plant in the region. However, considering the regional development, hydropower has more advantage than coal thermal power. Because, water resources is the sustainable asset, of which development leads to increase the value of the regional asset, but coal mining is the consumable asset of which to increase the consumption lead to decrease the regional assets. Accordingly, consideration of the maximum usage of water resources is the right way for the regional development with a long term view. Coal mining is actually exporting and becomes important income source of the region together with oil mining. Therefore, The JICA Team recommends to promote hydropower development of the region.

(2) Power Supply/Demand Balance in the Southern Part of Sumatra (Region IV)

Generating capacity in the region IV is currently 570.7 MW (as of 1991/92), composed of diesel, coal-fired steam, gas-turbine, oil-fired steam and hydropower. The sharing of the each generating facilities is as follows:

Table 6.1.3 The Sharing of The Power Generators in Region IV

Type of Plant	Installed Capacity (MW)	Share (%)
Diesel	286.4	50.1
Coal-fired steam	130.0	22.8
Gas turbine	85.9	15.1
Oil-fired steam	50.0	8.8
Hydropower	18.4	3.2
Total	570.7	100.0

Source: PLN, Palembang

An annual average growth ratio has recorded 17.4% for the installed capacity, and 15.4% for the energy production in the region since the year of 1981/82. More than 50% of the total energy in the region has been produced by the diesel power plants since the year of 1985/86 even the national policy of saving oil consumption. This trend is however, will be still maintained even after operation of such large scale power stations as Bukit Asam and Keramasan. About 40% of energy in the region IV is consumed by the Cabang Palembang, energy to where are supplied by diesel generators operated in the area and transmitted from the Bukit Asam and Keramasan power stations.

There are currently major three systems in region IV, South Sumatra - Lampung system, Bengkulu system and Jambi system. The South Sumatra and the Lampung system has been interconnected, and the Bungkulu system is scheduled to be interconnected to the system in the near future. It is estimated from the experienced record in 1991/92 that the unified system will share the power market of more than 70 % of the whole region IV. Thus, the majority of the power market of region IV is shared the South Sumatra, Lampung and Bengkulu systems.

Demand forecast for the region conducted by PLN results in that the peak demand will reach 1,110 MW increasing at an average annual rate of 12.8% by the year of 2003/04, and the energy consumption will reach 4,885GWh at an rate of 13.3% in the same year. The results of demand forecast is shown in Appendix A6.2.

PLN has already worked out the power installation schedule until 2003/04 (Appendix A6.2). Total programmed generating facilities will be. However, beyond the anticipated power demand. Then the plan takes into account of the deteriorating plant capacity and the necessary reserve capacity to the system, which lead to the decreasing system reliability and discouraging the industrial investors to connect the system. The region consequently expects to import power and energy from the Java power system after the year of 1995/96, continuously thereafter, which is however, too optimistic to be realize. Because the Java system is more serious to fulfill the demand and that is also expected to import power and energy from Sumatra. Under such situation, all the programmed projects is required to be implemented as scheduled, and moreover, to review the current installation plan is strongly required to meet the power and energy requirement in the region IV.

(3) Regional Impact

The major prospects of Way Semangka Hydropower Schemes are to supply electric energy to Bandarlampung City, and to major cities in Kabupaten Lampung Selatan such as Kota Agung, Wonosobo, Prinsewu, Gadingrejo and so on.

Electric energy supply for Bandarlampung city is currently depended on the diesel power plants in Lampung Province. In addition, transmission line of 150 KV from Bukit Asam Coal Thermal Station in South Sumatra Province is under construction and will be completed in 1993. Tarahan Coal Thermal Power Station with an installed capacity of 130 MW is also under-planning, expected the commencement of operation in the year of 1997/98, for the further electric energy supply for Bandarlampung city. However, coal mining in the region is mainly consumed in Java and exported with a great deal of contribution to the regional income. The transportation capacity of coal mining, railway from Bukit Asam to Lampung is limited up to the amount to transport to Java. Therefore, the reliability of the coal transport to Tarahan is so far unknown. Accordingly, there is a difficulty to increase the regional consumption of coal mining in the future. Moreover, there is an idea to connect the transmission line to Java to supply electric energy from Sumatra to mainly Jakarta. If the idea realize, most of the energy output of Bukit Asam and Tarahan Coal Thermal Power Station will be consumed in Java. Accordingly, it is preferable to develop sustainable electric energy resources, such as hydropower development along Way Semangka River for the further stable electric energy supply for Bandarlampung City and Lampung Province.

11 Major Kecamatans, located between Way Semangka Hydropower Development Potential site and Bandarlampung City, are currently supplied electric energy by isolated diesel power stations. The population and present installed capacity of Diesel power plant is as shown in Table 6.1.4.

Table 6.1.4 Current Electricity Supply Condition Between Way Semangka and Bandar Lampung

Kecamatan	Population (1990)	Installed Capacity (MW)	Energy Output (GWh)
Wonosobo	84,596	0.14	0.09
Kota Agung	73,227	0.46	0.36
Pulau Panggung	81,356	-	-
Talang Padang	113,088	5.36	2.73
Pagellaran	100,535	-	-
Pardasuka	44,567	0.20	0.12
Sukoharjo	81,068	-	-
Prinsewu	80,417	-	-
Gadingrejo	58,105	-	-
Kedongdong	76,007	-	-
Gedontataan	125,430	-	-
Total	926,396	6.16	3.30

Source: PLN, Lampung.

Total installed capacity of Lampung Province is 166.82 MW, and the most of the plants are diesel power generators. Moreover, there area 191 units of private generators in Lampung and the total installed capacity is estimated 117.6 MW. Considering the above, the other electric power resources is required to develop for the further stable electric energy supply for Bandarlampung city and the whole Lampung Province. Appendix A6.3 lists all the power generating facilities in Lampung.

6.1.5 Major Development Issues

(1) Bukit Barisan Selatan National Park

The Upper Semangka and Lower Semangka potential sites are located in the area of Bukit Barisan Selatan National Park, and the Semung potential site is located in the area of protection forest. Both area is generally limited of development activity. According to Ministry of Environment, the limitation of activities of the natural reserve area are as shown in Table 6.1.5.

Table 6.1.5 Categories of Reserve Area and Activities

Activities	National Park	Nature Reserve	Wildlife Reserve	Recration Park	Hunting Park	Protection Forest
Growing food crops	X	X	X	X	X	X
Growing tree crops	X	X	X	O	O	O
Human Settlement	X	X	X	X	X	X
Commercial logging	X	X	X	X	X	X
Collecting herbs & firewood	X	X	O	X	X	O
Hunting	X	X	X	X	O	O
Fishing	O	X	X	X	O	O
Camping	O	X	O	O	O	O
Scientific collecting	O	X	O	O	O	O
Active habitat management	O	X	O	O	O	O
Non-exotic introduction	O	X	O	O	O	O
Collecting ratan & poles	X	X	O	O	O	O
Mineral exploration	O	X	O	X	O	O
Wildlife control	O	X	O	O	O	O
Visitor use	O	X	O	O	O	O
Exotic introduction	X	X	X	O	X	O

Note : (O): Permitted, (X): Prohibited
Source : Environment and Conservation Aspects of Forestry in Indonesia (MOF/FAO,1989)

According to the above regulation, hydropower development is included mineral exploration, then the development of hydropower will be permitted however, it is required to carry out detail environmental impact study at the early stage of the project with dew caution. Particularly, development of Way Semung schemes might be adverse effect to the forest protection area, because of the improvement of road network from Kota Agung for the access to the construction site. It is required that the special countermeasures to avoid the forest degradation due to the hydropower development.

(2) Volcanic Activities along the Great Sumatran Fault

The Great Sumatran Fault zone exist along Way Semangka river, and frequent earthquakes were previously observed, being listed in Appendix A6.4. There were 24 times of major earthquakes observed in Sumatra, and the most of the earthquakes related to the Great Sumatra Fault Zone. In the Way Semangka River basin, three major earthquakes, Kota Agung in 1900, Krui in 1923 with a magnitude of 5.8 and Kota Agung in 1933 with a magnitude of 6.7 are remarkable. Considering the above, it is strongly required to carry out detail geological survey at the stage of feasibility study, to be carefully selected the sites of diversion weir, head race tunnel route and power stations.

6.1.6 Project Justification

Project cost for the seven schemes were tentatively estimated based on the topographic map with the scale of 1:50,000 and based on the unit cost of the previous hydropower projects with run-of-river type in Sumatra. The total construction cost is US$ 404.51 million , and summarized in Table 6.1.6 (Appendix A6.5).

Table 6.1.6 Summary of Tentative Construction Cost

Scheme	Installed Capacity (MW)	Energy Output (GWh)	Construction Cost (US$ mil.)	Cost/KW (US$/KW)	Cost/KWh (US$/KWh)
Upper Semangka 1-3	78.2	418.1	130.65	1,671	0.0312
Lower Semangka 1-2	75.9	391.5	178.55	2,352	0.0456
Sumung 1-2	62.5	325.3	95.31	1,525	0.0293
Total	216.6	1134.9	404.51	1,868	0.0356

Source: Estimated by the Team.

The estimated construction cost seems very attractive to develop. Compareing to the other identified schemes in region IV, Way Semangka Hydropower schemes remark better cost performance in the view of unit construction cost per KWh. Particularly, Upper Semangka schemes and Semung Schemes have an advantage for the early implementation together with Manna-1 Scheme in Bengkulu Province in respect to the economic viability. The ranking of the identified hydropower schemes in region IV is shown below:

Table 6.1.7 Cost Performance of Identified Hydropower Schemes in Region IV

Scheme	Location	Installed Capacity (MW)	Energy Output (GWh)	Const. Cost (Mil.US$)	Cost per KWh (US$/KWh)	Maturity of Project	Schedule of operation
Manna-1	Bengkulu	77.2	629.6	132.2	0.0280	(*2)	
Sumung 1-2	Lampung	62.5	325.3	95.3	0.0293	(*1)	
Up.Semangka 1-3	Lampung	78.2	418.1	130.7	0.0312	(*1)	
Besai-1	Lampung	28.6	241.1	56.1	0.0316	D/D'91	1997
Musi-1	Bengkulu	69.2	582.5	148.8	0.0347	D/D'93	1999
Merangin-2	Jambi	232.5	1,230.3	394.3	0.0364	F/S'89	2000
Lw.Semangka 1-2	Lampung	75.9	391.5	178.6	0.0456	(*1)	
Komering-2	S.Sumatra	21.0	184.0	91.0	0.0495		
Merangin-5	Jambi	84.9	478.9	210.8	0.0522	Pre F/S'87	
Ketaun-1	Bengkulu	19.8	128.7	59.5	0.0599	F/S'89	2003
Merangin-3	Jambi	57.4	302.4	170.2	0.0638		
Ketaun-4	Bengkulu	40.8	216.7	124.6	0.0655		
Lematang-4	S.Sumatra	83.2	276.4	308.2	0.0673	Pre F/S'87	
Merangin-1	Jambi	41.2	217.5	137.2	0.0716		
Komering-1	S.Sumatra	73.0	443.7	273.7	0.0767		
Asai-4	Jambi	41.9	203.1	156.1	0.0826		
Luas-3	Bengkulu	32.2	200.0	132.4	0.0834		
Kutu	S.Sumatra	39.6	266.4	190.8	0.0948		
Ranau	S.Sumatra	28.0	165.6	130.7	0.0964	F/S'87	

Source : Hydro Power Potential Study 1983, IBRD
Note : (*1) : Pre-Feasibility Study by JICA Study Team on LTA-129.
(*2) : Selected as high priority projects on JICA LTA-129 Study.

6.1.7 Conclusions and Recommendations

As mentioned in Chapter 6.1.4 (2), region IV is insufficient of power supply facilities. It is strongly required to be accelerate to develop the new power generating facilities particularly hydropower and coal fired power plants. However, the development of coal fired power plant is inevitably required the strategy of coal mining usage in the national view point.

On the other hand, hydro-electric power is the sustainable assets for the region, and the development must be beneficial to increase the regional income. Huge development potential for both of coal mining and hydropower is still exist in the region, then the strategy of the long term usage and development is required.

As for Way Semangka River Hydropower Project, it is recommended to carry out more detailed survey and to confirm the feasibility of the project. Way Semangka River is undoubtedly good performance for hydropower development, therefore basinwide assessment for the hydropower development potential , and continuously to carry out the feasibility study are recommended.

Appendix A6.1 Meteorological Data in Way Semangka Basin

Table A6.1.1 Mean Monthly Rainfall Record in Way Semangka Basin

(1) Station Name : Srikaton / Srikuncoro (Lampung Selatan) (Unit :mm)

Year	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Total
1973/74	284.4	206.4	238.1	159.5	52.8	20.2	169.0	145.9	118.5	148.0	51.4	327.7	1922
1974/75	258.2	212.3	206.2	219.0	331.8	215.4	174.0	150.6			202.6	260.6	
1975/76	166.2	163.0	188.2	189.8	272.0	252.2	331.4			55.6	66.3	42.7	
1976/77	68.8	147.1	142.7	55.8	76.0	73.4	226.2	88.6	160.4	107.4	98.0	175.2	1420
1977/78	105.8	194.4	129.7	96.4	369.2			82.5	195.7	198.3	328.5	264.5	
1978/79	489.4	361.3	313.1	466.4	257.4	182.7	176.6	246.2	249.0	180.5	383.0	323.0	3629
1979/80	373.0	205.5	175.7	225.4	255.2	303.0	59.1	180.4	150.5	78.1	187.7	138.2	2332
1980/81	438.2	388.2	492.4	340.9	114.7	120.5	187.6	399.1	288.3	43.0	158.5	178.1	3150
1981/82	379.7	224.1	261.6	179.7	196.3	199.3	263.8	345.4	265.4	74.7	92.5	94.5	2577
1982/83	120.6	269.0	32.0	213.1	262.9	216.0	178.2	198.0	291.0	155.6	121.0	115.6	2173
1983/84	187.2	320.0	301.0	227.0	161.5	141.6	280.0	162.3	145.0	97.0	148.0	281.0	2452
1984/85	351.0	270.0	274.0	198.0	386.0	137.0	177.0	233.0	209.0	209.5	165.5	248.5	2859
1985/86	388.5	526.5	153.0	230.0	320.0	231.5	276.5	115.5	176.1	386.5	193.0	838.0	3835
1986/87	491.5	748.5	438.5	214.0	381.0	316.0	340.0	450.0	180.0	108.0	102.5	121.5	3892
1987/88	81.0	391.5	483.0	319.5	379.5	63.0	328.5	111.0	168.0	57.0	62.0	203.0	2647
1988/89	184.0	241.0	344.5	145.5	225.0	315.5	194.0	198.0	129.0	146.0	192.5	99.3	2414
1989/90	316.6	423.0	381.0	301.5	267.0	224.5	180.5	135.0	187.0	135.0	153.5	157.5	2862
1990/91	168.0	231.0	120.5	271.0	235.0	70.5	231.0	232.0	54.0	67.5	63.0	63.0	1807
1991/92	257.5	142.0	321.5	330.0	246.0	148.5	328.0		238.0				
No.	19	19	19	19	19	18	18	17	17	17	18	18	
Ave.	268.9	298.1	263.0	230.7	252.1	179.5	227.9	204.3	188.5	132.2	153.9	218.4	2664.5
Max.	491.5	748.5	492.4	466.4	386	316	340	450	291	386.5	383	838	3891.5
Min.	68.8	142.0	32.0	55.8	52.8	20.2	59.1	82.5	54.0	43.0	51.4	42.7	1419.6

(2) Station Name : Liwa (Lampung Barat) (Unit : mm)

Year	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Total
1973/74					127.7	267.7	87.0	371.7	325.1	87.1	124.6	291.2	
1974/75	328.3	268.5	276.3	328.8	261.1	296.1	223.9	205.4			293.7	199.6	
1975/76	255.9	189.8	178.6	172.6	249.5	196.1	245.8			68.4	145.8	97.3	
1976/77	100.7	414.8	374.6	240.4	329.4	247.7	328.1	216.2	174.5	97.4	71.4	124.6	2720
1977/78	146.1	58.7	356.5	215.5	281.5			160.6	247.9	91.1	219.4	136.6	
1978/79		281.0	244.0	425.2			236.3	373.1	197.7	144.0	128.4	114.3	
1979/80	146.2	321.4	212.1		266.2	263.0	209.5	330.0	157.2	90.2	161.6	143.9	2301
1980/81	248.8	336.9	540.4	363.9	225.2	225.5	460.6	337.4	396.0	125.5	191.7	133.9	3586
1981/82	261.0	307.2	231.9	272.4	349.5	214.6	166.5	302.7	212.4	63.4	130.0	40.0	2552
1982/83	117.9	85.6	202.4	178.2	244.9	136.5	374.4	122.0	329.5	78.8	33.4	181.3	2085
1983/84	73.8	411.2	331.1	323.6	162.7	152.5	316.9	326.8	222.0	85.9	84.5	196.5	2688
1984/85	144.4	308.2	126.5	265.9	259.4	171.6	114.5	187.7	227.5	56.8	78.3	89.2	2030
1985/86	162.8	258.3	374.4	109.3	183.0	187.6	338.8	265.7	106.5	21.6	195.9	149.7	2354
1986/87	312.4	355.4	244.7	364.8	254.4	236.9	184.2	188.0	77.9			24.4	
1987/88	16.3	62.1	163.0	32.1	53.4	61.2	173.0	126.6	46.0	13.0	0.9	119.0	867
1988/89	146.5	292.5	125.2	146.8	202.3	281.9	32.8		49.1	15.1	34.4	149.4	
1989/90	192.0	97.8	65.2	74.5				142.2	79.5	94.4	80.7	31.3	
1990/91	292.8	87.4	154.9	160.2	54.2	68.9		7.8	3.0		1.0	2.8	
1991/92	47.1	62.1	343.1	257.4	191.1	148.1	166.6						
No.	17	18	18	17	17	16	16	16	16	15	17	18	
Ave.	176.1	233.3	252.5	231.3	217.4	197.2	228.7	229.0	178.2	75.5	116.2	123.6	2353.5
Max.	328.3	414.8	540.4	425.2	349.5	296.1	460.6	373.1	396	144	293.7	291.2	3585.8
Min.	16.3	58.7	65.2	32.1	53.4	61.2	32.8	7.8	3.0	13.0	0.9	2.8	866.6

Table A6.1.2 Mean Monthly Runoff Record in Way Semangka Basin

(1) Station Name: Srikaton / Srikuncoro (Lampung Selatan)
CA=1,413 Km2

(Unit :m3/s)

Year	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Annual
1973/74					37.7	37.4	34.5	68.1	87.5	35.4	35.1	
1974/75	61.1	72.5	87.6	73.8	113.5	107.4	63.3	89.7	71.1	36.9	35.4	71.3
1975/76	45.6	51.3	80.3	45.5	80.2	94.5	82.8	92.2	66.3	32.6	26.3	60.6
1976/77	18.5	41.3	102.8	62.5	85.4	87.9	88.0	99.2	70.9	85.7	36.6	66.4
1977/78	40.2	16.0	29.5	76.5	120.6	70.3	119.5	70.3	157.3	124.2	113.6	87.7
1978/79	109.3	118.4	158.7	146.3	127.8		62.3	113.6	78.0			
1979/80	51.4	42.8	50.8	69.6						30.9	26.5	
1980/81	60.4	85.2	161.6	120.0								
1981/82												
1982/83												
1983/84												
1984/85					93.0	98.1	73.2	84.6	76.6	69.0	56.8	
1985/86	58.8	96.8	86.5	79.5	100.6	108.1	114.2	73.9	58.6	61.1	90.6	85.8
1986/87	115.3	161.5	156.9	115.9	121.0	127.1	117.0	130.5	106.6	78.8	65.6	
1987/88		89.8	76.5	110.9	118.7	99.3	122.8	73.1	78.6	56.8	52.6	
1988/89	53.0	59.8	103.2			117.6	88.8	95.5	87.7	98.8		
1989/90		105.5	128.0	148.7	71.8	84.1	83.3	60.1	52.8	65.3	70.7	
1990/91	97.3	60.6	71.6	109.7	122.6	79.9	64.0	49.5	36.9	18.4	15.1	62.0
1991/92	21.0	18.7	50.3	71.5								
No.	12	14	14	13	12	12	13	13	13	13	12	
Ave.	61.0	72.9	96.0	94.6	99.4	92.6	85.7	84.6	79.1	61.1	52.1	72.3
Max.	115.27	161.45	161.63	148.71	127.79	127.14	122.81	130.47	157.29	124.15	113.57	87.7
Min.	18.5	16.0	29.5	45.5	37.7	37.4	34.5	49.5	36.9	18.4	15.1	60.6

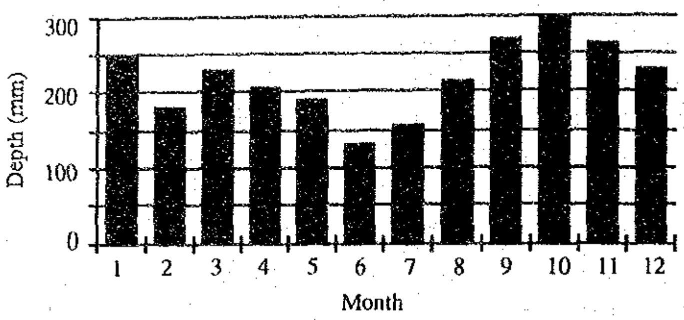
(2) Station Name: Liwa (Lampung Barat)
CA=243 Km2

(Unit :m3/s)

Year	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Annual
1973/74											8.94	
1974/75	15.74	15.24	14.44	12.48	19.23	20.23	11.89	11.27	11.44	8.70	8.28	13.1
1975/76	9.84	8.97	13.44	8.02	8.32	9.42	11.48	16.69	9.44	6.33	6.45	9.6
1976/77	6.42	8.91	26.23	13.06	16.55	17.06	18.45	26.59	13.57	13.55	8.82	14.6
1977/78	9.96	6.47	8.72	14.40	19.52	13.93	29.93	11.79	18.90	10.70	10.36	13.7
1978/79	14.83	14.84	19.04	33.29	26.96	44.87	11.42	25.33	19.90	12.68	12.37	20.5
1979/80	10.82	11.46	13.21	11.54	15.91	10.43	12.55	14.20	11.46	8.54	7.30	11.3
1980/81	10.80	12.47	34.83	28.71								
1981/82												
1982/83					22.39	12.89	16.13	14.50	15.17	10.15	8.01	
1983/84	4.98	7.67	17.10	17.74								
1984/85						18.41	15.90	17.22	17.20	15.57	16.59	
1985/86	13.62	14.74	15.87	23.02	33.44	11.37	27.84	11.65	11.62		13.88	
1986/87	24.55	20.64	18.21	17.21		8.65	7.76	7.37	7.37	3.95	2.37	
1987/88	1.09	1.93	1.91	6.81	24.56	18.75	23.98	16.53	18.39	15.36	12.99	12.9
1988/89	12.90	16.76	21.30	15.41	24.27	19.64	17.77	17.77	15.96	15.76	14.44	17.1
1989/90	16.46	14.25	17.26	22.62	12.12	16.95	17.75	13.75	13.09	12.14	10.23	14.5
1990/91	6.36	4.92	6.35	11.21	18.49	14.74	14.62	17.31	20.60	10.01	7.38	11.5
1991/92	6.13	5.59	16.36	21.86								
No.	15	15	15	15	12	14	14	14	14	13	15	
Ave.	11.0	11.0	16.3	17.2	20.1	17.0	17.0	15.9	14.6	11.0	9.9	13.9
Max.	24.55	20.64	34.83	33.29	33.44	44.87	29.93	26.59	20.6	15.76	16.59	20.47
Min.	1.1	1.9	1.9	6.8	8.3	8.7	7.8	7.4	7.4	4.0	2.4	9.6

Figure A6.1.1 Monthly Rainfall Pattern at Srikaton and Liwa

(1) Station Name : Srikaton



(2) Station Name : Liwa

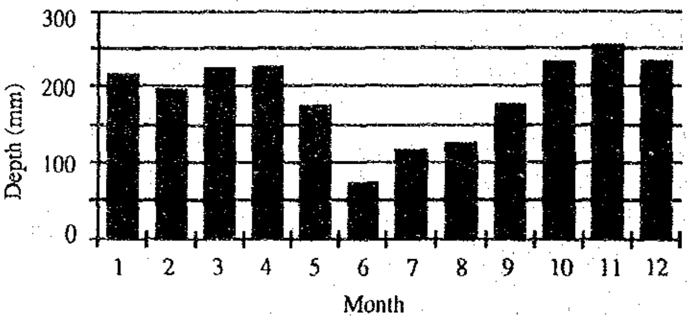
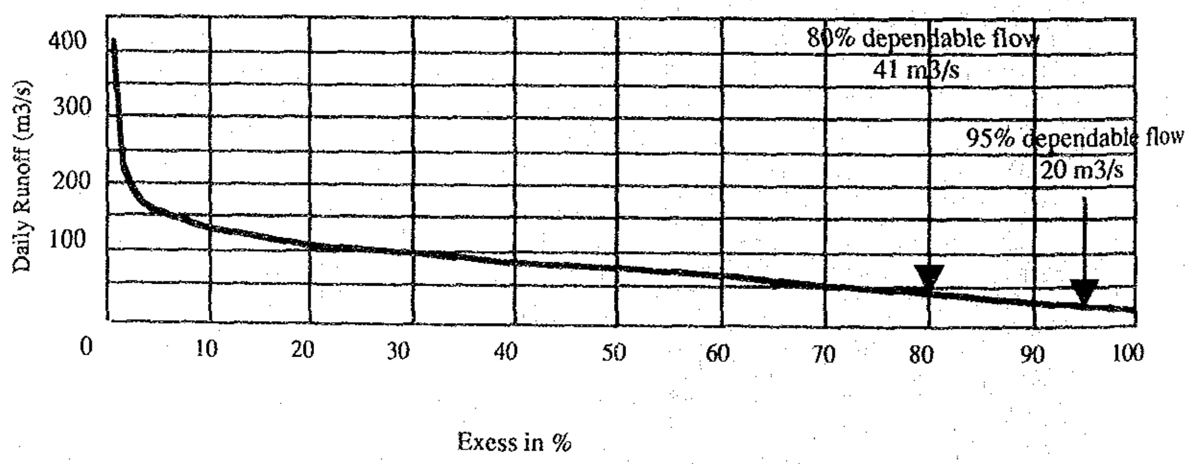


Figure A6.1.2 Daily Duration Curve at Srikuncoro Gauge

Srikuncoro (CA =1,413 Km2)



Excess (%)	0	1	2	3	4	5	6	7	8	9	10	20	30	40	50	60	70	80	90	91	92	93	94	95	96	97	98	99	100
Runoff (m3/s)	412	223	188	170	160	154	147	144	138	134	131	107	95	83	74	64	52	41	27	25	24	23	21	20	19	18	16	15	12

Appendix A6.2 Future Power Demand and Supply of Wilayah IV

Table A6.2.1 Power Demend Forecast of Wilayah IV

	1990/91	1991/92	1992/93	1993/94	1994/95	1995/96	1996/97	1997/98	1998/99	1999/00	2000/01	2001/02	2002/03	2003/04
RESIDENTIAL														
Population (10~3)	17000.7	17621.1	18260.2	18920.1	19599.8	20268.1	20958.5	21670.2	22395.8	23143.4	23911.1	24690.1	25486.2	26275.8
Electrification Ratio (%)	14.9	16	17.3	18.6	20	21.4	22.9	24.3	25.8	27.3	28.7	30.1	31.5	32.9
No of Customers (10^3)	505.1	565.6	630.4	704.9	784	868.4	958.4	1054.7	1157.6	1264.1	28.7	30.1	31.5	32.9
Growth of GDP Total (%)	7.3	6.99	7.01	6.92	6.68	6.77	6.78	6.8	6.81	6.82	6.83	6.84	6.85	6.86
Consump/Customer (kwh)	860.6	818	810.6	799.9	791	796.2	784	784.4	786.7	792.9	802.6	815.5	831.2	849.7
Energy Consumption (GWh)	417.6	484.5	511	563.9	620.1	682.7	751.5	827.3	910.7	1002.3	1103.1	1213.8	1335.6	1469.5
(annual growth rate : %)	9.7	18	5.5	10.3	10	10.1	10.1	10.1	10.1	10.1	10	10	10	10
Share to Total (%)	43.1	39.3	39.9	38.7	37.5	36.5	35.5	24.6	33.8	33	32.2	31.4	30.7	30.1
COMMERCIAL														
No of Customers	25168	28566	31841	35603	39597	43860	48410	53271	58468	63847	69414	75180	81156	87356
Elasticity	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Growth of GDP Selection (%)	6.32	6.34	6.36	6.38	6.39	5.91	5.92	5.94	5.95	5.97	5.99	6	6.01	6.03
Consump/Customer (kWh)	3248.3	3235.7	3290.8	3342.1	3404.1	3456.5	3516.6	3583.9	3657.8	3743.8	3841.1	3949.1	4067.8	4196.7
Energy Consumption (GWh)	81.8	93.5	104.8	119	134.8	151.6	170.2	190.9	213.9	239	266.6	296.6	330.1	366.6
(annual growth rate: %)	11.2	14.4	12.1	13.6	13.3	12.5	12.3	12.1	12	11.8	11.5	11.4	11.2	11.1
Share to Total (%)	8.4	7.8	8.2	8.2	8.2	8.1	8	8	7.9	7.9	7.8	7.7	7.6	7.5
PUBLIC & OTHERS														
No of Customers	14167	15948	17776	19876	22106	24486	27026	29740	32641	35644	38752	41971	35307	48769
Elasticity	1.3	1.3	1	1	1	1	1	1	1	1	1	1	1	1
Consump/Customer (hWh)	5592.9	5556.9	5588	5611.1	5651.1	5677.8	5715.6	5763.2	5819.6	5892.8	5981	6083	6197.9	6325
Energy Consumption (GWh)	79.2	90.7	99.3	111.5	124.9	139	154.5	171.4	190	210	231.8	255.3	280.8	308.5
(annual growth rate : %)	7.2	14.5	9.5	12.3	12	11.3	11.1	11	10.8	10.6	10.3	10.2	10	9.8
Share to Total (%)	8.2	7.4	7.8	7.7	7.6	7.4	7.3	7.2	7	6.9	6.8	6.6	6.5	6.3
INDUSTRY														
No of Customers	1261	1459	1638	1825	2034	2259	2508	2786	3094	3437	3817	4240	4710	5232
Elasticity	1.5	1.5	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Growth of GDP Section (%)	12.91	10.76	10.77	10.02	10.02	9.7	9.7	9.7	9.71	9.71	9.71	9.72	9.72	9.72
Energy Ind. Demand (GWh)	1873.5	1924.8	2181.2	2430.3	2707.8	3007.2	3339.3	3709.3	4119.8	4575.9	5082.6	5645.6	6271.2	6966.2
Energy of Big Customer (GW	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Captive Power (GWh)	1484.3	1485.4	1615.9	1768.1	1934.7	2109.9	2301	2509.6	2737.1	2985.4	3256.3	3551.8	3874.3	4226.2
Captive Takeover (GWh)	0	111.3	29.3	32.3	35.4	38.7	42.2	46	50.2	54.7	59.7	65.1	71	77.5
Share PLN to Total (%)	20.77	24.57	25.92	27.25	28.55	29.84	31.1	32.34	33.56	34.76	35.93	37.09	38.22	39.33
Energy Consumption	398.2	563.3	565.3	662.2	773.2	867.4	1038.8	1199.8	1328.7	1590.5	1826.4	2093,8	2396.8	2740
(annual growth rate : %)	3.6	44.7	0.4	17.1	16.8	16.1	15.8	15.5	15.3	15	14.8	14.6	14.5	14.3
Share to Total (%)	40.2	45.7	44.2	45.5	46.6	48	49.1	50.2	51.3	52.3	53.3	54.2	55.2	56.1
TOTAL														
No of Customers (10^3)	545.6	611.5	661.7	762.2	847.7	939	1036.4	1140.5	1251.8	1367	1486.3	1609.8	1737.9	1870.9
Energy Consumption (GWh)	967.7	1232.1	1280.4	1456.6	1653	1870.7	2115	2389.3	2697.2	3041.9	3427.8	3859.8	4343.3	4884.6
Growth Rate (%)	7.1	27.3	3.9	13.8	13.5	13.2	13.1	13	12.9	12.8	12.7	12.6	12.5	12.5
T & D Losses (%)	17.8	17.3	16.7	16.2	15.7	15.2	14.7	14.2	13.7	13.2	12.7	12.2	11.7	11.3
Energy Sent Out (GWh)	1199.8	1504.6	1563.6	1766.9	1992.2	2239.8	2516	2824.2	3167.8	3550	3975.2	4448.1	3974.3	5566.5
Load Factor (%)	63.9	59	58.6	59	59.4	59.7	60.1	60.4	60.7	61	61.3	61.5	61.8	62
Peak Load (MW)	232.7	315.9	330.3	370.8	415.3	464.2	518.5	579	646.2	720.7	803.3	894.9	996.5	1110.6

Source : PLN, Jakarta

Table A6.2.2 Program of Installation of Generating Facilities and Energy Production in Wilayah IV

Item	89/90	90/91	91/92	92/93	93/94	94/95	95/96	96/97	97/98	98/99	99/00	00/01	O1/O2	O2/O3	O3/O4
1. Gross Generation (GWh)	1223.4	1317.3	1494.5	1895.6	1918.6	2180.4	2429	2728.5	3082.7	3435.3	3849.9	4311	4823.9	5394.5	6038.7
2. System Peak (MW)	230.2	267	293.4	330.3	370.8	415.3	464.2	518.5	579	648.2	720.7	803.3	894.9	998.5	1110.8
3. Installed Capacity (MW)															
(1) Hydro power station															
Basis	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4
Mini Hydro										1.3	1.3	1.3	1.3	1.3	1.3
Tes no.1			16	16	16	16	16	16	16	16	16	16	16	16	16
Besai								90	90	90	90	90	90	90	90
Musi										111	111	111	111	111	111
Merangin											338.5	338.5	338.5	338.5	338.5
Ketaun														84	84
(Sub. Total)	2.4	2.4	18.4	18.4	18.4	18.4	18.4	108.4	108.4	220.7	559.2	559.2	559.2	643.2	643.2
(2) Diesel power station															
Basis	297.5	290.1	282.8	275.7	268.8	262.1	256.6	249.2	243	236.9	231	225.2	219.6	214.1	208.7
Project	3.6	3.6	3.6	21.6	32.6	66.6	70.6	96.1	99.6	109.6	119.6	121.6	131.6	134.6	139.6
(Sub-total)	301.1	293.7	286.4	297.3	301.4	328.7	326.2	345.3	342.6	346.5	350.6	346.8	351.2	348.7	348.3
(3) Coal power station															
Bukit Asam No. 1-5	130	130	130	130	195	260	260	260	260	260	260	260	260	260	325
Tarahan No 1-2	0	0	0	0	0	0	0	0	65	130	130	130	130	130	130
(Sub-total)	130	130	130	130	195	260	260	260	325	390	390	390	390	390	455
(4) Residual oil power station															
Basis	25	25	25												
(5) Natural gas power station															
Basis			25	25	25	25	25	25	25	25					
(6) Gas turbine power station															
Natural gas	50.5	50.5	50.5	50.5	50.5	50.5	50.5	36	36	22	22	22	22	22	22
Destillate oil (HSD)	14	14	35.4	21.4	21.4	21.4	41.4	41.4	41.4	41.4	41.4	41.4	41.4	41.4	41.4
(Sub-total)	64.5	64.5	85.9	71.9	71.9	71.9	71.9	77.4	77.4	63.4	63.4	63.4	63.4	63.4	63.4
(7) Import from Jawa							100	100	100	100	100	100	100	100	100
Total	523	515.6	570.7	542.6	611.7	704	821.5	916.1	978.4	1145.6	1463.2	1459.4	1463.8	1545.3	1609.9
4 Energy production (GWh)															
(1) Hydropower plants	11.5	45.5	79.5	79.5	79.5	79.5	79.5	325.5	325.5	1138.5	n.a	n.a	n.a	n.a	n.a
(2) Diesel power plants	621.9	510.8	432	805.1	629.7	521.9	299.1	339.6	593.8	277.4	n.a	n.a	n.a	n.a	n.a
(3) Steam power plants	572.1	699	816	837	1122	1467	1392.1	1404	1467	1404	n.a	n.a	n.a	n.a	n.a
(4) Gas turbine plants	17.9	62	147	174	85	92	89	90	107	46	n.a	n.a	n.a	n.a	n.a
Total	1223.4	1317.3	1494.5	1895.6	1916.2	2160.4	1856.6	2159.1	1493.3	2865.9	3260.5	3721.6	4234.5	4805.1	5447.3

Source : Supporting document of PLN's investment program (High scenario) October 1991

Appendix A6.3 Power Generating Facilities in Lampung Province

Table A6.3.1 Existing Electric Power Generating Facilities in Lampung (PLN)

No.	Location	Type	Unit	Installed Capacity (MW)	Max. Output (MW)	Annual Energy (GWh)	Plant Factor (%)
1	Tarahan	Gas	1	21.35	18.00	12.41	7.87
2	Tarahan	Diesel	8	56.22	26.50	24.50	10.55
3	Telukbetung	Diesel	10	29.10	8.67	6.41	8.44
4	Metro	Diesel	9	8.96	6.97	4.53	7.42
5	Tegineneng	Diesel	3	28.20	27.00	0.15	0.06
6	Talang Padang	Diesel	8	5.36	5.10	2.73	6.10
7	Kotabumi	Diesel	9	4.69	3.68	0.00	0.00
8	Kalianda	Diesel	4	1.60	1.30	1.05	9.19
9	Kota Agung	Diesel	3	0.46	0.32	0.36	12.91
10	Bandar Jaya	Diesel	8	2.59	0.52	0.00	0.00
11	Bukit Kemuning	Diesel	3	1.10	0.95	0.74	8.87
12	Manggala	Diesel	3	0.46	0.36	0.19	5.90
13	Sribawono	Diesel	5	1.78	1.22	0.98	9.17
14	Sidomulyo	Diesel	2	0.44	0.31	0.22	8.33
15	Bangun Rejo	Diesel	3	0.24	0.21	0.12	6.85
16	Sumbur Jaya	Diesel	3	0.57	0.38	0.27	8.17
17	Kali Rejo	Diesel	1	0.10	0.09	0.09	11.29
18	Kenali	Diesel	1	0.10	0.85	0.05	0.63
19	Baradatu	Diesel	2	0.14	0.13	0.11	9.68
20	Liwa	Diesel	3	0.64	0.58	0.14	2.82
21	Krui	Diesel	2	0.32	0.26	0.18	7.77
22	Blambangan Umpu	Diesel	1	0.10	0.09	0.05	7.12
23	Tanjung Bintang	Diesel	1	0.10	0.10	0.08	9.73
24	Way Jepara	Diesel	1	0.22	0.17	0.13	8.99
25	Parda Suka	Diesel	2	0.20	0.16	0.12	8.70
26	Jabung	Diesel	2	0.14	0.12	0.07	6.85
27	Putihdoh	Diesel	1	0.04	0.04	0.03	8.81
28	Pulung Kencana	Diesel	2	0.20	0.18	0.13	8.18
29	Abung Timur	Diesel	2	0.08	0.06	0.04	7.04
30	Seputih Banyak	Diesel	2	0.08	0.08	0.06	9.22
31	Seputih Surabaya	Diesel	2	0.08	0.08	0.06	8.99
32	Wonosobo	Diesel	2	0.14	0.12	0.09	9.03
33	Padang Cermin	Diesel	2	0.80	0.08	0.07	10.68
34	Tanjung Karang	Diesel	1	0.22	0.15	0.00	0.00
	Total			166.82	104.77	56.14	6.12
	Jambi			49.42	26.56	*	*
	South Sumatra			341.21	283.62	238.77	9.61
	Bengkulu			48.36	34.58	19.88	6.56
	Region IV			605.80	449.53	*	*

Source : PLN, Lampung.

Table A6.3.2 Private Power Generators in Lampung

No.	Owner	Location	Unit (No.)	Capacity (MVA)	Capacity (MW)	Remarks
1	Metro Koperasi Listrik Pedesaan	Metro, LampTeng.	11	6.72	5.38	
2	PT. Jaka Utama Kreffuter	Bandarlampung	4	1.40	1.12	Food Processing Industry
3	PT.Lambasi Indah	Hanura, LampSel.	1	0.16	0.13	Private Cooperatiuon
4	PT. Bakrie Brothers	Tlk.betung Utara, LampSel	2	0.12	0.10	Coffee and Pepper Processing
5	PT. Indopell Raya	Bandarlampung	3	0.79	0.63	Plywood Industry
6	PT. Garuntang	Bandarlampung	3	1.02	0.82	Coffee and Pepper Processing
7	PT. Bumi Lampung Permai	Gunung Agung, LampTeng.	4	2.00	1.60	Sawmil Industry
8	PT.Andatu Group	Bandarlampung	6	3.81	3.05	Plywood Industry
9	Pelabuhan Penyeberangan	Bakauheni, LampSel.	3	0.47	0.37	Ferry boat company
10	PT.Grammer Stone	Bandarlampung	10	2.48	1.98	
11	PT.Sari Fortune	Kotabumi, LampUt.	4	0.96	0.77	Labor Factory
12	CV. Kota Agung	Bandarlampung	2	0.28	0.22	Food processing industry
13	PT.Gula Putih Mataram	Mataram Udik, LampTeng.	6	20.25	16.20	
14	PT.Semen Baturaja	Bandarlampung	5	7.85	6.28	Cement Factory
15	PT.Plind	Bandarlampung	1	0.34	0.27	Pepper oil factory
16	Bandara Branti	Branti Raya, LampSel.	9	0.47	0.38	
17	Chandra Supermarket	Bandarlampung	1	0.24	0.19	
18	PT.Aneka Sumbel Rencana	Bandarlampung	2	0.30	0.24	
19	PT.King Supermarket	Bandarlampung	2	0.50	0.40	Department Store
20	PT.Air Jadi	Natar, LampSel.	2	0.45	0.36	Ice Producing Factory.
21	PT.Multi Agro Co.	Gunung Batin, LampTeng	5	2.50	2.00	Wood Processing Factory
22	PT.Metro Abadi Makmur	Metro, LampTeng.	2	0.40	0.32	Ice Producing factory
23	PT.Perkubunan XXI-XXII	Ng. Tulangbawang, LampUt.	9	10.35	8.28	Sugar cane factory
24	PT.Perkubunan X	Rejosa, LampSel.	3	2.81	2.25	Plantation
25	PT.Budi Aci Jaya	Terbanggi B. LampTeng.	2	1.00	0.80	
26	PT.Tjipta Niaga	Bandarlampung	1	0.11	0.08	
27	PT.Andatu Lestari Plywood	Srengsem, LampSel.	1	1.20	0.96	Plywood factory
28	PT.Dipasena Citra Darmaja	Muara Tl.bawang, LampUt.	25	42.00	33.60	Shrimp Farm
29	PT.Arya Perca	Bedong Batin, LampUt.	3	0.68	0.54	
30	PT.Sari Segar Husana	Terbanggi B.,LampTeng.	2	1.00	0.80	Coconuts oil factory
31	PT.Multi Agro Chemical Ind.	Gunung Batin, LampTeng.	2	1.00	0.80	
32	PT.Sariwiguna Sejahtera	Bandarlampung	1	0.40	0.32	Coffe and Pepper Processing
33	PT.Daya Sakti		2	0.70	0.56	Plywood factory
34	PT.Gunung Madu Plantations	Terbanggi B.,LampTeng.	3	5.00	4.00	
35	PT.Eka Intitapioka Murni	Rumbia, LampTeng.	8	4.00	3.20	Tapioka factory
36	PT.Sarana Indoprotex	Bandarlampung	3	1.65	1.32	
37	PT.Pucuk Manis	Ketapang, LampUt.	2	0.80	0.64	Food Processing
38	PT.Eka Intitapioka	Sukaraja,LampTeng.	6	3.00	2.40	Tapioka factory
39	PT.Budi Acid Makmur	Gunung Batin,LampTeng.	5	2.50	2.00	
40	PT.Tipperary Indonesia	Jabung, LampTeng.	3	1.50	1.20	
41	PT.Budi Sulfat Jaya	Terbanggi B.,LampTeng.	4	2.00	1.60	
42	PT.Wira Tapioka Mandiri	Rumbia,LampTeng.	6	3.00	2.40	Tapioka and Sitrat factory
43	PT.Indo Miwon Citra Inti	Jabung,LampTeng.	1	5.50	4.40	
44	PT.Pola Marmer Kencana	Gedong Tataan, LampSel.	9	2.60	2.08	
45	PT.Lakop	Bandarlampung	2	0.27	0.22	Coffee and Pepper Processing
	Total		191	146.58	117.26	
	Jambi		497	467.38	373.90	
	South Sumatra		*	*	9.68	
	Bengkulu		45	1.6	1.28	
	Region IV		*	*	502.13	

Source : PLN, Lampung.

Appendix A6.4 Chronology of Earthquakes in Sumatra

Table A6.4.1 Histrical Earthquakes in Sumatra (1900 - 1980)

Date	Province	Magnitude	Site	Damage	Geological structure
6-1-1900	Lampung	Rather Strong Strong	Sukadana and Kota Agung		Semangko fault
22-10-1901	Sumatra	Strong	Pasir datar	Stone houses	Cimandiri fault
26-7-1914	Bengkulu	Very strong	Kepahian, Manna and Seluma	All stone,houses,and bridges down,20 persons killed	Semangko fault
4-1-1921	Sumatra and Aceh	6.8	Felt in Sabang, Penang and Gunung Sitoli W of Toba lake, Sipohon	I.X R.F ground slide ground slump and and building/bridge collapased at Sipohon	Semangko fault
5-12-1923	Jawa Barat and Sumatra Selatan	5.8	Krue to Pelabuhan Ratu	VII intensity, damage at several places, and water tower donw at Pelabuhan	Cimandiri fault and Semangko fault
28-6-1926	Sumatra barat	6.5	Singkarak, Sijunjung, Muara bungo, Asahan, Panjang and Padangpanjang	VIII to IX intensity, a part of Singkarak subsided and many people injured	Semangko fault
25-9-1931	Sumatra	6.2	Kalimantan and felt in South Sumatra, West Jawa and Padang	VII to VIII intensity, rumbling sound, foundation of building subsided and dificult to walk	-
25-6-1933	Sumatra Selatan	6.7	Kota Agung to Mekakan	VII to IX intensity, damage to structures over westren part of South Sumatra	-
21-11-1934	Sumatra Barat	5.7	Lubuk Sikaping	VII intensity,pendulum clock stopped, door and windows disturbed, crack in wall and roobs of some houses ruined	Sumatra fault
28-12-1935	Sumatra Barat Sumatra Utara	6	Batu Isle,Bola and Sigaba islets Padang and Sibolga	VII to VIII intensity, islet thrown up by shock wall crack in Padang, trees and telephone poles down and a few building collapsed	Sumatra fault
19-9-1936	Sumatra Utara	6.2	Karo, Kutarane, Kabanjahe,Prarat, Brastagi and Tanjungpuri	VII intensity, 17 people killed by landslide and wall crack at Langkat	Great Sumatran fault
27-11-1936	Sumatra Utara, Sumatra Barat and Riau	5.7	Tapanuli,West Sumatra and some local areas In East Sumatra	VII intentsity and slight damages to tructures, in various places	
18-8-1938	Sumatra Barat,Bengkulu and Palembang	5.5	Sumatra Barat Palembang,Beng kulu and Mentawai Island	VII intensity,fall of plaster and crack in wall	The great Sumatran fault

Date	Province	Magnitude	Site	Damage	Geological structure
10-11-1941	Sumatra Utara	5.5	Tapanuli and Sibolga	VII intensity, Strongly felt in west Tapanuli, and slight damage in Sibolga	The great Sumatranfault
16-12-1963	Jawa and Sumatra	4.7	Tasikmalaya, Kotabumi, Labu han and Priangan	II to V intensity, wall cracks at Labuhan	-
4-2-1964	Aceh	5.8	Banda Aceh	VII M.M.I. 30-40% brick building sustained damage	The great Sumatranfault
25-7-1965	Sumatra Utara	5.3	Sarulla and Onang Hosang Tapanuli	VII intesity in Sarulla and Onang Hosang Build ing damage	The great Sumatran fault
17-8-1965	Aceh	4.9 to 5.3	Takengon, Blang Bintang	II-III M.M.I., no damage	The great Sumatranfault
4-12-1967	Aceh	6.1	Jeunie, Pendada, Jempa Bireuen and felt from eastern Aceh to Kisaran and Takengon	VIII M.M.I. 80 big buildings collapsed and 2,000 houses down	The great Sumatranfault
2-4-1971	Sumatra Utara and Sumatra Barat	7	Pasaman, Natal Pinang sore, Sibolga Piasa Ulu	II to VI intensity, building damage in Sibolga and Pinangsore	-
20-3-1972	Sumatra Barat	4.8	Padang and Tabing	III to IV M.M.I., suspend ed object swung	-
3-9-1977	Sumatra Barat	6.2	Padang,Pasaman Teluk Bayur, Tapanuli,Sibolga	VII to VIII M.M.I., hundr eds of housing collapsed and 5 people injured	The great Sumatranfault
28-4-1979	Sumatra Barat	3.7	Merapi	no damage	-
15-11-1979	Bengkulu and Sumatra Selatan	6	Curup, Bengkulu Rejang lebong and Kepahiang	VII to VIII M.M.I., 5188 houses destroyed, road fractured for 3 Km, 5 bridges down, 13 people killed and 554 wounded	The great Sumatranfault

Source : Hydro Power Potential Study, 1983, IBRD

Appendix A6.5 Cost Estimate for Way Semangka Hydropower Development

Table A6.5.1 Project Cost for Way Semangka Hydropower Development

(Unit : US$1,000)

Item	Unit	Upper Semangka-1	Upper Semangka-2	Upper Semangka-3	Lower Semangka-1	Lower Semangka-2	Semung-1	Semung-2	Total
PRINCIPAL FEATURES									
Catchment Area	(Km2)	290	383	416	799	840	312	320	
Installed Capacity	(MW)	26.8	23.2	28.2	35.5	40.4	23.8	38.7	216.6
Annual Energy Output	(GWh)	143.8	122.8	151.5	182.5	209	123.2	202.1	1134.9
Maximum Discharge	(m3/s)	22.5	29.8	32.3	50.3	52.9	19.7	20.2	
Gross Head	(m)	147	98	110	90	98	150	236	
Headrace Tunnel (Diameter)	(m)	3.40	3.65	3.75	4.50	4.57	3.10	3.15	
Headrace Tunnel (Length)	(Km)	3.80	2.50	4.30	4.20	6.30	3.20	6.00	30.30
Access Road(New)	(Km)	1.00	1.00	0.50	2.80	0.40	3.10	3.50	12.30
Access Road (Improve)	(Km)	0.00	0.00	0.00	0.00	0.00	17.00	21.50	38.50
Transmission Line	(Km)	3.00	5.00	29.00	7.00	16.60	6.60	16.50	83.70
CONSTRUCTION COST									
1 CIVIL WORK		28,985	25,415	39,059	58,784	80,748	26,469	42,429	301,889
1.1 Preparatory Work		2,635	2,310	3,551	5,344	7,341	2,406	3,857	27,444
1.2 Access Road		457	457	228	1,279	183	4,003	4,871	11,478
1.2 Diversion Weir		3,410	4,503	4,891	9,394	9,877	3,668	3,762	39,506
1.3 Intake		1,556	2,061	2,234	3,480	3,659	1,363	1,397	15,752
1.4 Water Way		18,916	14,342	26,038	36,623	56,656	13,242	25,636	191,452
1.5 Power Station		2,011	1,741	2,116	2,664	3,032	1,786	2,905	16,256
2 METAL WORK		3,486	3,849	4,366	6,993	7,543	3,348	4,320	33,906
2.1 Diversion Weir		1,374	1,814	1,971	3,785	3,979	1,478	1,516	15,917
2.1 Intake		451	597	647	1,007	1,059	395	405	4,560
2.2 Penstock		1,661	1,438	1,748	2,201	2,505	1,475	2,399	13,428
2.3 Others									
3 ELECTRICAL WORK		5,811	5,030	6,114	7,697	8,759	5,160	8,391	46,961
4 TELEMERTERING SYSTEM		794	1,049	1,139	2,187	2,300	854	876	9,199
5 T/L AND S/S		450	750	4,350	1,050	2,490	990	2,475	12,555
TOTAL		39,525	36,093	55,028	76,711	101,840	36,821	58,490	404,510
Cost /KW	(US$)	1474.82	1555.73	1951.35	2160.89	2520.80	1547.12	1511.37	1867.54
Cost /KWh	(US$)	0.2749	0.2939	0.3632	0.4203	0.4873	0.2989	0.2894	0.3564
6 ENGINEERING SERVICE		3,953	3,609	5,503	7,671	10,184	3,682	5,849	40,451
7 CONTINGENCY		6,522	5,955	9,080	12,657	16,804	6,076	9,651	66,744
8 GRAND TOTAL		49,999	45,657	69,611	97,040	128,828	46,579	73,990	511,705

Source : Estimated by the Team

6.2 BATANG HARI INTEGRATED BASIN DEVELOPMENT PLAN

6.2.1 Background of the Project

The Batang Hari River Basin with the catchment area of 49,000km^2, is located in Jambi and West Sumatra Provinces in Central Sumatra. More or less 2 million people live in the basin, and depend on the Batang Hari River and the tributaries for their production, health and transportation. The study on "The Integrated Regional Development Plan for the Southern Part of Sumatra" is on-going by JICA, and the development concept of the Batang Hari River Basin was identified. The roles of the Batang Hari River Basin to the regional and national development are as follows:

1) Agricultural base for the "growth triangle" (Singapore - Johor - Riau)
2) Agricultural base for the "gateway triangle" (Palembang - Bandarlampung -Batraja)
3) Secondary agro-industrial center (Jambi City)
4) Connection point between northern and southern Sumatra
5) Principal caretaker of Kerinci Seblat National Park and Batang Hari River
6) Recipient of transmigrants.

Water Resources Plan of the regional development study pointed out that the basin-wide approach is required to clarify the environmental linkage among the following current issues in the Batang Hari River Basin:

1) Forest degradation in Kerinci Sebrat National Park (upstream),
2) Flood damage in Lake Kerinci Basin (upstream),
3) Debris flow damage in the Batang Suliti River (upstream of the Batang Hari River),
4) Bank erosion of the Batang Hari River (middle reach),
5) Flood damage in Jambi City (lower reach),
6) Influence river transportation due to excess sediment deposition (middle and lower reaches).

Jambi City and the other major townships along the Batang Hari River are currently threatened by flood, which caused damage the residential area. The urgent action for flood control work is undoubtedly required. On the other hand, the basin is strongly required to land and water resources development particularly for agriculture development such as estate and irrigation activities with transmigration for the further economic growth of which activities might be influence to the natural river condition. Moreover, environmental conservation related to the water catchment is currently focused in the basin. The linkage among the above flood control, land and water resources development, and environmental conservation is inevitable matter to consider in the view of the integrated regional development for the basin.

Flood control works can not directly yield the economic benefit but to be possible to reduce the social and economic damages. On the other hand, economic development activities will be directly contributed to the economic growth, but required higher grade of flood control works because the required scale of flood control is generally depended on the social and economic importance of the area to be protected. In addition the upstream development activity must be affected to the natural river condition of the downstream, resulting increase of peak flood volume and excess sediment deposition. These activities are required pre-supporting the countermeasures for environmental sustainability. Therefore, only the integrated basin development approach can consider the linkage among **economic growth** (land and water resources development), **social stability** (flood control and sabo) and **environmental sustainability** (basin management) for the river basin development.

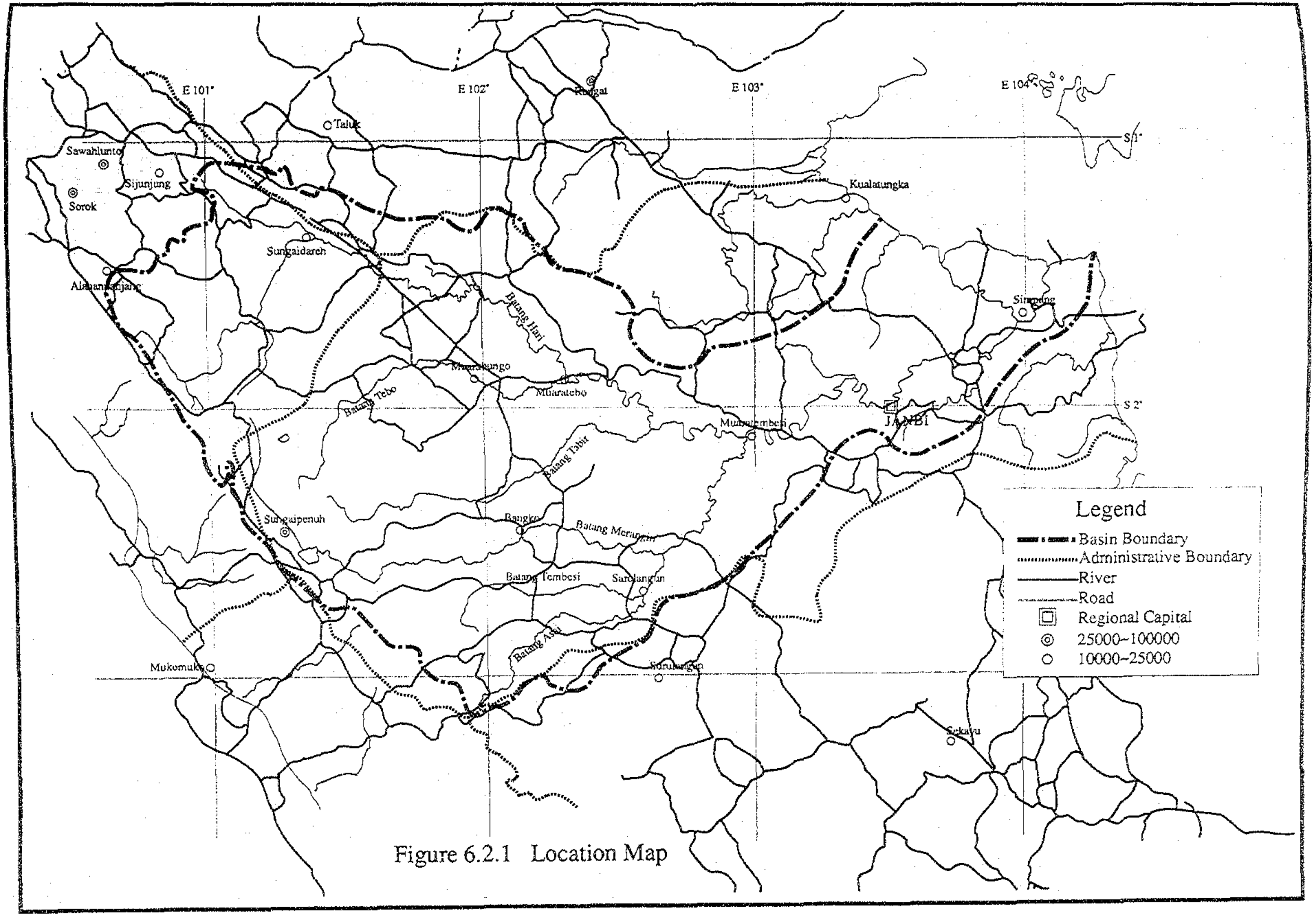


Figure 6.2.1 Location Map

6.2.2 Description of the Basin

The Batang Hari River is originated from the eastern flank of Bukit Barisan Range, flow south-westward through Jambi City to South China Sea. The location map is shown in Figure 6.2.1. The catchment area of the river is estimated at 49,100 km ^{2} at the estuary, the second largest basin in Sumatra Island. Upstream of the basin is endowed with abundant rainfall of 2,000 mm and 3,500 mm annually. Kerinci Seblat National Park, which includes huge forest area, covers whole area of upper basin, contributes as the natural reservoir of the water catchment and regulates runoff to the downstream. The hydrological observation system composed 34 rivers gauges, 27 raingauges and 6 climate stations, functions on the whole of the basin, although additional raingauges are still required particularly in the western high land in the basin.

Flood-prone areas spread at the low lying area along the Batang Hari, the Batang Tembesi and the Batang Tebo Rivers. Reflecting the long-term experience of regular overflow, the residential houses are traditionally designed in a higher floor type, and the wooden canoes are prepared as the transportation measure during the flood. 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 residential area in the flood prone area. Moreover, the flood itself has reportedly become more serious currently than in the past due to degradation of water holding capability of the upstream.

Small scale irrigation is well developed in high-land plateau and fan-formed area at the middle reach of the mainstream and the tributaries. The total irrigation area amounts to 15,500 ha with 114 schemes in Jambi Province, as shown in Table 6.2.1. The most of the schemes are semi-technical having simple intake structure and small main canal systems.

Table 6.2.1 Existing / Further Irrigation Development in the Region

Kabupaten	Technical		Semi-Technical		Simple		Total	
	No.	ha	No.	ha	No.	ha	no.	ha
Kerinci	0	0	26	9,277	8	604	34	9,881
Bungo Tebo	2	499	16	1,616	16	205	34	2,320
Sarko	0	0	19	1,616	16	15	35	1,631
Batang Hari	0	0	1	1,637	7	0	8	1,637
Tanjab	0	0	1	30	2	0	3	30
Total	2	499	63	14,176	49	824	114	15,499

Source : Pekapitulasi Inventarisasi Daerah Irigasi, PU, 1989

In-land swamp spread in low-land area in the upstream of Jambi City, which is so far unused for production, however, having high potential of agriculture products due to the land formed alluvial soil. On the other hand, the in-land swamp area is also contributed to Jambi City for flood retarding effect because the in-land swamp works as natural flood retarding basin to regulate the flood during the rainy seasons.

Jambi City with approximately 340,000 of the population is located in the downstream of the river at about 100 km upper reach from the river mouth. The prosperity of the city is mainly made by wood processing industry because of the advantage of the transportation of both materials and products through the Batang Hari. Urban drainage problem exists in the low-elevated area in the city because of backwater effect of the Batang Hari River.

The lower reach of the Batang Hari River between Jambi City and the river mouth forms huge area as estimated at 1,900,000 ha of tidal swamp. Some parts of the area are reclaimed as transmigration areas, although coastal forest and mangrove zone still remains.

The number of transmigrates is estimated at 17,000 families with the reclaimed area of 40,000 ha. They mainly produce upland paddy called "Pasang Surut" used by the tidal effect.

6.2.3 Major Development Issues

(1) Environment Issues in Kerinci Seblat National Park

Kerinci Seblat National Park, which spreads upstream of the basin, forms backbone of Sumatra Islands, where a wide range of ecosystem and extensive tropical forests exists. The main stream and most of the tributaries of the Batang Hari River Basin originate in this area. The abundant rainfall in the area is reserved and naturally regulated run-off to the downstream through these tributaries. Therefore, some 2,000,000 of the residents in Jambi Province depends on the water holding capability of the area.

However,the ecological viability of Kerinci Seblat National Park is threatened by the variety of human activities such as agricultural encroachment and logging. Forest degradation is particularly affected to the downstream residents in the view of river run-off fluctuation and excess sediment yield. Some conservation approaches are required together with alternative economic activities for the people within the national park to sustain the natural ecosystem.

The World Bank has proposed, on November 1991, to carry out "Integrated Conservation and Development Project (ICDP) for Kerinci Seblat National Park", to consider the countermeasures against to the above issues the proposed ICDP components are as follows:

1) Park management and protection, including boundary establishment,
2) People-forest interactions inside park and around boundaries, including buffer zone management, participatory development and resettlement,
3) Water catchment protection and regional economic development to be financed under a separate project linked to the ICDP,
4) Education, applied research, and monitoring and evaluation, and
5) Project coordination and management, including capacity-building for additional ICDPs.

(2) Flood Damage in Lake Kerinci Basin

Lake Kerinci is located on the plateau of Kerinci Seblat National Park, and that is the origin of Batang Merangin River, one of major tributary of the Batang Hari River. Upstream of Lake Kerinci constitutes plateau with fan-formation, which is brought about alluvial soil by Siulakderas River. The plateau is well-developed particularly for wetland paddy and tea plantation. The population of the plateau is estimated at about 280,000 as of 1990, marking high population density because of the limitation of available land. Average farmers land is more or less 0.2 ha per family, which is remarkably small comparing to the other area in Sumatra Island.

The residents have long suffered from the flood damage and also river bed aggradation due to excess sediment deposition especially in Sungaipunuh City. Cultivation land tends to spread over the upstream mountains of the lake basin by the pressure of high population density of the existing cultivation area. The urgent countermeasures such as levee dyking and construction of sabo dams were partly made by local government. However, the basin is still in urgent needs of the following activities: improvement of lake outlet, the basin conservation and furthermore alternative economic activity for residents together with re-settlement in the view of long-term river management.

(3) Debris Flow Damage in the Batang Suliti River

The Batang Suliti River originates from the north of Kerinci Seblat National Park to the south-eastward up to Muaralabuh Township, meandering to the north-eastward and meets the Batang Hari mainstream in West Sumatra Province. Debris flow attacks frequently to the river, particularly to the residential area, and resulting in damaging human lifes, residential houses, social infrastructure, paddy field with more than 1,000 ha and so on. Both geological and topographical conditions are considered to be main reasons of the occurrence. The basin is located among the Great Sumatra Fault Zone and frequent volcanic activities such as eruption and land slide are found. Excess sediment yield in the basin threatens the river bed aggradation, particularly in the downstream reach, which seriously affect the capacity of the flood control and the river transportation.

(4) Bank Erosion of the Batang Hari River

The bank erosion has actually damaged residential houses, mosques, road and cultivated land along the mainstream of the Batang Hari River, particularly in and around Jambi City. Remarkable river meandering is found all along the stretch, which is the main reason of the occurrence of the bank erosion and seriously affects river transportation activity due to river bed aggradation. River training works including short-cut, consolidation revetment and groynes are required.

(5) Flood Control for Jambi City

About 340,000 of Jambi citizen are threatened by frequent and habitual flood potential because of the forest development in water catchment basin and decrease in natural flood retarding capability of the upstream basin. An idea of "Mondahara Floodway" which is to divert river flow from the Batang Hari River at Sengeti Township to Mondahana River by artificial channel with 25 km length as shown in Figure 6.2.2 is to protect the city from habitual floods. This idea is derived from BAPPEDA of Jambi Province. Detailed study including topographic survey, hydraulic research and effectiveness are required to reveal the viability of the scheme together with the basin conservation plan.

(6) Village Economy

Table 6.2.2 shows the number of poor villages and types of villages in Jambi Province, revealed that 18.2 % of the villages defined as the poor villages, and of the about 80 % of poor villages are located in the lowland area in kabupatens Sarolangun Bangko, Bungo Tebo and Batang Hari. These poor villages mainly depends on upland crop and plantation for their production and required somehow to improvement of the village economy.

Table 6.2.2 Village Situation in Jambi Province

Kabupaten	Type of Villages (Nos.)						Poor Village	
	DNL fishery	DPS paddy	DPL upland	DPB plantation	DIP trade	TOTAL	Number	Rate
Kerinci	0	162	39	43	8	252	23	9.1%
Sarko	0	56	85	110	6	257	52	20.2%
Bungo Tebo	0	37	132	19	6	194	29	14.9%
Batang Hari	0	0	0	195	0	195	76	39.0%
Tanjab	3	58	4	39	1	105	13	12.4%
Kota. Jambi	0	2	1	1	51	55	0	0.0%
TOTAL	3	315	261	407	72	1,058	193	18.2%

Source: Type dan Klasifikasi Desa 1990, by BANDEGAS of Jambi Province

Poverty is caused by the mixture of factors of social system, such as shortage of resources, mono-sectoral economic structure, low skill, low productivity, low level of education, over population, lack of physical infrastructure which support socio-economic activities, under priced products from rural areas against relatively over-priced products from

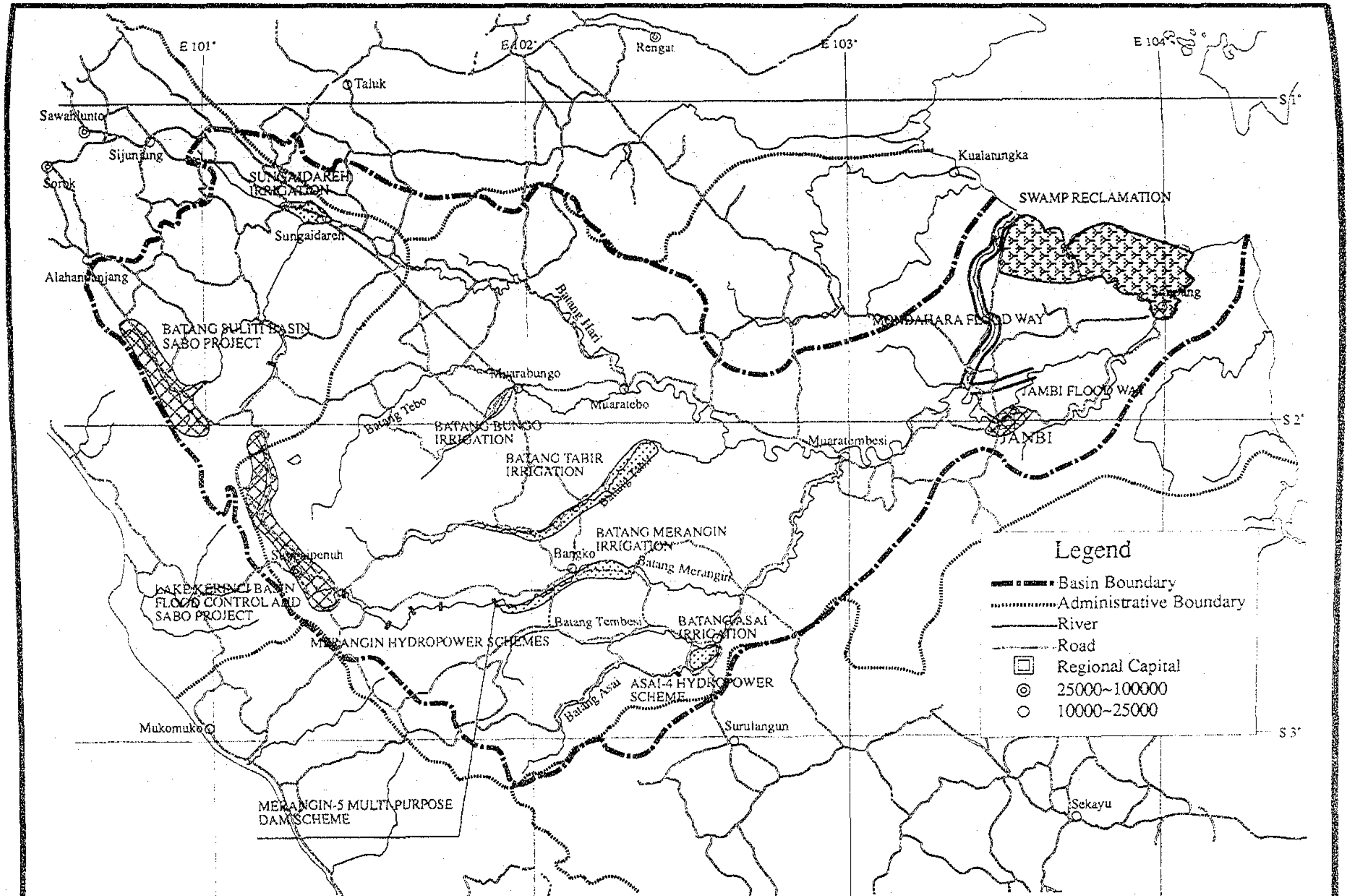


Figure 6.2.2 Project Ideas on Batang Hari Basin

urban areas, lack of access to market and credit, and so on. They often reinforce each other and have cumulative effects.

(7) Protection of "Orang Kebu"

Orang Kubu live in the forest area of middle reach in the basin, along the Batang Hari and the Batang Tembesi River Basins. They still depend on the primitive hunting and the forest nutritious of their lives, and keeping disconnection to the economic system of Indonesia. Recent development of road network is however, affected to the minority's life style. Minority is sometimes to appear the road in the forest area, approaching to the cars, and requesting some foods, money and so on. It is important to take into account of the minority protection for the further development and co-existence.

6.2.4 Development Potentials

(1) Land Development Potential

Potential of land development for Sumatra Island has been revealed by the "Regional Physical Planning Programme for Transmigration (RePPProt)", in August 1988, under Ministry of Transmigration. This study provided present land use map, soil map, land suitability map, and the data base of Geographical Information System (GIS). These informations are available for the consideration of the further integrated basin development.

(2) Large Scale Irrigation Development Potential

It is reported that 133,000ha of potential area for irrigation development exists in Jambi Province, particularly in Kabupaten Sarolangun-Bangko, located in the middle reach of the Batang Hari River Basin. This area is mainly developed as transmigration from Java and Lampung. However, the migrants have long suffered from low agriculture productivity because of lack of infrastructures. Irrigation development in the area was identified to be suitable in the view of land, water and labor resources, tendency of the residents and also flood regulation to the downstream industrial area. The following seven schemes in Table 6.2.3 are identified for irrigation and improvement of transmigration area (Figure 6.2.2):

Table 6.2.3 Identified Large Scale Irrigation Development Schemes

Scheme	Irrigation Area (ha)	Location	Existing Transmigration Area
(1) Batang Bungo	7,400	Bungo Tebo	
(2) Batang Tabir	50,000	Sarko	Hitam Ulu Mangoyoso
(3) Batang Merangin	60,000	Sarko	Pemenang Kubang Ujo
(4) Batang Asai	7,000	Sarko	
(5) Batang Limun	2,400	Sarko	
(6)Batang Reban	2,200	Sarko	
(7) Batang Sangkut	4,400	Sarko	
TOTAL	133,400		

Source: DPU, Jambi Province

Development priority among the above seven projects is however, still unknown. It is required to compare these projects and to determine the timing of development considering the urgency and further transmigration plan.

(3) Development of Tidal Swamp Area

Huge tidal swamp area, which spreads on the eastern coastal area at the lower reach of the Batang Hari River Basin, has not to be utilized for agriculture purpose yet even though large scale of tidal paddy field (Pasang Surut) as rice production center of the Province exists. The Provincial Government of Jambi is quite interested in intensive development for export products, taking advantage of proximity to the "Growth Triangle". It is required to improve the river facilities such as drainage system and control tidal effects to support the government strategy. Furthermore, it is important to research ecosystem in the area of river/swamp environment including conservation and development.

(4) Hydropower Development Potential

Plenty of hydropower development potential sites are investigated in "Hydro Power Potential Study " by PLN/ IBRD in 1983. 43 potential sites were listed up and 5 sites were selected as the most viable schemes which are listed in Table 6.2.4.

Table 6.2.4 List of Hydropower Development Potential Sites

Name of Scheme	Type	Installed Capacity (MW)	Energy Output (GWh/year)	Total cost (US$ mil.)
Merangin-1	Dam & Reserv.	41.2	217.5	137.2
Merangin-2	Dam & Reserv.	232.5	1,230.3	394.3
Merangin-3	Dam & Reserv.	57.4	302.4	170.2
Merangin-5	Dam & Reserv.	84.9	478.9	210.8
Asai-4	Dam & Reserv.	41.9	203.1	156.1

Source: Hydro Power Potential Study, 1983, IBRD

The Batang Merangin River is the most promising basin for hydropower development in the basin. The river flow is stable through the year due to natural water regulation effect of the lake because the river originates in Lake Kerinci with more or less 2,000 ha of surface area. Upstream of Sungai Manau Township forms deep valley and steep graduation of the river, which is also a great advantages. The feasibility study for Merangin-2 Hydropower Project was made by PLN/IBRD in 1990, marking high rate of economic feasibility of 24.8% .

Transmission line network has been so far disconnected in the basin. However, interconnection of PLN Region III, covering West Sumatra and Riau Provinces, and Region IV, covering four Provinces of the southern part of Sumatra, has been recommended for implementation within the period between 1993 and 1998 in the Long Range Power Development Study of Sumatra. Hydropower schemes along the Merangin River are expected to supply electric power to the both PLN Regions.

6.2.5 Project Formulation

(1) Needs of the Basin-wide Masterplan

Basin-wide approach is not new way to assess the maximum usage of water resources development potential. Because, water resources is one of most important assets in the region, and a river basin is recognized as the most suitable unit to consider water resources development. The sub-sectors to be taken into account in the basin-wide study depend on the specific condition of respective basin. Table 6.2.5 shows the list of previous studies and the sub-sectors to be included.

Table 6.2.5 General Features of the Previous Basin-wide Master Plans

River Basin	Province	Study Area (Km^2)	Sub-sector to be included: BM	FC	AG	IR	WS	PW	RT	Year	Fund
1) Sekampung- Seputih	Lampung	12,900				X		X		1978	U.K.
2) Komering	S. Sumatra	12,400				X		X		1982	JICA
3) Tulang Bawang- Mesuji	Lampung	17,900	X	X	X	X	X	X	X	1989	EEC
4) Musi	S. Sumatra	79,000	X	X	X	X	X	X	X	1990	EEC
5) Belawan-Padan	N. Sumatra	2,300	X	X			X			1990	JICA
6) Rokan	Riau	20,000	X		X	X				1992	JICA

Note : BM : Basin Management
FC : Flood Control
AG : Agriculture
IR : Irrigation
WS : Water Supply
PW : Hydropower
RT : River Training

The way of approach for water resources development planing has changed due to the recent global environmental attention. And the integrated basin development approach has started in a few major river basins in Sumatra Island. Considering the recent circumstance and the importance of the Batang Hari River Basin, it is strongly recommended to apply the integrated approach to assess the further development and conservation of the basin

More or less 2 million people live in the basin, and depend on the Batang Hari River and tributaries for their production, health and transportation. The respective issue listed in chapter 3 and 4 is not independent but strongly related each other. It is required to tackle the issues from the basin-wide viewpoint. Because, basin-wide is recognized as the most appropriate unit to formulate the integrated regional development plan in the case of Jambi Province and the Batang Hari River Basin. Framework plan and long-term plan are to be provided in the integrated basin development study. Framework plan includes the basic policy to water resources development and the basin conservation, and also flood control policy, which should be parallels to the spatial plan for the basin. Long-term plan, on the other hand, includes the timing of implementation of respective project considering the urgency, economic and financial viability under the policy provided in the Framework Plan.

It is therefore, recommended to carry out "Batang Hari Integrated Basin Development" following the "Integrated Regional Development Plan for the Souther Part of Sumatra". Because the basic regional policy has to be discussed and revealed the basin wide approach is required for the Batang Hari from both of regional and sectoral viewpoints.

(2) Objectives

The objective of the Study is to formulate an integrated basin development plan for the Batang Hari River, which is a long-term basin development and conservation master plan composed of :

1) Environmental management plan
2) Flood control plan
3) Sabo plan
4) Large scale irrigation development plan
5) Land development / conservation plan
6) Swamp reclamation / conservation plan
7) Rural development plan
8) Domestic and industrial water supply and sewerage plan
9) Hydropower development plan
10) Inland navigation plan.

The integrated basin development plan should cover the following aspects:

1) To clarify the present conditions on all sectors in the Study.
2) To identify the existing problems and needs related to the basin development and management including institutional, regal and financial matters.
3) To list up all the potential sites for the basin development such as multi-purpose dams, multi-purpose diversion channels, natural retarding basins, irrigation development areas and so on.
4) To clarify the economic and social viability of the respective projects which are identified in the each sectral study.
5) To formulate a framework plan which is an inventory of development potential limited in the environmental sustainability.
6) To formulate a master plan with priority of implementation targeting until 2010.
7) To select urgent projects in the view of urgency and economic viability targeting within the next 5-year plan.

(3) Framework

The study will be conducted over a period of 28 months by dividing into five phases as shown below:

Phase I	:	Survey and Investigation
Phase II	:	Framework Plan Formulation (Development potential study)
Phase III	:	20 years master plan formulation (Integrated Basin Development Plan)
Phase IV	:	5 years Urgent Plan Formulation
Phase V	:	Compilation of Final Report.

(4) Scope of Works

The study shall include all the work to meet the objectives described in the foregoing Chapter 2 within the above five phases. The time schedule is shown in Figure 6.2.3. The scope of work in respective phases will cover but not the limited to the following:

Phase I: Survey and Investigation

1) Review and evaluation of the previous studies concerning mainly on the environmental conservation, swamp area development, regional development strategy, irrigation development and hydropower development.
2) Examination of the existing and on-going development programs directly relevant to the study.
3) Data collection, processing and examination such as:
   a) Topographic maps with scale of 1:50,000 and 1:250,000;
   b) Landsat image with scale of 1:200,000;
   c) Meteorology, hydrology and hydraulics;
   d) Land use, land system and land suitability;
   e) Soils;
   f) Existing irrigation and drainage system;
   g) Existing domestic and industrial water supply system;
   h) Agriculture, fishery, agro-economy and agro-industry ;
   i) Water quality;
   j) Natural and environmental;
   k) Inland navigation;
   l) Regional economy and sociology; and

m) Institutional and regal related to the basin development.

4) Field investigation and hearing survey to observe the present natural and socio-economic conditions in the study area.
5) River morphological survey and study including river condition, water quality, sediment transport, tidal fluctuation and salinity intrusion.
6) Investigation of the previous flood record, innundation area and flood damage.
7) Investigation of the present water use condition in the study area.
8) Investigation of the existing irrigation system including the command area, water intake capacity and the irrigation efficiency.
9) Investigation of the present condition of the coastal swamp area including the existing infrastructures in transmigration area and voluntary settlement area.
10) Investigation of the rural area including minority's area in the mountain.
11) Investigation of natural environmental condition in the mountain and the lower reach of the river including rain-forest, mangrove forest and wild life reserve.
12) Institutional and regal survey and study to identify expected problems and needs for institutional and regal framework related to the basin management.

Phase II: Framework Plan Formulation

13) Meteorological and Hydrological analysis.(low flow and flood)
14) Land use, land system and land suitability analysis.
15) Sediment analysis.
16) Socio-economic analysis.
17) Preparation inventory of development potential on land, water, swamp reclamation.
18) Identification of the constraints for the land, swamp and water resources development / conservation.
19) Identification of all the potential dam sites for multi-purpose dam plan, including the preliminary study and screening.
20) Hydropower development survey and study to assess the further development prospect of hydropower schemes.
21) Inland navigation survey and study to make inventory survey for existing and planned navigation in the rivers, and to review and assess problems and needs involved in navigation in the river and community traffic in the region.
22) Identification of the environmental protection area in the view of sustainable development and nature conservation.
23) Preparation of village inventory.
24) Economic analysis for environmental conservation.
25) Formulation of framework plan.

Phase III: Integrated Basin Development Plan Formulation

26) Definition of the target of economic development on 2010.
27) Estimation of the demand to development on:
   a) Land resources;
   b) Water resources;
   c) Irrigation;
   d) Swamp reclamation;
   e) Domestic and Industrial water supply and sewerage;
   f) Hydropower;
   g) Flood control;
   h) Sabo;
   i) Rural economy;
   j) Environmental conservation;

28) Screening on the priority project, from the framework plan to meet the demand defined in item (27).

29) Preparation of an institutional plan for implementation of the integrated basin development.

Phase IV: Urgent Development Plan Formulation

30) Installation of new hydrological observation stations for the effective basin management, if recommended by the Study team.

31) Comparative study between selected project in the integrated basin development plan with pre-F/S level.

32) Screening on the urgent project concerning the urgency, budget and economic viability to implement in the next 5 year plan.

Phase V: Compilation of Final Report

33) Topographic survey and mapping with the scale of 1:5,000 for the selected urgent development schemes.

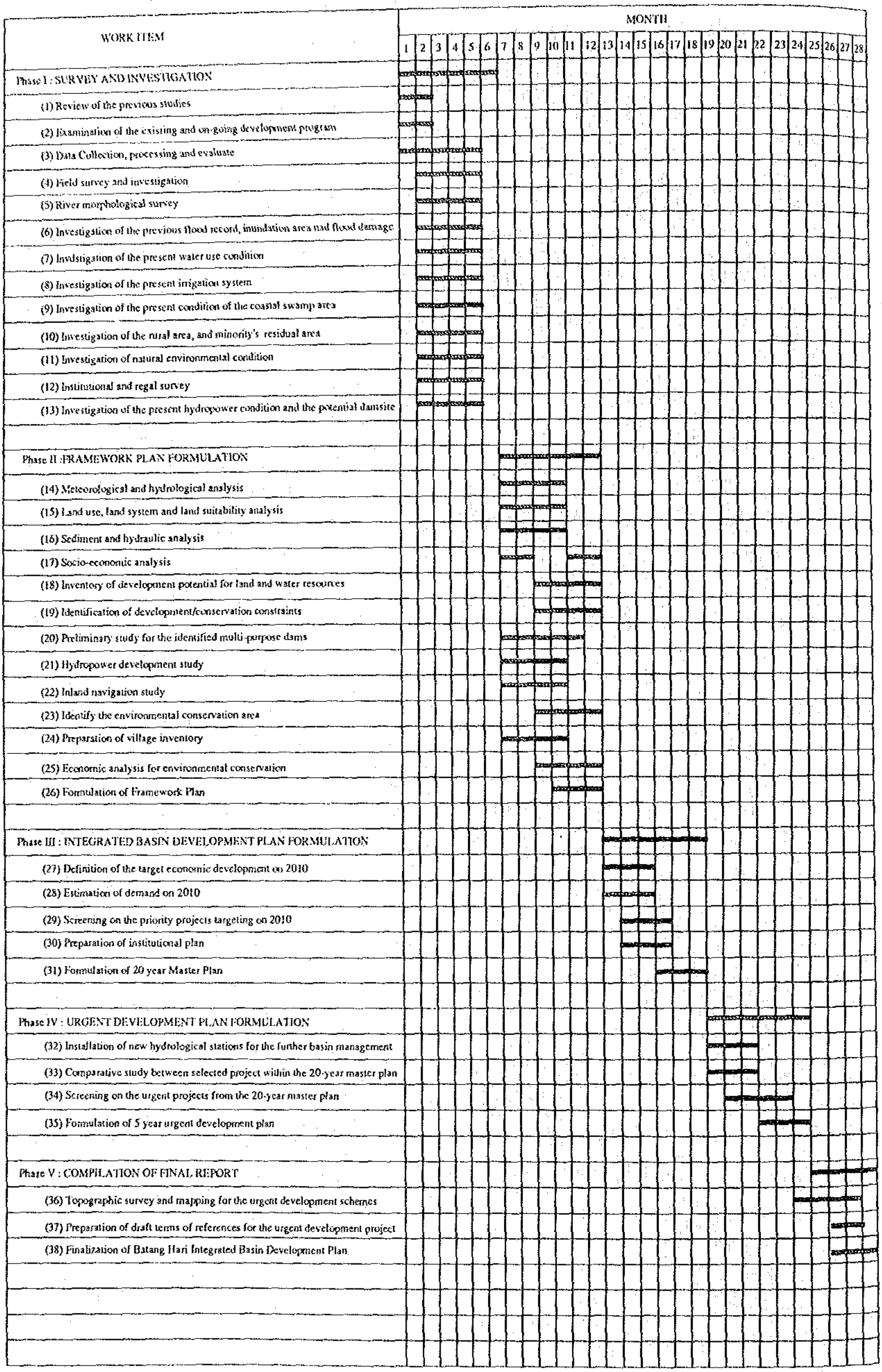
34) Preparation of draft terms of reference for the selected urgent development schemes.

35) Finalization of the Integrated Basin Development Plan (5-year plan, 20-year plan, and framework plan)

(5) Cost Estimate

The study shall require expatriated staff of about 200 M/M with a duration of 28 month of the study period. The estimated cost is about US$ 5 million.

Figure 6.2.3 Work Schedule for Batang Hari Integrated Basin Development Plan



6.3 LOWER KOMERING INTEGRATED AGRICULTURE DEVELOPMENT PROJECT

6.3.1 Background of the Project

The project area is located in Kabupaten Ogan Komering Iril, hereinafter "OKI", in South Sumatra Province, about 150 km from Palembang to the south ward. Figure 6.3.1 shows the location map of the project area. Because of the recent quick economic growth of Palembang and Bandar Lampung cities, this area is becoming strategic important regions as the hinter land of the both cities due to the location between the above two cities. The proposed Eastern Sumatra Highway among Bandar Lampung - Palembang - Jambi - Riau - Medan is currently under study by JICA, is greatly expected as the further main development axis of Sumatra. The project area is just along the eastern highway and then expected intensive development in the Sumatran economic viewpoint.

The Project has firstly identified by "Master Plan for The Komering River Basin Development Project", in 1981 by JICA, which covers whole Komering River Basin. The study recommended to develop the Upper Komering River Basin as the first priority area of irrigation development. The first stage of the Upper Komering Irrigation Project is currently under construction.

"Musi River Basin Study", which covers whole sectors related to the water resources development and river management for Musi River Basin including all the tributaries such as Ogan and Komering Rivers, has carries out in 1989 by EEC. The study recommended to implement the Lower Komering irrigation development during the Reperita VI (1994 -99). The study made the preliminary study for the Lower Komering Irrigation Schemes and tentative implementation cost has estimated.

"The Study on The Integrated Regional Development Plan for the Southern Part of Sumatra (LTA-129)", hereinafter "LTA-129 Study", is underway by JICA, which will be completed in February 1993, covers four provinces of Jambi, South Sumatra, Bengkulu and Lampung of Sumatra Island. The Lower Komering Integrated Agriculture Development Project will be identified as the priority development project in view of the integrated regional development. Figure 6.3.2 shows the development concept of the Southern part of Sumatra. According to the study, the Lower Komering area is defined as the part of "Gateway triangle", which is composed of Palembang - Bandar Lampung - Batraja, is the strategic important are for the integrated regional development for the above four provinces.

Another remarkable information of the area is the strategy of irrigation development for whole Indonesia. According to the Ministry of Public Works, GOI expects several provinces including South Sumatra to be extensive paddy production with high efficiency to maintain the national self-sufficiency of rice. Accordingly, the Lower Komering Irrigation Development is required in view of the national rive production policy. The provincial government is also expected to the Lower Komering Area together with the on-going Upper Komering Area to be state and provincial rice granary.

Considering the above, Lower Komering Integrated Agriculture Development Project has taken as the pre-feasibility schemes within LTA-129 Study.

6.3.2 Present Condition of the Project Area

The Komering River originates from Lake Ranau with a surface area of 127 km^2 and the elevation of 542 m above sea level. Annual average runoff of the Komering River is estimated about 206 m^3/s with monthly fluctuation from 292 m^3/s in April to 136 m^3/s in September at Martapula with a catchment area of 4,260 km^2. From Lake Ranau, about 18.4 m^3/s of average runoff flows to the Komering River through the year, which is greatly

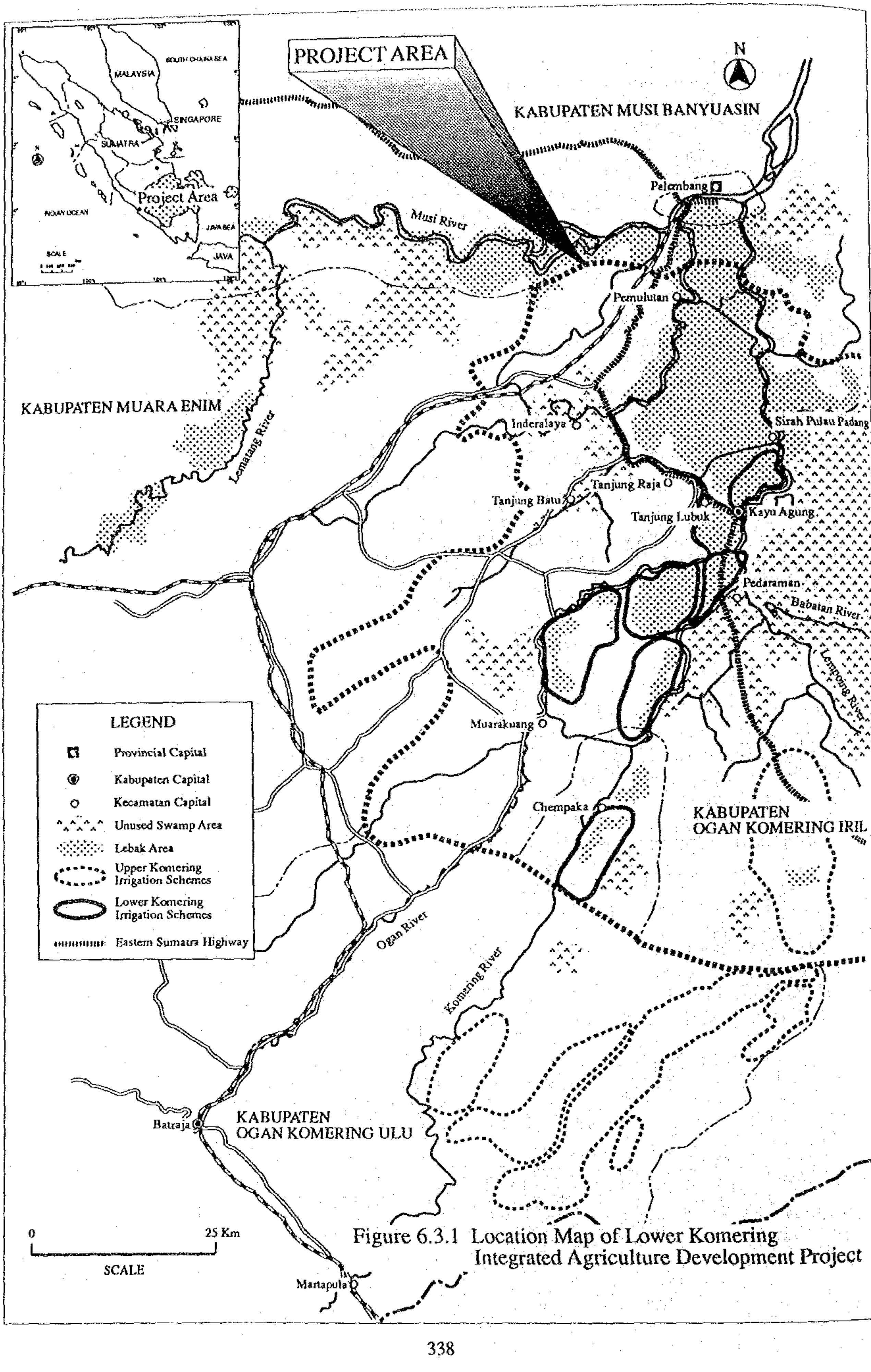


Figure 6.3.1 Location Map of Lower Komering Integrated Agriculture Development Project

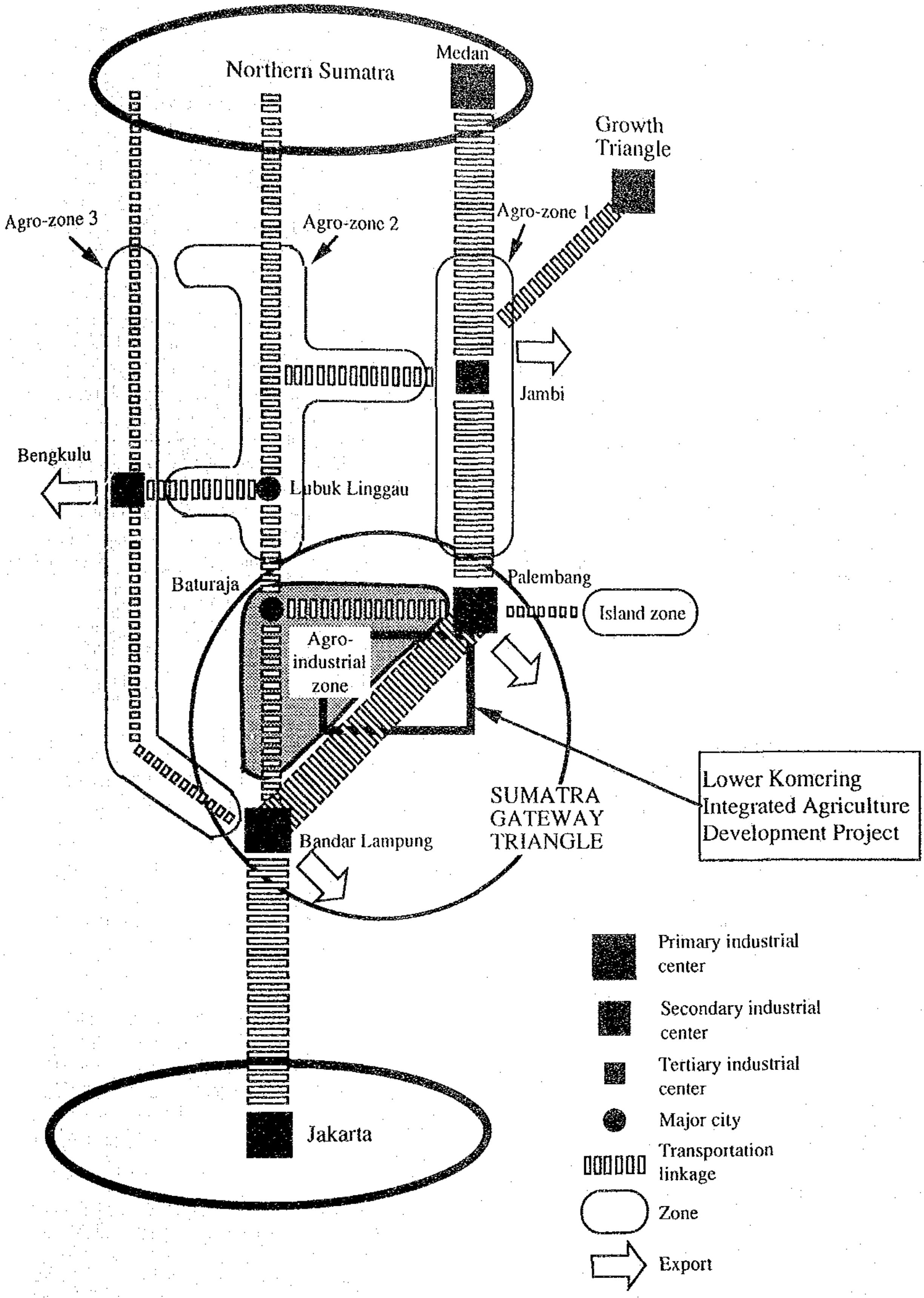


Figure 6.3.2 Development Concept of the Southern Part of Sumatra

contribute to the flow regulation particularly during the dry season. The sediment yield of the Komering River basin is estimated 1,000 m^3/km^2 in annual average.

Table 6.3.1 shows the economic and rice production conditions of the southern part of Sumatra. Kabupaten OKI is situated one of major rice granary in the region, but relatively low production yield of paddy, population density and GRDP per capita.. Huge swamp land with an area of 15,370 km^2 exists in Kabupaten OKI, which shares 73% of the total land of the Kabupaten. Most of the swamp land is unused, however the paddy production in OKI is mainly made on the swamp area under the natural condition. The area of swamp paddy field is estimated 87,000 ha, which is mainly located in non tidal swamp area along the Ogan and the Komering Rivers.

The proposed project area is composed of 8 Kecamatans in OKI with a total area of 5,229 km^2. In addition, Lebak Semendawai Irrigation Scheme in Kecamatan Cempaka of Kabupaten Ogan Komering Ulu (OKU) is considered for the project formulation. the area to be proposed irrigation development is mainly located between Ogan and Komering Rivers as shown in Figure 6.3.1. The main production activity of the area is swamp paddy production called "Lebak", which is utilized seasonal swamp land along the river during the dry season. The plantation timing is depended on the meteorological condition, between February and May on the beginning of the dry season. There are six irrigation development schemes in the proposed project area. Table 6.3.2 shows general information of the project area. The estimated population in the project area is 573,833 as of 1990 with a population density of 109.74 persons/km^2, which is rather high comparing to the one of the southern part of Sumatra with 71 persons/km^2.

6.3.3 Development Potentials and Needs

(1) Needs of Area Wide Integrated Agriculture Development

It was revealed that the previous irrigation development in the region has contributed to the regional economic growth, but not directly contributed to the improvement of the farmers income in the project area. Co-relation analysis was made to clarify the impact of irrigation development using the statistic data of all kabupatens in the region as shown in Table 6.3.1.

Figure 6.3.3 shows the co-relation between irrigation area and production yield of paddy. The figure indicates there is deep relation between these two parameters. Accordingly, irrigation development has effect on the increase of production yield of paddy, in other words, contributing the maximizing use of the natural resources of the area.

Increase of production yield of paddy, however, does not contribute to the growth of per capita GRDP as shown in Figure 6.3.4. In case of the region, the 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, on the other hand 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 on the both area. This figure may suggest the irrigation development does not directly contribute to the farmers income growth in the irrigation area.

Figure 6.3.5 is the co-relation between population density and production yield of paddy, showing deep 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 increase of labor opportunity, and accelerate of migration from the outside poorer villages. On the other hand, there is less impacts of the income growth for the original farmers in the irrigation area.

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

Table 6.3.2 Present Conditions of the Project Area

No. Items	Kabupaten Kec.	OKI Muara Kuang	OKI TJ. Lubuk	OKI Kayu Agung	OKI Pedamaran	OKI SP.Padan	OKI TJ.Raja	OKI TJ.Batu	OKI Pemulutan	OKU Cempaka	TOTAL
1 Administrative Area	Km2	582	305	1,696	1,306	346	245	543	206		5,229
2 Number of Villages	Nos.	27	27	46	18	30	42	28	22		240
3 Population as of 1990	Nos.	32,157	46,320	144,519	43,059	66,736	95,568	61,960	83,514		573,833
4 Population Density	Nos./Km2	55.25	151.87	85.21	32.97	192.88	390.07	114.11	405.41		109.74
5 Number of Families	Nos.	5,895	9,083	30,156	8,999	14,248	19,108	12,351	15,369		115,209
6 Average Number per Family	Nos.	5.45	5.10	4.79	4.78	4.68	5.00	5.02	5.43		4.98
Present Condition of Paddy Field											
11 Irrigation Area	ha	0	0	120	0	0	618	0	3,206	4,342	8,286
12 Reinfed Paddy Field	ha	0	126	7,313	150	0	0	0	0	2,805	10,394
13 Lebak Paddy Area	ha	3,464	9,310	4,621	2,035	13,375	12,625	1,037	15,700	9,262	71,429
14 Other Wetland	ha	2,170	799	0	0	1,435	0	0	1,440	1,347	7,191
15 Total of Wetland Area	ha	5,634	10,235	12,054	2,185	14,810	13,243	1,037	20,346	17,756	97,300
16 Irrigation Ratio	%	0.00	0.00	0.01	0.00	0.00	0.05	0.00	0.16	0.24	0.09
Land Development Potential											
Grass Land	ha	0	1,200	1,814	237	1,375	300	12,830	0	0	17,756
Swamp Land	ha	15,520	7,945	45,476	74,692	10,709	180	13,389	1,800	7,500	177,211
Fallow Land	ha	0	0	36,800	23,681	950	200	3,012	450	10,896	75,989
Wooded Land	ha	13,304	3,726	26,700	9,095	1,650	860	16,779	300	1,903	74,317
Total of Un-used Land	ha	28,824	12,871	110,790	107,705	14,684	1,540	46,010	2,550	20,299	345,273
Proposed Irrigation Schemes											
17 Lebak Semendawai	ha									5,300	5,300
18 Lebak Paras	ha							8,750			8,750
19 Lebak Bungur	ha		6,594								6,594
20 Sungai Rotan	ha		5,080								5,080
21 Tanjung Balai	ha		1,750								1,750
22 Lebak Air Daros	ha					1,000					1,000
23 Total of The Proposed Area	ha	0	13,424	0	0	1,000	0	8,750	0	5,300	28,474
Flood Damage Condition in 1987											
24 Number of Damaged Villages	Nos.	12	11	7	4	0	42	0	22		98
25 Number of Damaged Houses	Nos.	2,383	5,975	2,652	1,369	0	16,087	0	10,840		39,306
26 Damaged Population	Nos.	20,599	31,448	39,557	30,794	0	93,335	0	58,091		273,824
27 Damaged Settlement Area	ha	219	1,830	1,920	60	0	7,500	0	226		11,755
28 Damaged Paddy Field	ha	5,383	4,720	6,818	1,875	4,690	5,180	8,750	13,800		51,216
29 Damaged Plantation	ha	0	8,535	0	0	0	10,584	0	98		19,217
30 Total Estimated Loss	mil. Rp.	4,182	6,815	6,514	775	1,758	7,006	3,281	5,492		35,823

Sources: Dalam Angka for Kabupaten Ogan Komering Iril (1990)
Musi River Basin Study, Ministry of Public Works, EEC (1989)

Figure 6.3.3 Relationship Between Irrigation Area and Production Yield of Paddy

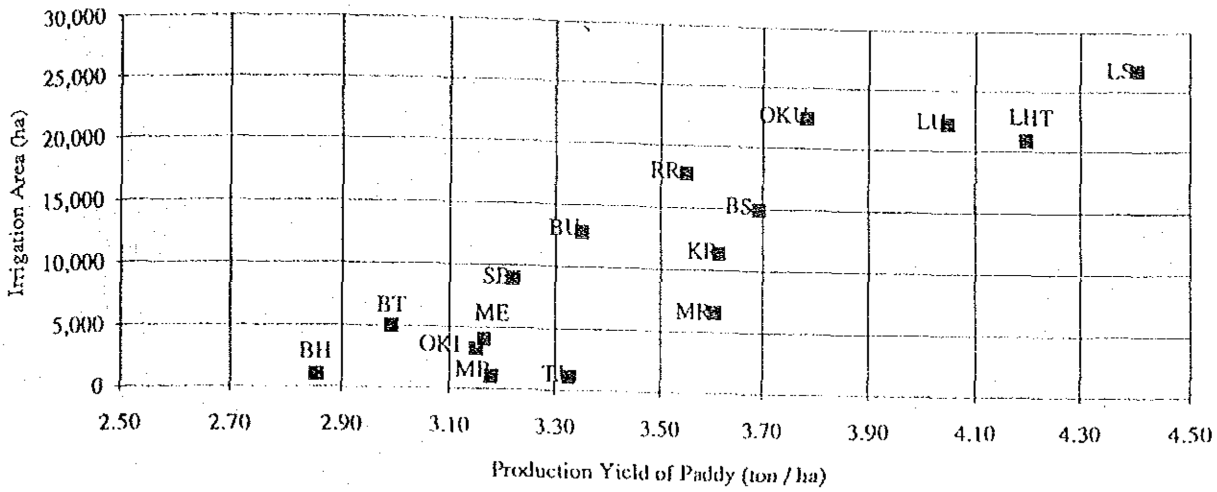


Figure 6.3.4 Relationship between GRDP per Capita and Production Yield of Paddy

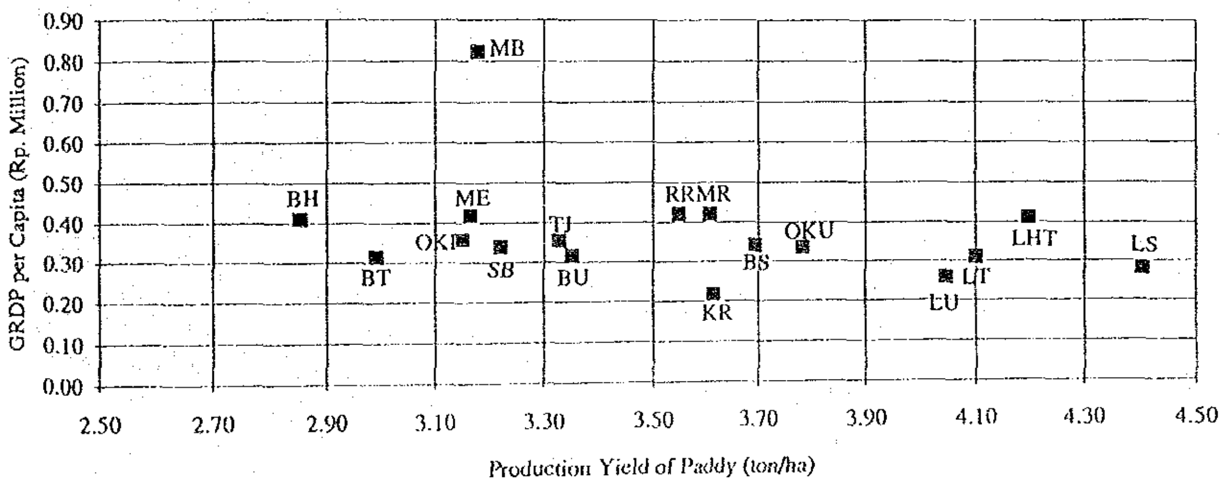
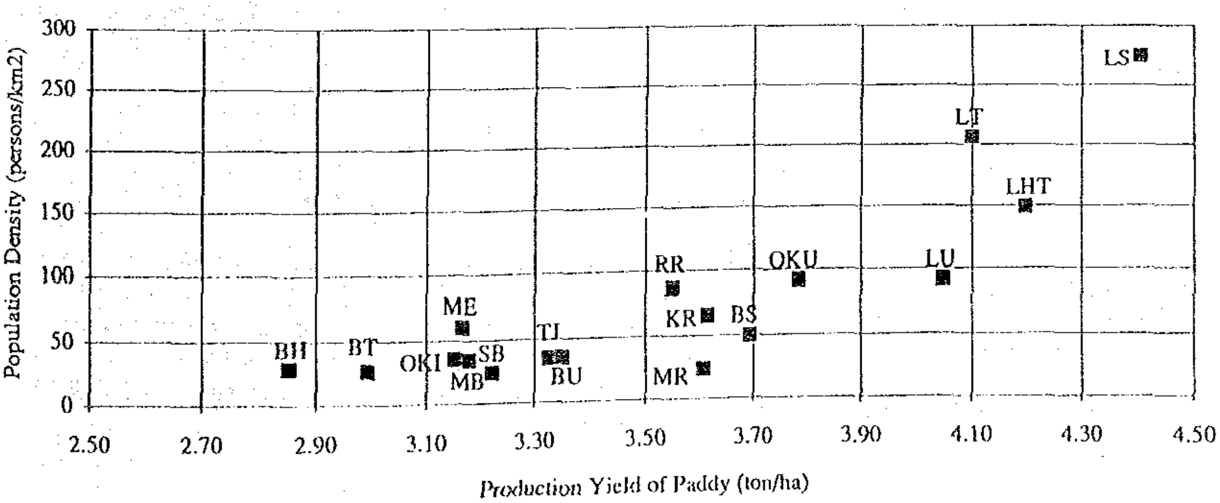


Figure 6.3.5 Relationship between Population Density and Production Yield of Paddy



Considering the above results, it is required to take into account the additional counter measures aiming at improvement of income level for the original farmers. Area wide Integrated Agriculture Development Approach is consequently recommended instead of the previous large scale irrigation development project. This approach differs from the previous approach as shown below;

1) Project Area is defined as Kabupaten wide or Provincial wide to consider th regional impact of the project such as laboring opportunity, farmers income, regional production and so on,
2) Formulation of irrigation management system is included to assist smooth operation and maintenance after the project completed,
3) Social study is included to forecast the further social condition after the project completed.

(2) Eastern Sumatra Highway

Once this road network completed, the route will constitute a new and more efficient artery for Sumatra than the existing Trans Sumatra Highway for the following reasons:

1) It will link major urban centers, Medan , Pekanbaru, Jambi, Palembang and Bandar Lampung containing the main concentrations of population, commerce, industry and Ports.
2) The improved design will make possible rapid and safe shipping by more economical multi-axle trucks and large coaches for passengers, significantly cutting travel times.
3) Because its southern terminus will be at Bakahuni, Java access from all of the provinces will be greatly improved.

Taking into such circumstance, LTA-129 Study has proposed to formulate "Gateway Triangle", consisted of Palembang, Bandar Lampung and Batraja, as the hub of the regional development. The project area is defined as the agro-industrial zone aiming at marketing to Palembang, Bandar Lampung, and Java. Under the above circumstance, area wide integrated agriculture development for the Lower Komering area is quite important for the region.

(3) Population Pressure to Palembang City

LTA-129 Study also revealed that the poverty area in Palembang City is mainly formed by the surround poorer Kabupatens such as OKI and Musi Banyuasin. The team made the investigation on the poor urban villages of Palembang City in cooperation with University of Sriwijaya.

According to the research, migrants from OKI, who are the major rural -urban migrants in Palembang City, suffered diminishing returns from agriculture, resulting from reduces land available for smallholder farming with the spread of large estate. Moreover, lack of intensification or diversification in traditional tidal and non-tidal swamp agriculture is suffered from the smallholders. Some labouring opportunities are available in large estate, but with the positions are limited and wages low between Rp.1,500 and 2,000 per day. Consequently, they move to Palembang City and form poorer villages or slums.

In Palembang City, there are so many poorer villages, located mainly along the Musi River and the tributaries in the city without appropriate job, infra-structure, potable water and so on. The settlements frequently become as the obstacle for the municipal improvement works for the city's infrastructures. Because, most of the poorer villages is formed without any permission by the municipality. This is one of the major issues for the urban development for Palembang City.

6.3.4 Major Development Issues

(1) Lack of Intensification or diversification of "Lebak"

As mentioned in Section 6.3.3, OKI is expected as the Agro-industrial Zone in future, and many large estates have developed. Consequently, available land for smallholders is decreasing, and they must select from two ways, drift to Palembang City or stay as workers in the estate with small wage. This tendency will accelerate in future together with completion of Easten Sumatra Highway. Considering that, it is required to develop the existing swamp paddy field for intensification or diversification aiming at increase labor receipt capability for the existing swamp paddy field.

(2) Habitual Flood damage

The project area has an advantage of marketing to Palembang, however the economic condition of the area is insufficient due to habitual overflow from Ogan and Komering Rivers. The identified irrigation development area is located between these rivers, and there are several streams flowing from the Komering River to the Ogan River. The main reason for the habitual flood of the area is caused by the connecting streams, to which the most part of the flood in Komering River diverts, and flow to the Ogan River. The proposed irrigation development area and the downstream is subsequently forming seasonal swamp. That is the major constraints for the development of the area. Flood control works will also expect to extend the land for cultivation for large estate or smallholders.

(3) Adverse Effect to Palembang City

On the other hand, such flood performance has greatly contributeed to the development of Palembang City in view of the flood mitigation effect for the City. Palembang City is located just downstream of the Ogan and Komering Rivers, and the flood from these rivers temporary stored the above seasonal swamp area, therefore, the flood to Palembang City is regulated and retarded by the natural condition.

6.3.5 Project Formulation

(1) Objectives

The objectives of the captioned project are as follows :

1) To carry out irrigation development, composed of the 6 irrigation schemes with a total area of 28,470 ha.
2) To reduce the flood damage for the populated zone and cultivation area in the project area.
3) To propose the way of improvement of the existing swamp paddy field located outside of the proposed irrigation command area, such as diversification and so on.
4) To forecast the further economic and social conditions of the project area and to feed back to the project planning, if necessary.
5) To improve the regional social and economic conditions particularly for the smallholders.
6) To maintain the environmental condition of the huge swamp area located on the right bank of Lower Komering River.
7) To assess the adverse effect to Palembang City due to the proposed flood control and drainage projects and to provide the countermeasures to avoid the flood increment to the downstream.

(2) Executing Agency

Directorate of Water Resources Development in Ministry of Public Works is to be an executing agency. In addition, Bappeda TK I, South Sumatra Province, Bappeda TK II, Kabupaten Ogan Komering Iril, and Ministry of Agriculture are to be involved as the cooperative agencies.

(3) Scope of Works

Phase I: Survey and Investigation

1) Review and evaluation of the previous studies concerning mainly on the irrigation development, regional development strategy, swamp land development and conservation.
2) Data collection, processing and examination such as:
   a) Topographic maps with scale of 1 : 50,000;
   b) Landsat image with scale of 1 : 200,000;
   c) GIS information for Kabupaten OKI;
   d) Meteorological and hydrological data of the Ogan and Komering River Basins;
   e) Land use, land suitability and soil data;
   f) Regional statistics, such as economy and sociology; and
   g) Institutional and regal related to the agriculture, irrigation development.
3) Field investigation and hearing survey to observe the present natural and socio-economic conditions in the study area.
4) River morpholosical survey and study including river condition, water quality, sediment transport, tidal fluctuation, and salinity intrusion.
5) Investigation of the previous flood record, inundation area and flood damages.
6) Investigation of bankfull capacity of the existing river channels.
7) Review of the existing irrigation development plan.
8) Identification of the irrigation development schemes.
9) Construction of flood runoff model for The Ogan and Komering River System.
10) Identification of the flood control schemes, including diversion channels if necessary.

Phase II: Master Plan Formulation

11) Definition of the target of economic development for the Kabupaten OKI on 2015.
12) Estimation on the demand to development on:
   a) Land resources;
   b) Water resources;
   c) Irrigation;
   d) Swamp reclamation;
   e) Flood control;
   f) Laboring opportunity; and
   g) Rural economy.
13) Preparation of advisory report for the income grade up for the smallholders outside of the selected irrigation command area, such as diversification plan, and inland fishery plan as the side business in rainy season.
14) Formulation of Master Plan for the area development of Kabupaten OKI targeting on 2015.

Phase III: Screening for The Feasibility Study

15) Screening on the priority project, from the master plan for the irrigation development schemes and flood control schemes, and village improvement schemes.
16) Topographic survey for the selected projects with appropriate scale for the feasibility study.

Phase IV: Feasibility Study

17) Survey and investigation of the command area of the projects in view of hydrology, soil condition, and so on.
18) Basic design of the structure based on the topographic maps provided in 16).
19) Cost estimation and economic analysis of the schemes.
20) Operation and maintenance plan formulation for the project viability.

(4) Project Components

Figure 6.3.6 describes the main components of the proposed projects, which is composed of the 6 irrigation development schemes, 1 flood way scheme, and flood control schemes. General description of each scheme is as follows:

1) Irrigation Development Schemes

Six irrigation development schemes have identified in MRBS. The features of the respective schemes is summarized below:

Scheme	Location	Area
Lebak Semendawai	OKU	5,300 ha
Lebak Palas	OKI	8,750 ha
Lebak Bungur	OKI	6,594 ha
Sungai Rotan	OKI	5,080 ha
Tanjung Balai	OKI	1,750 ha
Lebak Air Daros	OKI	1,000 ha
Total		28,470 ha

2) Komering Flood Way Scheme

Komering Flood Way has proposed to divert the flood from The Komering River at the downstream of Cempaka Township to The Babatan River. The Babatan River originates from the Lake Tampang in the huge swamp area located on the west of Kayu Agung City. The river flows within the swamp area with a length of 65 km, and meet to Mesuji River at Pageldewa village. The total length of Komering Flood Way is 25 km, and most part of the stretch can utilize the existing stream channel, and the required new channel excavation is about 5 km.

3) Flood Control Schemes

Flood control schemes are composed of levee embankment, drainage construction and plugging to the existing connecting streams between Ogan and Komering Rivers. Among the above, drainage construction will be included in the irrigation development. The identified levee embankment sections and plugging channels are considered with the Komering Flood Way. Consequently, the downstream of the diversion site is not included. The proposed section of flood control scheme is as follows :

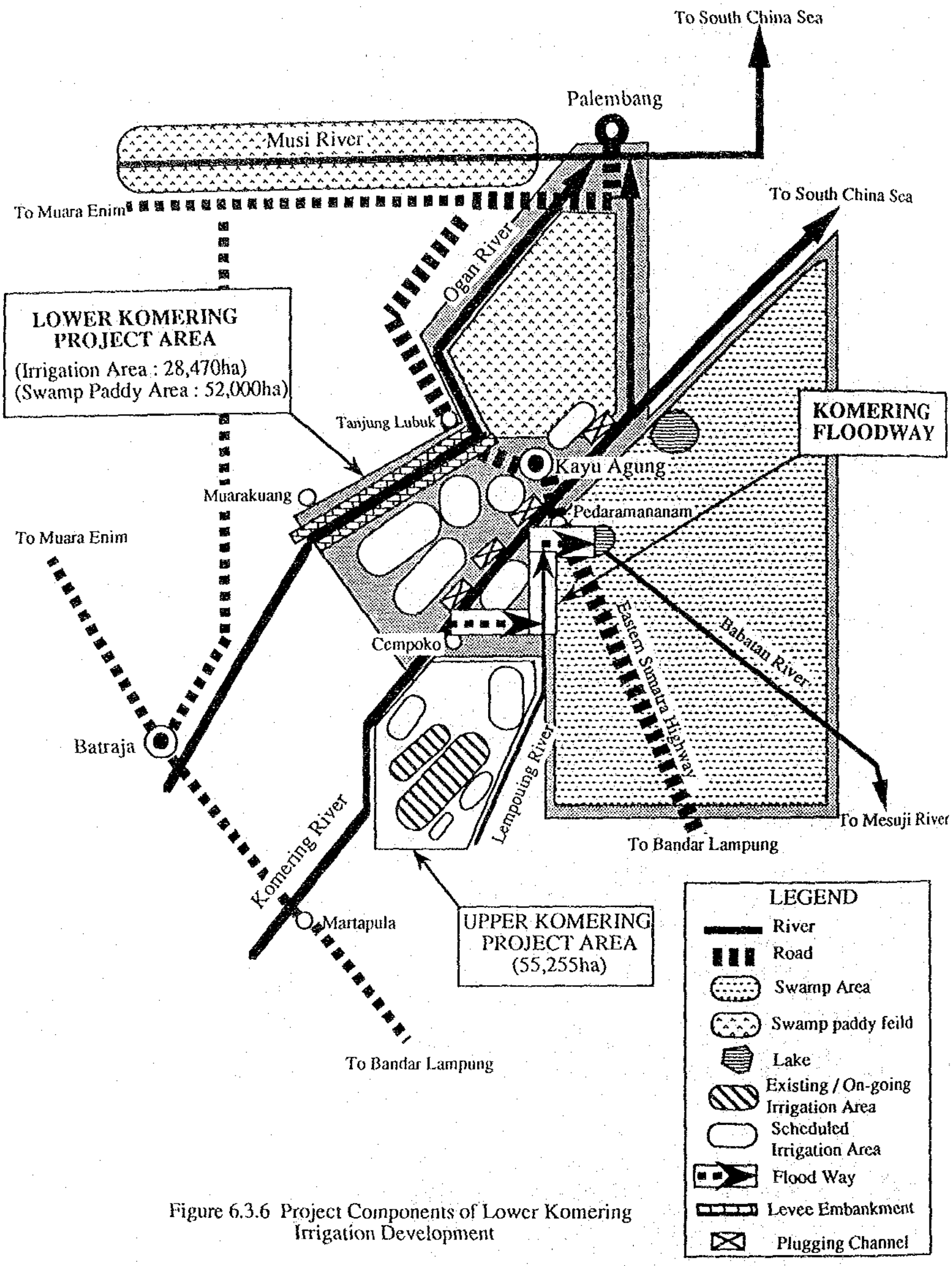


Figure 6.3.6 Project Components of Lower Komering Irrigation Development

a) Levee Embankment : The both sides of Ogan River between Muara Kuang and Tanjung Lubuk with a length of 47.5 km.

b) Plugging of Channel : Randu River, Jambur River, Segonangr River , and Terusan River.

4) Agriculture Improvement Plan for the Outside of Irrigation Command Area

For smallholders outside of the irrigation command area in the project area, some ideas for their income grade up will propose such as diversification, inland fishery business in rainy season and so on. This proposal will be made based on the analysis of land use, land suitability study and marketing study for the project area.

6.3.6 Cost Estimate

Project cost for the implementation has estimated by MRBS. According to the study, total cost for the irrigation development is estimated to 108 million US$. Cost for the flood control work is estimated to 26 million US$, which is excluded the Komering Flood Way.

6.3.7 Conclusions and Recommendations

The proposed project is required comprehensive master plan because the river system is quite complicate and the basinwide study is inevitably required for the development particularly to assess the adverse effect to Palembang City and environmental affect to the swamp area where the Komering Flood Way is proposed. In addition, it seems to be still remaining the potential of the irrigation development such as the area between Palembang and Kayu Agung, and along the Ogan River in the upstream of Muara Kuang.

7. TRANSPORTATION

Some additional analysis has been prepared on one road project, and on two seaport projects. These types of infrastructure require very large investment, extensive planning, and some coordination. The road project is a proposed outer bypass route around the Bandar Lampung area, and the port projects are located in Sumatra Selatan and Jambi provinces. These analyses have not been prepared with the benefit of on-site analysis as to soil conditions, cost analysis or supply and demand evaluation required for feasibility analysis.

7.1 OUTER BYPASS AROUND BANDAR LAMPUNG

The main features of this proposed new road are summarized in the table below. Figure 7.1.1 depicts the route as it would cross the Bandar Lampung metropolitan area. Figure 7.1.2 situates this area in relation to eastern Lampung province and shows three routes that the interisland ferry traffic to and from Java will be able to use. Of vital importance is the availability of safe roads for heavy vehicles, particularly multi-axle tractor trailor trucks. Although today usage of these trucks is minimal and generally limited to the Trans-Sumatra Highway between Panjang port and Tegineneng, in the future wider use of them will be required for both port (Panjang) shipping and ferry traffic (Bakauheni) to Java.

Table 7.1.1 Outer Bypass - Main Alignment Features

Length	:	45 km		
Terrain	:	generally flat		
Existing development	:	airport rubber plantations	agro-industry plants Tarahan coal terminal	
Drainage	:	adequate		
Alignment notes	:	1-7 km through Branti production forest 1-5 km through PTP X #48 rubber plantations intersection at midpoint with Sribowono rd 4-5 km through protection forest #17 rural character of vicinity with numerous villages		
Erosion	:	minimal		
Traffic counts (1991)	:	18,253 per day at north terminus (Trans-Sumatra Highway) 16,884 per day above south terminus (Trans-Sumatra Highway) 6,031/2,787 below south terminus (Trans-Sumatra Highway)		
Saving for distance & time	:	inner bypass outer bypass difference	56 km 45 km 10 km	60 minutes 35 minutes 25 minutes

Source : Study estimates
Notes : All data are approximate and subject to local survey.

7.1.1 Objectives and Roles

The primary objective is to improve the flow of interurban traffic, mainly consisting of the heavy vehicles using the Java-Sumatra ferry, or using Panjang port, around the metropolitan area, traffic which today is using the existing bypass (the Inner Bypass). This bypass function would shift to the Outer Bypass.

A second objective is to prolong the design life of the soon-to-be congested sections of the Trans Sumatra Highway to the north and to the south of the existing Inner Bypass. The Outer Bypass can be evaluated as an alternative to the widening to 4 lanes of the

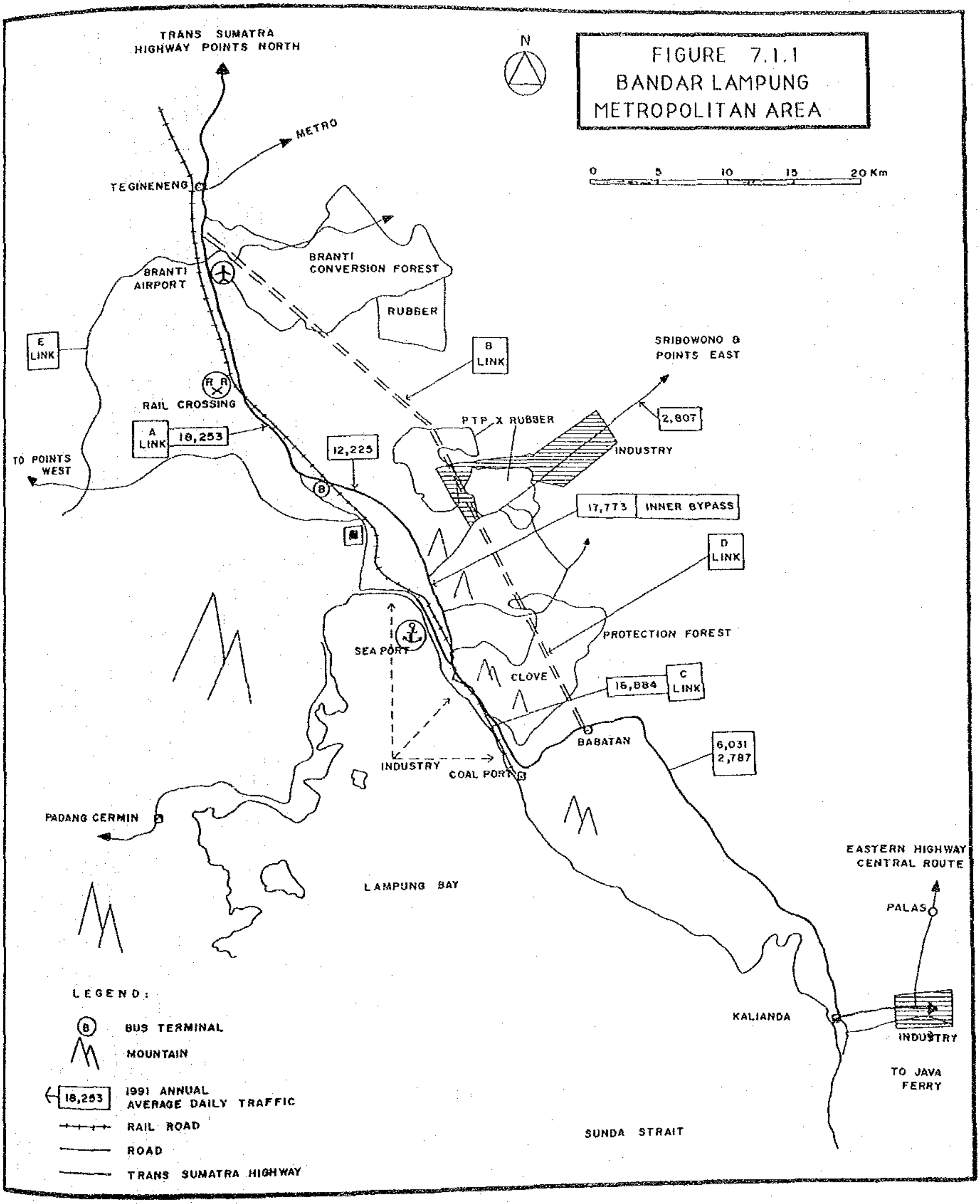


FIGURE 7.1.1
BANDAR LAMPUNG
METROPOLITAN AREA
N
0 5 10 15 20 Km
TRANS SUMATRA HIGHWAY POINTS NORTH
METRO
TEGINENENG
BRANTI CONVERSION FOREST
BRANTI AIRPORT
RUBBER
E LINK
B LINK
SRIBOWONO & POINTS EAST
RAIL CROSSING
A LINK
18,253
12,225
PTP X RUBBER
2,807
INDUSTRY
TO POINTS WEST
17,773
INNER BYPASS
D LINK
SEA PORT
PROTECTION FOREST
CLOVE
16,884
C LINK
BABATAN
6,031
2,787
INDUSTRY
COAL PORT
PADANG CERMIN
LAMPUNG BAY
EASTERN HIGHWAY CENTRAL ROUTE
PALAS
KALIANDA
INDUSTRY
TO JAVA FERRY
SUNDA STRAIT
LEGEND:
BUS TERMINAL
MOUNTAIN
18,253
1991 ANNUAL AVERAGE DAILY TRAFFIC
RAIL ROAD
ROAD
TRANS SUMATRA HIGHWAY

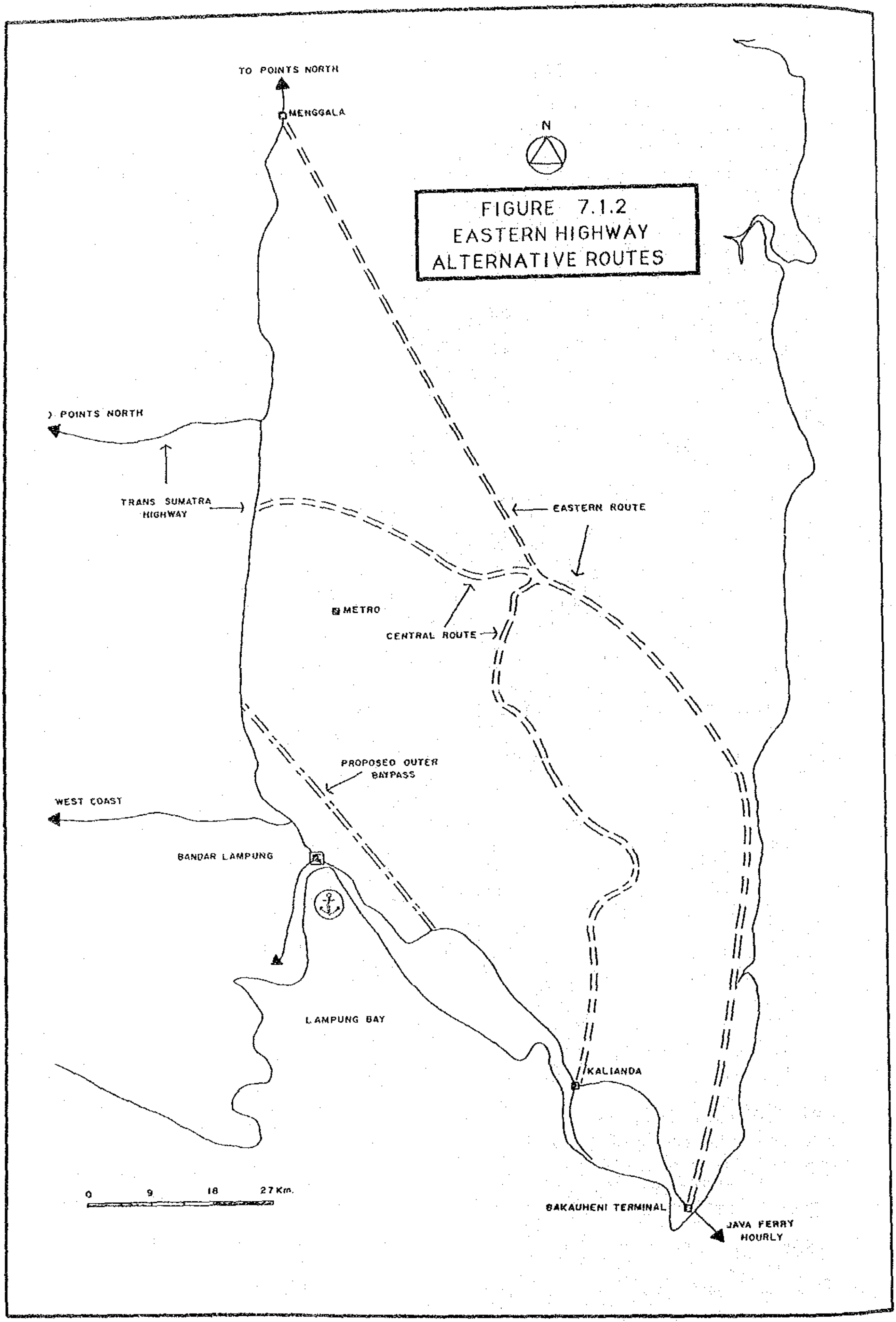


FIGURE 7.1.2
EASTERN HIGHWAY
ALTERNATIVE ROUTES

Trans Sumatra Highway, or at least as an option making possible postponement of the widening.

A third objective is a developmental one, opening up more land for industrial and residential development to the north and east of the city. Because of the mountainous surroundings, industrial development to the south and west is limited, and in the long run will probably be concentrated in a northern corridor and an eastern one beyond the mountains. The proposed road would improve access to these areas and relieve pressure from the existing Trans-Sumatra Highway. Access to Panjang port would be better with less congestion on the Trans-Sumatra Highway near the port, and with the availability of a second approach highway from the worth.

7.1.2 Location

The northern terminus of the road would be on the Trans-Sumatra Highway in the vicinity of Branti Airport or Tegineneng at the northern end of the metro area. The southern terminus is in the area of Babatan, on the Trans-Sumatra Highway, at the southern end of the metro area. It is bisected by the east-west road to Sribowono, along which plantations and several agro-industrial plants are located.

A possible variation for this route is for it to form part of a ring road extending from the road to the west (see "E link" on Figure 7.1.1), up to the airport and down along the proposed alignment. This would constitute a larger project.

In addition, another link of approximately 15 km in length can be studied to connect B link to Metro (not shown on the figures), possibly crossing the Branti conversion forest. This link would serve to divert some traffic between Metro and Bandar Lampung off the existing Metro-Tegineneng Road and the Trans-Sumatra Highway and onto the Outer Bypass.

7.1.3 Executing Agency

The Department of Highways of the Ministry of Public Works is the established agency for projects of this nature.

7.1.4 Expected Benefits

There are benefits in the form of travel time savings and reduced travel distances (Table 7.7.1) that can be quantified. These would apply to primarily inter-island and port traffic, but also to some local traffic. Traffic beteen Metro and Bandar Lampung could also use it as a second route. Tables 7.1.2 and 7.1.3 provide a rough estimation of the traffic volume on the two links that would make up the road (B link and D link). Other benefits include:

1) reduced congestion on the Trans-Sumatra Highway and prolongation of its lifespan (by 3-4 years),
2) for heavy vehicles a safer route without any mountain grades such as the one existing above Tarahan, nearly 4 km long,
3) the complete segregation of interurban traffic from urban traffic on different roads,
4) a more dispersed spatial pattern of industrial/residential development in the metro area, and
5) an environmentally more suitable alternative to capacity expansion (road widening) projects of existing roads requiring population resettlement and possibly the cutting of mountains.

Table 7.1.2 Forecast Traffic Load Tegineneng-Rajabasa Link B

(unit: average daily 2 way traffic)

Link	Gross Corridor Traffic	Ferry Traffic Share	Lost Ferry Traffic	Net Effective Corridor Traffic A	Road Capacity A	Vol/ Capaty Ratio (%) A	Captured Traffic for B Ferry B	Captured Traffic for B Excess B	Captured Traffic for B Total B
1991	18,253	2,430	0	18,253	22,816	80			
1992	19,622	2,612	0	19,622	22,816	86			
1993	21,094	2,808	0	21,094	22,816	92			
1994	22,676	3,019	0	22,676	22,816	99			
1995	24,376	3,245	649	23,727	22,816	104			
1996	26,205	3,489	698	25,507	28,520	89			
1997	28,170	3,750	750	27,420	25,668	107	3,000	0	3,000
1998	30,283	4,031	1,209	29,073	25,668	113	2,822	583	3,405
1999	32,554	4,334	1,300	31,254	25,668	122	3,034	2,552	5,585
2000	34,995	4,659	1,398	33,598	25,668	131	3,261	4,668	7,929
2001	36,745	4,892	1,957	34,788	25,668	136	2,935	6,185	9,120
2002	38,582	5,136	2,055	36,528	25,668	142	3,082	7,778	10,860
2003	40,512	5,393	2,157	38,354	25,668	149	3,236	9,450	12,686
2004	42,537	5,663	2,265	40,272	25,668	157	3,398	11,206	14,604
2005	44,664	5,946	2,378	42,286	25,668	165	3,568	13,050	16,617
2006	46,897	6,243	2,497	44,400	25,668	173	3,746	14,985	18,732
2007	49,242	6,556	2,622	46,620	25,668	182	3,933	17,018	20,951
2008	51,704	6,883	2,753	48,951	25,668	191	4,130	19,152	23,282
2009	54,289	7,227	2,891	51,398	25,668	200	4,336	21,394	25,730
2010	57,004	7,589	3,036	53,968	25,668	210	4,553	23,747	28,300

Annual Traffic Growth : to 2000 1.075
from 2000 1.05

Source : JICA Study estimation.

Note:

(1) Diversion of ferry traffic to other routes is assumed as follows:
by 1995 20% of volume
by 2000 40% of volume

(2) Volume/capacity ratio assumed .80 for 1991.

(3) 4 lane Trans Sumatra Highway expansion assumed not feasible.

(4) Traffic peaking pattern by time of day is disregarded.

(5) 100% of all ferry traffic is assumed to shift to link B.

(6) Road completion is assumed in 1997.

(7) Effective capacity is 90% of full capacity when alternate route is available.

Table 7.1.3 Forecast Traffic Load Panjang-Tarahan Coal Port Link D

(unit: average daily 2 way traffic)

Link	Gross Corridor Traffic	Ferry Traffic Share	Lost Ferry Traffic	Net Effective Corridor Traffic C	Road Capacity C	Vol/ Capaty Ratio (%) C	Captured Traffic for D: Ferry D	Captured Traffic for D: Excess D	Captured Traffic for D: Total D
1991	16,884	3,078	0	16,884	25,200	67			
1992	18,150	3,309	0	18,150	25,200	72			
1993	19,512	3,557	0	19,512	25,200	77			
1994	20,975	3,824	0	20,975	25,200	83			
1995	22,548	4,111	822	21,726	25,200	86			
1996	24,239	4,419	884	25,507	25,200	93			
1997	26,057	4,750	950	27,420	25,200	100	2,546	0	2,546
1998	28,011	5,107	1,532	29,073	28,980	91	2,395	0	2,395
1999	30,112	5,490	1,647	31,254	26,082	109	2,575	0	2,575
2000	32,371	5,901	1,770	33,598	26,082	117	2,768	1,751	4,518
2001	33,989	6,196	2,479	34,788	26,082	121	2,491	2,938	5,429
2002	35,689	6,506	2,602	36,528	26,082	127	2,615	4,389	7,004
2003	37,473	6,831	2,733	38,354	26,082	133	2,746	5,512	8,659
2004	39,347	7,173	2,869	40,272	26,082	140	2,884	7,206	10,396
2005	41,314	7,532	3,013	42,286	26,082	147	3,028	9,192	12,219
2006	43,380	7,908	3,163	44,400	26,082	154	3,179	10,955	14,134
2007	45,549	8,304	3,321	46,620	26,082	162	3,338	12,807	16,145
2008	47,826	8,719	3,488	48,951	26,082	170	3,505	14,752	18,257
2009	50,218	9,155	3,662	51,398	26,082	178	3,680	16,793	20,474
2010	52,728	9,613	3,845	53,968	26,082	187	3,864	18,937	22,801

Annual Traffic Growth : to 2000 1.075
from 2000 1.05

Source : JICA Study estimation.

Note:

(1) Diversion of ferry traffic to other routes is assumed as follows:
by 1995 20% of volume
by 2000 40% of volume
(2) Volume/capacity ratio assumed .67 for 1991.
(3) 4 lane Trans Sumatra Highway expansion assumed not feasible.
(4) Traffic peaking pattern by time of day is disregarded.
(5) 90% of all ferry traffic is assumed to use this link.
(6) 67% of retained ferry traffic shifts from C to D.
(7) Road completion is assumed in 1997.
(8) Effective capacity is 90% of full capacity when alternate route is available.

7.1.5 Outline of the Project

The Dept of Highways has a planning system in place for betterment and upgrading of the existing road network. For construction of totally new routes it frequently relies on foreign funding and assistance, and it is likely that this project would be best handled within the framework of a foreign-funded road package.

The initial planning period will be required to determine the optimal alignment in view of several factors:

1) the long term development of Branti Airport,
2) affected properties including:
   a) the Branti conversion forest
   b) PTP X rubber plantations
   c) the Batu Serumpuk protection forest (north of Tarahan)
3) the timing of improvement of the Trans-Sumatra Highway (ie widening to 7 meters plus shoulder expansion, railroad overpass, sidewalks),
4) construction of a second railroad line to Tarahan coal port,
5) ultimate full completion of the Eastern Highway for heavy vehicles (6 meter width, 10 ton minimum axleload strength), and
6) use of existing local roads.

The more the above projects are postponed, the greater the congestion will be in the urban area, and the more desirable an alternative becomes. The basic parameters of the project have been outlined in Table 7.1.1.

7.1.6 Phasing

A possible time frame for this project is proposed below:

Step 1	:	full economic & environmental feasibility (1 year)
Step 2	:	design finalization, land acquisition (1 year)
Step 3	:	construction of two links (3 years)

With an overall time frame of 5 years, the project could be accomplished within one Repelita period. Tables 7.1.2 and 7.1.3 contain traffic projections that suggest that by 1998 the existing Trans-Sumatra Highway, even after some capacity expansion in the interim is assumed, and after deduction of some of the ferry traffic, may once again reach capacity before the year 2000. Consequently, the project could be timed for Repelita VI.

The JICA Development Study on Coastal Roads in East Sumatra (currently in draft final stage) projects higher traffic growth rates of roughly 11% for Lampung province in the near and mid terms (for inter-provincial traffic), in which case these traffic forecasts (which include both inter-provincial and local traffic) may be somewhat conservative. In this case, capacity expansion measures would be required sooner than indicated by this analysis.

The Outer Bypass could logically be divided into two sections, an upper one (B link) and a lower (D link) one which could be built in sequence over the 3 year period. One or both could initially be built to a lower standard (5-6 meters width, 8 ton strength) as a provincial road, and upgraded in the future as heavy (container) truck traffic develops.

7.1.7 Cost Estimation

An average per kilometer cost of Rp 300 million can be assumed to obtain an order of magnitude of cost without benefit of any specific research. No major bridge structures appear to be necessary, and kabupaten maps indicate that flooding is not a problem in the area. Total cost would be Rp 13,500 million (US$6.6 million). It may be possible to use existing roads for much of the alignment of this project, to reduce land acquisition costs.

7.1.8 Appraisal

No appraisal work has been done for this project idea. In addition to the usual road costs and benefits, the appraisal will have to take into account benefits/costs such as:

1) output lost (cost) in affected plantations and forest areas
2) costs saved (benefit) of road widening programs on city roads that are downscaled or canceled because of this project, particularly of A link, Trans-Sumatra Highway 4 lane widening.
3) the environmental impact of building a road through forests and farmland.

The traffic volumes indicated on the following tables, exceeding 9,000 vehicles per day within five years, suggest that traffic is sufficient to justify the new road.

7.1.9 Major Preconditions and Recommendations

(1) Need for an Urban Development Master Plan

A major road of this nature near a metropolitan area should not be undertaken without the benefit of a long term urban development master plan that evaluates short and long term infrastructural needs and proposes as a component a long term plan for the future development of the area's road system. A properly designed road development plan will be integrated or at least coordinated with an urban master plan so that new roads (and other infrastructure) will be built not only to avoid congestion but also to accommodate different types of land uses where they are functionally compatible in the long term perspective. Simple observation of current conditions in Bandar Lampung suggests that growth will extend primarily northward and east where there is flat land (and where this road is proposed). However, a plan that clarifies spatially directions for growth rather than observation, is needed before any major road such as a bypass or ring road can be committed.

(2) Need for a Road Network Analysis

This study focuses on a proposal for one new road in the Metro area. However, other projects are closely related to it, including:

1) the widening of A link (Trans-Sumatra Highway)
2) the widening of C link (Trans-Sumatra Highway)
3) construction of a new link to Metro
4) improvement of E link as a western bypass

What is required is a network analysis for the Metro area to clarify the form of the optimal network and the phasing of the projects over the coming years. This can be accomplished by the normal road planning process of Bina Marga (possibly with need for some foreign planning assistance).

(3) Toll Road

As regards the possibility of a toll road, it appears that traffic volumes would not be sufficient to justify one, in view of the dilution of the ferry traffic into three alternative routes. However, any major road project must be studied with a valid traffic forecast for the vicinity, which at present is not available.

(4) Natar Railroad Crossing

At present the Trans-Sumatra Highway has a railroad crossing at grade which among other factors, cuts the capacity of the road. Replacement of this with a flyover is a possibility to be studied. The proposed outer bypass would not require any crossings unless a rail line is built in the vicinity, which seems very unlikely at this time.

(5) Current Condition of the Trans-Sumatra Highway

This road is probably handling daily traffic of 20,000 vehicles, largely freight trucks and buses, and it suffers from the handicaps of the above mentioned railroad crossing, heavy pedestrian traffic in populated areas, uneven pavement width, and constant interruption by public service passenger vehicles. Upgrading of this road in the near term is required and has been assumed in the traffic projections appearing in this section. The outer bypass road would supplement this road, not replace it. Only the ferry and port traffic and some local traffic would shift.

(6) Traffic Pattern by Hour of the Day

Good traffic pattern measurement by hour of the day is needed to determine the degree of congestion and more accurate volume/capacity ratios characterizing existing roads. Traffic patterns vary by time of day and day of week, and for a better understanding of capacity and congestion, a database including readings of this kind is necessary to clarify obsolescence or insufficiency of existing roads such as the Trans-Sumatra Highway in urban areas, and to justify major road expansions such as widening to four lanes.

7.2 DEEP SEA PORT CONSTRUCTION (JAMBI)

(1) Objectives
1) Reduction of transportation cost through use of large cargo vessels.
2) Increased capability for handling containerized cargo.

(2) Location
1) Muara Sabak, Jambi province (Project Number: G-25)
2) Sungai Rimau, Jambi Province (Project Number: G-26)

(3) Executing Agency
Directorate General of Sea Communication (DGSC)

(4) Outline of the Project

The approach channel of the Port of Jambi, (which has the longest Wharf in Jambi Province) is limited in terms of its water depth and its ability to accommodate longer vessels. The maximum draft and length for calling vessels are 3.5 meters and 75 meters in dry season respectively because each ship must clear 19 difficult points between the port of Jambi and the mouth of the Batang Hari river. The entrance channel at the mouth of the river is being kept open by dredging a volume of about 350,000 cu.m every year. There is no container wharf in Jambi province. Therefore, containerized cargo is not handled in Jambi province. For the above reasons, the government of this province desires to construct a deep sea port in the coastal area. The government has three proposed sites on the east cost of this province for a deep sea port: Sungai Licin, Labuan Pering and Sungai Remau. The depth of Sungai Remau is deeper than Sungai Licin and Labuan Pering.

About 60% or 70% of the export cargo in this province is transported through the Batang Hari River. Therefore, the down stream section (near the river mouth) of Batang Hari River is also a possible area for this project.

With that in mind, deep sea container wharves will be constructed at Sungai Remau and Muara Sabak in this project. The main facilities of this project are as follows: For

Sungai Remau a) Quay wall with approach bridge, b) Break water, c) Container yard with asphalt pavement, d) containerized freight station (CFS), e) Gantry cranes. For Muara Sabak a) Quay wall with approach bridge, b) Container yard with asphalt pavement, c) CFS, d) gantry cranes. Table 7.2.1 shows the tentative plan of required facilities at the container wharves at each location.

(5) Phasing

The "containerization wave" has already reached Palembang, Panjang and other ports in Sumatra. So, a port in Jambi province will be required to have container facilities. However, the present condition of the infrastructure especially the roads and bridges, in Jambi province is not sufficient for container transportation. Therefore, the implementation of this project will not commence in the near future. The required period for construction of this project (except access road) is about 2 or 3 years. We recommend the following phase plan:

Start of feasibility study	:	1998
Start of detailed design	:	2002
Start of Construction	:	2005

(6) Cost Estimation

We collected information on necessary unit costs for this project in Jambi and Jakarta from interviews.

The main items of construction work of this project are as follows: 1) dredging, 2) Reclamation 3) construction of quay wall with approach bridge, 4) construction of yard with asphalt pavement, 5) construction of a building, 6) Gantry cranes.

We estimated a rough construction cost of this project. Result of the estimate is shown in Table 7.2.1 (except access road). Road projects G-47 and G-48 provide the link between Muara Sabak and the interior.

(7) Appraisal

1) Methodology

In this study the appraisal of this project is carried out by comparison of total transportation cost from Jambi to Singapore via Sungai Remau, via Muara Sabak and via Kuala Enok.

2) Assumptions:

a) Port of Kuala Enok and its access road will be constructed by 2010.
b) Capacity of container vessels calling at Sungai Remau, Muara Sabak and Kuala Enok is about 1,200 TEU, 450 TEU and 1,200 TEU respectively. (TEU: Twenty Foot Equivalent Unit)
c) Capacity of trucks is 17 tons
d) Ship management cost is calculated based on the International Hire Base.
e) Container cargo handling volume at Muara Sabak and Sungai Rimau are about 1,000,000 tons and 1,200,000 tons respectively.

3) Result

Result of the calculation is shown in Table 7.2.2.

According to Table 7.2.2, total transportation cost from Jambi to Singapore via Kuala Enok is greatly cheaper than via the other two routes. Therefore, if the port of Kuala Enok is constructed before 2010, the potential of these projects is reduced. Table 7.2.3 provides cost calculation details supporting Table 7.2.2.

(8) Recommendation

The following points should be considered in studying the feasibility of this port:

a) Because the construction cost is likely to be relatively high, subsidization will probably be necessary to keep user fees from being prohibitive.

Table 7.2.1 List of the Main Facilities and Construction Cost for South Sumatra and Jambi Seaport Projects

Project Number	G-29	G-25	G-26
Project Title	Deep Seaport Construction (South Sumatra)	Deep Seaport Construction (Jambi)	
Location	Tg. Apiapi	Muara Sabak	Sungai Rimau
Quay wall			
Length (m)	280	180	280
Depth (m)	11	7.5	11
Approach bridge (detached pier)			
Length (m)	100	20	100
Break water			
Length (m)			350
Depth (m)			12
Yard			
Area (sq.m)	40,000	10,000	40,000
Road			
Length (m)	8,000		8,000
Building			
CFS, Office and etc.	CFS and office	CFS	CFS and office
Movable ramp (with related facilities)			
Width (m)			
Gantry crane			
Number	2	2	2
Construction cost (Rp million)	154,200	144,350	165,575
Construction cost (US$ 1,000)	77,100	72,175	82,788

Note: CFS means Container Freight Station.

Table 7.2.2 Transportation Cost Comparison Between Jambi and Singapore via Three Alternative Routes

(unit: Rp/ton)

Route	Go/From	Jambi/Singapore		
	Via	Muara Sabak	Sungai Rimau	Kuala Enok
Project Number		G-25	G-26	-
Land Transportation Cost	Road construction	23.1	35.5	22.7
	Transportation	1,290.7	1,740.7	2,605.1
	Total	1,313.8	1,776.1	2,627.7
Sea Transportation Cost	Port construction	5,774.0	5,519.2	1,329.6
	Transportation	2,743.6	3,099.7	1,328.5
	Total	8,517.6	8,618.9	2,658.0
Total		9,831.4	10,395.0	5,285.8

Table 7.2.3 Tentative Calculation of the Trannsportation cost Jambi/Singapore

1.Via Kuala Enok

1)Land transportation cost between Jambi and Kuala Enok

Load construction cost Selensen/Bg.Jaya: 34569600 thousand Rp.
Bg.Jaya/Kuala Enok: 42900000 thousand Rp.
Depreciation period of road: 50 years
Depreciation expense per year for road(for dry area): 691392
(for swamp area)(1000Rp.): 858000
Ratio of volume for the harbor transportation to total transportation
between Selensen and Bg.jaya: 0.005
between Bg.jaya and Kuala Enok: 0.02
Depreciation expense per ton: 15.126162 Rp./ton
Operation cost of Truck per ton: 469.76 Rp./ton
Fuel cost of truck per ton: 2135.29 Rp/ton
Load maintenance cost per ton:7.5630814 Rp/ton
Total load transportation cost Jambi/Kualaenok per ton: 2,628 Rp./ton

2)Sea transportation cost between Kuala Enok and Singapore

Navigation day: 0.3 day
Management cost per ton: 1328.46 Rp./ton
Port construction cost at Kuala Enok: 139000000 thousand Rp.
Port maintenance cost per ton: 664.79 Rp./ton
Depreciation expense for port per ton: 664.79 Rp./ton

Total sea transportation cost K.Enok/S.pore: 2,658.04 Rp./ton

3)Total transportation cost Jambi/Singapore via Kualaenoku: 5285.7883

2.Via Sungai Remau

1)Load transportation cost between Jambi and Sungai Remau

Load construction cost Jambi/S.Remau: 70980000 thousand Rp.
Depreciation period of road: 50 Year
Depreciation expense per year for road: 1419600 thousand Rp.
Ratio of volume for the harbor transportation to total transportation: 0.02
Depreciation expense for road per ton: 23.66 Rp./ton
Operation cost of Truck per ton: 313.89 RP./ton
Fuel cost of truck per ton: 1,426.76 Rp./ton
Load maintenance cost per ton: 11.83 Rp./ton
Total load transportation cost Jambi/S.Rimau per ton: 1,776.14 Rp./ton

2)Sea transportation cost between S.Rimau and Singapore

Navigation day: 0.7 Day
Management cost per ton: 3,099.73 Rp./ton
Port construction cost at S.Rimau: 165575000 thousand Rp.
Port maintenance cost per ton: 2,759.58 Rp./ton
Depreciation expense for port per ton: 2,759.58 Rp./ton
Total sea transportation cost S.Riau/S.pore: 8,618.90 Rp./ton

3)Total transportation cost Jambi/Singapore via S.Rimau: 10395.041

3.Via Muara Sabak

1)Load transportation cost between Jambi and Muara Sabaku

Load construction cost Jambi/Muara Sabak: 38511200 thousand Rp.

Depreciation period of road: 50 Year

Depreciation expense per year for road: 770224 thousand Rp.

Ratio of volume for the harbor transportation to total transportation: 0.02

Depreciation expense for road per ton: 15.40 Rp./ton

Operation cost of Truck per ton: 232.75 RP./ton

Fuel cost of truck per ton: 1,057.94 Rp./ton

Load maintenance cost per ton: 7.70 Rp./ton

Total load transportation cost Jambi/S.Rimau per ton: 1,313.79 Rp./ton

2)Sea transportation cost between Muara Sabak and Singapore

Navigation day: 0.5 Day

Management cost per ton: 2,743.62 Rp./ton

Port construction cost at S.Rimau: 144350000 thousand Rp.

Port maintenance cost per ton: 2,887.00 Rp./ton

Depreciation expense for port per ton: 2,887.00 Rp./ton

Total sea transportation cost S.Riau/S.pore: 8,517.62 Rp./ton

3)Total transportation cost Jambi/Singapore via Muarasabaku: 9,831.42 Rp./ton

b) Study of the future operations at the region's other ports is needed to evaluate future alternatives for cargo traffic.

c) Study of the future operations at the region's other ports, particularly those in lower Riau and South Sumatra provinces, is needed to evaluate future alternatives for cargo traffic.

d) There are indirect benefits to be evaluated such as any stimulus to local industry, or benefits for nearby transmigration communities.

We stress that a thorough analysis of all potential sites is needed to clarify which sites are the most efficient from the regional perspective. The major road improvements in the Region (particularly completion of the Eastern Sumatra Highway) is having the major benefit of extending port hinterlands. We recommend full consideration of these factors in any feasibility assessment of these projects to identify the most feasible location.

7.3 DEEP SEA PORT CONSTRUCTION (SOUTH SUMATRA PROVINCE)

(1) Objective

Reduction of transportation cost through use of larger cargo vessels. Increased capability for containerized cargo, and for coal.

(2) Location

Tanjung Apiapi, South Sumatra Province

(3) Executing Agency

Directorate General of Sea Communication (DGSC)

(4) Outline of the Project

The port of Palembang, which handles the largest cargo volume in the southern part of Sumatra has a limited water depth. The depth of the public wharves at Palembang Port is about 6.5 m in dry season. The volume of maintenance dredging is about 2,500,000 cu.m per year. The cargo throughput at Palembang Port reached 8,200,000 tons per year in 1990. In particular, the number of containers, which already exceeds 20,000 TEUs, is increasing rapidly. In South Sumatra Province, there are big veins of coal with total deposits of about 21 billion tons. From above situation, the government of South Sumatra Province desires to construct the deep sea port in the coastal area. The government has proposed a site located at Tg.Apiapi.

In this project, deep sea wharves for containerized cargo and coal will be constructed at Tg.Apiapi in accordance with the government opinion. The main facilities of this project are as follows: for container cargoes a) Quay wall with approach bridge, b) Container yard with asphalt pavement, c) CFS, d) Gantry cranes. For coal, a) Detached pier with approach bridge for belt conveyer, b) Loader and belt conveyer, c) Stock yard. Tables 7.2.1 and 7.3.1 show the tentative contents and cost of this project.

(5) Implementation

The implementation of this project requires several years of study and preparation and is affected by several related factors. There is a proposed World Bank funded study that will focus on port requirements in Java and Sumatra covering a broad region. It is expected to present recommendations on fundamental issues regarding a regional strategy for deepwater port development in West Java and in Sumatra since they are related. These recommendations should be highly relevant in studying the feasibility of new port development at any location in Southern Sumatra.

In addition, it should take approximately three years to survey the natural conditions at Tanjung Apiapi's proposed location at the mouth of a river, relating to soil conditions and sedimentation characteristics. It is essential to conduct this survey before a feasibility study can start to enable proper estimation of construction cost and digging and dredging costs. If this work is completed during Repelita VI, a full feasibility assessment can begin during Repelita VI or later.

(6) Cost Estimation

We collected the necessary information of unit cost for this project from interviews in Palembang and Jakarta. The main items of construction of this project are as follows: for container wharf 1) Reclamation, 2) Construction of quay wall with approach bridge, 3) Construction of a yard with asphalt pavement, 4) Construction of buildings, 5) Gantry cranes. For the coal wharf 1) Reclamation, 2) Construction of a detached pier with approach bridge for belt conveyer, 3) Loader and belt conveyer, 4) Stock yard. We estimated a rough construction cost of this project. The result of the estimation is shown in Tables 7.2.1 and 7.3.1.

(7) Cargo Forecast

1) Container Cargo Volume

(a) Assumptions

a) The present capacity of private wharves except special wharves for bulk cargo will not be changed in future.
b) The ratio of the cargo volume handled at public wharves to total cargo volume at Palembang Port (excluding oil, fertilizer and general cargo handled at private wharves) is estimated using data in 1991.
c) The ratio of container cargo volume to total cargo volume at the public wharves is estimated using a linear equation.

(b) Methodology

The methodology of the estimation of container cargo handling volume in 2010 is shown by the flow chart in Fig. 7.3.1. Table 7.3.2 and Table 7.3.3 show the present cargo volume (except oil and fertilizer) between 1984 and 1989 and total cargo handling volume (except oil and fertilizer) by packing style in 1991.

(c) Result

Result of the estimate is show in Table 7.3.4.

2) Cargo Volume of Coal

(a) Assumptions

a) All of the coal handled at Tg.Apiapi wharf is exported to ASEAN countries.
b) The ratio of coal supply from Indonesia to ASEAN countries is 30% of total increased volume of the demand in these countries from 1990/1995 to 1995/2000.
c) The ratio of coal supply from South Sumatra Province to ASEAN countries is 50% of total export volume from Indonesia to ASEAN countries.

(b) Methodology

The Projection methodology of coal volume at Tg.Apiapi wharf in 2010 is shown by the flow chart in Fig. 7.3.2.
Table 7.3.5 shows the demand in ASEAN countries.

(c) Result

Result of the estimate is shown in Table 7.3.6.

(8) Appraisal

1) Methodology

In this study, the appraisal of this project for the container wharf is carried out by comparison of the total transportation cost from Palembang to Singapore via Tg.Apiapi and via Kuala Enok. For the coal facilities, the appraisal is carried out by comparison of the total transportation cost from Tg.Enim to Bangkok via Tg.Apiapi and via Tarahan. No option using a river barge was evaluated.

2) Assumptions

(a) Container transportation

a) Port of Kuala Enok and its access road will be constructed by 2010.
b) Capacity of calling vessels at Tg.Apiapi and Kuala Enok is 1,200 TEU respectively.
c) Capacity of trucks is 17 tons.
d) Ship management cost is calculated based on the International Hire Base.
e) Transportation cost is estimated as an economic cost.

(b) Coal Transportation

a) The coal between Tg.Enim and Tg.Apiapi and between Tg.Enim and Tarahan is transported by railway.
b) A New short-cut line is constructed between Tg.Enim and Baturaja.
c) A new rail line is constructed between Palembang and Tg.Apiapi.
d) The rail lines between Tg.Enim and Palembang and Baturaja and Tarahan are improved for the mass-transportation of coal.
e) The capacity of coal wagons is 50 tons.
f) The size of coal ships is 30,000 DWT.

3) Result

Result of the calculation is shown in Tables 7.3.7 and 7.3.8. According to Table 7.3.7, total transportation cost for container cargo from Palembang to Singapore via Kuala Enok is significantly cheaper than via Tg.Apiapi. For coal cargo, total transportation cost from Tg.Enim to Bangkok via Tg.Apiapi is cheaper than via Tarahan. Appendix Table 7.3.1 provides cost calculation details supporting Table 7.3.7.

(9) Recommendation

The following points should be considered in studying the feasibility of this port:

a) To prevent duplicated expenses of operating and maintenance costs it is best for the province to concentrate its port facilities at one location rather than at two or more locations.
b) The construction cost for a break bulk (general cargo) port facility will probably be so high that subsidization would be necessary to keep user fees from being prohibitive.
c) A bulk port would probably be less costly and more profitable than a general cargo port.
d) Study of the future operations at the region's other ports is needed to evaluate future alternatives for cargo traffic.
e) There are indirect benefits to be evaluated such as any stimulus to local industry, the greatly improved ferry service to Bangka Island, or benefits for nearby transmigration communities. In this preliminary assessment they have not been considered.

The focus of this preliminary analysis has been on relative transportation cost, the primary benefit of the proposed project. We recommend that the essential survey of natural conditions be undertaken in the short term, followed by a feasibility study that evaluates direct and indirect benefits.

Table 7.3.1 Quantity of Main Facilities and Construction Cost of Tanjung Apiapi Coal Port

Project Title		Deep Seaport Construction (South Sumatra)
Location		Tg. Apiapi
Jetty or detached pier		
	Length (m)	220
	Depth (m)	11
Trestle bridge for belt conveyors		
	Length (m)	500
Shiploader	Capacity	3,000
Stockyard	Area (sq.m)	60,000
Construction cost (US$ 1,000)		54,385

Table 7.3.2 Cargo Volume (Without Oil and Fertilizer) at Palembang Port

(unit: 1,000 tons)

	1984	1985	1986	1988	1989
Foreign	967	924	926	967	1,142
Local	1,041	1,143	1,315	1,882	1,550
Total	2,008	2,067	2,241	2,849	2,692

Source: Brochure of Pelabuhan Palembang, 1991.

Table 7.3.3 Cargo Handling Volume at Palembang Port by Packing Style in 1991

(unit: 1,000 tons)

Item	General Cargo	Bagged Cargo	Liquid Bulk	Dry Bulk	Unitized Cargo
Volume	561	765	4,712	1,631	390

Source: Keclatan Operasional Pelabuhan, Perum Pelabuhan II, 1991.

Table 7.3.4 Projection of Container Cargo Volume at Palembang Port in 2005 and 2010

Year	Cargo Volume at Public Wharves Except Oil and Fertilizer (1,000 tons)	Ratio of Containerization (%)	Container Cargo Volume (1,000 tons)	Capacity for Container Cargo at Boom Baru (1,000 tons)	Container Cargo Cargo Volume at Tg. Apiapi (1,000 tons)
2005	1,156	60	452	550	-
2010	1,730	75	1,300	550	750

Table 7.3.5 Demand for Coal in 1995 and 2000 -- ASEAN Countries

(unit: million tons)

	Demand			Difference	
	1990	1995	2000	1990/1995	1995/2000
Philippines	3.1	8.4	12.5	5.3	4.1
Thailand	0.4	0.6	5.4	0.2	4.8
Malaysia	2.2	2.6	3.0	0.4	0.4
Total	5.7	11.6	20.9	5.9	9.3

Table 7.3.6 Export Volume of Coal in 2010 -- From South Sumatra

(unit: million tons)

	Demand		Difference	Share of Indonesia	Share of S. Sumatra	Export Volme from S. Sumatra Province
	1995	2010	1995/2010	2010	2010	2010
Philippines	8.4	22.1	13.7	-	-	-
Thailand	0.6	9.6	9.0	-	-	-
Malaysia	2.6	3.8	1.2	-	-	-
Total	11.6	35.5	23.9	30%	50%	5.3

Table 7.3.7 Transportation Cost Between Palembang and Singapore -- Container Freight

(unit: Rp/ton)

Route	Go/From	Palembang/Singapore	
	Via	Tanjung Apiapi	Kuala Enok
Project Number		G-29	-
Land Transportation Cost	Road construction	55.7	41.2
	Transportation	1,065.7	6,121.9
	Total	1,121.4	6,163.1
Sea Transportation Cost	Port construction	8,224.0	1,372.8
	Transportation	3,690.2	1,328.5
	Total	11,914.2	2,701.3
Total		13,035.6	8,864.4

Table 7.3.8 Coal Transportation Cost Per Ton via Tanjung Apiapi

(unit: US$/ton)

Route	Railway	Barge	Vessel	Handling Facilities	Total
Tg. Enim / Tg. Apiapi / Bangkok	3.2	0	4.2	2.4	9.8
Tg. Enim / Tarahan / Bangkok	3.6	0	5.5	2.3	11.4

Table 7.3.9 Tentative Calculation of the Trannsportation cost Palembang/Singapore

1.Via Kuala Enok

1)Land transportation cost between Palembang and Kuala Enok

Road construction cost Selensen/Bg.Jaya: 34569600 thousand Rp.
Bg.Jaya/Kuala Enok: 42900000 thousand Rp.
Depreciation period of road: 50 years
Depreciation expense per year for road(for dry area): 691392
(for swamp area)(1000Rp.): 858000
Ratio of volume for the harbor transportation to total transportation
between Selensen and Bg.jaya: 0.005
between Bg.jaya and Kuala Enok: 0.02
Depreciation expense per ton: 27.48928 Rp./ton
Operation cost of Truck per ton: 1,103.95 Rp./ton
Fuel cost of truck per ton: 5017.94 Rp/ton
Road maintenance cost per ton: 13.74464 Rp/ton
Total road transportation cost Palembang/Kualaenok per ton: 6,163 Rp./ton

2)Sea transportation cost between Kuala Enok and Singapore

Navigation day: 0.3 day
Management cost per ton: 1328.46 Rp./ton
Port construction cost at Kuala Enok: 139000000 thousand Rp.
Port maintenance cost per ton: 686.42 Rp./ton
Depreciation expense for port per ton: 686.42 Rp./ton

Total sea transportation cost K.Enok/S.pore: 2,701.30 Rp./ton

3)Total transportation cost Palembang/Singapore via Kualaenoku: 8,864.42 Rp./ton

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2.Via Tj.Api api

1)Land transportation cost between Palembang and Tj.Api-api

Road construction cost Palembang/Tj.Api-api: 69680000 thousand Rp.
Depreciation period of road: 50 years
Depreciation expense per year for road: 1393600 thousand Rp.
Depreciation expense for road per ton: 37.16 Rp./tpn
Operation cost of Truck per ton: 192.18 Rp/ton
Fuel cost of truck per ton: 873.53
Road maintenance cost per ton: 18.58 Rp./ton
Total load transportation cost Palembang/Kualaenok per ton: 1,121.45 Rp./ton

2)Sea transportation cost between Tj.Api-api and Singapore

Navigation day: 0.8 day
Management cost per ton: 3,690.16 Rp./ton
Port construction cost at Tj.Api-api: 154200000 thousand Rp.
Port maintenance cost per ton: 4,112.00
Depreciation expense for port per ton: 4,112.00 Rp./ton
Total sea transportation cost Tj.Api-api/S.pore: 11,914.16

3)Total transportation cost Palembang/Singapore via Tj.Api-api:13,035.61 Rp./ton

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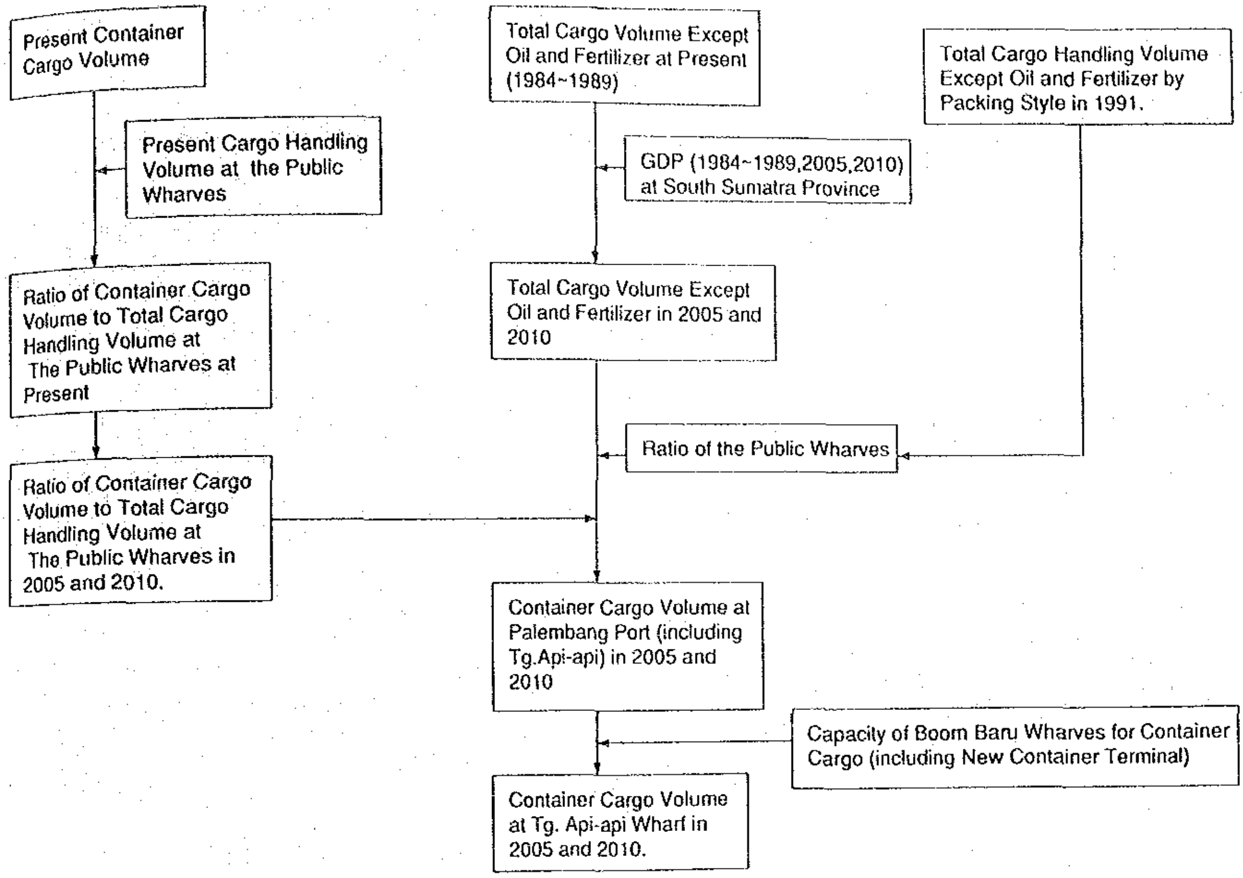

Figure 7.3.1 Flow Chart of Container Cargo Forecast at Tanjung Apiapi Port

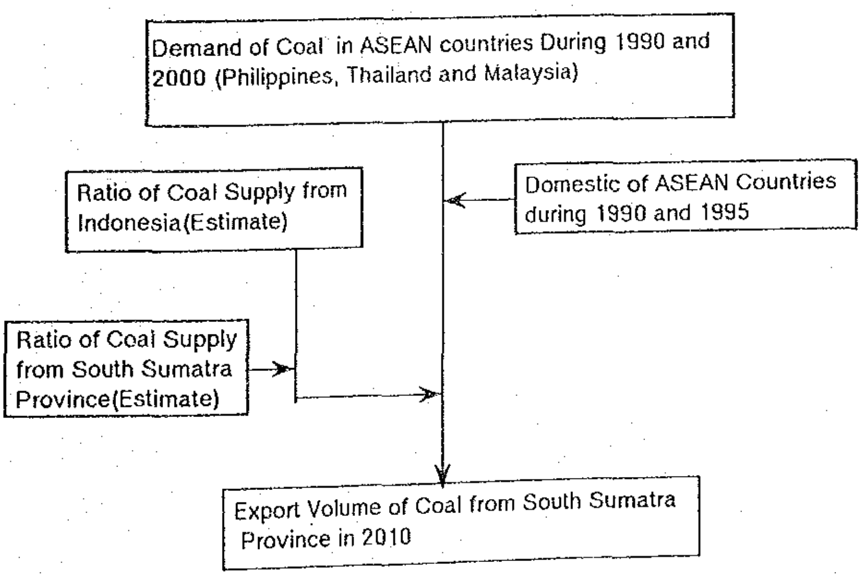

Figure 7.3.2 Flow Chart of Cargo Forecast for Coal at Tanjung Apiapi

8. TELECOMMUNICATION

8.1 RURAL TELECOMMUNICATION SYSTEM

8.1.1 Objectives of the Project and its Role in the Regional Development

1) Objectives
   a) To extend the telecommunication network to rural area (desa level).

2) Its roll in the Regional Development
   a) To avoid isolation from information from other areas.

8.1.2 Location

All Desas in a kecamatan

8.1.3 Executing Agency

1) Directorate General of Post and Telecommunications,
2) Ministry of Tourism, Post and Telecommunications.

8.1.4 Expect benefits

1) Value Added

   a) The society will change to advanced one and make economic activity effectively.

2) Employment

   a) Good communication makes chances to get good work.
   b) The system also needs some maintenance persons itself.

3) Poverty Alleviation

   a) Through telecommunication, market becomes close to the site to get market information.
   b) They can get information about business.
   c) They support poverty alleviation.

4) Support for Economic Activity

   a) Getting market information.
   b) Communicating business information.
   c) Having good opportunity of business.
   d) They support economic activity.

5) Social Development

   a) Preventing isolation from information.
   b) Keep social security.
   c) Quick action for emergency time.

6) Human Development

   a) By getting information from outside, they can promote themselves to higher level, and they can have much knowledge.

7) Environment

a) Quick action by the information from a lookout post.

8.1.5 Outline of the Project

Based on the future network planned by another JICA study team on TELECOMMUNICATION NETWORK DEVELOPMENT PLAN FOR REPELITA-VI, they planned to expand the network up to all kota kecamatans by 1998. But it is assuming to use a kind of digital radio multiple access system from nearest telephone exchange center to kota kecamatans.

To extend the network to desa level, the station of each kota kecamatan should be replaced to the base station. Then, from the base station to desas, here is using a kind of digital radio multiple access system again.

Fig.8.1.1 is an example of rural network of a typical kecamatan.

8.1.6 Phasing

As above mentioned in (8.1.5), telecommunication network will expand to all ibukota kecamatan by 1998. After that from 1999, the network will expand to desa level. Therefore, before 1999, the study including site survey and designing should be started. Then construction will start in 1999. The system will come into service in 2000.

8.1.7 Cost Estimation

Next is cost assumption of this study.

			UNIT US$ 1,000
1)	Base station	less than 400 subscribers:	US$ 264
		500 subscribers:	US$ 300
		600 subscribers:	US$ 334
		700 subscribers:	US$ 376
		800 subscribers:	US$ 410
		900 subscribers:	US$ 446
		1000 subscribers:	US$ 480
2)	Terminal station	less than 8 subscribers:	US$ 32
		16 subscribers:	US$ 43
		24 subscribers:	US$ 45
		32 subscribers:	US$ 46
		40 subscribers:	US$ 48
		48 subscribers:	US$ 50
		56 subscribers:	US$ 52
		64 subscribers:	US$ 53
3)	Repeater station	less than 8 subscribers:	US$ 57
		16 subscribers:	US$ 58
		24 subscribers:	US$ 60
		32 subscribers:	US$ 62
		40 subscribers:	US$ 64

All station equipment includes antenna tower construction, battery charger and storage battery, etc.

Cost for employment per one person : Pp.700,000/month x 12
= Rp. 8,400,000/year
= US$ 4,200/year

(US$ 1.0 = Rp. 2,000)

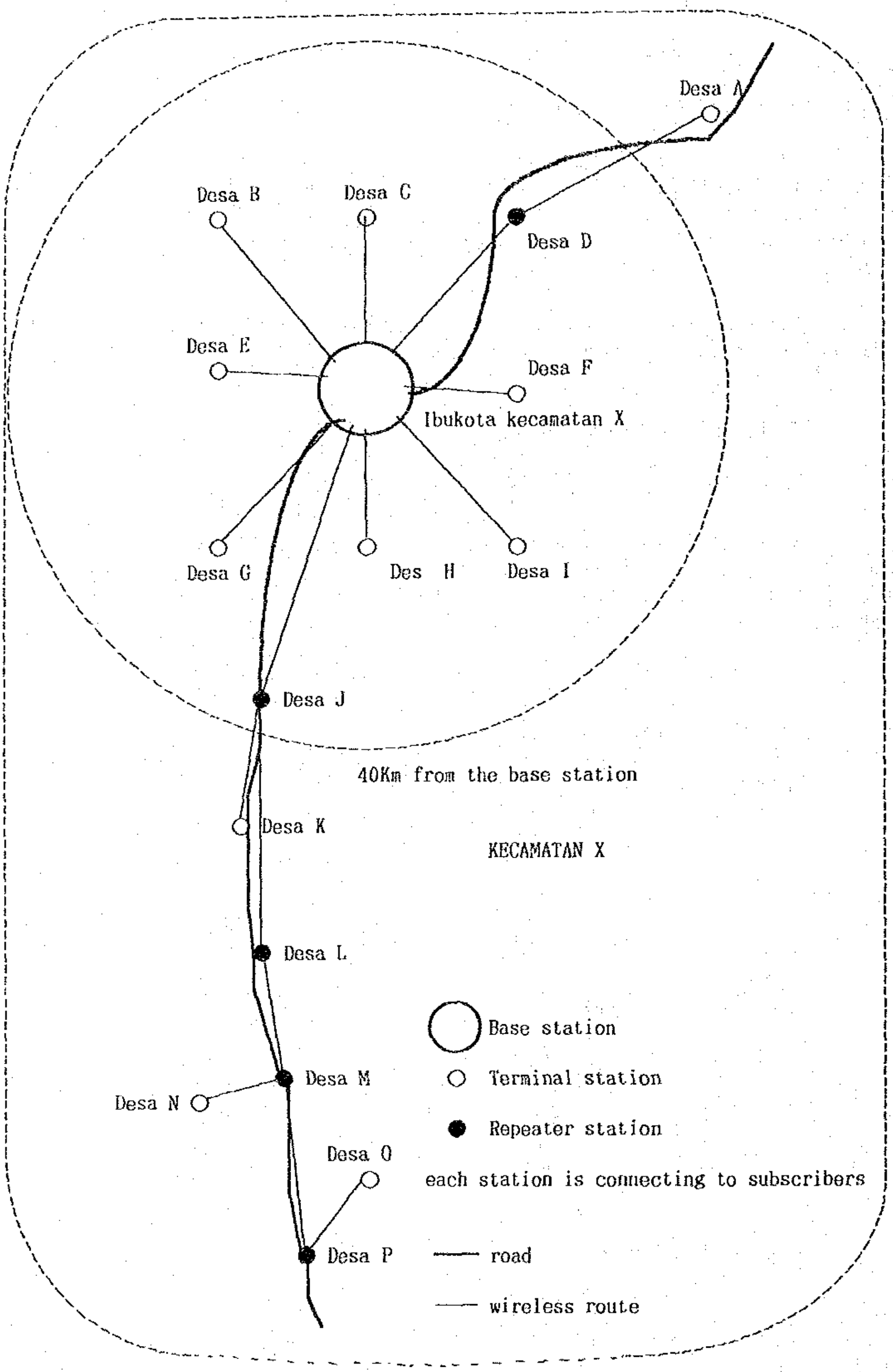

Figure 8.1.1 Rural Telecommunication Model for A Typical Kecamatan

8.1.8 Appraisal

(1) Technical

It is advanced technology using digital technic. This field is progressing very quickly. In the future, this kind system will become cheaper, smaller, easier maintenance and more economical system. But in this study, we adopted today's technical condition.

(2) Economic

1) The output of Financial Internal Rate of Return (F) IRR is about -20% (see Appendix A8.1).
2) It means no profit in this system for rural area.
3) Mach investment and less income.

8.1.9 Major Preconditions and Recommendations

1) The biggest problem is financial condition.
2) It is no profit.
3) Expansion of telephone network to desa level is too much heavy load for PT.TELKOM.
4) It means some support from outside, for example government support or aid from international organization is essential.

Appendix A8.1 Financial Evaluation of A Typical Rural Telecommunication

Financial evaluation of a typical rural telecommunication model for a kecamatan was made on the following assumptions :

1) The equipment cost is today's one, but the assumed construction year is 1999.
2) The annual increasing ratio of cost and operating income unit price is 10%.
3) The cost of equipment is no inflation.
4) Each subscriber uses telephone about 300 unit of charging in a month, based on the average use of a telephone of the Southern Part of Sumatra area.
5) All operating income includes inflow of this system.

Table 8.1.1 IRR of a Typical Rural Telecommunication Model for a Kecamatan

Unit:US$ 1,000

	Year	1999	2000 S.in	2001	2002	2003	2004	2005	2006	2007	2008	2009
	Year After S In		1	2	3	4	5	6	7	8	9	10
Demand and	Total Denamd		80	100	130	170	220	280	350	430	520	620
Sales Plan	New Subscribers(for sales)		80	20	30	40	50	60	70	80	90	100
	Accumulated Number of Lines		80	100	130	170	220	280	350	430	520	620
	Average Number of Lines in the Year		40	90	115	150	195	250	315	390	475	570
	Average Number of Subscribers in Each Terminal		5	6	8	11	14	18	22	27	33	39
Investment	Subtotal	941	32	8	138	16	52	24	49	100	70	114
	Exchange		24	6	9	12	15	18	21	24	27	30
	Base station	264								36	34	42
	Terminal Station	352			121		22		11	22		22
	Rpeater Station	285			6		10		10	10		10
	2 Viecles	40										
	Telephone Sets		8	2	3	4	5	6	7	8	9	10
Depreciation	Subtotal	85	88	88	101	102	107	109	113	122	129	44
	Depreciation for Fixed Asset(1999)	85	85	85	85	85	85	85	85	85	85	0
	Remaining Value for Fixed Asset(1999)	856	772	687	602	518	433	348	263	179	94	94
	Depreciation for Fixed Asset(2000)		3	3	3	3	3	3	3	3	3	3
	Remaining Value for Fixed Asset(2000)		29	26	23	20	18	15	12	9	6	3
	Depreciation for Fixed Asset(2001)			1	1	1	1	1	1	1	1	1
	Remaining Value for Fixed Asset(2001)			7	7	6	5	4	4	3	2	2
	Depreciation for Fixed Asset(2002)				12	12	12	12	12	12	12	12
	Remaining Value for Fixed Asset(2002)				126	113	101	88	76	63	51	39
	Depreciation for Fixed Asset(2003)					1	1	1	1	1	1	1
	Remaining Value for Fixed Asset(2003)					15	13	12	10	9	7	6
	Depreciation for Fixed Asset(2004)						5	5	5	5	5	5
	Remaining Value for Fixed Asset(2004)						47	43	38	33	29	24
	Depreciation for Fixed Asset(2005)							2	2	2	2	2
	Remaining Value for Fixed Asset(2005)							22	20	18	15	13
	Depreciation for Fixed Asset(2006)								4	4	4	4
	Remaining Value for Fixed Asset(2006)								45	40	36	31
	Depreciation for Fixed Asset(2007)									9	9	9
	Remaining Value for Fixed Asset(2007)									91	82	73
	Depreciation for Fixed Asset(2008)										6	6
	Remaining Value for Fixed Asset(2008)										64	57
	Depreciation for Fixed Asset(2009)											10
	Remaining Value for Fixed Asset(2009)											104
	Remaining Value											446
Operation Cost	Subtotal		73	76	80	84	88	93	97	102	107	113
	Wage (for 6 Persons)		26	27	29	30	32	33	35	37	38	40
	Viecle Maintenance		10	11	11	12	12	13	13	14	15	16
	Office Utility		10	11	11	12	12	13	13	14	15	16
	Expendable Cost		10	11	11	12	12	13	13	14	15	16
	Miscellaneous		10	11	11	12	12	13	13	14	15	16
	Contingency(10% of OP cost)		7	7	7	8	8	8	9	9	10	10
Operating	Sub Total of Operating Income		18	24	31	40	52	66	83	102	123	147
Income	Registration Fee		8	2	3	4	5	6	7	8	9	10
	Call Charge(300 unit)		7	16	21	27	35	45	57	70	86	103
	Basic Charge		2	5	7	9	12	15	19	23	29	34
	Charge Increasing Ratio(10%)		1	1	1	1	1	1	1	1	1	1
Cash Flow	Cash Inflow	0	18	24	31	40	52	66	83	102	123	147
(without	Cash Outflow	941	105	84	218	100	140	117	146	202	177	227
capital loan)	Total Cash Flow + Remaining Value	-941	-87	-61	-187	-60	-88	-51	-64	-101	-54	366
	Accumurated Cash Flow	-941	-1,028	-1,089	-1,276	-1,336	-1,425	-1,475	-1,539	-1,839	-1,694	-1,328
IRR	FIRR(10 years)	-0.201										
	Expecting ratio of FIRR	0.100										