly required to assess the environmental impact and adverse economic effect to the other area together with the economic viability of the project. The projects in a river basin are not independent but strongly related to the other issues within the same basin. River basin approach must be the most suitable way to assess the conservation, development and management of the land and water resources, particularly for the major river basins.

Sectoral approach can be recommended for the river basin where basin-wide master plan has completed as shown below:

1) Musi River Basin Study in 1989 (whole South-Sumatra Province)
2) Water Resources Development Master Plan for Mesuji-Tulangbawan River Basins in 1989 (Lampung Utara)
3) Master Plan Study for Komering River Basin 1982 (OKU and OKI)
4) Water Resources Development Master Plan for Way Sekampung and Way Seputih River Basins in 1978 (Lampung Selatan, Tengah)

Irrigation development and Flood control project are particularly required basin-wide approach. Accordingly the proposed irrigation and flood control projects in the Study are mainly located in the above 6 river basins.

The proposed area for a basin wide water resources development approach are shown in Figure 6.3.4. For the further water resources development and conservation, it is strongly recommended to take immediate actions to start Master Plan Study for Batang Hari River Basin, since this is the only major river basin which still lacks a basinwide master plan.

6.4 IDENTIFIED PROJECTS

41 Projects related to water resources sector have finally selected as the components of The Integrated Regional Development Master Plan for The Southern Part of Sumatra. These projects have been identified by the various agencies such as the central and provincial governments, international agencies and also the study team based on the field investigation. Figure 6.4.1 presents the location of the selected 41 projects which are well distributed by the province, 10 projects in Jambi, 16 in South Sumatra, 10 in Bengkulu and 11 in Lampung Province.

8 of the above 41 projects have defined high priority projects because of the importance, the urgency and the economic viability to the region. The detailed procedures how to define the high priority project is shown in Section 2.10 of Volume 2, "Main Report". Figure 6.4.2 shows the schematic location map of the high priority projects and the features are as follows;

(1) Batang Hari Integrated Basin Development Plan (Jambi Province)

It is recognized that water and land resources are the most important assets in Sumatra, and their effective and sustainable development is required for further national/regional development. The Batang Hari River basin with the second largest catchment area in Sumatra is blessed with abundant water and land development potentials for which efficient and harmonious development is considered important paramountly, and the national and provincial governments have accordingly identified significant necessity of conducting the Batang Hari River Integrated Basin Development Study considering the linkage among flood

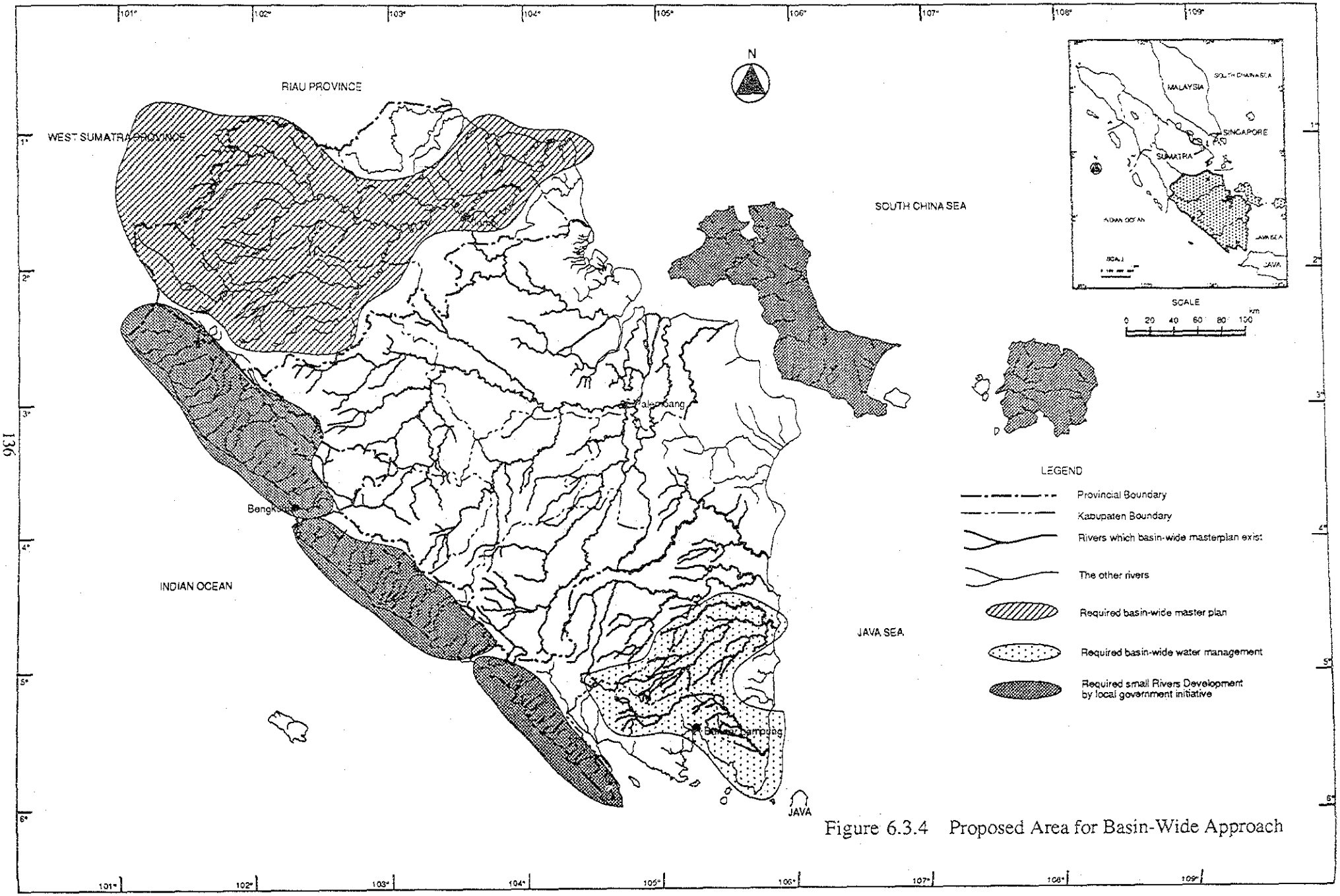


Figure 6.3.4 Proposed Area for Basin-Wide Approach

control, land/water resources development, and environmental conservation in view of the integrated regional development for the basin.

(2) Rural Water Supply Project for The Eastern Lowland Area (Tanjung Jabung, Musi Banyasin, and Ogan Komering Ilir)

Eastern coast of the southern part of Sumatra is generally isolated by road network, and scattered in the populated area. The villages, located on the area are generally suffering from the access to the potable water. Because the river water contains salt due to the backwater effect of the sea, and the shallow wells less than 50 m of the depth is almost affected acidity, which is not suitable for the drinking purpose. However, water supply project for such serious coastal area is situated low priority under the current program of the central government. Because, the priority of the water supply project is depended on the population density and there is no consideration of the availability of present potable water resources. Therefore, it is recommended to prepare the special program for rural water supply project for such low land area.

(3) Rehabilitation and Extension of The Existing Irrigation Schemes in Kabupaten Lahat (Lahat)

Kabupaten Lahat is located on the hilly land in South Sumatra Province. There are 29 existing irrigated schemes in Kabupaten Lahat with a total area of 10,673ha. Most of the schemes are rather small scale due to the topographic constraints. There is less potential for the extensive development for large scale irrigation , and consequently the major activity for the irrigation development is focused in the rehabilitation and expansion of the existing irrigation systems. The following 3 schemes are included in the project; Air Mulak with 2,207ha, Air Kuruh with 1,531ha and Lintang Kanan with 3,509ha.

(4) Lower Komering Integrated Agriculture Development Project (Ogan Komering Ilir)

The project are with 5,229 km^2 is located between Palembang City and on-going Upper Komering Irrigation Project site, where soil condition is adequate for paddy field, and expected advantage of marketing to Palembang City. The GOI expects the area is to be developed as *national rice granary together with Lampung Province. Current economic* condition is however insufficient due to habitual overflow of Ogan and Komering Rivers, and the irrigation development is inevitably required to consider the flood control of Ogan-Komering River System. On the other hand, the project area is currently forms seasonal swamp and contribute to flood mitigation for Palembang City as the natural flood retarding basin. Therefore, it is required the integrated approach to develop the area. The project is composed of 6 irrigation schemes with a total irrigation area of 28,470ha.

(5) Peninjauan Swamp Land Development Project (Bengkulu Selatan)

Swamp reclamation project for Peninjauan area with 10,600ha is on-going, and the main purpose is to develop irrigated agriculture land for transmigrants, who are long suffered from low intensity of production due to habitual inundation. In view of the regional development for Bengkulu Province, agro-industrial development is expected and Peninjauan Area is the most suitable location as the industrial development center. Because Peninjauan Area is located just next to the Bengkulu Port, and only 20 km from Bengkulu City, which has high advantage for the market access. The proposed study is accordingly to review the present land use plan considering the regional economic development with the improvement of the existing villages in Peninjauan Area.

(6) Tulang Bawan River Basin Irrigation Development Project (Lampung Utara)

(5) Peninjauan Swamp Land Development Project (Bengkulu Selatan)

Swamp reclamation project for Peninjauan area with 10,600ha is on-going, and the main purpose is to develop irrigated agriculture land for transmigrants, who are long suffered from low intensity of production due to habitual inundation. In view of the regional development for Bengkulu Province, agro-industrial development is expected and Peninjauan Area is the most suitable location as the industrial development center. Because Peninjauan Area is located just next to the Bengkulu Port, and only 20 km from Bengkulu City, which has high advantage for the market access. The proposed study is accordingly to review the present land use plan considering the regional economic development with the improvement of the existing villages in Peninjauan Area.

(6) Tulang Bawan River Basin Irrigation Development Project (Lampung Utara)

Lampung Province has situated as a part of the national rice granary of which rice produced is not only for the regional supply but also for maintaining the national self-sufficiency of rice. The current center of paddy field is Kabupaten Lampung Tengah but shifting to the north due to the urbanization and industrialization of the southern part of Lampung Province. Under such circumstance, EEC carried out "Water Resources Master Plan Study for Tulang Bawang and Mesuji River Basins" in 1989, to provide the 20 years development scenario for the river basins mainly for irrigation development. The proposed study is to follow the above development scenario to carry out the feasibility study for the high priority projects as follows; Way Abung with 8,225ha, Way Pedada with 13,550ha, Way Saka/Bahuga with 12,600ha , and Quick Yielding Schemes with 15,060ha.

(7) Way Sekampung Water Allocation Study (Lampung Selatan, Bandar Lampung)

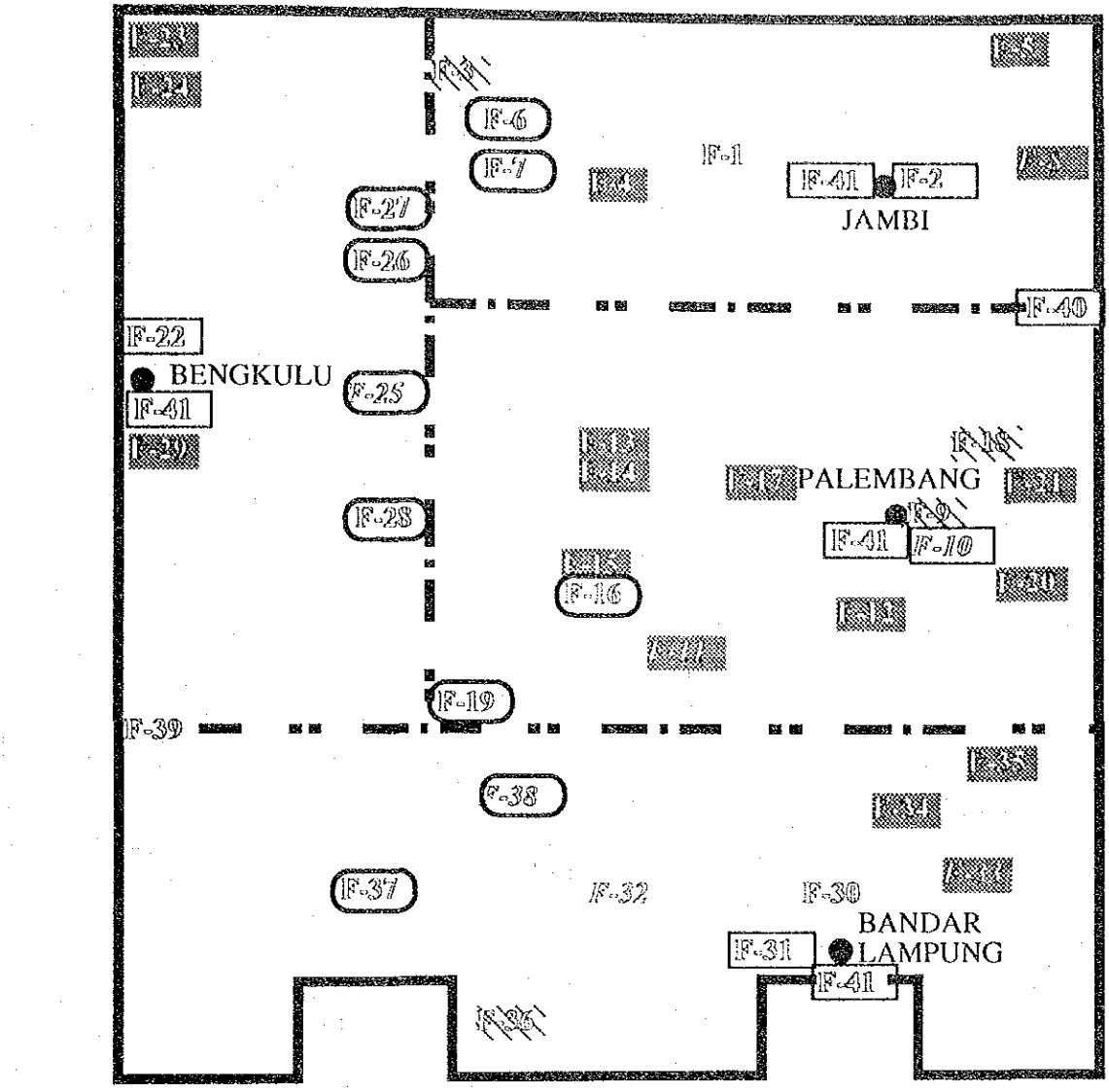
Way Sekampung River with a catchment area of 5,500 km^2 flows the north of Bandar Lampung City. All the river water in dry season is currently diverted to Way Sekampung Irrigation System with a total area of 94,123ha. Batutegi Multipurpose Dam with a height of 120m and a catchment area of 424 km^2, located on the mainstream of Way Sekampung River, has committed for the construction by OECF finance. The purpose of the dam has defined to firm up the irrigation water in dry season, flood control to the downstream and hydropower with an installed capacity of 24 MW. On the other hand, water supply for Bandar Lampung City is currently critical condition, and the Municipality is expected to be allocated water from Way Sekampung River. The proposed study is to review the water allocation plan of Batutegi Dam considering the both of irrigation water supply and potable water supply for Bandar Lampung City.

(8) Way Semangka Hydropower Development Project (Lampung Selatan, Lampung Barat)

Way Semangka River with a catchment area of 2,100 km^2 has advantages for the hydropower development such as steep gradient, stable river flow through the year, and the closer to the demand area of Bandar Lampung City. There are 7 schemes identified as the hydropower development potential sites with a total installed capacity of 216.6MW. All the schemes are the run of river types and the cost performance is attractive comparing to the other candidates in the region. The proposed study includes the review of the hydropower development potential in the basin, identification of the priority development schemes and the feasibility study.

6.5 DATA BASE

Appendix to this Chapter contains some basic data collected and compiled by the Team.



LEGEND

- Provincial Boundary
- Provincial Capital
- F-1 Basin wide/ Water Resources Project
- F-1 Irrigation / Drainage Project
- F-1 Water Supply / Sewerage Project
- F-1 Flood Control / Sabo Project
- F-1 Hydropower Project
- F-1 On-going Project

Figure 6.4.1 Schematic Location Map for Water Resources Project

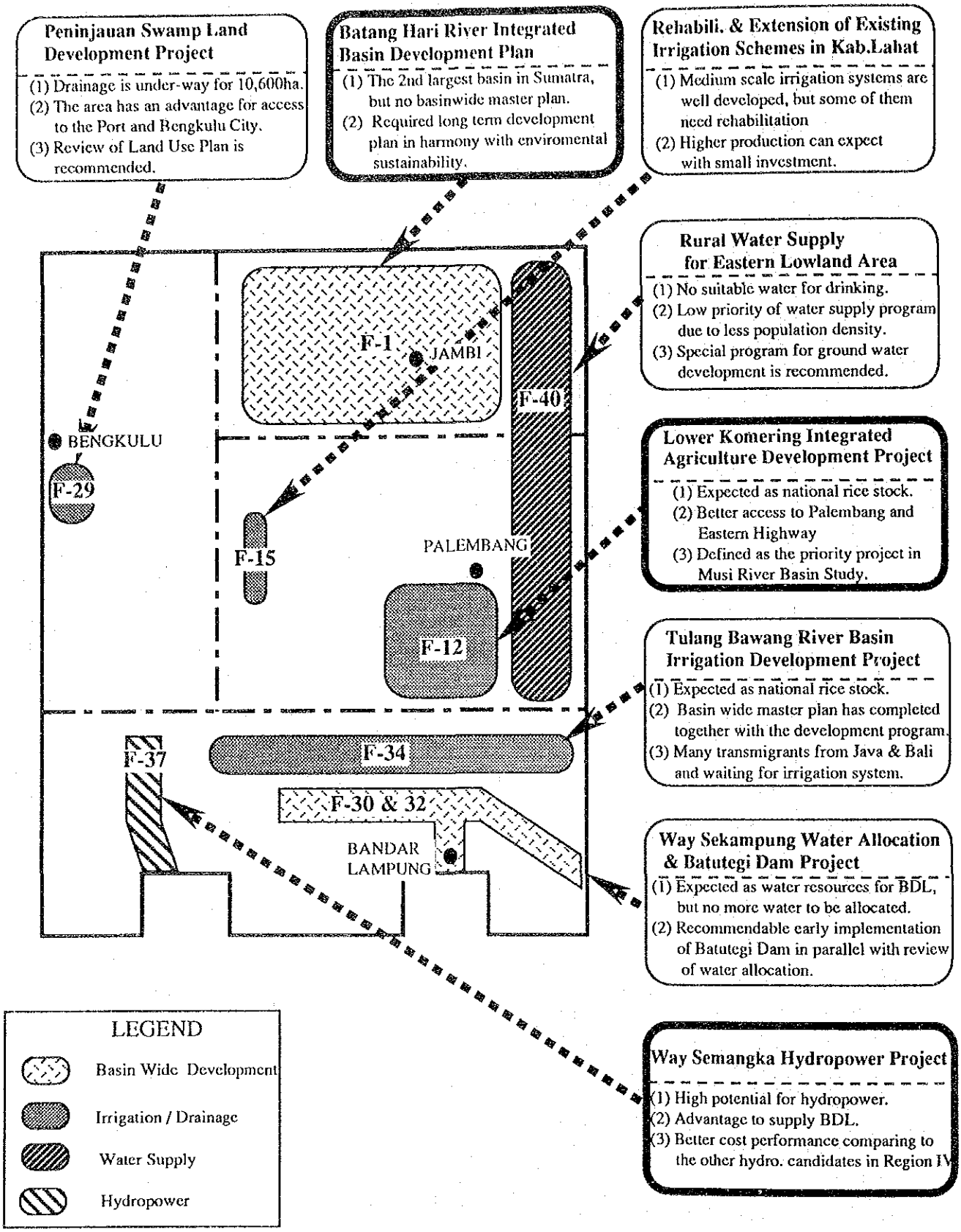


Figure 6.4.2 High Priority Projects for Water Resources Sector

Appendix

Table A-1 List of River System

ID	River System	CT Area (Km2)	WL Gauge (nos.)	ID	River System	CT Area (Km2)	WL Gauge (nos.)
BJ1	S.Air Hitam Laut	1,900	0	BB1	A.Menjuta	770	2
BJ2	S.Batanghari	49,100	33	BB2	A.Selagan	660	3
BJ3	S.Mandahara	990	0	BB3	A.Dikit	2,400	1
BJ4	S.Pangkalandur Besar	440	0	BB4	A.Bantal	660	0
BJ5	S.Bontara	1,100	0	BB5	A.Teramang	770	2
BJ6	S.Tungkal	4,300	1	BB6	A.Ipuh	1,300	3
				BB7	A.Seblat	660	3
BS1	S.Jeriju	1,500	0	BB8	A.Ketahun	2,800	6
BS2	S.Lumpur	3,600	0	BB9	A.Seranggai/Bintunan	550	2
BS3	S.Lebonghitam	1,100	0	BB10	A.Pagang/Lais	880	4
BS4	S.Riding	990	0	BB11	A.Palik	550	0
BS5	S.Pidada	440	0	BB12	A.Lemau	660	2
BS6	S.Batang	770	0	BB13	A.Bengkulu	770	3
BS7	S.Buranrinding	2,900	0	BB14	A.Nelas/Ungkal	660	3
BS8	S.Saleh	12,400	0	BB15	A.Seluma	880	4
BS9	S.Musi	39,500	47	BB16	A.Talo	660	0
BS10	A.Banyuasin	14,100	0	BB17	A.Alas	880	1
BS11	S.Sembilang	1,300	0	BB18	A.Maras	440	3
BS12	S.Bakorendo	1,200	0	BB19	A.Manna	770	2
BS13	S.Benu	990	0	BB20	A.Nipis	440	1
BS14	S.Cerucuk	660	0	BB21	A.Benkenang	440	1
BS15	A.Sapti	880	0	BB22	A.Padangguci	770	1
BS16	S.Linggang	550	0	BB23	A.Kinal	220	0
BS17	S.Manggar	660	0	BB24	A.Luas	1,100	0
BS18	A.Rengas	770	0	BB25	A.Nasal	990	0
BS19	A.Cengal	440	0	BB26	A.Menula	550	0
BS20	S.Kebiang	110	0				
BS21	S.Kampa	550	0	BL1	A.Melaya	330	0
BS22	S.Mancong	1,500	0	BL2	W.Kru	660	0
BS23	S.Jeruk	440	0	BL3	W.Tenumbang	330	0
BS24	S.Menduk	550	0	BL4	W.Biha	220	0
BS25	S.Bangkakota	660	1	BL5	W.Ngamburbunuk	330	0
BS26	S.Balar	330	0	BL6	W.Temuli	330	0
BS27	S.Bengkayan	550	0	BL7	W.Ngaras	110	0
BS28	S.Ulin	660	0	BL8	W.Pintan	110	0
BS29	S.Kepoh	330	0	BL9	W.Bambang	220	0
BS30	S.Jelamu	220	0	BL10	W.Pamerihan/Cangup	330	0
BS31	S.Ketiak	110	0	BL11	W.Menanga Kiri	330	0
BS32	A.Lengko	220	0	BL12	W.Belanbang	330	0
BS33	S.Kurau	770	0	BL13	W.Semangka	2,100	5
BS34	S.Selindung	330	0	BL14	W.Guring	770	0
BS35	S.Mapur	1,100	0	BL15	W.Campong	770	0
BS36	S.Layang	330	0	BL16	W.Sekampung	5,500	16
BS37	A.Anton	440	0	BL17	W.Jepara	880	1
				BL18	W.Kambas	440	1
				BL19	W.Tursan	660	0
				BL20	W.Seputih	7,400	17
				BL21	W.Tulangbawang	10,900	13
				BL22	S.Mesuji	7,000	0

*Suurce : RePProt 1988

Table A-2 List of Water Level Gauge in Jambi Province

Gauge ID	Basin ID	Kab. ID	River System	River Name	Place	CT Area (Km2)	Start Year	Owner
RJ1			Bt.Hari	Bt.Tembesi	Pauh	10,821	1976	DPUP
RJ2			Bt.Hari	Bt.Tembesi	Muara Inum	1,455	1972	DPMA
RJ3			Bt.Hari	Bt.Tabir	Muara Jerunih	886	1972	DPMA
RJ4			Bt.Hari	Bt.Uleh	Lb.Tapus	221	1972	DPMA
RJ5			Bt.Hari	Bt.Tebo	Air Gemuruh	1,810	1977	DPMA
RJ6			Bt.Hari	Bt.Hari	Muara Kilis	17,824	1976	DPMA
RJ7			Bt.Hari	Bt.Hari	Muara Tembesi	36,135	1976	DPMA
RJ8			Bt.Hari	Bt.Kempeh	Pemp.Bidaro	375	1977	DPMA
RJ9			Bt.Hari	D.Kerinci	Sanggaran Agung	966	1974	PLN
RJ10			Bt.Hari	Bt.Hari	Duren	38,704	1979	DPMA
RJ11			Bt.Hari	S.Ulak	S.Ulak Deras	188	1979	DPMA
RJ12			Bt.Hari	Bt.Merao	Debai	51	1980	DPUP
RJ13			Bt.Hari	Bt.Sangkir	Tanah Kampung	425	1980	DPUP
RJ14			S.Pengauan	S.Pangabuan	Merlung	813	1982	DPMA/PHBD
RJ15			Bt.Hari	Bt.Asai	Benso	1,258	1983	DPMA/PHBD
RJ16			Bt.Hari	Bt.Bungo	Rantau Pandang	411	1983	DPMA/PHBD
RJ17			Bt.Hari	Bt.Merangin	Lb.Paku	1,228	1974	PLN
RJ18			Bt.Hari	Bt.Singkut	Tenang	328	1983	DPMA
RJ19			Bt.Hari	Bt.Merangin	Bangko	3,645	1983	DPMA
RJ20			Bt.Hari	Bt.Tabir	R.Panjang	1,046	1983	DPMA
RJ21			Bt.Hari	Bt.Pelepat	R.Kelayang	413	1984	PHBD
RJ22			Bt.Hari	Bt.Alai	Tirta Kencana	655	1984	DPMA
RJ23			Bt.Hari	Bt.Limun	Muara Kutur	504	1984	Dit.Gasi
RJ24			Bt.Hari	Bt.Siulak	Kubang	647	1981	DPUP
RJ25			Bt.Hari	Bt.Sangkir	Tanah Kampung	425	1981	DPUP
RJ26			Bt.Hari	Bt.Hari	Sungai Manau	397	1984	PHBD
RJ27			Bt.Hari	Bt.Merangin	P.Rengas	2,916	1984	PHBD
RJ28			Bt.Hari	Bt.Merangin	Sanggaran Agung	966	1974	PLN
RJ29			Bt.Hari	Bt.Air Asam	Dudun Tebat	-	-	-
RJ30			Bt.Hari	Bt.Air Jujuhan	Rantau Ikil	-	-	-
RW18			Bt.Hari	Bt.Sangir	Sampu	-	-	-
RW19			Bt.Hari	Bt.Hari	Sungai Dareh	-	-	-
RW21			Bt.Hari	Bt.Siat	Koto Baru	-	-	-
RW28			Bt.Hari	Bt.Suluti	Air Ipuh	-	-	-

*Source: RePPProt 1988 (Catchment Area : DPMA)

Table A-3 List of Water Level Gauge in South Sumatra Province

Gauge ID	Basin ID	Kab. ID	River System	River Name	Place	CT Area (Km2)	Start Year	Owner
RS1			A.Musi	S.Musi	Upang	51,238	1972	DPUP
RS2			A.Musi	S.Musi	Tebing Abang	32,275	1971	DPUP
RS3			A.Musi	S.Musi	Gandus	34,509	1973	DPUP
RS4			A.Musi	S.Lambi Daro	Gandas	34,508	1982	DPUP
RS5			A.Musi	S.Kelekar	Muara Penimbung	1,244	1973	DPUP
RS6			A.Musi	S.Ogan	Muara Pemulutan	8,001	1973	DPUP
RS7			A.Musi	S.Lematang	Sungai Rotan	6,890	1971	DPUP
RS8			A.Musi	S.Lematang	Lebak Budi	2,040	1982	DPMA
RS9			A.Musi	S.Beliti	Rantau Bingin	817	1974	PLN
RS10			A.Musi	S.Musi Ulu	Muara Semanggus	9,778	1982	PLN
RS11			A.Musi	S.Rawas	Bingin Teluk	4,310	1980	PLN
RS12			A.Musi	S.Rupit	Tg.Beringin	906	1980	PLN
RS13			A.Musi	S.Baai	Terawas	-	1982	PLN
RS14			A.Musi	S.Kungku	Ciptonadi	221	1984	DPUP
RS15			A.Musi	S.Komering	Cempaka	4,383	1976	DPUP
RS16			A.Musi	S.Belitang	Ranau Condong	319	1976	DPUP
RS17			A.Musi	S.Belitang	Tirtonadi	77	1976	DPUP
RS18			A.Musi	S.Macak	Jaya Mulya	65	1976	DPUP
RS19			A.Musi	S.Lengkayap	Batu Putih	970	1980	DPUP
RS20			A.Musi	S.Ogan	Tanjung Agung	850	1983	DPUP
RS21			A.Musi	S.Malus	Tanjung Raya	75	1981	DPUP
RS22			A.Musi	S.Lakitan	Selangit	531	1981	DPUP
RS23			A.Musi	S.Dulu	Bukit Ulu	40	1981	DPUP
RS24			A.Musi	A.Rawas	Muara Rupit	3,138	1981	DPUP
RS25			A.Musi	S.Temelet	Ciptonadi	86	1981	DPUP
RS26			A.Musi	S.Perigit	Suka Karya	74	1981	DPUP
RS27			A.Musi	A.Enim	Dusun Lingga	990	1974	PLN
RS28			A.Musi	A.Rawas	Pulaukida	1,325	1983	DPMA
RS29			A.Musi	A.Enim	Suka Raja	627	1984	DPMA
RS30			A.Musi	S.Keruh	Talang Bungur	269	1984	DPMA
RS31			A.Musi	A.Beliti	Muara Saling	554	1984	DPMA
RS32			A.Musi	W.Selabung	Kota Agung	1,228	1984	DPMA
RS33			A.Musi	S.Kikim	Gunung Kembang	289	1984	DPMA
RS34			A.Musi	S.Pangi	Ulak Bandung	409	1984	DPMA
RS35			A.Musi	S.Semanggus	Rantau Sibobo	1,536	1984	DPMA
RS36			A.Musi	A.Rupit	Suka Menang	9,663	1973	DPUP
RS37			A.Musi	A.Gegas	Suka Karya	251	1973	DPUP
RS38			A.Musi	A.Musi	Mambang	7,748	1974	DPMA
RS39			A.Musi	A.Megang	Megang Sakti II	292	1983	DPUP
RS40			S.Bangka	S.Bangka Ujung	Badengung	-	1984	PMA
RS41			A.Musi	S.Lematang	Pinang Berlarik	3,676	1984	DPMA
RS42			A.Musi	Bt.Hari Leko	Bandar Jaya	2,821	1984	DPMA
RS43			A.Musi	A.Klingi	Lima	374	1985	DPMA
RS44			A.Musi	A.Lematang	Ujung Mas	-	-	-
RS45			A.Musi	A.Klingi	Lubuk Linggau	-	-	-
RS46			A.Musi	A.Musi	Des Patah	-	-	-
RS47			A.Musi	S.Beliti	Rantau Bingin	-	-	-
RS48			A.Musi	A.Kati	Lb.Tanjung	-	-	-

*Source: RePPProt 1988 (Catchment Area : DPMA)

Table A-4 List of Water Level Gauge in Bengkulu Province

Gauge ID	Basin ID	Kab. ID	River System	River Name	Place	CT Area (Km2)	Start Year	Owner
RB1			A.Seluma	A.Seluma	Puding	331	1977	DPMA
RB2			A.Seluma	A.Seluma Hilir	Pasar Seluma	460	1979	P3SA
RB3			A.Seluma	A.Seluma	Pasar Seluma	459	1981	P3SA
RB4			A.Seluma	A.Seluma	Bnd.Seluma	344	1982	DPUP
RB5			A.Bengkulu	A.Bengkulu	Tb.Trujam	444	1977	DPMA
RB6			A.Bengkulu	A.Bengkulu	Kancing	376	1980	DPMA
RB7			A.Manjuto	A.Manjuto	L.Luwas	444	1977	DPMA
RB8			A.Manjuto	A.Manjuto Hlr.	Lb.Pinang	622	1980	P3SA
RB9			A.Selagan	A.Selagan Hlr.	Muko-Muko	724	1981	P3SA
RB10			A.Nelas	A.Nelas	Lb.Puding	86	1982	DPMA
RB11			A.Nelas	A.Jenggalu	Parit Lima	256	1982	P3SA
RB12			A.Nelas	A.Nelas	Cahaya Negeri	139	1977	DPUP
RB13			A.Lais	A.Lais	Kuro Tidur	143	1978	DPUP
RB14			A.Ketahun	A.Ketahun	Gunung Payung	1,833	1978	DPMA
RB15			A.Ketahun	A.Ketahun	Tes	583	1982	DPMA
RB16			A.Ketahun	Danau Tes	Tes	452	1982	PLN
RB17			A.Lais	A.Hitam	Tg.Terdana	16	1982	P3SA
RB18			A.Padang	A.Padang	Masigit	123	1978	DPUP
RB19			A.Padang	A.Padang	Km 0 Tidus III	105	1979	DPUP
RB20			A.Bintunan	A.Bintunan	Lb.Banyau	294	1979	DPUP
RB21			A.Mana	A.Mana	Bdr.Agung	588	1979	P3SA
RB22			A.Nipis	A.Nipis	Palak Bangkrung	56	1979	P3SA
RB23			A.Ketahun	A.Ketahun	Tunggang	969	1978	DPUP
RB24			A.Ipuh	A.Ipuh	Sibak Mukomuko	696	1978	DPMA
RB25			A.Dikit	A.Dikit	Sari Bulan Muko	1,002	1979	DPUP
RB26			A.Selagan	A.Selagan	Teras Trujam	411	1979	P3SA
RB27			A.Alas	A.Alas	Rt.Panjang	431	1982	DPMA
RB28			A.Ipuh	A.Ipuh	Sie Ipuh	753	1979	DPMA
RB29			A.Leman	A.Leman	Karang Panggung	72	1980	P3SA
RB30			A.Leman	A.Leman	Paku Haji	171	1984	DPUP
RB31			A.Kedurang	A.Kedurang	Batu Ampar	43	1981	P3SA
RB32			A.Nipis	A.Bengkunang	Suka Rami	128	1980	P3SA
RB33			A.Teramang	A.Bantal	Pondok Baru	391	1981	DPUP
RB34			A.Lelangi	A.Lelangi	Lb.Mindai	225	1981	DPUP
RB35			A.Sebelat	A.Sebelat	Pasar Sebelat	935	1981	DPUP
RB36			A.Sebelat	A.Sebelat	Tl.Gelumpang	901	1984	DPMA
RB37			A.Maras	A.Maras	Maras Hulu	20	1981	P3SA
RB38			A.Maras	A.Maras	Ps.Maras	80	1981	P3SA
RB39			A.Selagan	A.Hitam	Pondok Baru	34	1982	P3SA
RB40			A.Pasdang Guci	A.Pasdang Guci	Bungin Tambun	159	1981	P3SA
RB41			A.Rami	A.Rami	Pulau	170	1982	DPUP
RB42			A.Teramang	A.Teramang	Tunggang	331	1983	DPUP
RB43			A.Urai	A.Urai	Urai Hulu	88	1984	DPMA
RB44			A.Seranggai	A.Seranggai	Peninjau	159	1984	DPMA
RB45			A.Bengkulu	A.Bengkulu	Karang Tinggi	98	1984	DPMA
RB46			A.Ketahun	A.Ketahun	Karang Dapo	-	-	-

*Source: RePPProt 1988 (Catchment Area : DPMA)

Table A-5 List of Water Level Gauge in Lampung Province

Gauge ID	Basin ID	Kab. ID	River System	River Name	Place	CT Area (Km2)	Start Year	Owner
RL1			W.Tulangbawang	W.Abung	Ogan Enam	158	1974	DPUP/P3SA
RL2			W.Seputih	W.Tatayan	Sumbur Sari	33	1968	DPMA
RL3			W.Seputih	W.Waya	Banyu Wangi	240	1968	DPMA
RL4			W.Sekampung	W.Sekampung	Pujo Rahayu	1,696	1968	DPMA
RL5			W.Sekampung	W.Sekampung	Jurai	812	1968	DPMA
RL6			W.Sekampung	W.Sekampung	Kunyir	719	1968	DPMA
RL7			W.Sekampung	W.Sekampung	Tegineneng	2,084	1982/83	Retired
RL8			W.Seputih	W.Seputih	Segala Mider	190	1976	DPUP/P3SA
RL9			W.Tulangbawang	W.Rarem	Pekurunan	293	1973	DPUP/P3SA
RL10			W.Seputih	Bt.Hari	Ramang Fajar	208	1977	DPUP/P3SA
RL11			W.Tulangbawang	W.Umpu	Rantau Tamiang	205	1973	DPUP/P3SA
RL12			W.Seputih	W.Seputih	Buyut Udik	1,648	1976	DPUP/P3SA
RL13			W.Semangka	W.Semangka	Liwa	220	1973	DPUP/P3SA
RL14			W.Tulangbawang	W.Umpu	Negeri Batin	547	1974	DPUP/P3SA
RL15			W.Tulangbawang	W.Giham	Rantau Jangkung	513	1975	DPUP/P3SA
RL16			W.Sekampung	W.Bulak Dam	W.Gatel	783	1973	DPUP/P3SA
RL17			W.Seputih	W.Tatayan	Sindangsari	86	1971	DPUP/P3SA
RL18			W.Sekampung	W.Tebo	Banjar Agung	139	1973	DPUP/P3SA
RL19			W.Sekampung	W.Bulok	Bulo Kerto	850	1973	DPUP/P3SA
RL20			W.Sekampung	W.Semah	Sukodadi	6	1973	DPUP/P3SA
RL21			W.Sekampung	W.Padang Ratu	Cipadang	120	1973	DPUP/P3SA
RL22			W.Sekampung	W.Sekampung	Argoguruh	1,975	1973	DPUP/P3SA
RL23			W.Tulangbawang	W.Besai	Petay	389	1974	DPUP/P3SA
RL24			W.Tulangbawang	W.Besai	Banjar Masin	664	1974	DPUP/P3SA
RL25			W.Sekampung	W.Pisang	Palas Jaya	177	1974	DPUP/P3SA
RL26			W.Seputih	W.Terusan	G.Batin	480	1974	DPUP
RL27			W.Tulangbawang	W.Umpu Kanan	Paknan Ratu	3,355	1972	DPUP/P3SA
RL28			W.Semangka	W.Semangka	Sri Kuncoro	1,352	1972	DPUP/P3SA
RL29			W.Tulangbawang	W.Tahmi	Tanjung Agung	509	1973	DPUP/P3SA
RL30			W.Tulangbawang	W.Rarem	Kota Bumi	828	1974	DPUP
RL31			W.Seputih	W.Seputih	Ajibaru	476	1974	DPUP
RL32			W.Jepara	W.Jepara	Jepara	147	1968	DPMA
RL33			W.Seputih	W.Pangbuan	Terbangi	638	1968	DPUP
RL34			W.Sekampung	W.Ketibung	Sidomulyo	116	1975	DPUP
RL35			W.Seputih	W.Pengbuan	Blambang Pagar	644	1977	DPUP
RL36			W.Sekampung	W.Kandis	Tri Kota	165	1977	DPUP
RL37			W.Seputih	W.Seputih	Sri Ungo	1,541	1977	DPUP
RL38			W.Seputih	W.Raman	Hendra	178	1977	DPUP
RL39			W.Semangka	W.Semong	Banding	432	1977	DPUP
RL40			W.Semangka	W.Semangka	Suka Jadi	407	1977	DPUP
RL41			W.Semangka	W.Semangka	Tulang Asahan	1,392	1977	DPUP
RL42			W.Tulangbawang	W.Kiri	Tulang Bawang	2,238	1980	DPUP
RL43			W.Tulangbawang	W.Giham	Saling Beringin	364	1983	DPMA
RL44			W.Seputih	W.Pengbuan	Gedong Harta	99	1974	DPUP
RL45			W.Tulangbawang	W.Besai	Jemb.Suka Jaya	324	1981	DPUP
RL46			W.Sekampung	W.Tebo	Walia Jati	-	-	-
RL47			W.Sekampung	W.Buloh	Bulkerto	-	-	-
RL48			W.Sekampung	W.Sekampung	Negeri Jemanten	-	-	-
RL49			W.Seputih	W.Seputih	Negeri Aji	-	-	-
RL50			W.Seputih	W.Pengubuan	Trimodadi	-	-	-
RL51			W.Pegadungan	W.Sukadana	Sukadana	-	-	-
RL52			W.Seputih	W.Rarem	Metro	-	-	-
RL53			W.Seputih	W.Batang Hari	Metro	-	-	-

*Source: RePPProt 1988 (Catchment Area : DPMA)

Table A-6 List of Meteorological Stations

No.	Station Name	Province	Location Lat.	Long.	Elevation (El.m)	Data Period From	To
CJ1	Pelayang	Jambi	01 26'S	101 51'E	76	1977	1983
CJ2	Kota Baru Hiang	Jambi	02 04'S	101 28'E	800	1978	1982
CJ3	Bangko	Jambi	02 05'S	102 16'E	75	1982	1983
CJ4	Jambi	Jambi	01 35'S	103 37'E	10	1971	1979
CS1	Palembang	S.Sematra	02 59'S	104 45'E	12	1971	1979
CS2	Pangkal Pinang	S.Sematra	02 10'S	106 08'E	33	1971	1979
CB1	Kuro Tidur	Bengkulu	03 23'S	102 10'E	244	1979	1984
CB2	Bengkulu	Bengkulu	03 48'S	102 15'E	15	1971	1979
CB3	Pajar Bulan	Bengkulu	04 15'S	102 48'E	200	1982	1984
CL1	Kasui	Lampung	04 43'S	104 26'E	200	1975	1980
CL2	Astra Ksetra	Lampung	04 37'S	105 14'E	19	1971	1979
CL3	P. Bulan	Lampung	05 04'S	104 25'E	810	1975	1980
CL4	Gunung Megang	Lampung	05 19'S	104 40'E	550	1975	1980
CL5	Tanjung Karang	Lampung	05 27'S	105 16'E	10	1975	1979

Table A-7 Mean Monthly Temperature of the Study Area

No.	Station Name	Mean Monthly Temprature (°C)												
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
CJ1	Pelayang	26.5	29.2	28.5	29.4	28.7	28.0	27.3	28.1	29.3	27.2	25.8	26.8	27.9
CJ2	Kota Baru Hiang	24.5	28.3	25.3	25.8	25.7	25.1	24.7	24.7	24.3	24.7	24.1	25.0	25.2
CJ3	Bangko	29.1	28.6	28.6	29.1	28.7	29.4	27.1	29.4	30.4	28.9	28.8	29.0	28.9
CJ4	Jambi	26.6	26.8	27.2	27.4	27.5	27.3	27.0	27.2	27.0	27.3	27.0	26.8	27.1
CS1	Palembang	26.6	26.8	27.2	27.6	27.9	27.4	27.0	27.3	27.2	27.6	27.3	26.7	27.2
CS2	Pangkal Pinang	25.8	25.8	26.3	26.9	27.0	26.6	26.4	26.8	26.5	27.0	26.4	25.8	26.4
CB1	Kuro Tidur	26.0	25.6	25.6	26.1	26.1	26.1	26.0	26.0	25.9	25.6	26.6	26.4	26.0
CB2	Bengkulu	26.8	27.0	27.1	27.4	27.4	27.1	26.7	26.7	26.7	26.7	26.6	26.6	26.9
CB3	Pajar Bulan	26.0	25.6	25.6	26.1	26.2	26.1	26.0	26.0	25.9	25.6	26.6	26.7	26.0
CL1	Kasui	25.2	26.7	25.8	25.4	26.8	24.7	24.6	25.6	25.5	26.6	26.0	25.3	25.7
CL2	Astra Ksetra	26.6	26.6	26.9	27.2	26.8	27.0	26.7	27.0	27.1	27.7	27.6	27.1	27.0
CL3	P. Bulan	21.6	21.8	20.7	20.4	20.8	21.3	20.8	20.6	20.9	22.1	21.7	22.1	21.2
CL4	Gunung Megang	23.3	23.8	24.8	24.9	25.1	25.1	23.5	23.0	23.8	24.3	24.3	23.8	24.1
CL5	Tanjung Karang	26.2	26.3	26.7	26.9	27.0	26.4	25.9	26.1	26.3	27.0	27.0	26.6	26.5

Table A-8 Mean Monthly Related Humidity of the Study Area

No.	Station Name	Mean Monthly Related Humidity (%)												
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
CJ1	Pelayang	77.0	95.0	95.0	96.0	95.0	97.0	94.0	93.0	98.0	94.0	93.0	95.0	93.0
CJ2	Kota Baru Hiang	94.0	92.0	93.0	95.0	97.0	94.0	96.0	93.0	93.0	93.0	93.0	92.0	93.8
CJ3	Bangko	96.0	93.0	95.0	96.0	92.0	95.0	93.0	96.0	94.0	97.0	96.0	96.0	94.9
CJ4	Jambi	84.0	85.0	85.0	86.0	84.0	84.0	82.0	81.0	83.0	83.0	85.0	86.0	84.0
CS1	Palembang	86.0	86.0	86.0	86.0	85.0	83.0	82.0	81.0	82.0	81.0	85.0	86.0	84.1
CS2	Pangkal Pinang	85.0	85.0	85.0	84.0	83.0	81.0	79.0	78.0	81.0	81.0	84.0	88.0	82.8
CB1	Kuro Tidur	95.0	96.0	96.0	95.0	96.0	96.0	96.0	95.0	95.0	97.0	96.0	96.0	95.8
CB2	Bengkulu	84.0	84.0	84.0	86.0	85.0	84.0	85.0	85.0	87.0	85.0	84.0	85.0	84.8
CB3	Pajar Bulan	93.0	93.0	94.0	93.0	95.0	93.0	93.0	95.0	95.0	95.0	93.0	95.0	93.9
CL1	Kasui	77.0	88.0	92.0	91.0	90.0	90.0	90.0	90.0	91.0	90.0	90.0	91.0	89.2
CL2	Astra Ksetra	83.0	86.0	84.0	86.0	86.0	83.0	86.0	87.0	88.0	86.0	87.0	84.0	85.5
CL3	P. Bulan	86.0	86.0	69.0	83.0	70.0	81.0	68.0	83.0	82.0	81.0	82.0	70.0	78.4
CL4	Gunung Megang	84.0	84.0	84.0	83.0	83.0	83.0	82.0	82.0	80.0	78.0	79.0	80.0	81.8
CL5	Tanjung Karang	84.0	84.0	84.0	83.0	83.0	83.0	82.0	82.0	80.0	78.0	79.0	82.0	82.0

Table A-9 Mean Daily Sun-shining Hour of the Study Area

No.	Station Name	Mean Daily Sun-shining Hour (Hour)												
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
CJ1	Pelayang	4.32	3.87	4.72	5.20	5.40	5.07	5.01	5.74	4.89	4.76	4.10	4.55	4.80
CJ2	Kota Baru Hiang													
CJ3	Bangko	3.54	5.63	5.63	6.05	5.10	5.64	5.53	5.28	4.54	3.63	2.32	4.88	4.81
CJ4	Jambi	3.27	3.18	3.44	3.48	4.39	4.44	4.54	4.45	3.29	3.61	3.33	3.32	3.73
CS1	Palembang	3.59	3.68	4.07	4.74	5.27	5.17	4.86	5.28	4.52	4.58	4.24	3.70	4.48
CS2	Pangkal Pinang	3.84	3.72	3.90	4.38	4.70	5.68	5.44	5.88	4.48	4.70	3.62	2.72	4.42
CB1	Kuro Tidur	4.42	4.78	4.72	4.78	5.56	6.00	5.54	5.57	4.15	3.74	3.75	4.52	4.79
CB2	Bengkulu	4.56	4.92	4.94	5.40	5.74	5.78	5.74	5.41	4.67	4.39	4.22	4.13	4.99
CB3	Pajar Bulan	4.76	4.74	4.78	4.51	4.10	6.82	6.15	5.06	4.96	4.56	4.20	4.48	4.93
CL1	Kasui	4.60	5.20	5.50	6.60	6.15	6.80	6.90	6.60	6.70	6.40	5.90	5.10	6.04
CL2	Astra Ksetra	3.86	4.48	3.85	4.71	4.80	3.99	4.54	4.52	3.71	3.69	3.55	4.27	4.16
CL3	P. Bulan	4.00	4.10	4.70	5.40	6.00	6.00	5.80	6.00	5.20	5.10	4.30	3.80	5.03
CL4	Gunung Megang	3.60	3.90	5.00	5.70	6.10	6.00	6.00	6.20	5.10	5.60	4.50	3.80	5.13
CL5	Tanjung Karang	3.55	3.81	4.59	5.12	5.54	5.54	5.20	4.83	3.79	5.48	3.72	4.04	4.60

Table A-10 Mean Monthly Wind Speed of the Study Area

No.	Station Name	Mean Monthly Wind Speed (m3/s)												
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
CJ1	Pelayang	0.37	0.25	0.26	0.28	0.26	0.23	0.40	0.29	0.23	0.33	0.20	0.28	0.28
CJ2	Kota Baru Hiang	0.57	0.62	0.68	0.67	0.82	0.62	0.74	0.99	0.82	0.70	1.10	0.74	0.76
CJ3	Bangko	0.37	0.25	0.26	0.28	0.26	0.23	0.40	0.29	0.23	0.33	0.20	0.27	0.28
CJ4	Jambi	0.25	0.22	0.18	0.17	0.17	0.19	0.22	0.23	0.22	0.17	0.16	0.21	0.20
CS1	Palembang	0.29	0.26	0.25	0.20	0.21	0.24	0.27	0.28	0.27	0.25	0.21	0.24	0.25
CS2	Pangkal Pinang	0.36	0.36	0.32	0.32	0.29	0.35	0.42	0.41	0.38	0.36	0.29	0.29	0.35
CB1	Kuro Tidur													
CB2	Bengkulu	0.24	0.24	0.37	0.20	0.20	0.20	0.22	0.24	0.19	0.20	0.22	0.22	0.23
CB3	Pajar Bulan	0.31	0.27	0.27	0.27	0.27	0.26	0.26	0.29	0.28	0.41	0.37	0.32	0.30
CL1	Kasui	0.84	1.10	0.75	0.57	0.59	0.67	0.66	0.65	0.58	0.62	0.55	0.66	0.69
CL2	Astra Ksetra	0.24	0.23	0.20	0.17	0.10	0.17	0.15	0.14	0.15	0.15	0.22	0.18	0.18
CL3	P. Bulan	0.69	0.71	0.68	0.50	0.44	0.47	0.50	0.53	0.56	0.63	0.61	0.67	0.58
CL4	Gunung Megang	0.40	0.35	0.45	0.35	0.34	0.35	0.31	0.43	0.42	0.54	0.50	0.42	0.41
CL5	Tanjung Karang	0.24	0.57	0.21	0.20	0.2	0.21	0.28	0.18	0.17	0.21	0.20	0.20	0.24

Table A-11 Mean Monthly Evaporation of the Study Area

No.	Station Name	Mean Monthly Evaporation (mm/day)												
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
CJ1	Pelayang	3.84	3.87	4.17	4.22	3.92	3.53	3.56	4.08	4.15	3.97	3.47	3.64	3.87
CJ2	Kota Baru Hiang	3.00	3.54	3.86	3.78	3.53	3.44	3.43	3.51	3.71	3.81	3.43	3.24	3.52
CJ3	Bangko	3.62	4.38	4.46	4.46	3.86	3.89	3.66	4.01	4.23	3.78	3.22	4.00	3.96
CJ4	Jambi	3.47	3.55	3.75	3.60	3.62	3.44	3.54	3.75	3.61	3.79	3.50	3.34	3.58
CS1	Palembang	3.56	3.69	3.91	3.94	3.84	3.59	3.59	3.94	3.96	4.12	3.80	3.57	3.79
CS2	Pangkal Pinang	3.53	3.61	3.80	3.83	3.66	3.69	3.73	4.11	3.91	4.10	3.56	3.18	3.73
CB1	Kuro Tidur	3.40	3.61	3.80	3.53	3.76	3.75	3.70	3.86	3.60	3.41	3.32	3.41	3.60
CB2	Bengkulu	3.87	4.10	4.17	4.04	3.83	3.61	3.63	3.82	3.85				3.88
CB3	Pajar Bulan	3.79	3.80	3.84	3.59	3.18	3.60	3.55	3.53	3.75	3.76	3.71	3.75	3.65
CL1	Kasui	3.99	4.23	4.12	4.07	3.82	3.48	3.59	3.93	4.22	4.47	4.13	3.83	3.99
CL2	Astra Ksetra	3.70	3.91	3.85	3.85	3.53	3.24	3.36	3.61	3.62	3.82	3.65	3.82	3.66
CL3	P. Bulan	3.35	3.45	3.76	3.38	3.35	3.09	3.26	3.35	3.51	3.78	3.46	3.63	3.45
CL4	Gunung Megang	3.40	3.57	3.97	3.89	3.68	3.46	3.36	3.62	3.78	4.14	3.77	3.49	3.68
CL5	Tanjung Karang	3.61	3.79	4.00	3.93	3.63	3.46	3.44	3.62	3.66	4.33	3.78	3.76	3.75

Table A-12 List of Raingauge Stations in Jambi Province

ID No.	Basin No	Station Name	Period of Record From	To	Location Lat.	Long.	El. (El.m)
173		Muara Sabaik	1931	1958	01 08'S	103 51'E	4
174		Pelabuhan Dagan	1931	1941	01 09'S	103 05'E	10
175		Jambi	1931	1967	01 36'S	103 37'E	15
175 b		Palmerah	1952	1970	01 38'S	103 39'E	17
176		Lubuk Rusa	1931	1960	01 34'S	103 21'E	10
177		Muara Tembesi	1931	1954	01 42'S	103 06'E	12
177 b		Pauh	1931	1953	02 08'S	102 49'E	28
178		Muara Tebo	1931	1958	01 27'S	102 29'E	36
178 b		Teluk Kayuputih	1931	1960	01 11'S	101 59'E	57
178 c		Jambu	1931	1941	01 08'S	102 21'E	50
179		Muara Bungo	1909	1975	01 27'S	102 06'E	80
180		Tanah Tumbuh	1931	1941	01 26'S	101 52'E	100
181		Rantau Panjang	1931	1951	01 48'S	102 15'E	75
182		Bangko	1931	1958	02 04'S	102 05'E	75
182 a		Muara Siau	1931	1955	02 27'S	102 05'E	200
184		Sanggaran Agung	1931	1959	02 07'S	101 31'E	600
185		Sungai Penub	1931	1970	02 04'S	101 27'E	630
186		Sorolangun	1931	1958	02 18'S	102 43'E	37
187		Rantau Panjang Azai	1931	1941	02 30'S	102 15'E	142

Table A-13 List of Raingauge Stations in South Sumatra Province

ID No.	Basin No	Station Name	Period of Record From	To	Location Lat.	Long.	El. (El.m)
188		Surulagun	1931	1958	02 37'S	102 34'E	1205
189 c		Suban Burung	1931	1951	02 32'S	103 24'E	55
189 f		Lilin	1937	1960	02 38'S	104 09'E	2
190		Sungsang	1931	1941	02 22'S	104 54'E	5
190 c		Plaju	1931	1970	03 00'S	104 50'E	1
190 d		Sungai Gerong	1950	1970	02 59'S	104 50'E	7
191		Plembang	1931	1941	02 59'S	104 51'E	10
191 a		Talang Betutu	1931	1970	02 54'S	104 42'E	12
192		Paya Kabung	1931	1941	03 12'S	104 35'E	12
193		Tanjung Raja I	1913	1974	03 20'S	104 46'E	8
193 b		Kayu Agung	1931	1957	03 24'S	104 50'E	10
194		Gelumbang	1931	1941	03 14'S	104 26'E	19
195		Muara Kuang	1931	1960	03 40'S	104 33'E	14
197		Prabumulih	1953	1970	03 26'S	104 15'E	35
199		Gunung Merang	1931	1960	03 27'S	103 53'E	21
200		Sekayu	1931	1941	02 53'S	103 50'E	9
200 a		Talang Akar	1931	1941	03 11'S	103 46'E	70
200 b		Tugumulyo	1938	1970	03 01'S	102 50'E	79
201 f		Taba Pungin	1931	1954	03 19'S	102 56'E	90
201 j		Lubuk Linggau	1934	1956	03 014'S	102 50'E	79
202		Tebing Tinggi	1931	1960	03 45'S	103 15'E	120
203		Labat	1931	1959	03 48'S	103 32'E	358
204		Muara Bnim	1931	1957	03 40'S	103 47'E	15
205		Padang Burnai	1931	1960	03 50'S	103 02'E	405
207 a		Padang Karit	1931	1952	03 59'S	103 19'E	752
207 b		Sungai Baru	1931	1957	03 08'S	103 15'E	60
208		Pagaralam	1931	1970	04 01'S	103 15'E	900
209		Talang Bedug	1931	1941	04 03'S	103 06'E	1000
210 a		Tebatgunung	1927	1970	04 04'S	103 21'E	665
212		Padandulang	1931	1941	04 01'S	103 47'E	212
213		Penfadoran	1931	1960	04 07'S	103 50'E	136
214		Barueaja	1927	1975	04 17'S	104 11'E	150
214 c		Blitang	1950	1970	04 08'S	104 39'E	51
215		Martapura	1931	1960	04 27'S	104 21'E	20
216		Muara Dua	1931	1956	04 37'S	104 03'E	150
217 a		Ranau	1931	1941	04 47'S	103 58'E	710
251		Muntok	1931	1970	02 04'S	105 10'E	20
251 a		Mayang	1931	1955	01 58'S	105 17'E	20
251 c		Klapa	1931	1970	01 53'S	105 40'E	20
251 d		Tempilang	1931	1941	02 07'S	105 27'E	3
252		Jebus	1931	1959	01 45'S	105 46'E	20
253		Blinyu	1931	1970	01 38'S	105 51'E	15
253 a		Lumut	1939	1954	01 46'S	105 29'E	12
253 b		Mantung	1950	1970	01 38'S	105 59'E	45
254		Sungai Selan	1931	1967	02 23'S	106 07'E	2
255		Sungai Liat	1931	1970	01 51'S	106 06'E	10
256		Baturusa	1931	1958	02 01'S	106 07'E	20
257		Pangkalpinang	1931	1970	02 08'S	106 07'E	20
261		Toboali	1931	1960	03 01'S	106 07'E	6
262		Tanjung Pandang	1931	1960	02 45'S	107 38'E	34
262 b		Buluh Tumbang	1949	1968	02 45'S	107 45'E	55
263 a		Klapa Kampit	1931	1960	02 42'S	108 04'E	10

Table A-14 List of Raingauge Stations in Bengkulu Province

ID No.	Basin No	Station Name	Period of Record From	To	Location Lat.	Long.	El. (El.m)
7		Bintuhan	1931	1958	04 47'S	103 20'E	0
8		Muara Saung	1931	1959	04 32'S	103 20'E	400
8 a		Muara Sidang	1931	1941	04 28'S	103 34'E	750
9		Mana	1931	1959	04 28'S	102 55'E	1
13		Bengkulu	1931	1959	03 47'S	102 15'E	0
14		TAbah Penanjang	1931	1957	03 42'S	102 29'E	105
14 b		Aur Gading	1934	1958	03 31'S	102 18'E	195
15		Kepahiang	1931	1960	03 38'S	102 34'E	517
15 a		Bukit Kaba	1931	1953	03 27'S	102 38'E	1130
15 c		Pematang Danau	1931	1938	03 27'S	102 35'E	1090
15 e		Waringit Tiga	1931	1941	03 27'S	102 41'E	1000
16		Padanfulaktanding	1931	1960	03 22'S	102 47'E	255
17		Curup	1931	1960	03 27'S	102 31'E	635
18 a		Lais I	1931	1959	03 22'S	102 03'E	8
18 b		Air Simpang	1931	1937	03 24'S	102 34'E	931
20		Air Nening	1931	1941	03 20'S	102 23'E	1000
21		Muara Aman	1931	1960	03 10'S	102 10'E	391
21 a		Lebong Donok	1931	1941	03 11'S	102 08'E	395
23		Lebong Tandu	1931	1941	03 02'S	101 56'E	180
24		Napal Putih	1931	1941	03 12'S	101 15'E	40
24 a		Ipuh	1931	1957	03 01'S	101 29'E	0
25		Muko-Muko	1931	1957	02 36'S	101 05'E	0

Table A-15 List of Raingauge Stations in Lampung Province

ID No.	Basin No	Station Name	Period of Record From	To	Location Lat.	Long.	El. (El.m)
2		Mutaralam	1931	1941	05 05'S	104 50'E	872
3		Negarabatin	1931	1960	05 04'S	104 05'E	900
5		Kroe	1931	1960	05 14'S	103 53'E	0
220 a		Tulung Buyut	1931	1941	04 35'S	104 32'E	81
222		Menggala	1903	1975	04 28'S	104 15'E	18
223		Wiralaga	1931	1941	03 51'S	105 29'E	5
225 a		Kota Bumi	1931	1941	04 51'S	104 53'E	32
228		Suka Dana	1931	1960	05 04'S	105 33'E	20
228 c		Metro	1939	1960	05 04'S	105 24'E	57
229		Ulusemung	1931	1941	05 13'S	105 26'E	700
230		Ulu Belu	1932	1941	05 21'S	104 36'E	800
230 a		Tangkit Serdang	1931	1941	05 21'S	105 50'E	214
231		Talang Padang I	1931	1941	05 22'S	104 47'E	243
232		Kota Agung	1931	1960	05 29'S	104 37'E	225
232 a		Tanjung Jati	1931	1941	05 12'S	104 17'E	235
233		Pulih Doh	1931	1941	05 39'S	105 52'E	10
233 b		Pesawaran	1931	1941	05 29'S	105 57'E	160
234		Kedondong I	1931	1941	05 28'S	104 59'E	116
235		Gedong Tatakan	1931	1960	05 23'S	105 06'E	100
235 b		Wai Beruluk	1931	1960	05 20'S	105 10'E	150
238		Wai Halim	1931	1960	05 26'S	105 16'E	100
241 a		Tanjung Kemala	1931	1941	04 54'S	104 48'E	107

Table A-16 Monthly Rainfall in Jambi Province

ID No.	Station Name	El.	Mean Monthly Rainfall (mm)												
		(El.m)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
173	Muara Sabalk	4	248	216	237	184	154	95	100	120	143	173	188	322	2180
174	Pelabuhan Dagan	10	232	167	189	250	188	130	120	137	185	250	312	228	2388
175	Jambi	15	313	226	327	324	268	156	148	157	137	299	365	343	3063
175 b	Palmerah	17	216	187	248	246	167	118	114	129	109	209	244	253	2240
176	Lubuk Rusa	10	207	196	231	254	168	80	83	113	127	187	270	286	2202
177	Muara Tembesi	12	258	207	221	272	188	143	89	124	163	220	288	288	2461
177 b	Pauh	28	309	309	286	264	221	128	111	129	154	253	308	370	2842
178	Muara Tebo	36	249	184	251	220	141	65	88	113	165	179	211	283	2149
178 b	Teluk Kayuputih	57	298	186	218	276	195	83	103	118	170	159	286	278	2370
178 c	Jambu	50	216	209	250	280	196	111	124	210	161	234	381	333	2705
179	Muara Bungo	80	302	239	300	306	205	117	131	150	165	223	269	313	2720
180	Tanah Tumbuh	100	339	273	230	353	171	109	115	181	191	217	336	411	2926
181	Rantau Panjang	75	302	234	275	317	236	147	121	209	165	269	280	343	2898
182	Bangko	75	313	268	325	299	245	142	147	206	170	297	345	389	3146
182 a	Muara Siau	200	361	265	282	307	251	214	140	193	234	277	383	327	3234
184	Sanggaran Agung	600	304	226	313	266	177	135	120	149	186	238	255	267	2636
185	Sungai Penub	630	242	182	193	203	125	108	88	103	143	169	200	237	1993
186	Sorolangun	37	347	292	336	311	239	127	127	192	216	279	353	383	3202
187	Rantau Panjang Azai	142	339	305	256	264	235	128	91	162	208	268	331	288	2875
	Average	115	284	230	261	273	198	123	114	152	168	232	295	313	2644

Table A-17 Monthly Rainfall in South Sumatra Province

ID No.	Station Name	Elevation	Mean Monthly Rainfall (mm)												
		(Elm)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
188	Surulagun	1205	390	326	328	301	237	138	178	246	211	260	328	393	3336
189 c	Suban Burung	55	289	230	337	289	246	133	122	178	213	282	368	355	3042
189 f	Lilin	2	271	241	353	284	294	156	116	179	156	276	274	416	3016
190	Sungsang	5	244	155	254	228	179	130	100	85	106	179	239	279	2178
190 c	Plaju	1	293	247	326	286	197	127	108	103	85	183	282	322	2559
190 d	Sungai Gerong	7	260	235	319	293	209	100	114	99	74	171	250	317	2441
191	Plembang	10	255	265	309	285	155	128	102	86	85	202	343	365	2580
191 a	Talang Betutu	12	281	249	300	261	213	119	98	104	112	193	268	333	2531
192	Paya Kabung	12	199	206	227	197	74	112	41	45	60	149	263	219	1792
193	Tanjung Raja I	8	326	284	396	261	176	116	814	114	121	157	254	342	3361
193 b	Kayu Agung	10	309	270	334	259	176	113	86	98	98	172	291	329	2535
194	Gelumbang	19	258	242	304	263	134	117	76	107	149	245	276	337	2508
195	Muara Kuang	14	348	323	360	286	161	143	101	113	90	185	297	335	2742
197	Prabumulih	35	382	270	349	312	178	102	129	113	88	187	323	389	2822
199	Gunung Merang	21	420	323	387	290	153	139	109	192	148	235	341	377	3114
200	Sekayu	9	303	248	283	296	198	110	103	157	136	227	262	352	2675
200 a	Talang Akar	70	369	311	385	321	196	170	115	198	188	305	325	391	3274
200 b	Tugumulyo	79	219	206	199	187	185	120	106	120	147	143	216	266	2114
201 f	Taba Pungin	90	372	407	300	281	254	187	161	194	217	285	324	356	3338
201 j	Lubuk Linggau	79	351	319	270	304	288	185	188	198	221	278	276	316	3194
202	Tebing Tinggi	120	420	363	327	279	213	157	153	201	267	362	299	341	3382
203	Labat	358	508	374	354	293	215	147	120	166	165	253	303	405	3303
204	Muara Bnim	15	479	383	348	319	217	170	113	193	208	255	298	435	3418
205	Padang Burnai	405	246	209	191	211	148	91	100	104	168	200	245	217	2130
207 a	Padang Karit	752	444	367	364	335	257	195	154	153	210	303	337	468	3587
207 b	Sungai Baru	60	471	374	333	254	203	167	121	204	185	231	286	384	3213
208	Pagaralam	900	257	209	211	226	171	126	93	124	119	179	218	239	2172
209	Talang Bedug	1000	358	376	334	371	276	233	131	195	176	315	379	418	3562
210 a	Tebatgunung	665	330	250	252	292	243	146	110	136	149	215	306	319	2748
212	Padandulang	212	377	319	458	312	238	190	107	128	167	295	358	438	3387
213	Penfadoran	136	393	266	351	373	269	161	141	234	163	217	317	400	3285
214	Barueaja	150	360	305	305	300	228	126	137	183	130	210	255	364	2903
214 c	Blitang	51	374	271	391	279	170	115	81	107	78	179	292	364	2701
215	Martapura	20	402	380	395	351	208	132	136	132	159	216	348	402	3261
216	Muara Dua	150	318	282	355	296	247	148	100	150	161	239	284	327	2907
217 a	Ranau	710	325	273	283	289	205	156	106	137	146	228	270	315	2733
251	Muntok	20	371	210	245	207	157	106	81	95	94	146	230	375	2317
251 a	Mayang	20	402	245	309	263	189	136	110	117	121	184	343	474	2893
251 c	Klapa	20	362	198	272	348	318	254	135	106	143	192	319	501	3148
251 d	Tempilang	3	285	190	259	212	181	118	117	81	90	173	250	303	2259
252	Jebus	20	461	211	228	247	259	192	189	137	161	236	325	465	3111
253	Blinyu	15	427	202	228	247	259	192	189	137	161	236	325	465	3068
253 a	Lumut	12	442	227	289	306	295	221	181	118	166	222	328	443	3238
253 b	Mantung	45	374	237	220	245	182	172	182	122	116	228	245	516	2839
254	Sungai Selan	2	274	226	277	275	238	166	157	131	185	231	290	295	2745
255	Sungai Liat	10	410	235	228	223	262	172	160	119	126	174	305	411	2825
256	Baturusa	20	337	202	261	246	241	178	155	143	149	178	222	307	2619
257	Pangkalpinang	20	317	247	247	281	254	184	160	135	106	156	235	337	2659
261	Toboali	6	123	105	127	130	165	125	86	66	61	112	144	138	1382
262	Tanjung Pandang	34	282	147	183	243	276	241	230	158	141	317	403	365	2986
262 b	Buluh Tumbang	55	371	191	287	315	276	191	188	167	145	336	385	444	3296
263 a	Klapa Kampit	10	256	136	207	272	287	192	163	134	71	193	251	290	2452
	Average	149	340	261	297	275	216	153	141	139	142	222	292	361	2840

Table A-18 Monthly Rainfall in Bengkulu Province

ID No.	Station Name	Elevation	Mean Monthly Rainfall (mm)												
		(El.m)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
7	Bintuhan	0	268	210	244	288	177	177	180	189	280	414	449	333	3209
8	Muara Saung	400	371	307	299	331	258	171	164	233	257	369	428	396	3584
8 a	Muara Sidang	750	423	330	345	354	226	184	103	134	137	246	343	351	3176
9	Mana	1	254	236	253	225	182	186	158	302	438	478	461	363	3536
13	Bengkulu	0	306	238	337	285	228	209	187	193	240	325	438	402	3388
14	TAbah Penanjang	105	351	329	361	407	231	195	213	216	270	371	470	465	3879
14 b	Aur Gading	195	369	210	346	343	258	197	203	331	432	515	488	446	4138
15	Kepahiang	517	361	273	323	271	192	132	126	149	162	259	354	385	2987
15 a	Bukit Kaba	1130	325	274	285	271	245	155	126	173	246	293	267	308	2968
15 c	Pematang Danau	1090	357	287	317	281	248	153	154	180	244	318	319	346	3204
15 e	Weringit Tiga	1000	363	302	320	260	283	168	148	189	259	253	279	363	3187
16	Padanfulaktanding	255	390	275	210	305	234	174	184	199	232	249	281	319	3052
17	Curup	635	293	251	255	239	191	114	115	151	149	232	256	301	2547
18 a	Lais I	8	292	246	242	267	217	183	182	179	272	364	372	347	3163
18 b	Air Simpang	931	374	342	343	370	245	171	166	179	275	450	440	488	3843
20	Air Nening	1000	286	267	307	314	275	164	148	163	229	328	342	351	3174
21	Muara Aman	391	391	350	414	363	274	174	169	193	217	367	386	456	3754
21 a	Lebong Donok	395	389	330	398	397	289	167	121	167	249	340	389	429	3665
23	Lebong Tandu	180	492	530	518	580	501	355	291	420	515	666	635	566	6069
24	Napal Putih	40	270	251	190	267	196	135	135	212	254	410	349	299	2968
24 a	Ipuh	0	239	179	242	229	232	115	158	214	262	404	333	334	2941
25	Muko-Muko	0	350	256	364	309	213	199	171	228	343	452	434	441	3760
	Average	410	342	285	314	316	245	176	164	209	271	368	387	386	3463

Table A-19 Monthly Rainfall in Lampung Province

ID No.	Station Name	Elevation	Mean Monthly Rainfall (mm)												
		(El.m)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2	Mutaralam	872	210	196	185	262	169	157	98	100	119	171	213	211	2091
3	Negarabatin	900	267	230	225	253	178	155	134	155	154	256	308	291	2606
5	Kroe	0	290	236	265	245	237	227	252	225	188	443	410	326	3344
220 a	Tulung Buyut	81	371	337	377	361	197	138	100	94	119	178	229	450	2951
222	Menggala	18	393	316	342	254	160	118	97	84	116	138	250	345	2613
223	Wiralaga	5	203	165	185	173	177	114	87	58	78	80	172	220	1712
225 a	Kota Bumi	32	339	278	322	266	191	147	135	85	138	143	259	320	2623
228	Suka Dana	20	344	268	258	170	142	132	83	71	78	110	285	349	2290
228 c	Metro	57	338	264	267	170	134	126	118	96	88	96	231	277	2205
229	Ulusemung	700	431	328	400	407	269	214	144	120	106	269	451	546	3685
230	Ulu Belu	800	249	257	250	202	168	154	112	122	128	190	216	240	2288
230 a	Tangkit Serdang	214	306	272	280	248	178	133	110	80	102	169	194	249	2321
231	Talang Padang I	243	296	266	235	222	146	123	97	79	114	182	162	243	2165
232	Kota Agung	225	187	136	175	187	161	137	179	259	368	415	288	199	2691
232 a	Tanjung Jati	235	235	243	205	262	205	174	182	238	306	544	391	285	3270
233	Pulih Doh	10	177	222	171	208	163	168	177	154	229	496	422	240	2827
233 b	Pesawaran	160	229	226	196	192	139	120	65	80	64	130	150	228	1819
234	Kedondong I	116	210	242	142	185	129	74	49	50	63	93	144	204	1585
235	Gedong Tatakan	100	223	210	207	157	105	97	77	71	78	107	130	203	1665
235 b	Wai Beruluk	150	262	246	242	208	124	109	101	78	100	111	172	222	1975
238	Wai Halim	100	333	276	273	174	149	129	113	109	103	140	170	285	2254
241 a	Tanjung Kemala	107	281	299	267	231	196	150	90	78	82	114	173	311	2272
	Average	234	281	251	249	229	169	141	118	113	133	208	246	284	2421

Table A-20 Daily Runoff Record at Sricuncolo on Way Semangka (1/14)

YEAR 1974
CA 1413 Km2
RO-DPT 1245 mm/year

DATE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1	48	40	51	25	99	63	49	37	31	89	83	69	
2	51	40	84	29	58	56	33	44	29	85	79	74	
3	51	39	60	28	61	47	31	46	29	82	100	75	
4	46	35	46	45	90	43	30	34	29	105	143	89	
5	49	31	37	56	75	42	29	29	30	76	104	78	
6	43	31	34	52	97	39	27	27	43	76	92	72	
7	41	30	31	85	78	37	26	28	64	86	82	76	
8	39	37	30	76	98	37	29	33	92	68	82	93	
9	39	46	29	52	95	35	44	29	113	56	70	78	
10	59	85	29	81	97	32	55	31	91	66	76	72	
11	54	61	29	84	106	31	51	28	87	52	76	67	
12	43	44	29	65	123	33	33	29	94	50	67	62	
13	39	35	29	66	124	49	37	41	98	51	66	58	
14	36	32	26	96	110	31	42	38	82	53	105	63	
15	35	32	25	111	99	32	33	37	72	73	111	58	
16	33	43	24	106	101	29	29	34	57	73	94	54	
17	33	42	23	105	93	28	28	29	47	57	98	57	
18	32	35	23	120	108	27	31	26	42	50	100	47	
19	30	32	23	104	98	27	32	27	52	46	85	48	
20	29	32	22	75	104	31	31	39	61	45	98	54	
21	28	40	24	66	106	31	27	39	62	48	96	54	
22	28	33	28	81	112	24	25	58	53	49	75	66	
23	27	31	27	86	92	27	24	63	51	51	70	67	
24	27	30	42	60	71	27	33	58	59	62	71	77	
25	27	29	50	47	65	29	53	46	50	90	85	66	
26	27	27	29	41	61	34	49	34	48	76	80	142	
27	27	26	89	39	55	42	37	35	50	71	95	185	
28	38	28	25	42	48	32	32	41	65	105	84	90	
29	39		23	52	52	30	38	47	70	108	87	75	
30	35		23	69	59	37	36	49	81	130	73	64	
31	37		26		78		35	37		118		58	
AVERAGE	37.74	37.36	34.52	68.13	87.52	35.40	35.13	37.84	61.07	72.48	87.57	73.81	55.76
MAX	59	85	89	120	124	63	55	63	113	130	143	185	185
MIN	27	26	22	25	48	24	24	26	29	45	66	47	22
No.	31	28	31	30	31	30	31	31	30	31	30	31	365

Table A-20 Daily Runoff Record at Sricuncolo on Way Semangka (2/14)

YEAR 1975
CA 1413 Km2
RO-DPT 1449 mm/year

DATE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1	54	113	81	53	66	43	31	35	41	35	73	47	
2	64	113	72	48	73	41	28	38	61	34	74	43	
3	88	112	71	56	56	39	28	49	71	33	65	40	
4	90	161	76	75	47	43	25	40	46	33	67	37	
5	135	151	111	60	46	51	24	36	38	41	60	37	
6	150	134	107	52	50	62	25	46	46	47	104	43	
7	224	133	83	84	66	50	25	64	51	33	103	38	
8	248	122	75	135	84	40	23	37	39	42	114	40	
9	201	106	75	138	83	38	22	31	46	47	103	34	
10	138	95	75	182	95	36	22	49	58	38	80	34	
11	119	92	67	137	80	35	23	43	60	48	81	31	
12	114	100	65	129	70	33	28	37	51	58	83	26	
13	99	96	65	120	98	36	28	30	38	46	88	27	
14	97	165	73	116	99	42	35	64	35	37	75	26	
15	91	148	69	120	109	37	32	68	47	42	64	25	
16	80	115	67	119	102	35	39	59	54	48	71	24	
17	82	98	73	114	83	33	39	43	40	75	95	41	
18	85	93	63	104	70	33	30	65	35	74	101	56	
19	97	83	54	88	62	49	26	52	35	82	91	39	
20	92	82	50	88	61	44	31	52	52	62	85	33	
21	119	92	49	92	68	38	27	58	37	49	80	33	
22	117	108	49	77	64	31	38	38	34	84	74	33	
23	102	103	46	72	69	28	54	33	31	73	88	61	
24	104	91	51	65	73	27	45	31	32	51	81	94	
25	106	79	51	72	83	26	35	31	31	52	81	67	
26	101	72	49	66	79	25	38	45	31	67	86	47	
27	94	71	45	54	71	24	94	38	45	68	73	62	
28	98	78	40	54	53	23	75	36	86	54	64	88	
29	107		37	55	48	26	49	31	59	47	56	78	
30	110		37	67	50	38	42	28	37	41	50	67	
31	112		37		47		35	26		48		58	
AVERAGE	113.48	107.36	63.32	89.73	71.13	36.87	35.35	43.00	45.57	51.26	80.33	45.52	64.92
MAX	248	165	111	182	109	62	94	68	86	84	114	94	248
MIN	54	71	37	48	46	23	22	26	31	33	50	24	22
No.	31	28	31	30	31	30	31	31	30	31	30	31	365

Table A-20 Daily Runoff Record at Sricuncolo on Way Semangka (3/14)

YEAR 1976
CA 1413 Km2
RO-DPT 1353 mm/year

DATE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1	43	78	72	80	137	39	24	93	23	18	65	36	
2	47	101	65	74	116	38	23	109	19	21	87	34	
3	59	97	59	71	102	42	22	68	17	29	108	33	
4	65	82	101	71	90	42	22	33	16	26	104	31	
5	62	75	103	78	82	36	22	29	14	27	96	28	
6	49	76	93	131	77	34	23	29	15	29	80	26	
7	45	71	72	133	73	34	25	26	17	39	54	25	
8	72	82	72	130	70	34	23	24	23	25	40	27	
9	90	148	59	105	80	39	21	22	19	24	85	35	
10	76	173	51	91	89	34	23	21	15	34	80	40	
11	79	147	48	83	82	34	25	20	13	33	57	39	
12	77	111	45	78	86	34	33	20	22	45	108	51	
13	76	99	46	75	91	35	35	20	15	71	98	80	
14	79	86	42	56	83	32	27	21	12	59	134	88	
15	102	87	51	75	74	31	24	34	12	40	162	63	
16	110	82	50	72	64	33	23	24	14	123	151	91	
17	107	93	48	79	57	32	22	21	14	97	145	71	
18	87	92	46	84	71	29	21	24	15	84	144	101	
19	89	119	61	95	68	29	20	24	15	54	223	84	
20	101	112	133	94	40	28	19	21	15	33	180	68	
21	87	102	167	93	39	27	19	19	15	30	168	86	
22	87	89	133	78	40	27	19	19	14	28	128	93	
23	77	76	107	80	36	28	26	18	19	24	103	80	
24	83	76	114	91	48	27	21	18	30	22	90	74	
25	99	46	116	71	41	26	18	18	30	25	84	78	
26	94	97	110	81	37	28	18	20	29	25	79	76	
27	99	79	104	106	35	42	17	28	30	21	73	98	
28	91	82	102	107	37	34	33	30	25	25	64	93	
29	78	81	116	145	38	26	61	29	20	47	52	84	
30	93		96	159	36	25	41	24	18	62	42	72	
31	84		84		35		66	24		61		52	
AVERAGE	80.19	94.45	82.84	92.20	66.26	32.63	26.32	30.00	18.50	41.32	102.80	62.48	60.64
MAX	110	173	167	159	137	42	66	109	30	123	223	101	223
MIN	43	46	42	56	35	25	17	18	12	18	40	25	12
No.	31	29	31	30	31	30	31	31	30	31	30	31	366

Table A-20 Daily Runoff Record at Sricuncolo on Way Semangka (4/14)

YEAR 1977
CA 1413 Km2
RO-DPT 1360 mm/year

DATE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1	48	117	46	156	113	142	27	25	35	21	15	113	
2	49	95	37	145	92	103	31	24	30	19	15	102	
3	43	97	34	111	87	82	30	23	29	19	15	83	
4	83	101	35	87	66	83	69	23	27	19	15	101	
5	94	90	48	77	64	101	84	22	25	19	15	80	
6	73	82	62	77	69	101	55	22	22	18	15	56	
7	55	88	57	76	78	139	37	22	21	18	15	88	
8	73	92	55	97	78	121	35	21	19	18	15	79	
9	118	79	51	144	66	99	29	20	19	18	15	62	
10	103	80	51	115	80	87	25	19	18	17	16	99	
11	76	121	80	97	94	80	24	19	17	16	17	82	
12	69	137	90	105	77	80	23	19	18	15	16	79	
13	82	125	77	148	51	99	26	19	113	15	19	107	
14	64	107	72	134	110	90	44	16	73	15	26	89	
15	64	94	72	109	107	87	34	15	89	15	23	83	
16	79	92	79	94	74	101	41	15	89	16	22	76	
17	69	88	77	85	55	121	55	15	55	16	20	58	
18	74	70	71	83	43	94	41	14	40	15	25	40	
19	80	76	80	82	33	82	31	14	53	15	21	76	
20	82	70	57	95	31	60	27	14	43	15	23	62	
21	94	72	95	83	35	24	26	14	41	15	20	69	
22	109	57	138	78	31	94	24	14	34	15	24	49	
23	162	66	115	105	43	109	24	14	46	15	34	70	
24	132	83	139	94	93	97	24	14	44	15	51	55	
25	105	78	138	80	88	79	24	14	43	14	113	71	
26	97	77	157	74	69	60	35	14	41	13	102	82	
27	92	64	157	76	79	40	38	14	40	14	57	40	
28	85	62	139	73	62	46	46	13	38	14	33	77	
29	80		134	88	44	35	43	13	23	14	31	88	
30	107		144	107	72	34	41	21	22	13	57	72	
31	106		141		115		40	49		14		82	
AVERAGE	85.39	87.86	88.00	99.17	70.94	85.67	36.55	18.55	40.23	15.97	29.50	76.45	60.94
MAX	162	137	157	156	115	142	84	49	113	21	113	113	162
MIN	43	57	34	73	31	24	23	13	17	13	15	40	13
No.	31	28	31	30	31	30	31	31	30	31	30	31	365

Table A-20 Daily Runoff Record at Sricuncolo on Way Semangka (5/14)

YEAR 1978
CA 1413 Km2
RO-DPT 2636 mm/year

DATE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1	88	93	37	93	105	103	105	105	111	111	225		
2	66	97	44	97	105	105	103	105	105	147	234		
3	85	105	76	105	118		102	105	105	163	202		
4	95	109	76	109	150		102	105	113		211	166	
5	95	102	105	102	211		101	102	107		184	114	
6	110	66	109	66	225	179	99	101	107		160	97	
7	87	37	154	37	192	125	98	102			145	101	
8	69	35	148	35	173	106	97	106			148	111	
9	49	34	142	34	235	117	135	103			166	128	
10	148	60	154	60	218	234	114	170	105		138	150	
11	179	41	159	41	235	193	110	106	103	76	159	166	
12	182	49	156	49	264	144	135	106	103	41	177	179	
13	118	46	198	46	253	122	139	103	103	43	195	141	
14	110	44	129	44	253	119	153	103	103	40		128	
15	101	44	105	44	225	138	121	103	103	37		144	
16	113	44	144	44	202	124	107	138	111	48		162	
17	117	44	124	44	163	110	105	107				168	
18	106	49	144	49	127	109	103	145	114			135	
19	124	60	166	60	119	107	103	141				162	
20	125	88	156	88	117	106	105	157	106		170	189	
21	154	129	153	129	110	106	105	138	106		145	181	
22	160	103	142	103	106	106	105	128	118		131	147	
23	232	60	119	60	106	111	105	141	134		128	151	
24	170	69	106	69	106	106	102	115	124	97	137	176	
25	138	57	99	57	107	153	109	106	111	107	122	160	
26	122	44	127	44	110	109	151	105	113	109	114	148	
27	113	57	111	57	117	105	156	105	106	144	109	128	
28	122	80	94	80	109	105	121	103	106	275	121	101	
29		145	80	145	105	105	107	103	106	211	128	99	
30		118	70	118	105	105	109	103	109	190		174	
31			77		105		111	103		173		189	
AVERAGE	120.64	70.30	119.48	70.30	157.29	124.15	113.57	114.94	109.28	118.35	158.65	146.25	118.12
MAX	232	145	198	145	264	234	156	170	134	275	234	189	275
MIN	49	34	37	34	105	103	97	101	103	37	109	97	34
No.	28	30	31	30	31	27	30	31	25	17	23	28	331

Table A-20 Daily Runoff Record at Sricuncolo on Way Semangka (6/14)

YEAR 1979
CA 1413 Km2
RO-DPT 1707 mm/year

DATE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1	145			71	97	77				24	57	35	
2	111		69	71	93	66				31	71	34	
3	90		72	84	119	77				82	40	31	
4	83		72	145	144	94				38	95	34	
5	78		93	222	101	95				31	110	92	
6	101		79	215	83	92				29	90	51	
7	144		74	163	78	87				26	83	49	
8	122		66	139	78	74				30	98	89	
9	88		58	122	82	69				129	83	49	
10	74		58	151	73	62				87	49	37	
11	121		57	174	71	82				115	40	34	
12	160		51	156	71	73				99	37	31	
13	162		49	119	60					76	34	29	
14	127		53	95	55					43	31	34	
15	160		64	88	51					33	33	37	
16	197		44	83	48					30	37	46	
17	156		43	77	46					27	35	79	
18	129		40	73	57					24	34	80	
19	109		40	80	58					22	35	103	
20	117		53	87	53					34	35	129	
21	103		58	89	58					35	34	137	
22	114		70	78	113					34	31	150	
23	115		53	76	94					33	29	101	
24	124		44	87	92				49	27	43	103	
25	145		58	111	97				64	25	58	141	
26	190		74	122	87				77	23	62	110	
27	162		78	107	79				38	22	38	79	
28	151		89	107	73				72	22	35	62	
29			79	122	74				33	27	34	48	
30			66	93	64				27	34	33	73	
31			66		69					35		49	
AVERAGE	127.79		62.33	113.57	78.00	79.00			51.43	42.81	50.80	69.55	76.47
MAX	197		93	222	144	95			77	129	110	150	222
MIN	74		40	71	46	62			27	22	29	29	22
No.	28		30	30	31	12			7	31	30	31	230

Table A-20 Daily Runoff Record at Sricuncolo on Way Semangka (7/14)

YEAR 1980
CA 1413 Km2
RO-DPT 1815 mm/year

DATE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1							21	44	41	41	253	97	
2							20	72	26	31	217	134	
3							26	41	49	27	232	144	
4							26	30	79	26	223	184	
5							25	97	117	29	353	222	
6							23	95	95	27	280	207	
7							24	94	76	24	235	184	
8							23	101	102	24	185	163	
9							23	101	107	23	159	131	
10							22	43	92	22	153	135	
11						23		102	57	24	137	157	
12						22		85	62	57	101	141	
13						22		80	101	85	118	156	
14						33	24	69	82	74	147	170	
15						33	25	58	55	83	142	177	
16						35	46	55	82	82	159	134	
17						27	72	79	95	72	129	162	
18						30	38	77	53	58	119	87	
19						31	34	62	43	71	174	78	
20						31	30	57	44	48	189	76	
21						37	22	53	40	41	156	73	
22						31	19	49	35	49	128	69	
23						57	24	48	34	412	114	66	
24						44	18	44	34	80	87	64	
25						34	15	43	34	84	93	60	
26						31	16	43	34	127	79	53	
27						27	30	43	34	98	107	53	
28						26	18	43	34	132	97	57	
29						26	26	43	34	170	156	54	
30						26	26	41	41	257	127	114	
31						23	27	41		264		117	
AVERAGE						30.90	26.52	62.35	60.40	85.23	161.63	119.97	81.33
MAX						57	72	102	117	412	353	222	412
MIN						22	15	30	26	22	79	53	15
No.						21	27	31	30	31	30	31	201

Table A-20 Daily Runoff Record at Sricuncolo on Way Semangka (8/14)

YEAR 1985
CA 1413 Km2
RO-DPT 1766 mm/year

DATE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1	92	173	56	68	83	48	63		58	54	113	75	
2	94	223	58	63	76	53	62		63	54	105	71	
3	87	174	54	64	72	83	58		46	69	90	68	
4	84	147	51	65	69	75	54		38	91	80	63	
5	80	136	58	60	77	81	47		33	149	80	83	
6	76	121	71	69	79	79			59	68	79	92	
7	80	127	79	63	75	65			39	64	88	84	
8	87	116	81	63	81	60			36	76	84	76	
9	81	114	71	62	80	57			35	64	105	79	
10	80	108	62	83	79	64			34	60	105	81	
11	100	104	69	91	77	97			68	56	98	87	
12	119	98	81	157	100	100			130	50	102	100	
13	138	88	81	146	110	79			107	47	117	102	
14	133	83	76	128	102	73			73	46	100	85	
15	114	79	67	147	95	69			58	214	81	79	
16	88	75	73	111	105	124			51	117	91	72	
17	80	73	85	90	87	100			44	80	94	68	
18	75	71	100	83	77	79		38	56	169	79	64	
19	75	68	114	80	72	71		37	53	147	77	73	
20	77	68	88	81	68	68		36	47	83	76	69	
21	83	64	87	98	69	77		35	44	154	72	65	
22	81	72	76	81	73	68		33	41	238	72	72	
23	76	65	71	76	64	62		31	37	111	69	75	
24	84	62	71	75	59	56		30	54	85	63	77	
25	104	64	72	73	56	53		44	67	77	58	80	
26	114	62	64	68	59	50		43	77	71	76	87	
27	105	58	59	73	77	47		37	91	71	85	84	
28	87	54	57	80	79	45		35	92	102	92	79	
29	85		65	71	64	45		31	73	117	88	95	
30	101		92	68	57	43		29	60	104	76	100	
31	122		79	84	52			28		113			
AVERAGE	92.97	98.11	73.16	84.55	76.55	69.03	56.80	34.79	58.80	96.81	86.50	79.50	79.12
MAX	138	223	114	157	110	124	63	44	130	238	117	102	238
MIN	75	54	51	60	52	43	47	28	33	46	58	63	28
No.	31	28	31	31	31	30	5	14	30	31	30	30	322

Table A-20 Daily Runoff Record at Sricuncolo on Way Semangka (9/14)

YEAR 1986
CA 1413 Km2
RO-DPT 2338 mm/year

DATE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1	91	146	72	90	79	35	328	59	67	127	187	124	
2	107	157	79	83	63	41	164	72	84	133	183	120	
3	94	154	87	79	60	43	110	95	114	122	238	107	
4	92	188	92	75	75	80	90	95	94	119	277	101	
5	110	199	108	75	79	73	79	102	79	107	309	97	
6	131	185	147	72	73	53	69	95	84	107	251	92	
7	214	173	116	71	92	76	68	85	117	95	215	90	
8	232	138	135	80	90	63	68	80	107	91	157	87	
9	203	110	146	88	99	58	68	104	135	152	174	85	
10	154	98	151	79	95	54	95	116	135	164	154	98	
11	117	138	157	84	79	50	100	92	133	146	143	117	
12	95	113	171	95	69	59	90	77	130	130	135	107	
13	90	90	164	97	64	81	80	194	122	116	125	108	
14	90	84	138	88	62	73	101	223	98	116	122	113	
15	83	80	144	79	63	72	124	138	91	104	124	146	
16	84	83	147	72	56	76	124	50	104	98	116	128	
17	76	90	130	69	51	76	98	107	97	101	114	131	
18	73	79	113	68	48	60	84	98	114	161	111	143	
19	73	72	107	68	45	56	73	91	97	120	116	151	
20	71	71	128	77	44	53	65	85	90	143	114	122	
21	72	71	110	67	43	50	54	81	91	166	104	105	
22	73	68	92	62	43	47	62	77	130	190	101	114	
23	69	67	87	62	42	45	90	75	138	204	98	122	
24	64	71	97	63	47	42	88	83	139	240	125	108	
25	63	81	92	60	43	54	80	169	146	267	187	102	
26	60	75	90	59	36	83	63	105	174	236	183	94	
27	62	71	94	58	34	52	53	146	157	340	159	127	
28	79	75	90	57	34	43	51	98	139	259	136	133	
29	90		84	59	33	42	54	81	130	245	128	147	
30	88		85	80	36	143	67	73	122	228	122	133	
31	117		88		38		67	69		178		141	
AVERAGE	100.55	108.11	114.23	73.87	58.55	61.10	90.55	100.48	115.27	161.45	156.93	115.90	104.75
MAX	232	199	171	97	99	143	328	223	174	340	309	151	340
MIN	60	67	72	57	33	35	51	50	67	91	98	85	33
No.	31	28	31	30	31	30	31	31	30	31	30	31	365

Table A-20 Daily Runoff Record at Sricuncolo on Way Semangka (10/14)

YEAR 1987
CA 1413 Km2
RO-DPT 2302 mm/year

DATE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1	144	92	110	101	131	64	63	203			64	117	
2	122	92	122	91	143	62	63	147			62	95	
3	107	92	138	85	114	73	64				75	113	
4	111	91	164	88	102	76	63				68	120	
5	139	100	143	81	104	79	65				67	113	
6	152	88	166	91	114	77	60				73	127	
7	146	97	146	108	117	87	58				95	146	
8	146	100	124	92	114	91	57				97	136	
9	124	101	139	110	104	117	57				81	133	
10	119	95	128	102	108	94	57				97	201	
11	133	116	129	111	159	87	56				107	173	
12	124	133	122	242	169	76	56			104	127	131	
13	114	152	113	174	147	73	53			108	95	110	
14	117	151	104	249	124	71	58			108	77	110	
15	105	139	98	206	113	69	57			108	71	101	
16	119	146	94	244	107	69	56			108	67	100	
17	104	195	100	169	116	69	53			108	65	101	
18	119	161	100	136	119	68	52			108	64	95	
19	117	151	101	120	104	104	75			108	64	147	
20	117	169	114	117	107	97	64			110	63	154	
21	110	208	101	131	97	69	81			110	63	124	
22	111	136	122	114	98	94	69			91	72	104	
23	110	120	117	111	92	92	77			72	85	95	
24	159	117	113	125	88	65	76			71	77	85	
25	130	116	95	110	83	67	75			71	67	79	
26	120	154	90	117	80	91	77			69	63	75	
27	113	131	85	105	76	69	92			69	62	72	
28	105	117	83	101	73	66	76			69	60	71	
29	110		102	119	69	64	76			68	68	69	
30	104		138	164	67	63	75			68	98	71	
31	100		125		64		72			67		69	
AVERAGE	121.00	127.14	116.97	130.47	106.55	78.77	65.58	175.00		89.75	76.47	110.87	103.14
MAX	159	208	166	249	169	117	92	203		110	127	201	249
MIN	100	88	83	81	64	62	52	147		67	60	69	52
No.	31	28	31	30	31	30	31	2		20	30	31	295

Table A-20 Daily Runoff Record at Sricuncolo on Way Semangka (11/14)

YEAR 1988
CA 1413 Km2
RO-DPT 1780 mm/year

DATE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1	88	117	51	107	65	59	50	46	47	48	72	128	
2	83	105	75	105	63	77	48	46	46	46	75	97	
3	108	105	108	97	64	65	47	45	45	46	80		
4	107	124	105	90	105	62	50	52	47	51	122		
5	102	255	85	84	105	65	51	58	90	51	135		
6	91	219	111	79	83	72	52	58	67	48	136		
7	90	146	171	75	81	77	50	62	59	48	94		
8	114	117	117	80	77	68	47	54	54	44	100		
9	94	111	122	83	72	64	46	51	48	45	88		
10	79	97	104	75	73	62	46	48	47	45	85		
11	95	91	119	75	85		45	47	46	47	95		
12	97	88	149	72	80	59	45	45	46	45	100		
13	103	97	130	67	84	56	45	51		108	88		
14	122	80	120	75	92	53	47	48		80	87		
15	154	80	102	98	108	52	53	47	47	63	85		
16	124	79	105	80	114	50	84	48	46	50	85		
17	120	79	102	69	117	47	83	52	46	45	83		
18	127	72	94	64	98	46	76	51	47	52	80		
19	130	67	135	62	83	45	72	48	53	53	76		
20	144	67	111	62	76	44	62	45	57	46	85		
21	156	114	107	60	71	43	57	45	60	53	100		
22	194	97	197	60	67		52	48	57	72	91		
23	201	83	273	59	67		50	45	56	127	259		
24	154	73	197	57	64		50	45	47	91	146		
25	124	68	136	57	62	52	47	64	50	83	116		
26	107	67	124	56	62	51	47	77	54	69	92		
27	101	64	107	56	75	51	47	68	59	62	92		
28	110	60	97	54	63	54	46	60	51	57	91		
29	124	57	114	68	62	52	46	56	58	52	85		
30	120		119	68	60	50	45	51		67	173		
31	117		120		59		45	48		59			
AVERAGE	118.71	99.28	122.81	73.13	78.61	56.77	52.61	51.90	52.96	59.77	103.20	112.50	79.75
MAX	201	255	273	107	117	77	84	77	90	127	259	128	273
MIN	79	57	51	54	59	43	45	45	45	44	72	97	43
No.	31	29	31	30	31	26	31	31	27	31	30	2	330

Table A-20 Daily Runoff Record at Sricuncolo on Way Semangka (12/14)

YEAR 1989
CA 1413 Km2
RO-DPT 2380 mm/year

DATE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1	183.55	85.83		102.96	65.99	119.45	102.96	76.59		125.63	131.86	154.59	
2	188.85	93.75		104.45	64.71	114.82	91.5	73.7		121	135.07	139.88	
3	190.62	92.92		102.96	64.71	101.48	84.48	71.08		113.34	130.26	139.82	
4	187.08	127.17		102.96	63.44	114.82	83.13	75.05		111.86	125.63	190.63	
5	187.08	194.15		104.45	62.17	121.08	80.44	79.09		108.89	124.08	169.74	
6	188.85	135.07		104.45	68.53	133.47		81.79		107.41	127.17	162.88	
7	187.08	117.91		105.93	79.09	138.28		72.35		100	121	156.24	
8	187.08	133.47		110.27	71.08	121		69.8		101.48	128.72	152.93	
9	178.31	131.86		105.93	76.39	111.86		65.99		97.17	122.54	157.9	
10	88.66	102.96		105.93	84.48	103		62.17		94.33	116.36	154.59	
11	151.27	101.48		127.17	75.05	98.58		59.62		85.83	107.41	146.29	
12	187.08	104.45		108.89	85.83	105.93		54.84		80.44	100	147.95	
13		104.45		108.89	94.33	105.93		53.65		76.39	113.34	139.88	
14		101.48		107.41	94.33	102.96		52.46		77.74	107.41	131.86	
15		104.45	77.74	102.45	87.25	97.17		50.07		75.05	102.96	139.88	
16		105.93	77.74	100	85.83	91.5		51.26		75.05	116.36	139.88	
17		114.82	77.74	98.58	73.7	85.83		52.46		71.08	125.63	143.08	
18		127.17	73.7	97.17	81.79	84.48		47.68		71.08	121	139.88	
19		111.86	72.35	94.33	83.13	84.48		50.07		69.8	127.17	146.29	
20		116.36	75.05	94.33	75.05	75.05		48.87		94.33	135.07	133.47	
21		107.41	79.09	85.83	69.8	66.53		52.46		121	135.07		
22		107.41	79.09	87.25	69.8	69.8		51.26		122.54	136.67		
23		105.93	85.85	81.79	77.74	67.26		53.65		124.08	133.47		
24		104.45	88.66	79.09	77.74	71.08		59.62		124.08	147.95		
25		104.45	92.92	81.79	94.33	80.44		52.46		119.45	146.29		
26		162.88	94.33	76.39	107.41	79.09		50.07		128.72	149.61		
27		166.31	100	72.35	100	72.35		133.47		133.47	139.88		
28		127.17	114.82	71.08	117.91	88.66		122.54		135.07	144.69		
29			114.82	71.08	166.31	134.67		131.86		136.67	141.48	133.47	
30			102.96	67.26	169.74	122.54		102.96		133.47	146.29	146.29	
31			102.96		130.26			87.17		133.47		152.93	
AVERAGE	175.46	117.63	88.81	95.45	87.67	98.79	88.50	69.23		105.48	128.01	148.71	106.62
MAX	190.62	194.15	114.82	127.17	169.74	138.28	102.96	133.47		136.67	149.61	190.63	194.15
MIN	88.66	85.83	72.35	67.26	62.17	66.53	80.44	47.68		69.8	100	131.86	47.68
No.	12	28	17	30	31	30	5	31		31	30	23	268

Table A-20 Daily Runoff Record at Sricuncolo on Way Semangka (13/14)

YEAR 1990
CA 1413 Km2
RO-DPT 1638 mm/year

DATE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1	88.8	80.7	79.8	65.4	42	77.1	63.5	47.8	91.5	68.1	60.9	94.2	
2	84.3	83.4	73.5	74.4	41.4	66.3	60.9	47.8	161	73.5	60	102	
3	86.1	106	81.6	65.4	41.4	60.9	91.5	56	113	75.3	57.5	105	
4	87.9	96	78.8	60.9	40.8	57.5	87.9	56	110	69	60	150	
5	87.9	90.5	76.2	57.6	40.2	74.4	102	53.5	105	74.4	54.4	130	
6	88.8	87.9	92.4	79.8	42.6	95.1	94.2	74.4	97	63.6	52.8	125	
7	87	83.4	113	75.3	47.8	106	86.1	63.5	93.5	59.2	53.5	122	
8	83.4	81.6	108	72.5	43.8	96	82.5	69.5	102	56.8	52	121	
9	79.8	76.2	94.2	73.5	46.4	90.6	78	65.4	99	56	62.7	119	
10	76.2	69	94.2	70.8	50.6	82.5	87.9	60	102	54.4	62.7	117	
11	72.6	64.5	89.7	67.2	47.1	74.4	91.5	54.4	104	52.8	58.4	115	
12	69	60.9	85.2	65.4	52	68.1	85.2	54.4	98	52	55.2	105	
13	65.4	75.3	86.1	64.5	56.8	64.5	87	53.5	92.4	51.3	54.4	102	
14	65.4	65.4	84.3	76.2	58.4	60.9	80.7	54.4	87.9	50.6	49.9	88.8	
15	67.2	90.6	87	68.1	70.8	66.3	79.8	52	84.3	50.6	54.4	106	
16	65.4	90.6	84.3	60	70.8	60	79.8	47.8	108	50.6	162	108	
17	81.4	89.7	75.3	59.2	69	56	75.2	46.4	106	50.6	167	110	
18	70.8	87	70.8	58.4	65.4	55.2	69.9	47.1	101	49.9	60.9	108	
19	64.5	87	73.5	56.8	57.6	52.8	74.4	45.7	95.1	49.9	60.9	109	
20	60.9	92.4	67.2	56.8	57.6	53.6	69	45	90.5	49.2	56.8	111	
21	57.6	87.9	77.1	52	51.3	54.4	65.4	44	91.5	48.5	60	114	
22	56	88.8	80.7	52.8	49.9	53.6	62.7	44.4	98	47.8	60.9	103	
23	56	87	72.6	49.9	49.2	52	61.5	50.6	96	47.8	67.2	100	
24	61.8	84.3	76.2	48.5	47.8	52	42	65.4	94.2	55.2	97	98	
25	66.3	87	76.2	49.9	47.1	60	42.5	50.9	91.5	58.4	102	96	
26	65.4	87.9	87.9	47.1	46.4	57.5	49.9	60	90.6	56	88.8	93.3	
27	63.6	87.9	92.4	45	45.7	53.5	49.9	57.5	87.9	55.2	87	92.4	
28	59.2	85.2	90.6	44	49.2	51.3	47.8	56.8	83.4	54.4	80.7	102	
29	67.2		83.4	44	65.4	50.5	47.8	56	75.3	161	74.4	117	
30	62.7		78.9	42.5	64.5	55.2	47.8	55.2	68.1	67.2	73.5	118	
31	78		70.9		78		47.8	56.8		69.5		118	
AVERAGE	71.83	84.08	83.32	60.13	52.81	65.27	70.71	54.59	97.26	60.61	71.60	109.67	73.40
MAX	88.8	106	113	79.8	78	106	102	74.4	161	161	167	150	167
MIN	56	60.9	67.2	42.5	40.2	50.5	42	44	68.1	47.8	49.9	88.8	40.2
No.	31	28	31	30	31	30	31	31	30	31	30	31	365

Table A-20 Daily Runoff Record at Sricuncolo on Way Semangka (14/14)

YEAR 1991
CA 1413 Km2
RO-DPT 1054 mm/year

DATE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1	116	118	28	56	27.1	21	16.2	14.2	20	18.5		90.6	
2	118	119	26.7		26.3	21	16	14	20	18.2		85.2	
3	136	120	27.5		30.2	20.7	16	14	22.1	18.2		74.4	
4	121	118	46.4		28.6	20.7	15.8	14	23.5	17.9		69.9	
5	121	115	45.7		27.1	20.3	15.8	14	24.7	18.2		70.8	
6	157	109	49.9		31.9	20.3	15.6	14	20.7	19.4	53.8	97	
7	149	106	78		43.8	20	15.6	14	20	19.1	25.9	87.9	
8	128	108	70.8		59.2	20	15.4	14	21	17.9	23.5	80.7	
9	127	108	69	70.8	49.2	19.7	15.4	20	20.7	17.6	22.8	73.5	
10	127	108	71.7	64.5	65.4	19.4	15.4	19.7	20.7	17.9	22.1	92.4	
11	126	136	71.7	61.8	59.2	19.4	15.2	19.7	23.9	17.9	26.7		
12	126	114	67.2	71.7	58.4	19.1	15.2	20	21	17.6	29.1		
13	124	207	73.5	60.6	61.8	18.8	15.2	19.7	25.5	17.6	28.6	93.3	
14	122	109	78	55.2	58.4	18.5	15	20	25.5	18.5	28.6	94.2	
15	118	56.8	76.2	51.3	52.8	18.2	15	20	21.7	17.9	28.6	90.6	
16	117	41.4	74.4	56.8	46.4	17.9	15	20	21	19.4	33.6	82.5	
17	113	42.6	72.6	52.8	42	17.6	15	19.7	20.3	20.7	35.4	62.7	
18	113	39	62.4	47.1	37.2	17.6	15	19.7	20.3	18.8	39	47.1	
19	110	37.2	64.5	42.6	34.2	17.3	15	20.7	19.7	18.2	36	42.6	
20	119	36	59.2	42	31.3	17.3	14.8	21	19.7	19.7	37.8	39.6	
21	128	42.6	55.2	45.7	29.7	17	14.6	20	19.4	18.8	45	38.4	
22	109	36	72.6	54.4	27.5	17	14.6	19.7	19.4	20.7	54.4	46.4	
23	122	35.4	70.8	45	26.7	17	14.6	19.7	19.1	19.4	57.6	58.4	
24	121	36.6	74.4	42.6	25.9	17	14.6	19.4	19.4	22.1	78	61.8	
25	120	36	70.8	39	25.1	16.8		19.7	22.8	19.1	62.7	56	
26	119	35	82.5	36	24.3	16.4		19.4	20.3	18.2	86.1	63.6	
27	120	33.6	78.9	33	23.5	16.4		24.3	20.7	17.6	99	81.6	
28	120	33	70.8	30.2	22.8	16.4		21	19.4	19.4	109	78.9	
29	119		67.2	30.2	22.4	16.2	14.2	20.6	19.1	19.4	101	71.7	
30	118		67.2	28.6	22.1	16.2	14.2	20.7	18.8	19.4	94.2	72.6	
31	117		60.9	70.8	22.4		14.2	20		17.6		69.9	
AVERAGE	122.61	79.86	64.02	49.53	36.87	18.37	15.13	18.61	21.01	18.74	50.34	71.53	47.23
MAX	157	207	82.5	71.7	65.4	21	16.2	24.3	25.5	22.1	109	97	207
MIN	109	33	26.7	28.6	22.1	16.2	14.2	14	18.8	17.6	22.1	38.4	14
No.	31	28	31	24	31	30	27	31	30	31	25	29	348

7. TRANSPORTATION

Introduction

Indonesia is composed of more than 13,000 islands and extends over a distance of 5,000 km from Sumatra in the west to Irian Jaya in the east. Due to the archipelagic nature of the country, the nation's transportation and communications systems are vitally important for national cohesion, but difficult to develop coherently for the purpose of economic integration and development. Among these islands, Sumatra is the largest in land area and possesses a relatively well developed transportation infrastructure compared to the other islands of the country.

The transportation systems in the study area exhibit the historical pattern of separate and unintegrated development of agriculture and industries in the different provinces. The reliance on links with Java, primarily with the Jakarta area, is predominant while links with neighboring provinces tend to be weak by comparison. The transportation networks tend to be centered around the provincial capital cities all of which have ports providing sea access to Java and abroad. The Bukit Barisan mountain range represents a major natural obstacle that effectively isolated the west coast of the island from the main transportation networks and resources located in the study area.

Three factors responsible for the development of the transportation systems along these lines are the following:

- the insufficient level of investment in transportation infrastructure in the past;
- the bias of past investment in favor of mainly urban regions having relatively well developed systems;
- the lack of a comprehensive approach in the past to transportation planning that reflects interdependent relationships among different regions.

Historical Perspective

The existing transportation networks are heavily influenced by the colonial policies of the Dutch who ran the country from the early 17th century until the 1940s. As is the case in many developing countries, the Indonesian economy was molded by the colonial power into one of supplier of raw materials for the purpose of industrialization of the European country. Southern Sumatra was developed as a plantation economy with the creation of estates of oil palms, rubber and coconut destined to serve foreign markets. The national economy was focused on the island of Java, and transportation systems were likewise centered on Java. As a result the trading routes from Southern Sumatra historically lead first to Java and then abroad, or even directly abroad. Similarly, the railroad networks were built for the purpose of transporting industrial raw materials and mining products to the nearby ports for shipment onward to other parts of Indonesia or abroad.

After President Soeharto assumed the presidency in 1969, Indonesia's Five Year Plans were developed and institutionalized as the main planning tool for the country. A summary of the developmental objectives of the four past Pelita programs regarding transportation is provided in Table 7.1.1 below.

The most significant event in the transportation history in the study area is the completion in 1984 of the Trans-Sumatra Highway, nearly 2,700 km in length, which unites the island from north to south (Figure 7.1.1). It is the longest such route in the country and it is instrumental in the development of linkages between formerly independent regions. Its full benefits for the different provinces will take years to be realized as it undergoes successive improvement programs.

Table 7.1.1 TRANSPORT POLICY FOR PAST REPELITAS

	Target for Transportation Development	Target for Regional Economic Development	Remarks
Repelita I	• To vitalize neglected transportation facilities • Contribution to export increase	• Reconstruction of national economy • Stability in national economy • To arrest the process of economic deterioration	• Period of making investment inventory for the infrastructure abondoned during the preceeding period
Repelita II	• To revive the transportation facilities • Improvement in transportation efficiency • Establishment of transportation system	• Homogeneous development among sector • Stability in national economy • Equity in regional development	• Period of recovering self-confidence for the construction of the national economy
Repelita III	• Improvement in transportation efficiency • Construction and maintenance of transportation facilities	• Enhancement of living standard, technology and welfare standard in homogeneous manner. • Preparation of economic condition for coming development in the next stage	• Attainments of minimum substantial standard (self sufficiency of rice was first attained in this period) • Minimum level of infrastructure was going to be provided although it is not a satisfactory standard
Repelita IV	• Road development aimed at promotion of productive sector • Coordinated development among different transportation means • Airplane and ship service to the transportationally less developed area • Internationalization	• Economic growth to lead the national economy to the take-off stage • Social equity to ensure productive employment and renumerative income • Sustained stability from political, environmental and natural resources points of view	• Period of reviewing past Repelita with modest progress of society as achivable target

source : Repelitas

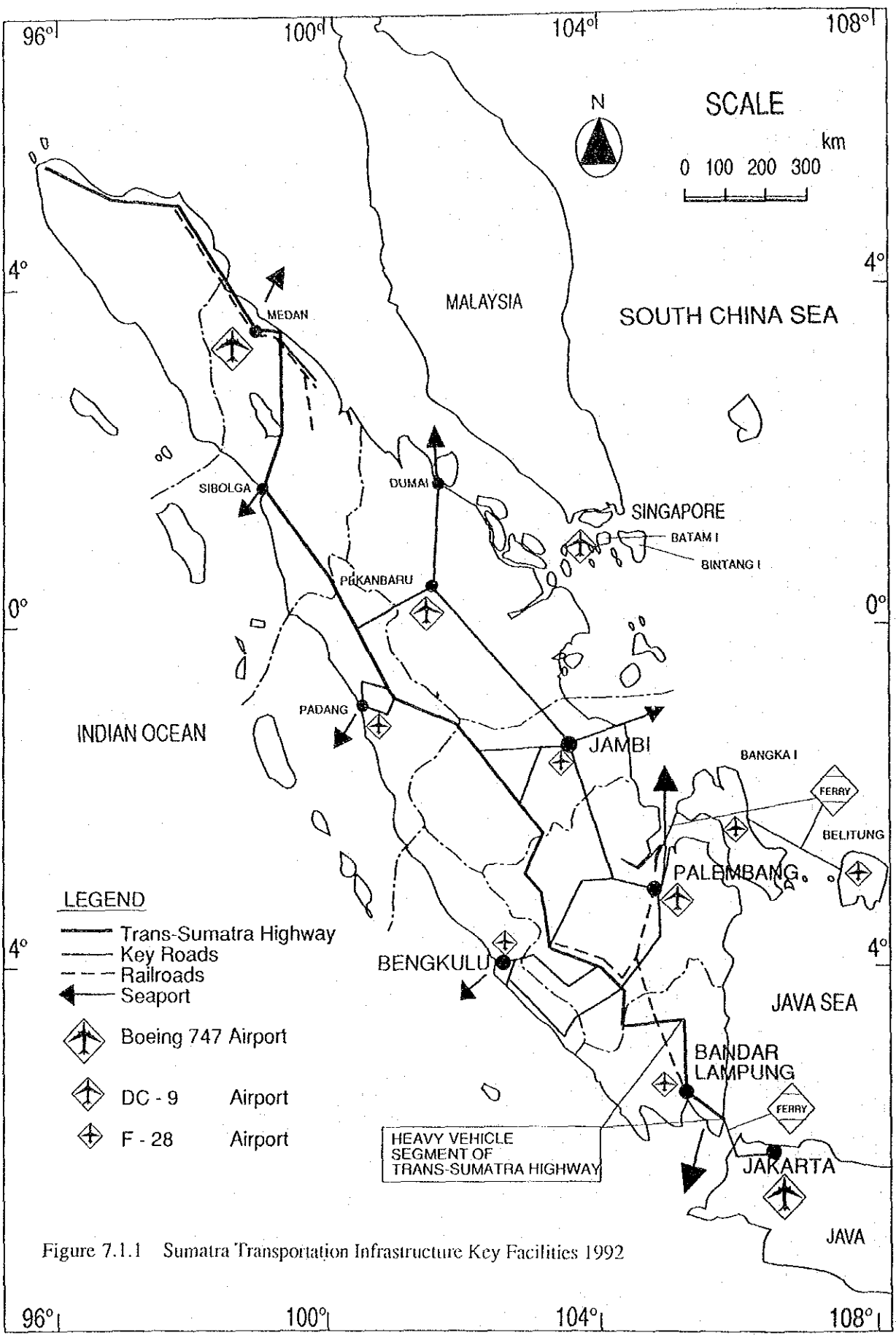


Figure 7.1.1 Sumatra Transportation Infrastructure Key Facilities 1992

7.1 CURRENT CONDITIONS

7.1.1 Description of Existing Infrastructure

(1) Roads

The road network in the four provinces consists of three road systems: the National, the Provincial and the local (kotamadya and kabupaten roads) networks which contain a combined total of approximately 29,000 km of roads. Just under one third, 9,000 km, is rated in good condition (1988). The GOI policy in recent years is to maintain and improve this network in Southern Sumatra, but not to substantially expand it by construction of new roads, with a few exceptions. The design standard for these roads generally features a 4.5 meter carriageway width and 8 ton ESA (equivalent standard axleload). Tables 7.1.2 and 7.1.3 provide statistics on the road networks and on their traffic volumes. Figures 7.1.2 to 7.1.6 present maps of the national and provincial road networks in each province.

1) The Trans-Sumatra Highway

The backbone of the network is the Trans-Sumatra Highway which extends from Aceh in the north to the ferry terminal at Bakauheni (Lampung) on the southern tip [Figure 1]. In Southern Sumatra it lies to the east of the Bukit Barisan mountain range roughly in the center of the island. It crosses each of the provinces in the study area except Bengkulu which lies entirely on the west slope of the Bukit Barisan and is therefore bypassed by the route. This highway also bypasses the cities of Palembang and Jambi City at distances of 170 and 200 km respectively. In the northern half of Sumatra it traverses generally mountainous terrain, almost touching the west coast at both Padang and Sibolga, before turning towards the east coast below Medan. The northernmost fourth of its length follows the coast along the Strait of Malacca. The road is generally constructed to the above mentioned design standard, and portions of it are benefitting from road betterment and improvement programs funded by foreign and domestic sources.

2) Highway Design Standards

The GOI is beginning to use a standard for roads that will be safe for use by heavy vehicles (container trucks, multi-axle trucks, large buses) that requires a minimum 6 meter carriageway width and 10 ton ESA strength. In view of the increasing use of large trucks for freight transport, upgrading of some sections to this higher standard has already been done by the Highways Dept. However, on the whole, the main roads vary in width from 3.5 to 5 meters (excluding shoulders), frequently lack stable shoulders, and reflect a geometric design that allows for average road speeds in the range of 40 to 60 kph.

3) Network Density

The kabupatens along the east coast contain swampland and therefore have fewer roads. The road network densities are highest in Lampung and Bengkulu (about 200 km/km2 of territory) where there is relatively less swampland. The lowest density is in South Sumatra which has by far the largest land area and the largest area of swampland. The sparseness of the road systems along the East coast is apparent on Figures 2, 3 and 6.

4) Vehicle Type Trend

The count of registered vehicles in Southern Sumatra has been increasing 7% per year (1985-1990), far higher than the 4% national average. Growth in registered trucks also averaged 7% for the Region, and only 2% for the nation. However, because of the small size of the roads of the Region, heavy vehicles such as multi-axle trucks or buses, especially container trucks, are entirely absent from the Region with one exception. A limited number of tractor-trailors hauling small containers to and from Panjang port (Lampung) use the TSH up to approximately 100 km north of Bandar Lampung. Large capacity intercity buses (up to

Table 7.1.2 CHARACTERISTICS OF ROAD NETWORKS AND 1990 TRAFFIC

	UNIT	JAMBI	SOUTH SUMATRA	BENGKULU	LAMPUNG	ALL SUMATRA	ALL JAWA	INDONESIA
area	km2	44,800	103,688	21,168	33,307	473,481	132,186	1,919,317
population 1990	000s	2,016	6,277	1,179	6,006	36,420	107,518	179,322
ROAD NETWORKS								
national & provincial	km	1,581	3,265	1,253	1,960	17,751	11,100	52,569
district	km	5,136	6,784	2,416	4,334	53,014	54,414	166,371
all types	km	7,155	10,848	4,073	6,880	76,136	79,769	244,668
Road Networks-Good Condition only :								
1988	km	1,240	4,089	1,361	2,008	24,196	25,458	82,180
1885	km	944	3,659	572	1,583	19,288	18,129	63,945
average yearly change	%	10%	4%	46%	9%	8%	13%	10%
network densities :								
all types	meters/km2	160	105	192	207	161	603	127
good condition only	meters/km2	28	39	64	60	51	193	43
all/1000 population	km/000 pop	4	2	3	1	2	1	1
VEHICLE REGISTRATIONS (including motorcycles)								
1989	vehicles	86,074	385,358	42,426	144,371	1,779,720	5,204,297	8,291,908
1985	vehicles	62,857	278,069	30,884	104,817	1,386,753	4,419,546	6,856,317
average yearly change	%	9%	10%	9%	9%	7%	4%	5%
trucks only :								
1989	trucks	10,284	52,346	11,067	28,054	246,710	559,774	952,461
1985	trucks	7,294	37,132	7,850	19,899	182,246	523,703	845,338
average yearly change	%	10%	10%	10%	10%	9%	2%	3%
TRAFFIC VOLUMES (national & provincial roads only)								
Full Networks :								
vehicle-kilometers	millions	538	2,422	922	1,619	10,402	19,549	36,723
traffic intensity/year	vk/km	340,101	741,654	735,674	826,122	585,990	1,761,153	698,569
daily average	vk/km	932	2,032	2,016	2,263	1,605	4,825	1,914
Good Condition Roads Only :								
total length	km	686	1,721	414	973	8,873	7,204	23,595
% of full network	%	43%	53%	33%	50%	50%	65%	45%
vehicle-kilometers	vk millions	345	1,859	427	1,211	7,458	16,378	27,391
percent of total vk	%	64%	77%	46%	75%	72%	84%	75%
intensity measure	%	148%	146%	140%	151%	143%	129%	166%
traffic intensity/yr	vk/km	502,915	1,080,186	1,031,401	1,244,604	840,527	2,273,459	1,160,882
traffic intensity/day	vk/km	1,378	2,959	2,826	3,410	2,303	6,229	3,180

Notes : Vehicle-km statistics exclude motorcycles. Good condition roads include roads with an International Roughness Index less than 6.

Sources : Min of Public Works-D G of Highways, Indonesian Highway Statistics, May 1991; BPS, Statistik Indonesia 1990.

Table 7.1.3 National & Provincial Road Network Densities in Southern Sumatra

(unit:)	Land Area (km2)	Road Length (km)	Network Density (m/km2)	Population Density (pop/km2)	Road Density /Capita (m/capita)
Jambi					
Kerinci	4,200	226	54	67	0.8
Sarko	14,200	533	38	25	1.5
Batang Hari	11,130	367	33	29	1.1
Tanjab	10,200	226	22	35	0.6
Bungotebo	13,500	411	30	27	1.1
Kdya Jambi	206	32	155	1,651	0.1
Totals	53,436	1,795	34	38	0.9
South Sumatra					
O K Ulu	10,408	628	60	93	0.6
O K Ili	21,658	293	14	36	0.4
Muara Enim	9,575	427	45	61	0.7
Lahat	4,034	427	106	149	0.7
Musi Rawas	21,513	404	19	24	0.8
Musi Banyuasi	25,664	462	18	34	0.5
Bangka	11,614	582	50	44	1.1
Belitung	4,532	317	70	43	1.6
K Palembang	224	62	277	5,094	0.1
K Pangkal	32	14	438	3,536	0.1
Totals	109,254	3,616	33	58	0.6
Bengkulu					
Selatan	5,949	322	54	50	1.1
Rejang Lebong	4,110	213	52	90	0.6
Utara	9,585	576	60	36	1.7
Kdya Bengkulu	145	71	490	1,175	0.4
Totals	19,789	1,182	60	60	1.0
Lampung					
Selatan	6,649	466	70	276	0.3
Tengah	9,190	599	65	207	0.3
Utara	19,369	872	45	85	0.5
K B Lampung	169	84	497	3,768	0.1
Totals	35,377	2,021	57	170	0.3
Southern Sumat	202,963	8,614	42	73	0.6
Northern Sumat	270,518	9,136	34	80	0.4
Sumatra	473,481	17,751	37	77	0.5
Java	132,186	11,100	84	813	0.1
Indonesia	1,919,317	52,569	27	93	0.3

Notes:
Land area data are approximate as sources differ slightly.
sources:
Provincial Bina Marga Offices, provincial Dalam Angka Publications;
Hoff & Oveigaard: Indonesian Highway Statistics, 1991.

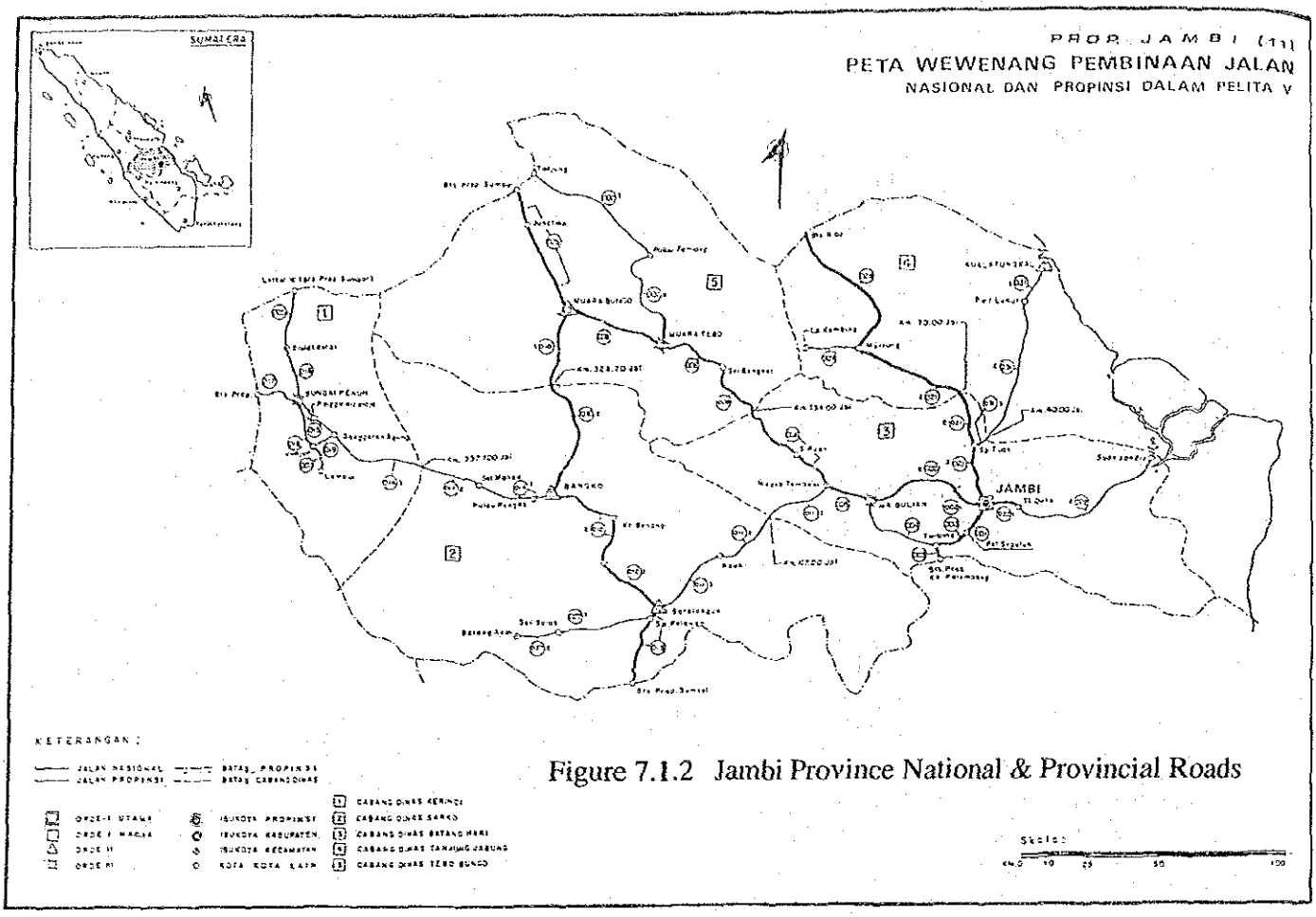


Figure 7.1.2 Jambi Province National & Provincial Roads

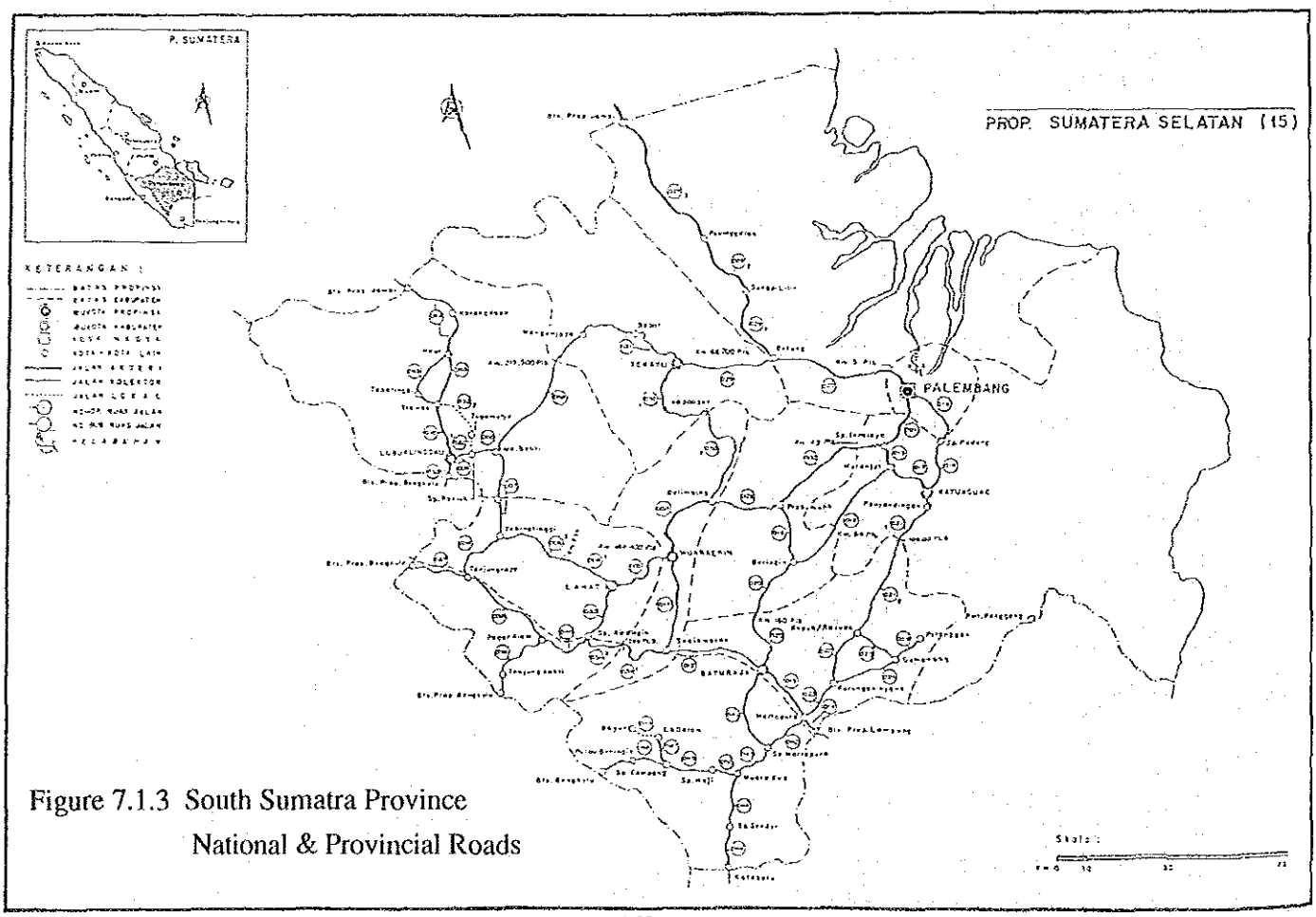


Figure 7.1.3 South Sumatra Province National & Provincial Roads

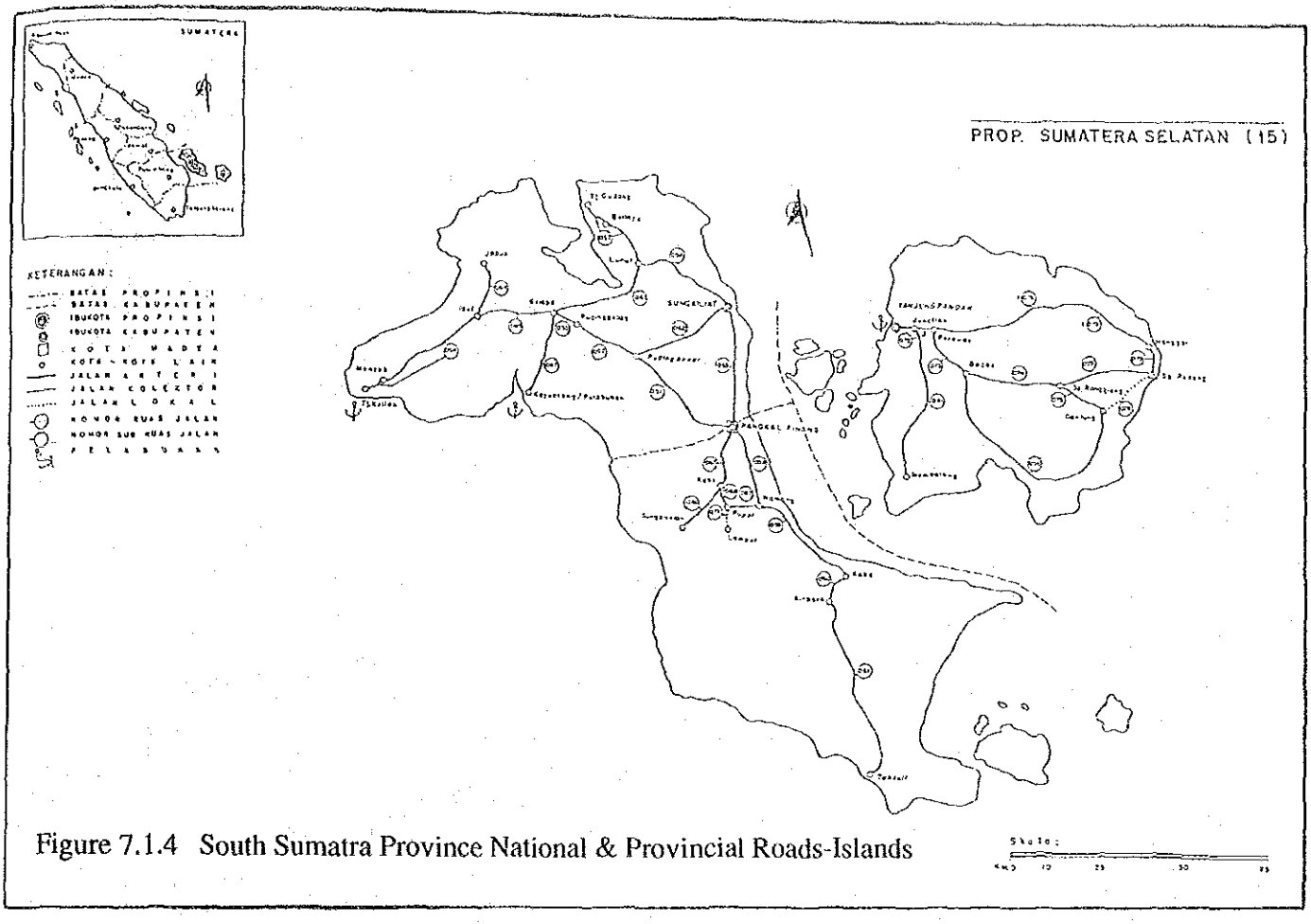


Figure 7.1.4 South Sumatra Province National & Provincial Roads-Islands

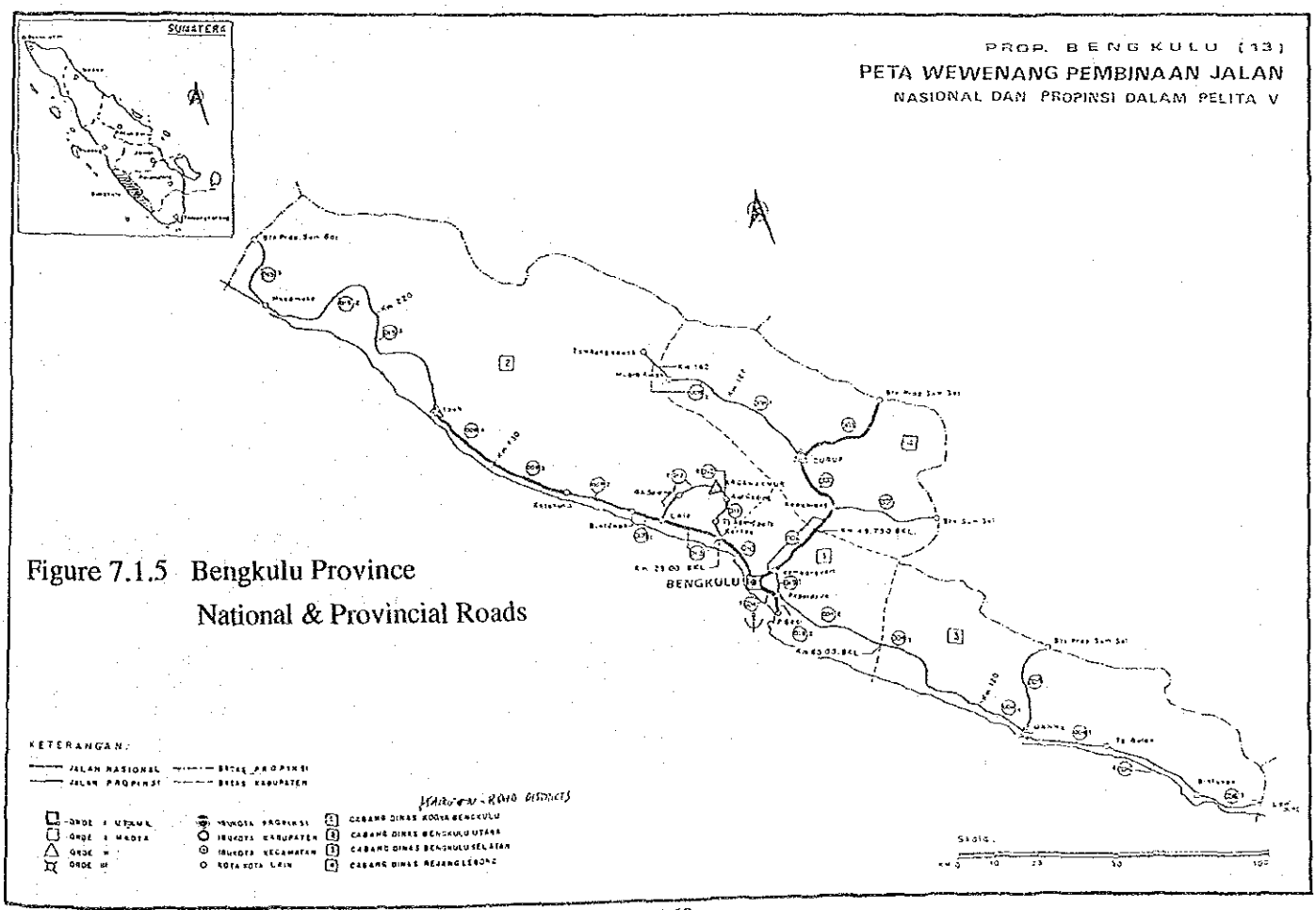


Figure 7.1.5 Bengkulu Province
National & Provincial Roads

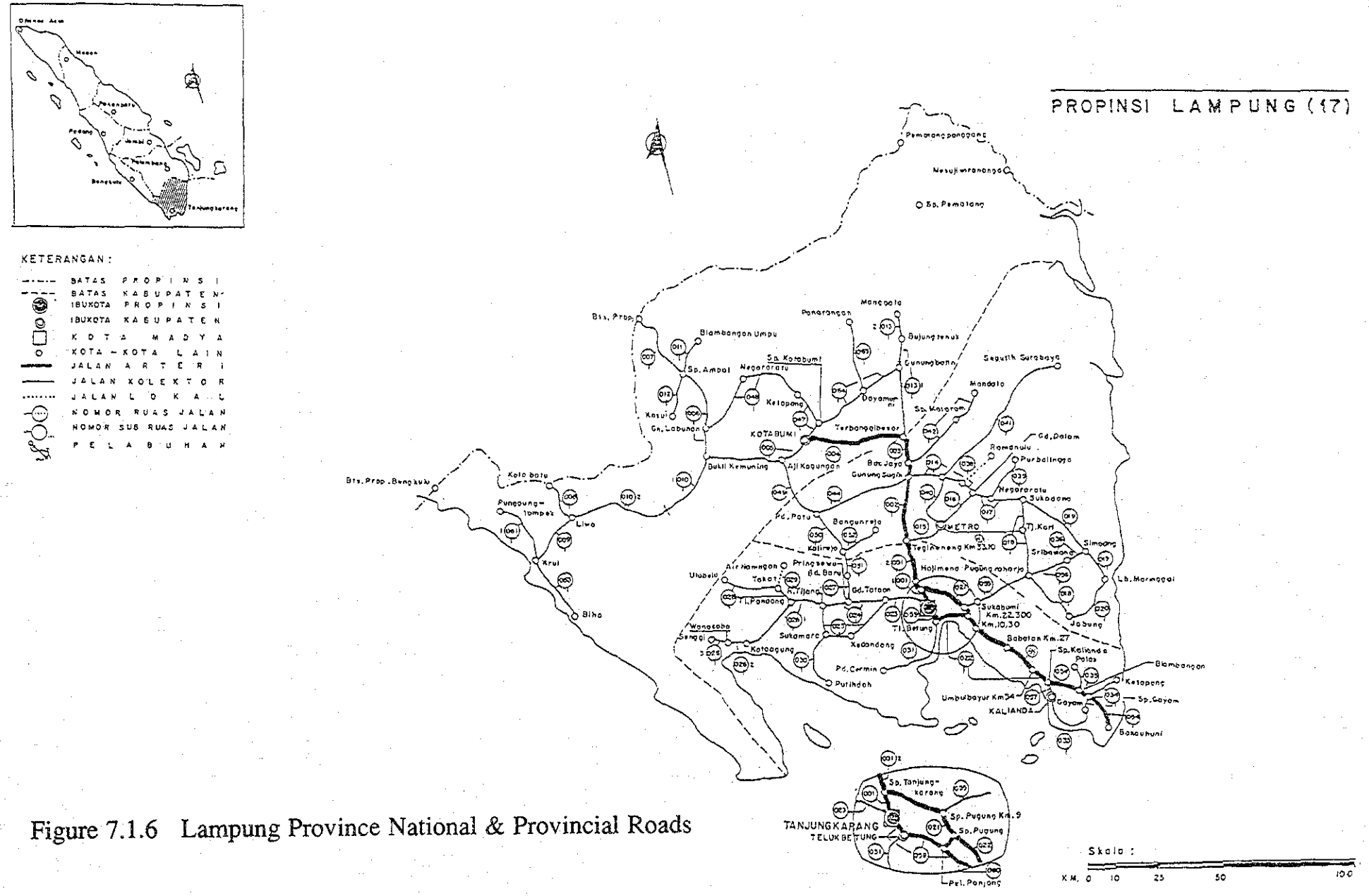


Figure 7.1.6 Lampung Province National & Provincial Roads

60 seats) are used mainly on the routes linking Jakarta to Palembang, Padang and other large cities in Sumatra.

5) Traffic Intensity

The intensity of road usage (traffic intensity; Table 7.1.2) in Southern Sumatra is far below that of Java island (1,605 vehicle kilometers/km of road per day in Sumatra versus 4,825 for Java). Within the Region, Jambi's usage level at 932 is far below those of the other provinces, all three of which exceed 2,000 daily vehicles. Average daily traffic levels outside of the urban centers seldom exceed 4,000 vehicles and congestion is generally absent from the Region's intercity roads. The two roads that are exceptions to this include the Palembang-Prabumulih road, which connects the city to the Trans-Sumatra Highway to the west, and the Trans-Sumatra Highway itself in the vicinity of Bandar Lampung.

6) Importance of Jakarta Access

Of great importance to Southern Sumatra is the quality of the surface link between Jakarta in West Java and the vital ferry service linking Java to Sumatra through the terminals at Merak and Bakauheni respectively. Although not located in Sumatra the Jakarta-Merak road is very important to Sumatra because it serves as the main access road to the Sumatra ferry terminal at Merak. Approximately one half of the overall distance of 110 km is covered by a toll road, and the journey takes 2 to 3 hours. Driving conditions on the portion that is not a toll road continue to be fair to difficult.

Another component of Jakarta access is the efficiency of the ferry link itself across the Sunda Strait. This is an operational issue somewhat beyond the scope of this study. The operation has undergone significant upgrading in recent years, and plans exist to make further improvements and to expand capacity as traffic on the route builds. During the day service is as frequent as every 40 minutes, and on normal days most vehicles experience little delay.

7) Jambi Province

The Trans-Sumatra Highway is the most heavily used road, followed by the Jambi-Palembang link. The entry point from Riau province north of Merlung has been in very poor condition and much of it has had only an earth surface. Consequently, the province has not had any good road link to points in Riau or North Sumatra. However, it has two links to West Sumatra, one being the Trans-Sumatra Highway, and the second being a cross mountain road from the Kerinci area to the west coast. The province's most vital link, however, is the Jambi City-Palembang road which is fully paved and can be covered in approximately four hours. The 1990 average daily traffic (vehicle) volumes at the entry points were:

Sarolangun-South Sumatra border [Trans-Sumatra Highway]	3,493
Muara Bungo-West Sumatra border [Trans-Sumatra Highway]	1,863
Tempino-South Sumatra border [Eastern Sumatra Highway]	1,285
Merlung-Riau border [Eastern Sumatra Highway]	226

There are two east-west routes linking Jambi City in the east with the interior areas and the Trans-Sumatra Highway. Each extends from Muara Tembesi, one to Muara Bungo and the second to Sarolangun. The networks for local roads are fairly well distributed across the province, although relatively sparse in the mountain zone of the province, and in the swampy area on the east coast.

8) South Sumatra Province

The province functions as a hub for the Region of Southern Sumatra since it has the Region's largest city and seaport at Palembang. It also has by far the most extensive road system, including nine crossings into neighboring provinces. With just over half of its network (national and provincial roads) in good condition (53%), the province has the Region's best road system. This includes the networks in the islands of Bangka and Belitung, both of which are fairly extensive. Outside the urban areas, traffic volumes generally fall below 3,000 per day, with the exception of a few points along the Trans-Sumatra Highway. Palembang is located a minimum of 170 km from this artery and as a result requires a daylong drive to reach the provincial capitals of Bengkulu and Bandar Lampung. In contrast, Jambi City to the north is accessible in approximately 4 hours by road.

9) Bengkulu Province

Bengkulu is the most isolated of the provinces as it has good road access only to the central part of the province, where Bengkulu City is located, and none in the north or south sections of the province. The province therefore is somewhat of an enclave. The Curup road leads to Lubuklinggau and the Trans-Sumatra Highway, and has a daily traffic volume of 1,576 vehicles (1990). The second access is the nearby Pasemah Highlands road from Kepahiyang which has a comparable traffic volume of 1,495 vehicles. The access road to West Sumatra to the north is in poor condition but carries some traffic, while the roads in South Bengkulu leading to South Sumatra and Lampung are in poor condition and carry minimal traffic.

10) Lampung Province

This province is the most densely populated in the Region and also has the densest road network (207 km/km2). However, the network is concentrated in the south central part of the province, while the upper part and the region west of the Bukit Barisan have the least developed networks. The Trans-Sumatra Highway functions as the main artery of the province (as it does for all of Sumatra) and handles the heaviest (exurban) traffic volumes, ranging from 2,100 to 9,800 vehicles (1992) with the lowest volume indicating the traffic level near the border with South Sumatra. Traffic at points in the Bandar Lampung area currently exceed 20,000 daily vehicles and represent the heaviest exurban volumes in the study area.

Heavy trucks hauling small containers use the Trans-Sumatra Highway between central Lampung province and Panjang port, over a distance of about 100 km. This is the only major road in the study area that is used regularly by heavy trucks, since the road system generally is not capable of accommodating heavy vehicles safely. However, because of the small size of the road, the lack of stable shoulders along much of it, and in view of the heavy pedestrian and small vehicle traffic (bicycles, becaks, bajajs, etc) along all the numerous populated stretches, even this moderate use by heavy vehicles is dangerous and hazardous to both pedestrians and vehicles. Some usage control for such vehicles (possibly by Time of day) might be considered until adequate upgrading of the road can be accomplished.

(2) Railroad

There is one major rail system operating in the study area, and its network includes a total track length of 654 km currently in operation (Figure 7.1.7). The key characteristics of this network are summarized in Table 7.1.4 below. A minor rail line is located in a mountainous region of North Bengkulu and is operated by a mining company, but it is an internal operation not providing any public transportation. There are also two rail systems located in the Northern part of Sumatra and in West Sumatra, which operate as separate divisions of Perumka and have no relation to the Southern Sumatra rail operation. They are smaller divisions operating networks of respec tively 493 and 233 km in length.

The main system is operated by Perusahaan Umum Kereta Api (Perumka) the state rail company (formerly PJKA) headquartered in Bandung. The system was built by the

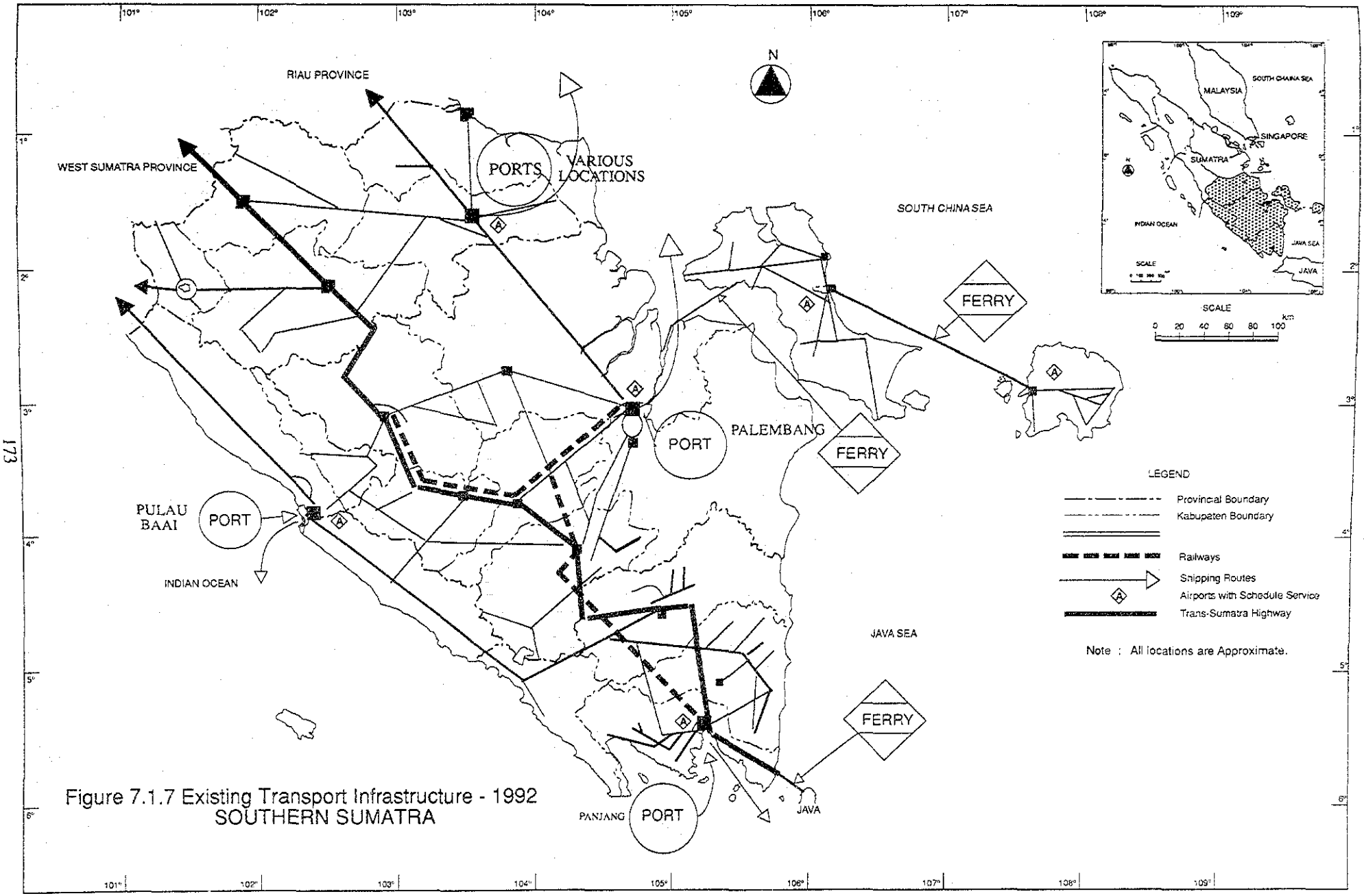


Figure 7.1.7 Existing Transport Infrastructure - 1992
SOUTHERN SUMATRA

Dutch in the 19th century and being a narrow gauge system, generally reflects the technology of that era. The network has not been modernized or expanded in recent years except for the branch to the Tarahan coal port. It has a fleet of foreign built diesel locomotives, coal hoppers and some upgraded passenger coaches, as well as some foreign built servicing equipment.

1) Freight Traffic and Coal Dominance

The system mainly hauls coal from the Bukit Asam mining area at Tanjung Enim in central South Sumatra to the Tarahan coal port south of Bandar Lampung. At Tarahan it is crushed and transferred to coal ships for transport to the power complex at Suralaya on the Java shore of the Sunda Strait. There is also a secondary coal shipping point at Palembang. It is this Suralaya coal traffic that has been the main source of growth in freight traffic nationally for Perumka, growing from 32 million ton/km in 1981/2 to 1,938 million in 1991. It generated 50% of Perumka's nationwide freight traffic and revenue in 1991, which is an indication of how vital this traffic is to Perumka's operations. In 1992 it is expected to haul approximately 5 million tons. The system also carries a limited volume of cement from the Baturaja cement plant to Palembang and some other bulk cargoes. For a while in 1991 Perumka ferried freight containers between Panjang and Palembang, but this traffic was recently discontinued as a result of a shift in shipping patterns of the containers to Singapore.

2) Passenger Traffic

Passenger services are offered over the entire system with two daily trains each way between Palembang and Bandar Lampung, and the same number between Palembang and Lubuklinggau. These passenger services compete directly with bus services over the same routes, and on the whole account for about 20% of total train kilometers. The recently introduced executive class service which provides air conditioned reserved seat service at higher fares is proving popular and competitive with bus and air services over the Palembang-Bandar Lampung route. According to Saltrannas, in 1988 318,000 persons used rail on trips between South Sumatra and Lampung provinces, and 225,000 on trips between South Sumatra and Java.

3) Other System Characteristics

In general, other than the coal handling infrastructure, the facilities of the system such as the rolling stock, rail lines and maintenance facilities are old and some in unsatisfactory condition. Average speeds fall in the 30-40 kph range and are low, service interruptions frequent, and large parts of the fleet out of commission. In the city of Bandar Lampung, there are approximately 8 grade crossings on the city's streets, and one at Natar on a heavily trafficked portion of the Trans-Sumatra Highway.

The financial health of Perumka as a state company which has never earned a profit is very uncertain. It is this coal hauling operation from Bukit Asam to Tarahan that is its most profitable operation, and the ESS that is its most efficient division. However, even this division has never been profitable and its future is unclear.

(3) Air

1) Infrastructure

Commercial air service to the Region is provided through six airports marked on Figures 7.1.1 and 7.1.8. All of these airfields are operated by the operating company of the Directorate General of Air Communication, and all are served on a daily basis with nonstop service from Jakarta operated by Merpati, the domestic subsidiary of the Garuda Indonesia Group. General information on these facilities appears in Table 7.1.5 below. Each airport operates with one paved runway generally on visual flight rules and handles only daylight

operations. The exception is Palembang's Badarudin II airport which has a functioning instrument landing system, runway lighting and scheduled night operations.

Table 7.1.4 Profile of Perumka Southern Sumatra Rail Division (Explotasi Sumatera Selatan)

Length of track (km)		654	km
Gauge of track (mm)		1,067	
Number of freight cars		2,120	
Number of passsenger cars		117	
Number of locomotives		82	
Number of operating stations		over 40	
Provinces served:		South Sumatra and Lampung	
Key points served:			
Palembang (terminus)		Bukit Asam (coal mines)	
Baturaja (cement)		Tanjung Karang	
Panjang (seaport)		Tarahan (coal port, terminus)	
Lubuklinggau (terminus)			
Traffic 1989-1990:			
Coal	tonnage	3.3	million
	ton-kilometers	1.2	billion
	average haul	364	km
Other freight	tonnage	0.9	million
	ton-kilometers	216.6	million
	average haul	241	km
Passengers	persons	1.0	million
	pax-kilometers	341.8	million
	average haul	342	km

1991 financial performance (all Perumka networks):

	yield (revenue)	cost
Freight	Rp 32/ton km	Rp 128/ton km
Passenger	Rp 14.8/passenger km	Rp 34/passenger km

Source: Various Perumka documents, Land Transport Development Plan Phase II Technical Appendix 1B Vol 3 (March 1992)

There are in addition some minor airfields in the Region including:

Pasir Mayang	(Jambi)	1,000 m runway	DHC-6
Depati Parbo-Kerinci	(Jambi)	650 m	DHC-6
Lubuklinggau	(South Sumatra)	construction suspended	
Mukomuko	(Bengkulu)	1,000 m	C-212
Astra Ksetra Military	(Lampung)	grass airstrip	

The ones in Jambi and Bengkulu are under DGAC responsibility, while the Lubuklinggau facility, which is incomplete, is an initiative of the kabupaten government. These fields are generally not equipped with navigational aids and are not always open for traffic. Some have handled public service functions such as transmigration flights.

The DGAC has spent minimal amounts on these airports in recent years, as its priorities for capital investment lie elsewhere in the country. Its position is to maintain them in operating condition without any major upgrading as regards safety or technical capability.

Table 7.1.5 Commercial Airports in Southern Sumatra

	Jambi	Palembang	Pangkal Pinang	Tanjung Pandan	Bengkulu	Bandar Lampung
runway length (meters)	1,650	2,200	1,620	1,650	1,800	1,850
apron area (sq meters)	20,368	17,651	14,400	10,701	12,000	20,425
terminal area (sq meters)	1,064	2,168	735	1,188	746	1,158
largest aircraft	F-28	DC-9	F-28	F-28	F-28	F-28
DGAC category	II	I	I	I	III	I
nstrument landing system	no	yes	no	no	no	no
1990 passengers (000s)	88.5	510.9	200.9	79.8	75.8	105.1
number carriers	2	4	3	2	1	1
daily flights	2	14	3	2	2	7
daily passengers (in & out)	242	1,400	550	219	208	288

Source: Directorate General of Air Communications materials, Merpati timetable

2) Traffic and Service Patterns

The traffic diagram (Figure 7.1.8) indicates how heavily focused traffic is on Jakarta and how weak links between the provinces are. Service between provincial capitals and Jakarta is generally reliable and is provided year round, while services between provincial capitals and Palembang is subject to frequent schedule changes, occasional cancellation, and suspension for months at a time. In 1992, the service betwen Jambi and Palembang was completely suspended for several months. Nearly all flights originate or terminate at Jakarta.

By far the most important route is the Palembang-Jakarta trunk route with over forty flights per week in each direction. As with most routes, this route is a monopoly operation of Merpati, which provides nearly all the service in the Region. Other carriers such as Pelita, Deraya and STP provide limited service on a small number of routes. At present there is no international service to the Region, and no nonstop service between Singapore and any point in the Region.

Air service on a per kilometer basis is by far the most costly mode of transportation and as such operates independently of other modes of transportation. Three main groups use air service in the Region, government officials, businessmen and high income individuals. Foreign or domestic tourists do not form a large part of traffic in this Region.

3) Capacity Utilization

The airports generally have plenty of unused capacity with daily flights ranging from 2 to 14. They can handle several times current passenger volumes without any major expansion. The F-28 twinjet aircraft is likely to remain the main aircraft serving this Region, and it is well adapted to the airport infrastructure. In the past several years, traffic patterns have been somewhat irregular with years of rising and falling traffic, but have generally shown growth in the area of 4% per year. Service is sometimes hampered by such problems

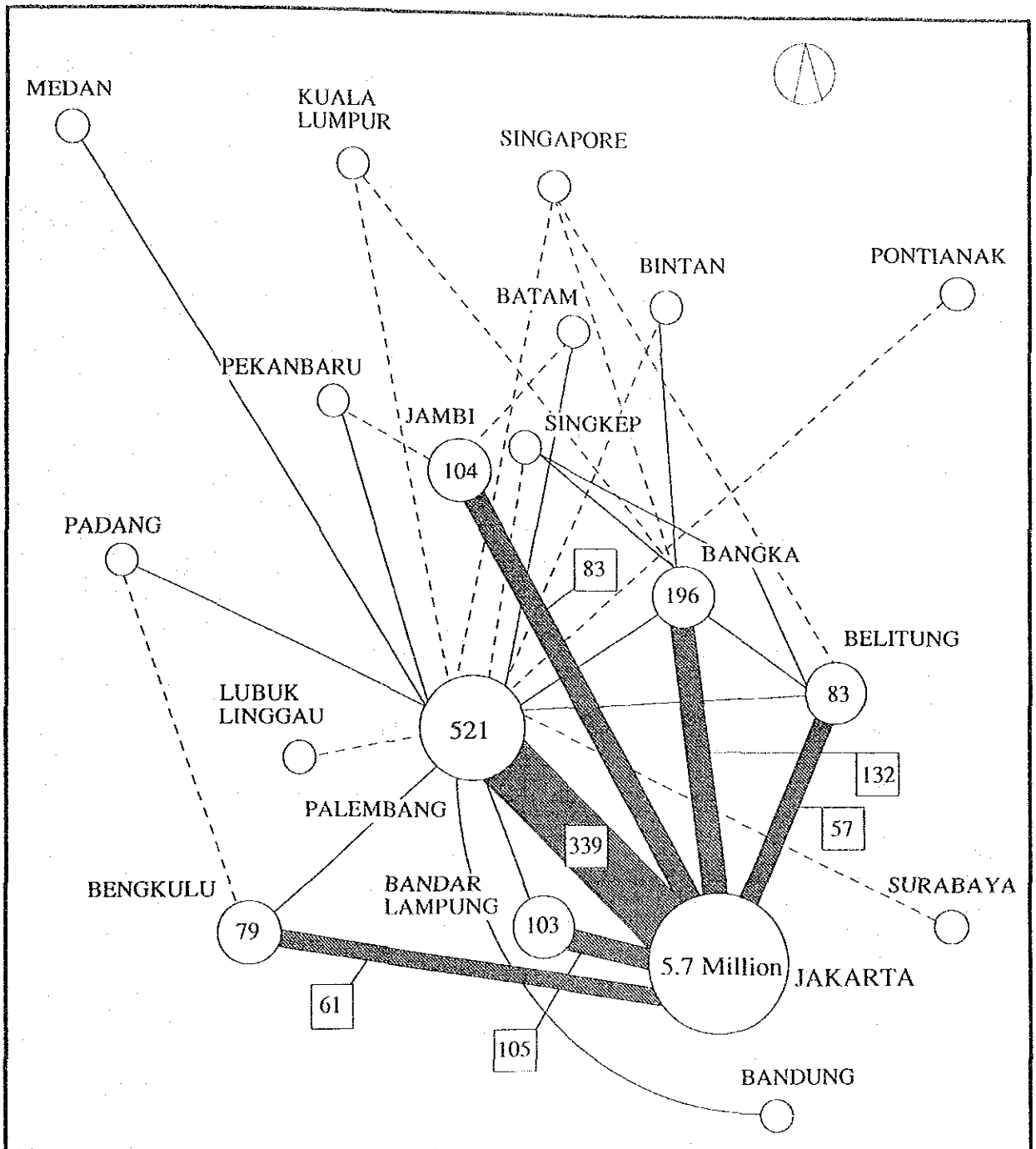


FIGURE 7.1.8 1989 AIR PASSENGER TRAFFIC AND POSSIBLE FUTURE ROUTES

(103) Annual Airport Passenger Volume (000s)

105 Annual Route Passenger Volume (000s)

Routes > 50,000 Volume

Routes < 50,000 Volume

Possible Future Routes

Note: Locations and data are approximate.

as poor visibility from forest fires, seasonal schedule reductions for the Haj flight program, and poor flying conditions during the monsoon season. Major airfare increases have also hampered growth in traffic.

(4) Water Transportation

The topography of the coastal line differs greatly between the east coast and west coast. The eastern part of the Region is flat with coastal swampland, and siltation along the coast is substantial. The west coast has a narrow coastal plain separating the Bukit Barisan from the sea: at some points it suffers from heavy erosion. On the south side (Sunda Strait) the twin bays of Semangka and Lampung offer good natural conditions for port construction.

1) Seaports

In the southern part of Sumatra, there are about 26 seaports consisting of 13 commercial ports and 13 non-commercial ports. The main commercial ports are Jambi City, Pulau Baai in Bengkulu city, Palembang's riverport, and Panjang port located in a suburb of Bandar Lampung. Figures 7.1.9 to 7.1.12 show the cargo volume of the four main ports.

Although the road system is undergoing significant expansion, sea and river transportation continue to carry most cargo for export, for Java and even for much of the intra-Sumatran traffic. This dominance of water transport should continue for the foreseeable future. Of all the tonnage moving between Java and Sumatra, 91% moved by sea according to the 1988 National Nonroad Origin and Destination Survey. The main reason is the importance of low value bulk cargoes for which sea transport is ideal. Another reason is that the design and condition of roads in Sumatra have generally been insufficient for the safe operation of most types of multi-axle vehicles needed for the most economical trucking transport.

Table 7.1.6 summarizes traffic at the Region's main ports in 1986 and in 1990. It indicates the strong growth in activity over the period, averaging 26% per year. It also indicates how domestic traffic dominates total activity, and how imbalanced flows are except at Jambi, with outbound cargo shares (share loaded) at Palembang, Bulau Baai and Panjang being respectively 78%, 80%, and 88%.

Table 7.1.6 Cargo Volume at Main Sea Ports

(Unit : 1000 tons)

	1986			1990			1990
Seaport	FOREIGN	DOMESTIC	TOTAL	FOREIGN	DOMESTIC	TOTAL	SHARE LOADED
Jambi (1)	398	491	889	530	970	1,500	54%
Palembang	1,340	2,352	3,702	1,207	7,023	8,230	78%
Containers (2)	-	-	12	-	-	21	-
Pulau Baai	120	248	368	318	574	890	80%
Panjang	547	975	1,522	1,513	4,145	5,653	88%
Containers (2)	-	-	2	-	-	19	-
4 ports total			6,481			16,273	
Panjang-oil only			419			527	
Tarahan-coal loaded			282			3,369	

(1) Includes Muara Sabak and Kuala Tungkal.
(2) Container Traffic in Thousands of TEUs. Figures are for 1987 and 1990.
Source : Port offices of PUP II port operating company.

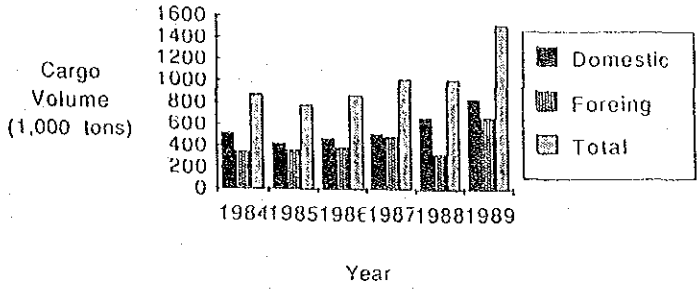


Figure 7.1.9 Cargo Handling Volume at Jambi Port

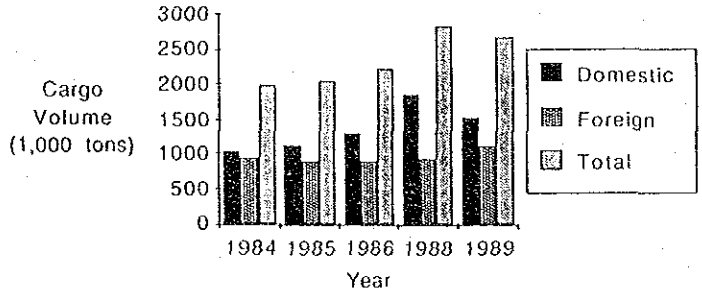


Figure 7.1.10 Cargo Handling Volume at Palembang Port

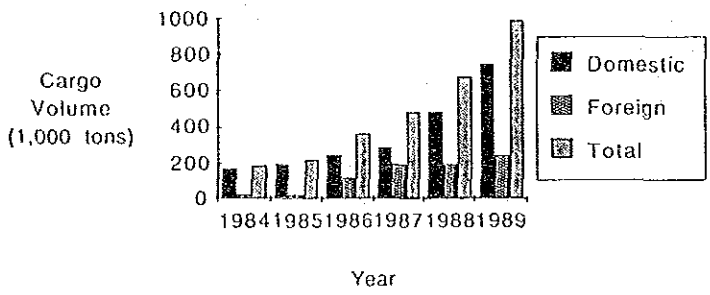


Figure 7.1.11 Cargo Handling Volume at Pulau Baai Port

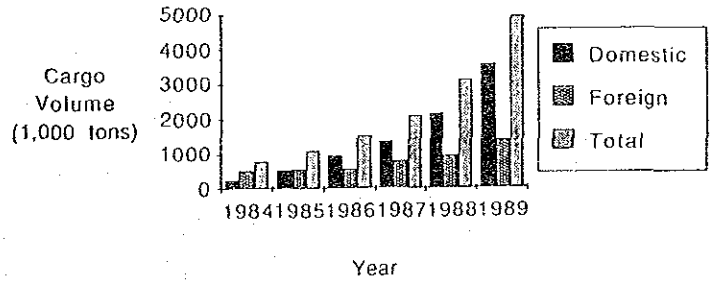


Figure 7.1.12 Cargo Handling Volume at Panjang Port

Jambi Province. The province has its main port at Jambi City on the Batang Hari River, with secondary ones at Muara Sabaka and Kuala Tungkal, and a less important one at Nipah Panjang. The former three ports are operated by one of the state port corporations and the latter port by the regional office of the Ministry of Communication. The common problems shared by the above ports are the large difference in water level between low water and high water, and also the sedimentation problem at the mouth of rivers. The volume of maintenance dredging is about 360 thousand cubic meters per year.

The main facilities of Jambi port are two pontoon berths (total length: 206 m), one quay wall for rainy season use only (length: 76 m), two transit sheds (area: 1,365 square meters) and two open storage areas (28,500 sq.m). The main commodities of Jambi Port are logs, sawn timber and oil.

The main facility at Muara Sabak port is a small wooden jetty whose length is 203 m with 5 m waterdepth in dry season. The main facilities of Kuala Tungkal are a small wooden jetty whose length is about 40 m with a 4 m waterdepth and a transit shed.

South Sumatra Province. The province has 11 public ports, namely Palembang and Sungai Lais on the mainland, Muntok, Pangkal Balam, Sungai Selam, Sungai Liat and Belinyu on Bangka Island, Tanjung Pandan on Belitung Island, all of which are operated by one of the state port corporations. In addition there is Sungai Lumpur on the mainland, Toboali on Bangka, and Manggar on Belitung, which are operated by the regional office of the Ministry of Communication. Palembang, Sungai Lais, Pangkal Balam and Sungai Liat are all river ports and have problems with sedimentation at the mouth of their rivers.

The biggest port in this province is Palaembang, which handles the largest cargo volume in the Southern part of Sumatra. Palembang port has a limited water depth of 6.5m at the entrance channel in dry season. The volume of maintenance dredging is about 2,500 cu.m per year. The main public facilities at Palembang port are:

a) total quay wall length: 1,020m
b) total transit shed area: 8,972 sq.m
c) total open storage area: 48,546 sq.m

Bengkulu Province. The province has 4 public seaports and two special purpose private ones. The public ones are Pulau Baai, Mukomuko, Linau (where construction of a small dock is imminent), and Enggano Island. The only substantial port of this province is Pulau Baai whose main facilities are a special coal loading wharf, a general cargo wharf and an oil jetty. The largest wharf at Pulau Baai port is the special coal loading wharf whose water depth is about 11 m. Pulau Baai port is located about 20 minutes south of Bengkulu City by road, in a well protected natural bay. The main commodity of this port is coal: volume reached about 770 thousand tons in 1989. A problem with this port is the sedimentation at the mouth of the bay.

Lampung Province. In Lampung province there are 9 public seaports, namely Panjang, Kota Agung, Kalianda, Teluk Betung on the south coast, Krui on the west coast, and Menggala, Mesuji, Way Seputih and Labuhan Maringgai on the east coast. Panjang port is operated by a state port corporation and the other ports are operated by the regional office of the Ministry of Communication.

Panjang port has good natural conditions for port construction. The major hinterland of this port is the province itself, where industry is growing rapidly. Some traffic for other provinces also uses this port, which is located directly on the Trans-Sumatra Highway. The growth rate of cargo volume here from 1985 to 1989 is about 45% per year, which is the highest growth rate in the Region. The number of containers reached 16,500 TEUs in 1990 which is about 10 times larger than the volume in 1987.

The main public facilities of Panjang port are as follows:

a) total berth length: 1,028m
b) total transit shed area: 20,582 sq.m
c) total open storage area: 57,248 sq.m

The Tarahan coal port which is located just to the south of Panjang port, is operated by the coal company and handles only coal. The volume handled at this port is about 2.5 million tons per year. This coal is transported to the Suralaya power plant, located some 60 sea miles to the east on the Java shore of the Sunda Strait, by two ships used only for this route. There is an elaborate coal processing station at Tarahan.

2) River Transportation

River transportation is used in Jambi, South Sumatra and Lampung provinces. Most of the facilities at these ports consist of small wooden wharves or pontoon docks. In many areas, as road and bridges are built, traffic has shifted from river to road resulting in the reduction or discontinuation of service on some river routes.

In Jambi province, Jambi city is the hub of a system of 8 routes. Recorded passenger traffic in the province has fallen from 300,000 in 1988 to 175,000 in 1990, while cargo amounted to 130,000 tons last year. In South Sumatra, only four routes are operated, two including Palembang, and volume is substantially higher than in Jambi: 358,000 passengers in 1990, and 531,000 tons of cargo. There is a clear trend of decline since 1986 (Figure 7.1.14). In Lampung, there is service along the Mesuji and Tulang Bawang rivers in the northeast corner of the province, and traffic is the lightest in the Region, 75,000 passengers and 102,000 tons of freight in 1990. Figures 7.1.13 to 7.1.15 show river traffic volumes for each of these provinces.

3) Ferry Services

The southern part of Sumatra has three ferry routes, Palembang to Kayu Arang (Bangka Island), Pangkal Balam (Bangka Island) to Tanjung Pandan (Belitung Island), and Bakauheni (Sumatra) to Merak (Java). Traffic on these routes has increased steadily. Figures 7.1.16 to 7.1.18 show the volumes on these routes. They also are marked on Figure 7.1.1.

Palembang - Kayu Arang. This route is one of the regional trunk routes and has substantial potential for growth with South Sumatra as its hinterland. The existing scheduled route of this service connects Palembang with Kayu Arang which is located on the Jering River about 20 km upstream from its mouth. At low tide it is sometimes difficult to enter or exit the mouth of the river because of shallow water conditions. Therefore, often the ferry is forced to divert to Muntok which is located on the coast, but which lacks proper docking facilities. Recently, the loading bridge at Kayu Arang was recently damaged and has not been operable.

The existing main facilities for the ferry terminal at Palembang include a pontoon dock with 3 m waterdepth, terminal building and parking space. Traffic on the route has shown growth since 1986. Recently a daily fast boast service for passengers between Palembang and Muntok (Bangka) was started linking the two points in 3 hours. The service has been increased to 3 departures daily and has proven to be popular.

Bangka - Belitung. The route between these two islands connects two river ports on these islands, which do not have ideal conditions. Pangkal Balam (Bangka) is a river port lying 6 km upriver from he estuary of the Mentawang River. Tg Pandan (Belitung) has a sea port that lies at the estuary of the Cerucup river. The total berth length at Pangkal Balam is 188 m with a 3.5 m water depth. Here there is a problem of sedimentation at the

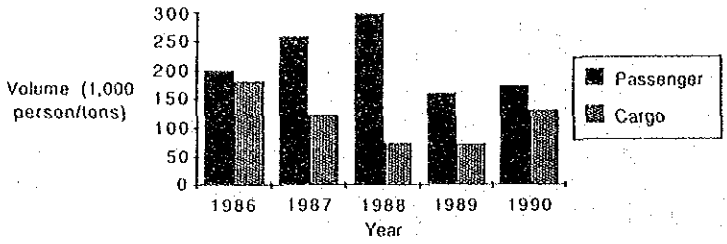


Figure 7.1.13 River Transportation in Jambi Province

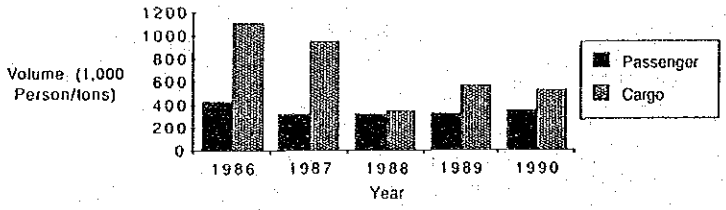


Figure 7.1.14 River Transportation in South Sumatra Province

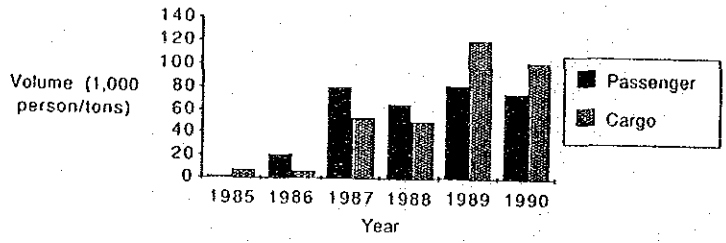


Figure 7.1.15 River Transportation in Lampung Province

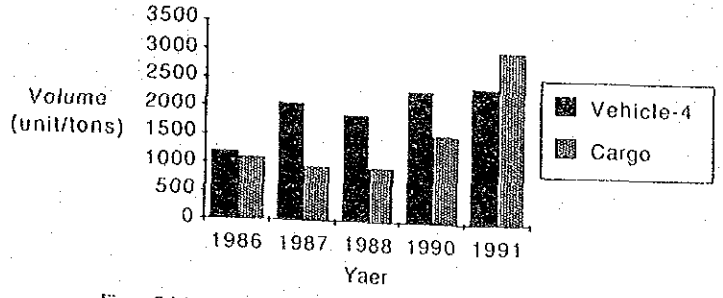


Figure 7.1.16 Ferry Transportation Palembang/Kayu Arang

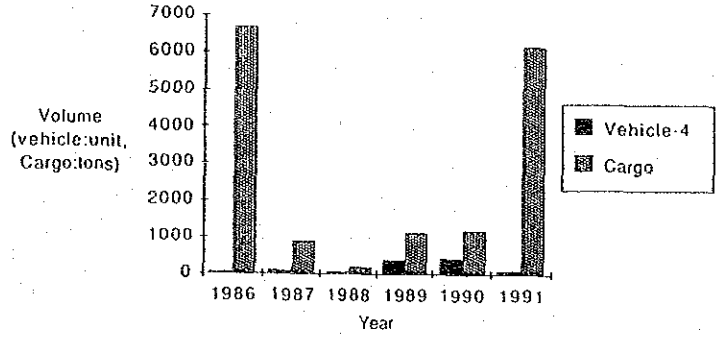


Figure 7.1.17 Ferry Transportatioa Bangka Island/Tanjung Pandan

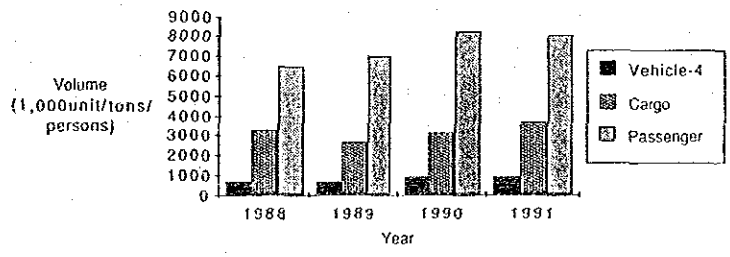


Figure 7.1.18 Ferry Transportation Bakauhuni/Merak