3.5 Inland Transportation Network

3.5.1 Road

Figure 3.5.1 shows present situation of road development in Riau, Jambi and South Sumatra. Road development of all the three provinces is behind the state average.

Table 3.5.1 Road Length in Riau, Jambi and South Sumatra

Province	Road Length (km)				Area (km2)	Road Density (km/km2)	Year
	State	Provincial	Regency/ Municipality	Total			
Riau	839	1,685	10,657	13,181	94,561	0.139392	1998
Jambi	749	1,264	6,230	8,243	53,436	0.154259	1999
South Sumatra	1,007	2,662	11,278	14,947	109,254	0.13681	1999
Indonesia	27,977	47,863	279,523	355,363	1,922,570	0.184837	1998

Source: Statistic Indonesia 1999, BPS Riau in Figures 1999, BPS of Riau
Jambi in Figures 1999, BPS of Jambi South Sumatra in Figures 1999, BPS of South Sumatra

Road system of each province is depicted in Figure 3.5.1, 3.5.2 and 3.5.3

(1) Riau

Road stock in Riau Province is not sufficient due to large area of the territory is swampy or mountainous. The road density is less than Indonesian average. Main road of Riau is The Trans Sumatra Highway, which runs midst low land of Riau on a parallel with the east coast of Sumatra connecting Jambi, Rengat, Perawang (a new port area of Pekanbaru Port), Pekanbaru, Minas, Duri and Dumai.

Road between Pekanbaru and Dumai has been developed connecting the two areas in four hours by a passenger car.

Although there are plans of a toll road (about 165 Km) between Pekanbaru and Dumai and A third Bridge over Siak River connecting the central district of Pekanbaru urban area and Siak north bank, the construction has not been realized yet.

(2) Jambi

A road from city of Jambi to Muara Sabak is temporarily constructed providing three-hour access and about half of it should be improved and/or repaved (Figure 3.5.4). And improvement of the road substructure is required. This road will be completed by 2004 and used as an access road of both the existing Muara Sabak Port and oil field (Santa Fe).
Moreover a shortcut road is planned from City of Jambi to Muara Sabak.

(3) South Sumatra

Basic road system is similar to that of Jambi.

A 68Km-long access road between city of Palembang and Tanjung Api-api has been planned (Figure 3.5.5) and the part of the road has been temporarily developed with provisional section. Out of the all length, only 15 Km has been paved although about half of the pavement is badly damaged, and 5 bridges out of 7 have been completed. As the road runs in swampy land, improvement of the geological condition and/or reinforcement of substructure are required, which means the construction of the road costs much. Although the construction is planned to complete by 2004, this project is likely to need longer years.

3.5.2 Railway

Only South Sumatra has railway in the tree provinces of the target ports. The railway connects Lampung, Baturaja, Perabumulih, Palembang, Muara Enim, Lahat, etc. as shown in Figure 3.5.3.

This railway is used for transportation of minerals such coal as well as passengers.

Railway construction plan from Palembang (Simpang) to Tg. Api-api (92km contiguous with the highway) has been proposed. The plan of extension route is shown in Figure 3.5.5.

Additionally, there is a framework of Trans Sumatra Railway.

3.5.3 Airport

Riau has five airports with runway of 1300m or longer in the main land. Main airports in the main land Riau are Sultan Syarif Kasim II Airport (2150m x 30m) at Pekanbaru, Sei Pakning Airport (1,900m x 30m) near Bengkalis and Pinang Kampai Airport (1,800m x 30m) near Duri.

Jambi has Sultan Thaha Airport with runway of 1900m at City of Jambi and several small size airports.

In South Sumatra, there are two airports with runway of 1300m or longer, S.M. Badaruddin Airport (Palembang) with 2,00m x 45m R/W and Pandopo Airport with 1,300m x 20m R/W.

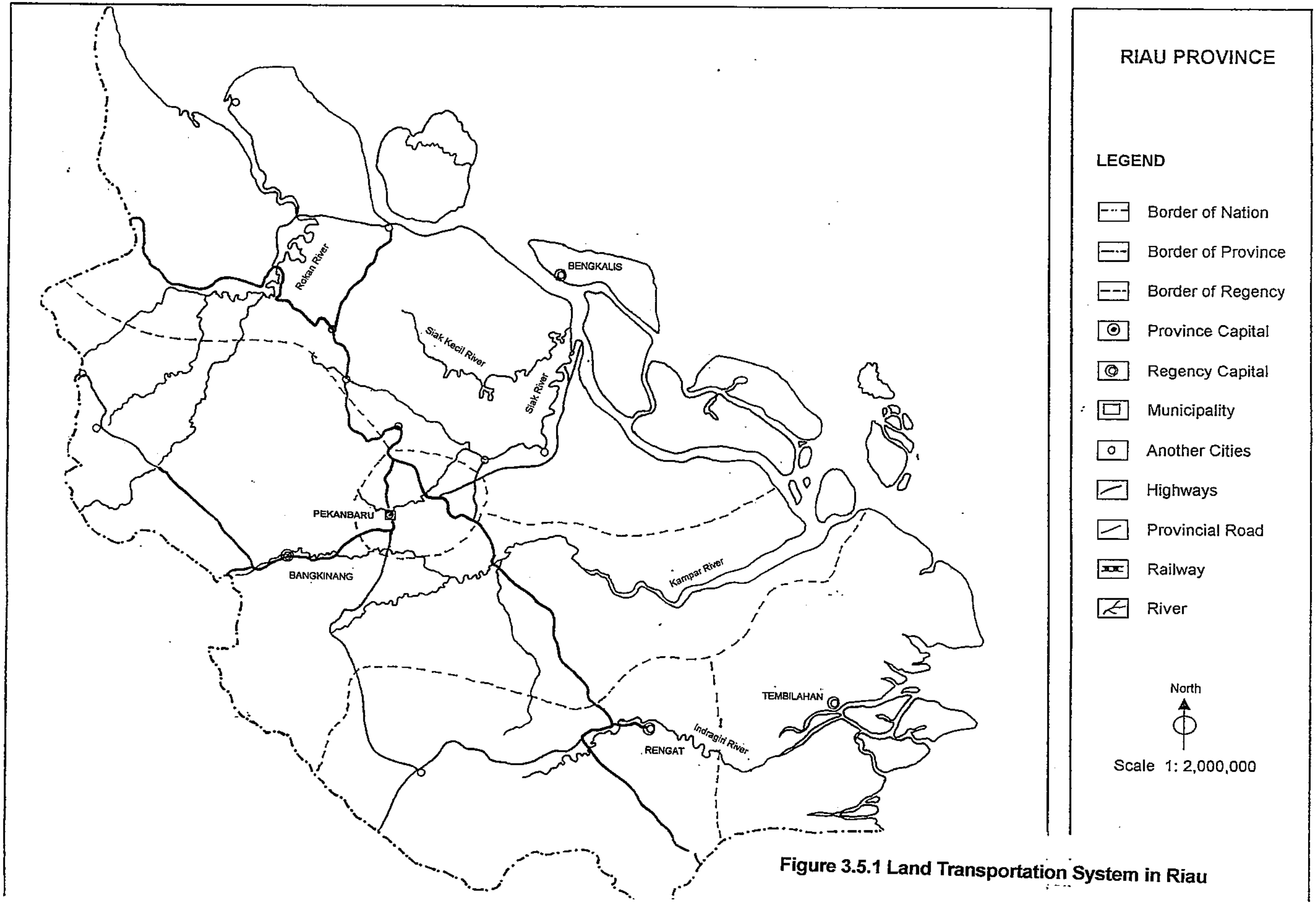


Figure 3.5.1 Land Transportation System in Riau

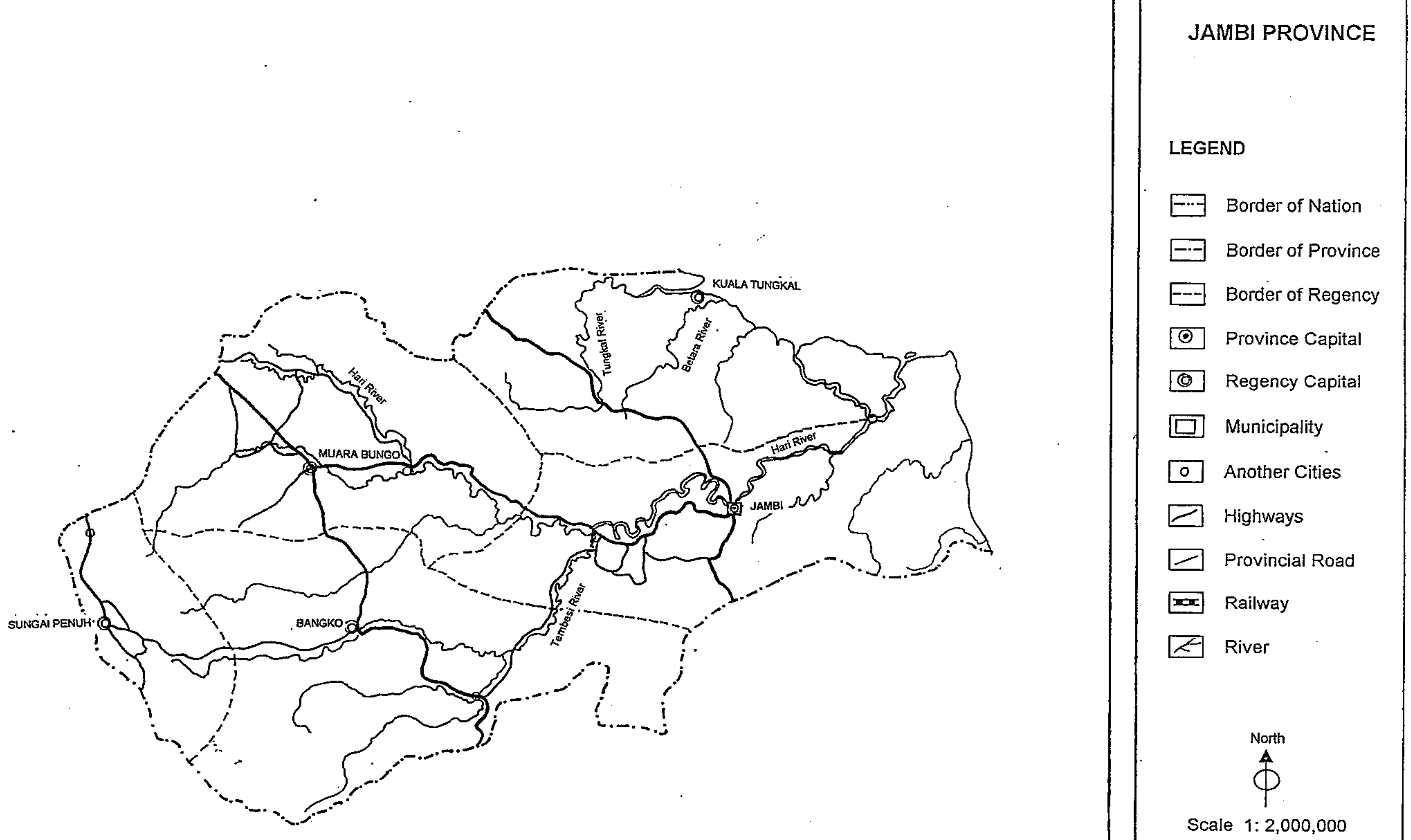


Figure 3.5.2 Land Transportation System in Jambi

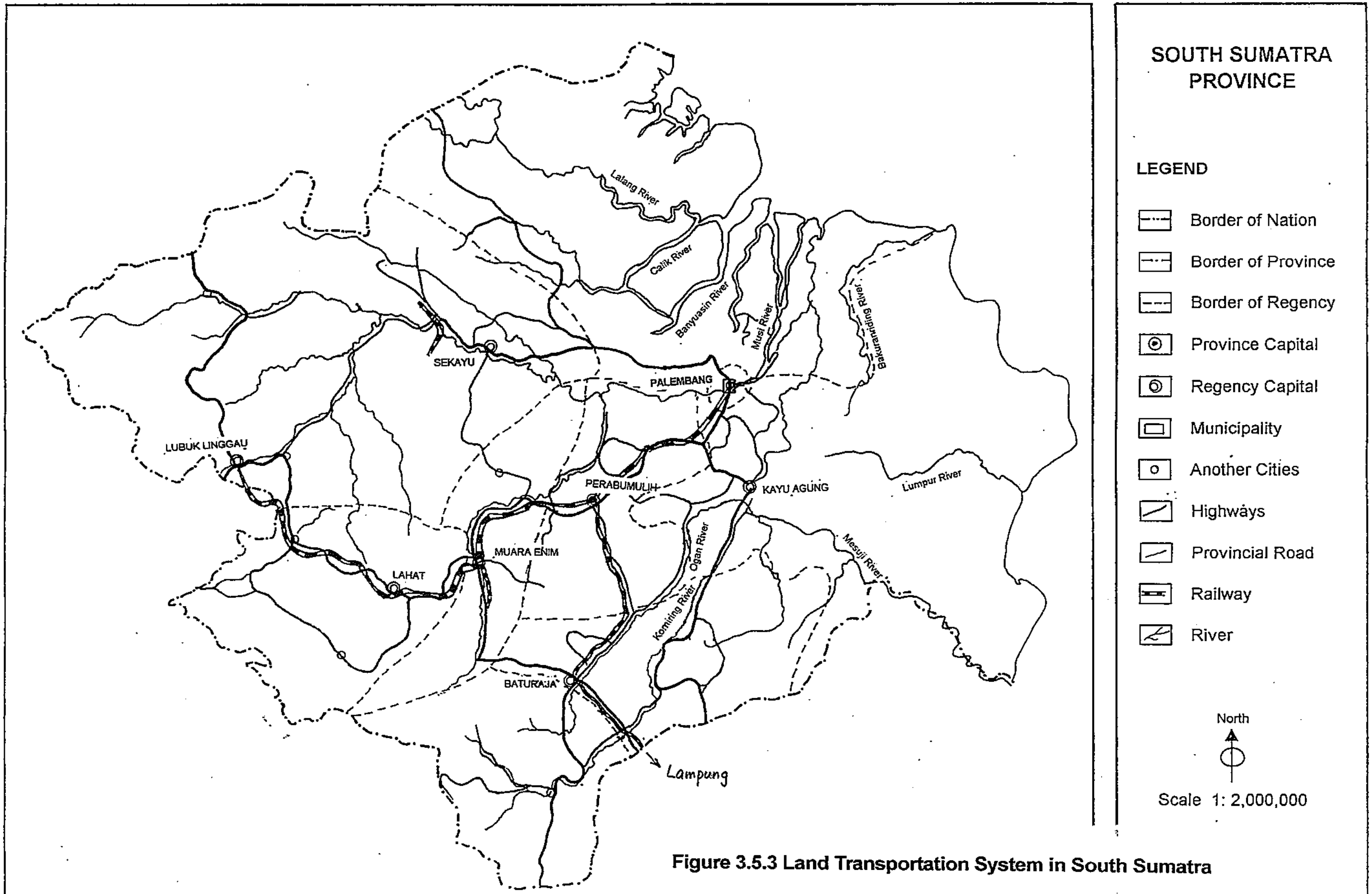


Figure 3.5.3 Land Transportation System in South Sumatra

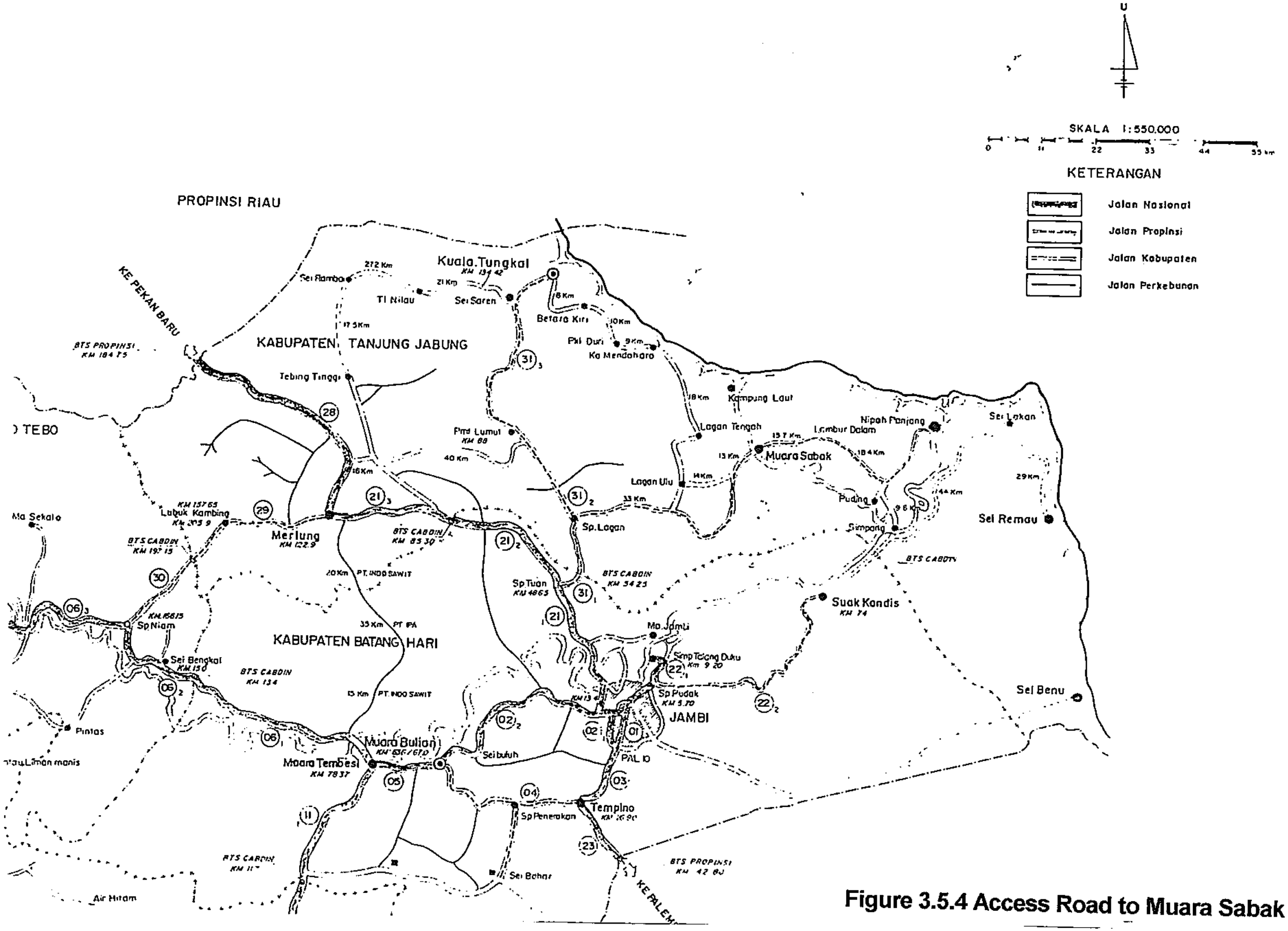


Figure 3.5.4 Access Road to Muara Sabak

ROUTE KE PELABUHAN TANJUNG API-API

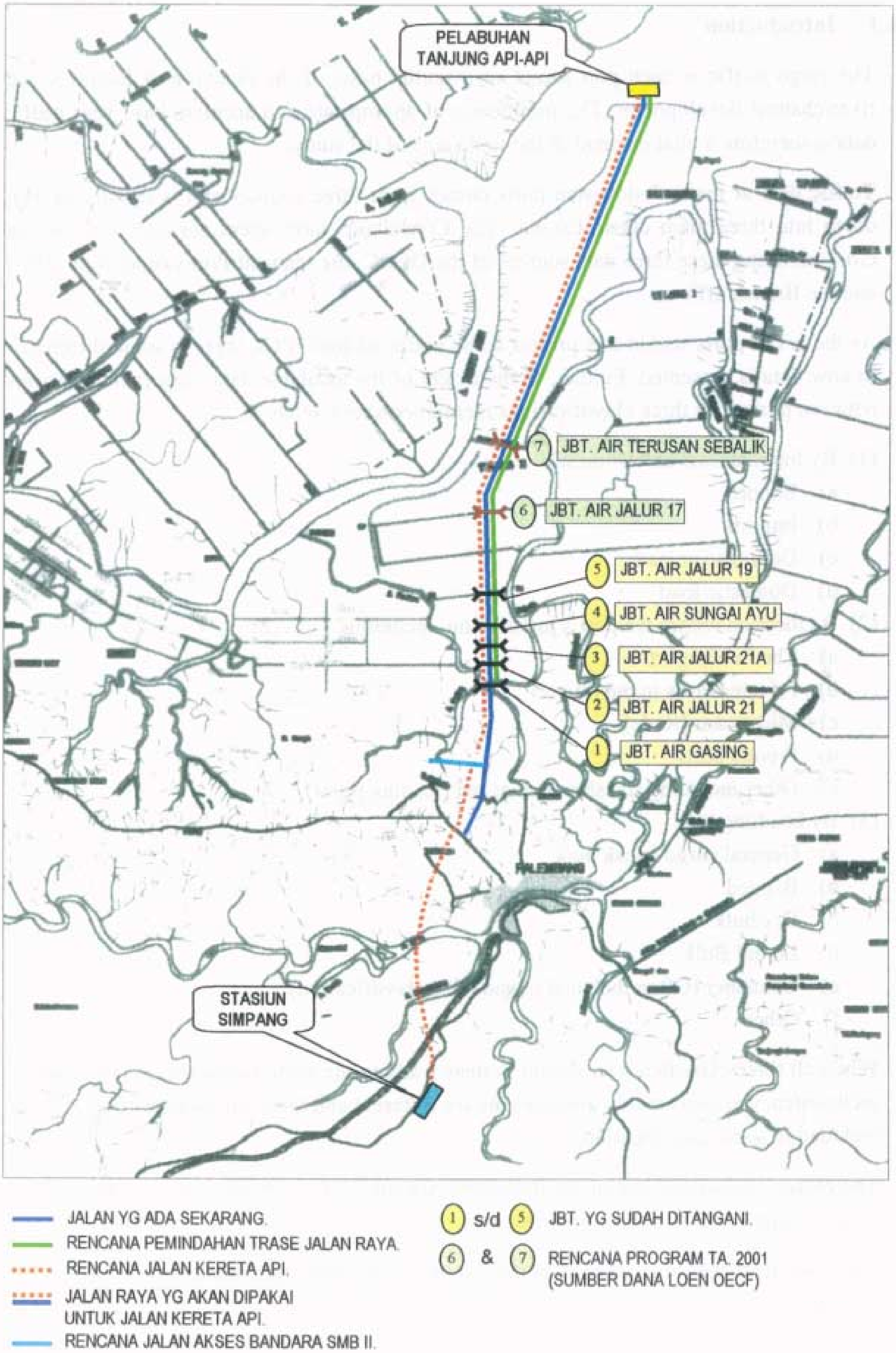


Figure 3.5.5 Access Routes to Tanjung Api-api

3.6 Port Cargo Throughput

3.6.1 Introduction

The cargo traffic at each port forms an essential basis of the planning of facilities and river/channel development. The production of appropriate and accurate base year traffic data is therefore a vital element of the first stage of the study.

Traffic data at major Indonesian ports comes from three sources and is usually broken down into three main classifications. The Consultants have spent considerable time in cross verifying these three data sources of the DGSC, the relevant Port Corporation (IPC) and the Branch office.

As the seven ports within this project come under all four IPCs, there is some difference in how data is presented. Further, to the extent of the available data, further detail varies between ports. The three classifications mentioned above relate to:

(1) By International and Domestic
  a) Exports
  b) Imports
  c) Domestic unload
  d) Domestic load

(2) By location within the port's jurisdiction, including:
  a) The Public port
  b) Private berths in public port
  c) Midstream (Rede)
  d) Private ports
  e) Other including transhipment at sea (loading point)

(3) By handling type
  a) General cargo-break bulk
  b) Bagged
  c) Dry bulk
  d) Liquid Bulk
  e) Container (Often included outside this classification)
  f) Other

While all three classifications should in theory add to the same totals, there is often some inconsistency as presumably assumptions are different and therefore some cargoes are not included in some classifications.

Therefore, the data and comments thereupon, set out the Consultants best interpretation of the data supplied by the three organisations.

The study team was also asked in particular to review domestic container traffic and CPO volumes.

The destination of containers appears not to be recorded by the branch offices, although for the priority ports data was collected where it was made available. As all the ports are river ports with limited draught, all container ships calling at the ports are feeder vessels, with a high proportion of traffic destined for Jakarta and Singapore/Malaysia. Discussions with the shipping companies elicited that a very high proportion of containers are purely domestic and form a very significantly higher proportion than the national average for container traffic. Indeed, there appears to be a high proportion of containers carrying general and consumer good cargoes, often as return loads to the provincial capitals.

Container data collected is shown under the individual ports as available.

CPO handled is shown under the commodity headings for each port below.

It is also to be noted that many IPC forecasts have been made in the period 1999 and 2000 when the recovery process was barely under way. Hence it may well be that their forecasts may be, to some extent, pessimistic. Therefore, except where specific cargoes such as palm oil are contemplated, such forecasts may not be very useful, unless as reference points.

The data presented below provides a summary of data collected and analysed.

Fuller details on cargo volumes are presented in spreadsheet format in the Appendices.

3.6.2 Pekanbaru Cargo

(1) Total Traffic

Table 3.6.1 Cargo Traffic at Pekanbaru Port, 1988-2000

Pekanbaru Port (In 000 tonnes)	1988	1990	1995	1999	2000
Public	n/a	n/a	149	144	89
Non- Public Port Areas*	n/a	n/a	2,064	4,748	5,505
Total	5,030	6,569	2,213	4,892	5,594

Source: Cabang

Defined throughout this report as those facilities which are not common user (i.e., not public facilities) and include facilities such as special wharf (Dermaga Khusus), Special Port (Pelabuhan Khusus), Rede and Loading Point.

Total traffic grew by some 20 percent per year between 1995 and 2000,with particularly fast growth outside the public port. However, over the longer term cargo traffic appears to have been fairly static.

(2) Public Port

According to the data, the public port handles a declining percentage of total cargoes, falling to only 3 percent in 1999. Public port traffic has been largely static up to 1999 but fell back in 2000 to under 90,000 tonnes. The dominance of bulk cargoes and the rapid expansion of container handling at other facilities is part of the explanation. The new area of Perawang may also introduce some confusion in the statistics.

(3) Other Areas

Cargo handled at the non-public areas grew by some 22 percent per year between 1995 and 2000 and particularly at the special berths.

(4) Handling Type

No data was available on cargo volumes by handling type but we can assume some indication of handling type from the cargoes handled.

Most of the public port cargoes are general cargo including bags. Exports in 1999 totalled 1.7 million tonnes of which 1.0 million was pulp and 0.6 million tons plywood.

Most of the unloaded domestic traffic amounting to 1.3 million tonnes was pulp which made up 1.0 million tonnes.

Of the loaded domestic cargoes totalling 1.4 million tonnes, just under half were logs, and stone and black oil made up a further 0.2 million tonnes each

(5) Container Traffic

Containers are handled at four locations: two private terminals, a public/private terminal and the public port.

Traffic growth has been rapid from a low base in 1995, more than doubling each year on average.

According to Cabang data the public facility handles very few containers, with PT IKPP/ PT RAPP (both private) handling 75,000 Teus and PT Siak Haska handling another 15,000 Teus. The total handled was 91,349 Teus in 1999.

(6) Main Commodities

The main commodities handled in the public port are domestic commodities (unloading) including flour, fertiliser and general cargoes and (loading) sawn timber and fuel. Domestic cargoes totalled some 90,000 tonnes in 1999. The remainder, about 40,000 tonnes were international including some coal for export and rice and fertiliser for import.

For the non-public cargoes of some 4.7 m. tonnes in 1999, export of pulp, followed by plywood make up the majority of exports. Imports are largely salt and general cargoes.

Inter-island cargoes (loading) are predominantly (80%) pulp, followed by CPO. Unloaded cargoes are dominated by logs (45%), followed by cement, salt and general cargoes.

CPO volumes reached 103,000 tonnes in 1999, up from 40,000 in 1995 an increase of some 26 percent per year.

(7) Passengers

Passenger data indicate peaks and troughs in demand. In 1991 and 1995 passenger flows reached 45,000 each year but fell back significantly after each peak to similar levels, of about 6,000 in 1999. This may reflect fluctuations in the PELNI shipping capacity supplied on this route.

(8) Trends and Comments

Data from the port sources show very little growth over the period in public cargoes but private cargoes have expanded rapidly since 1995. However, longer term trends show little growth in traffic. Container growth has, however, been very rapid.

3.6.3 Jambi Cargo

(1) Total Traffic

Table 3.6.2 Cargo Traffic at Jambi Port, 1989 to 2000

Cargo Location/Year (in 000 Tonnes)	1989	1994	1996	1998	1999	2000
Public	N/a	187	201	175	201	161
Non Public	N/a	1,934	2,756	3,150	2,918	3,356
Total	1,541	2,121	2,957	3,325	3,119	3,517

Source: Cabang

Total traffic has been increasing by 8 percent per year between 1994 and 1999 and this increased to 9 percent if 2000 is included. Between 1989 and 1999 the growth was 7 percent per year increasing to just under 8 percent if 2000 is included.

(2) Public Port

Public port traffic had been increasing by just over 1 percent up to 1999 but a relatively sharp drop in 2000 brought the long term growth rate down to (-2) percent per year. Low river levels and the economic recession were explanations given by the Cabang for the reduction in 2000.

(3) Other Areas

Much of the total port traffic is handled outside the public port as shown above with most of that traffic being handled at special wharves. A considerable amount of private cargo is handled at the private wharves and/or loading point related to the Tungkal river and comes under the sub port of Kuala Tungkal.

(4) Handling Type

Of the 3 million tonnes per year handled in 1999, the largest proportion was general cargo and bags (40%) the remainder being liquid bulk (34%) and other cargo. Container cargo makes up some 40 percent of the public port cargoes but under 8 percent of all cargoes.

(5) Container Traffic

Container tonnage has been increasing by some 27 percent per year since 1994 reaching 250,000 tonnes in 2000. Teu growth has been higher (implying less tonnes per teu) and reached almost 34,000 in the same year. According to the port data, the public wharf at Talang Duku only handled 80,000 tonnes of containerised cargoes which is about 30 % of the total.

(6) Main Commodities

The main commodities handled in the port are domestic, with 51 percent unloaded and 29 percent loaded making 80% domestic and another 20 % international. Logs, fertiliser, cement, nuts, fuel and glue make up most of the unloaded commodities, and pulp, oil, CPO and general cargo making up most of the loaded items.

CPO cargoes averaged 120,000 to 130,000 tonnes in 1999 and 2000.

Exports are mainly wood related including sawn timber, plywood and mouldings as well as crumb rubber. Imports are mainly general cargoes.

(7) Passengers

Passenger traffic reached 134,000 in 2000 a rapid increase of over 20% per year since 1996 or over 45% per year since 1995. Passengers are only transported to the passenger facility at Kuala Tungkal with bus/taxi connections to Jambi city / rest of the area.

(8) Trends and Comments

Data from the port sources show very considerable growth over the period though public cargoes have stagnated. This is probably due to the river draught problems around Jambi city. Container traffic growth has been considerable. Considerable analysis is required to examine the relationship of Kuala Tungkal, Muara Sabak, Talang Duku and other smaller local ports under the Jambi cabang.

3.6.4 Palembang Cargo

(1) Total Traffic

Table 3.6.3 Cargo Traffic at Palembang Port, 1994-2000

Cargo Type / Location (In 000 tonnes)	1994	1995	1996	1999	2000
Public	1,019	9,63	1,010	1,048	1,422
Non –Public Port Areas	9,266	10,290	10,492	8,334	9,501
Total Cargo	10,285	11,253	11,502	9,382	10,923

Source: Cabang

Total traffic has been relatively static over the period from 1994 to 2000, with increases in 1995 and 1996. Between 1988 and 2000, traffic increased by 3 percent per year.

(2) Public Port

Public port traffic has been increasing by some 8 percent per year over the above period.

(3) Other Areas

Traffic in the non public areas has been changing at a variable rate. Although small in absolute terms, Rede traffic grew by 17% per year, perhaps indicating the shortage of berth space at the port. Traffic at special wharves and special ports remained fairly constant over the period.

(4) Handling Type

Of the 9 million tonnes per year handled in 1999, 60 percent was in liquid bulk form, 22 percent dry bulk and 5 percent container with the remaining general and bagged cargo.

(5) Container Traffic

The volume of cargo in containers has continued to grow every year and longer term container growth in Teus has been solid, although the number of Teus in the crisis years fell back somewhat before advancing again in 2000 to reach about 500,000 tonnes or 46,000 Teu's.

Indeed, the actual volume of containerised cargo in 2000 now exceeds the forecast volume for 2004 made by IPC II. However, tonnage per Teu has been rising. Therefore, due to the IPC's low forecast estimate of tonnes per Teu, the forecast volumes of Teus remains more accurate.

According to Cabang data, the public facility handled over 98 percent of all containers at the port.

Table 3.6.4 Container Traffic at Palembang Port, 1994-2000

Container Traffic	1994	1996	1998	2000
Tonnes (000s)	318	463	467	493
Teus	44,209	53,421	51,826	45,946
Tonnes/Teu	7.2	8.7	9.0	10.7
Boxes	32,837	44,306	43,319	42,446

Source: Cabang and IPC2

(6) Main Commodities

Coal, BBM, oil, fertiliser and rubber make up over 85 percent of all commodities handled throughout the port in 2000. The public port handles some 1.4 million tonnes in total of which container tonnage makes up just under 0.5 million tonnes. Most of the remainder is general and bagged cargo comprising mainly cement, rice and other foodstuffs and consumer goods.

CPO cargo was averaging about 60-70,000 tonnes per year to 1999 but fell to zero in 2000. This may be incorrect as other traffic related to palm oil rose very substantially in 2000.

(7) Passengers

Passenger traffic grew rapidly over the period 1994 to 2000. This is consistent with most of Indonesia, which has seen remarkable growth in sea passenger traffic. A considerable increase in passenger traffic was noticeable during the economic crisis perhaps reflecting the high cost of air transport and the increased demand for inter island movement.

All sea passenger movements were domestic.

Table 3.6.5 Passenger Movements at Palembang Port

	1995	1996	1997	1998	1999	2000
Passengers (in 000s)	130	178	215	315	439	460
% per year	27.0	36.9	20.6	46.9	39.4	4.6

(8) Existing Forecasts

Existing forecasts made in 2000 by IPC II, using 1999 as base year show a forecast of about 5 percent per year in both public and non public cargo traffic between 2001 and 2005, resulting in nearly 13 million tonnes of cargoes in total by the end year.

Some 76,283 Teus are forecast by 2005, a growth rate of 13 percent per year between 2001 and 2005.

(9) Trends and Comments

There has been substantial growth over the period in public cargoes but non-public cargoes stagnated in the early crisis years before recovering in 2000.

Container cargo also suffered a minor set back in the crisis but seems to have recovered its longer term growth trend in 2000.

3.7 Calling Vessels

Table 3.7.1 shows the recent trend in ship calls at the subject ports. This table shows all vessels whether calling at public or private wharves. Clearly however, in line with increasing port cargoes, the number of vessels has been increasing even including the crisis years of 1998 and 1999.

Taking all three ports together, the data shows that international calling vessels increased by nearly 7 percent per year between 1995 and 1999, with average GRT increasing by nearly 1.5 percent. Domestic calls increased by over 4 percent per year with average GRT increasing by nearly 2 percent. These data reflect, somewhat, the situation where international bound vessels are already quite large (relative to the river/port capacity) whereas the domestic bound vessels are generally significantly smaller with much greater potential to expand.

The trend is often difficult to establish clearly due to the impact of the economic crisis on port cargo and thus, port calls in the last two years of the data. However, it is clear that at least until the crisis, vessel numbers were growing and vessel size was increasing to carry the strong cargo growth at the ports.

These data will be disaggregated in the later stages of the study for the selected ports, including division of the data into public and private wharves.

3.8 Origin and Destination of the Major Cargo Items

Insufficient data was available on specific cargo destinations related to each port to give a very clear picture of cargo origins and destinations. This is because of the transhipment nature of much of the river port international cargoes. General data was presented in Section 2 above on destinations of Indonesian exports.

Much of the container traffic is feeder traffic to Jakarta or Belawan, with general cargo (mainly raw or semi processed material) either being exported or feeding industries at key locations in Sumatra or Java.

Palm oil is either sent to the bulking stations at Dumai, Batam or Belawan with some exported.

Palembang coal is mainly sent to Java power stations and a small amount exported. Pulp is mainly sent to Java for processing by the domestic paper industry.

Table 3.7.1 Calling Vessels 1995 – 1999 for the Ports in Sumatra

Jambi

			1995	1996	1997	1998	1999	% 1995-1999
International	**Call**	**Number**	1,230	1,568	1,073	1,314	1,463	4%
	GRT	**ton**	2,908,956	3,542,786	2,524,029	2,951,667	3,318,195	3%
	Average GRT	**ton**	2,365	2,259	2,352	2,246	2,268	-1%
Domestic	**Call**	**Number**	3,723	4,283	2,849	3,431	3,582	-1%
	GRT	**ton**	1,487,525	1,587,819	1,260,693	2,233,570	2,060,612	8%
	Average GRT	**ton**	400	371	443	651	575	10%

Palembang

			1995	1996	1997	1998	1999	% 1995-1999
International	**Call**	**Number**	705	730	824	625	865	5%
	GRT	**ton**	2,279,158	2,305,792	2,880,389	2,127,087	2,455,561	2%
	Average GRT	**ton**	3,233	3,159	3,496	3,403	2,839	-3%
Domestic	**Call**	**Number**	2,851	2,790	2,961	2,772	2,887	0%
	GRT	**ton**	7,739,301	7,754,454	7,604,670	8,222,011	7,482,313	-1%
	Average GRT	**ton**	2,715	2,779	2,568	2,966	2,592	-1%

Pekanbaru

			1995	1996	1997	1998	1999	% 1995-1999
International	**Call**	**Number**	1,138	1,246	1,374	1,769	1,658	10%
	GRT	**ton**	4,581,829	5,228,171	5,680,491	6,893,885	7,634,288	14%
	Average GRT	**ton**	4026	4196	4134	3897	4605	3%
Domestic	**Call**	**Number**	3,510	4,507	4,908	5,384	5,494	12%
	GRT	**ton**	5,041,973	5,448,056	6,065,558	7,327,806	8,494,466	14%
	Average GRT	**ton**	1436	1209	1236	1361	1546	2%

ALL 3 PORTS			1995	1996	1997	1998	1999	% 1995-1999
International	**Call**	**Number**	3,073	3,544	3,271	3,708	3,986	6.7%
	GRT	**ton**	9,769,943	11,076,749	11,084,909	11,972,639	13,408,044	8.2%
	Average GRT	**ton**	3,179	3,125	3,389	3,229	3,364	1.4%
Domestic	**Call**	**Number**	10,084	11,580	10,718	11,587	11,963	4.4%
	GRT	**ton**	14,268,799	14,790,329	14,930,921	17,783,387	18,037,391	6.0%
	Average GRT	**ton**	1415	1277	1393	1535	1508	1.6%

Source: DGSC and Port Offices

3.9 Port Management Systems

3.9.1 Port Management System in Major Ports of Sumatra

(1) Present Situation

Sumatra Island consists of 8 provinces. As for public ports, Sumatra has 42 commercial ports and 129 non-commercial ports. There are 422 special ports.

The Indonesia Port Corporation (IPC) I manages 24 commercial ports located in D.I.Aceh, North Sumatra and Riau while IPC II is responsible for 18 commercial ports located in Jambi, West Sumatra, South Sumatra, Lampung and Bengkulu.
The branch offices of IPC in each port are in charge of the daily operation.

The Port Administrator Office (ADPEL), which used to be a lower branch of the Province Office (KANWIL) until 2001, is established in each commercial port categorized as class II, III and IV. The Port Administration Office (KANPEL), which was also the lower branch of KANWIL until 2001, is established in non-commercial ports.

IPC I manages 4 major river ports (Pangkalan Susu, Belawan, Teluk Nibung and Tanjung Balai Asahan) in the North Sumatra and 3 major river ports (Pekanbaru, Rengat and Tembilahan) in the Riau.

IPC II manages the Jambi port in Jambi and the Palembang port in the South Sumatra. Out of the 129 non-commercial ports in Sumatra, 12 are river ports.

3.9.2 Management and Organization of Principal River Ports

(1) Pekanbaru River Port

Pekanbaru port is located 96 miles (178km) upstream of the estuary of the Siak River. IPC I Pekanbaru branch office is responsible for the construction, maintenance, and operation of the port facilities.
The Organization Chart of IPC I Pekanbaru Branch Office is shown in Figure 3.9.1.

Pekanbaru ADPEL is responsible for safe navigation. ADPEL also approves the installation of navigation and mooring facilities in Pekanbaru port.

(2) Jambi River Port

Jambi port is located 90 miles (167 km) upstream of the estuary of the Batang Hari River. IPC II Jambi branch office is responsible for the construction, maintenance, and operation of the port facilities.
The Organization Chart of IPC II Jambi Branch Office is shown in Figure 3.9.2.

Jambi ADPEL is responsible for safe navigation. ADPEL also approves the installation of navigation and mooring facilities in Jambi port. Another ADPEL is established in

Kuala Tungkal ADPEL, a part of Jambi Port.

(3) Palembang River Port

Palembang port is located 43 miles (80 km) upstream of the estuary of the Musi River. IPC II Palembang branch office is responsible for the construction, maintenance, and operation of the port facilities.
The Organization Chart of IPC II Palembang Branch Office is shown in Figure 3.9.3.

Palembang ADPEL is responsible for safe navigation. ADPEL also approves the installation of navigation and mooring facilities in Palembang port.

3.9.3 Revenue and Expenditure of Three River Ports

Table 3.9.1 shows the revenue and expenditure of the above-mentioned 3 river ports during the past 5 years.

Table 3.9.1 Revenue and Expenditure of the River Ports in Sumatra

(Unit：Rp.1,000)

Year	Pekanbaru Office		Jambi Office		Palembang Office	
	Revenue	Expenditure	Revenue	Expenditure	Revenue	Expenditure
2000	8,832,503	4,934,618	7,166,417	6,129,881	34,360,000	21,957,000
1999	9,616,031	6,239,720	5,291,123	5,171,471	15,957,000	15,305,000
1998	-	-	5,330,688	4,131,985	14,055,000	11,053,000
1997	-	-	3,158,180	2,740,376	12,412,000	9,056,000
1996	-	-	2,899,866	2,643,658	8,707,000	7,871,000

Source: IPC Branch Office

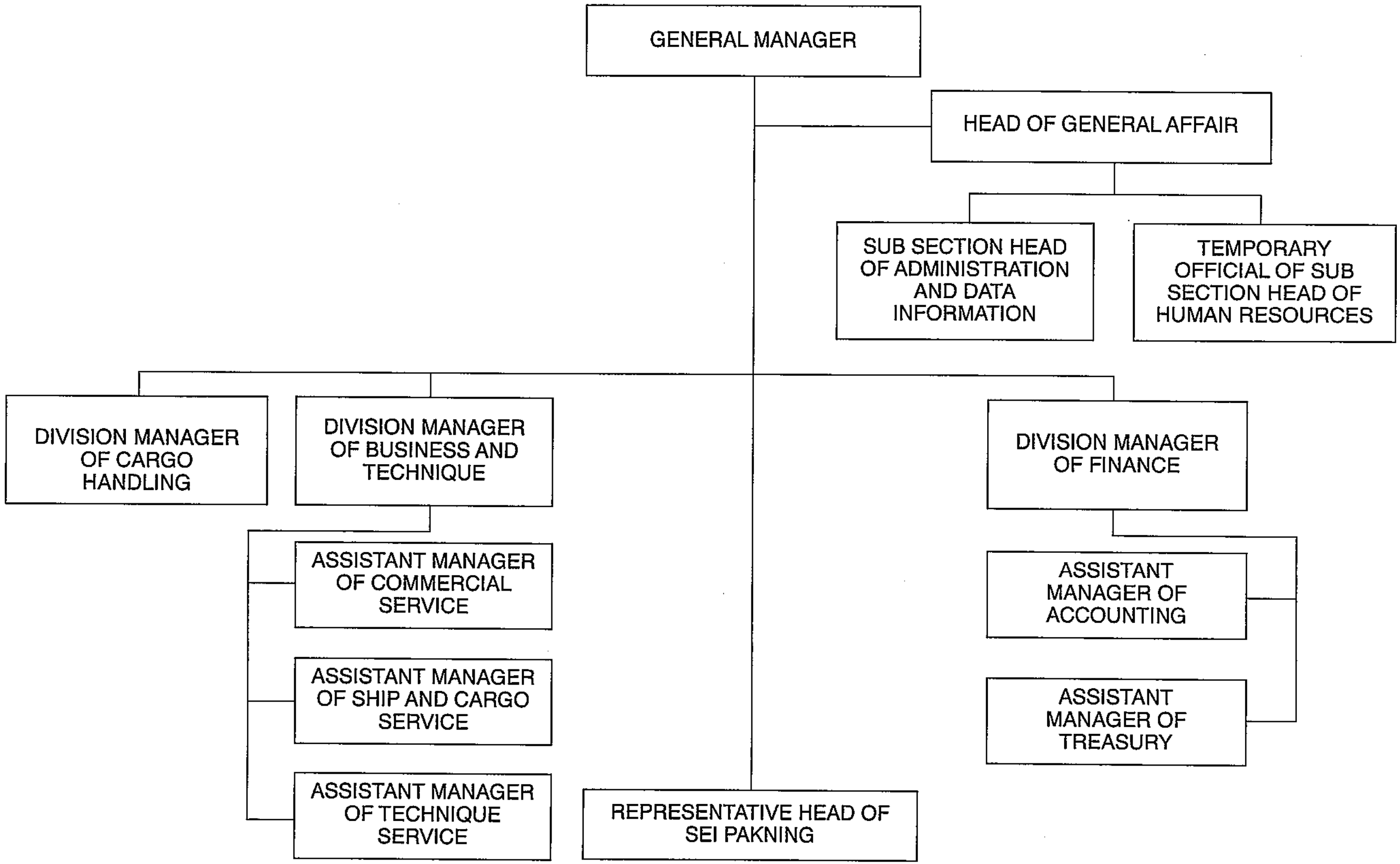


Figure 3.9.1 Organization Chart of IPC I Pekanbaru Branch Office

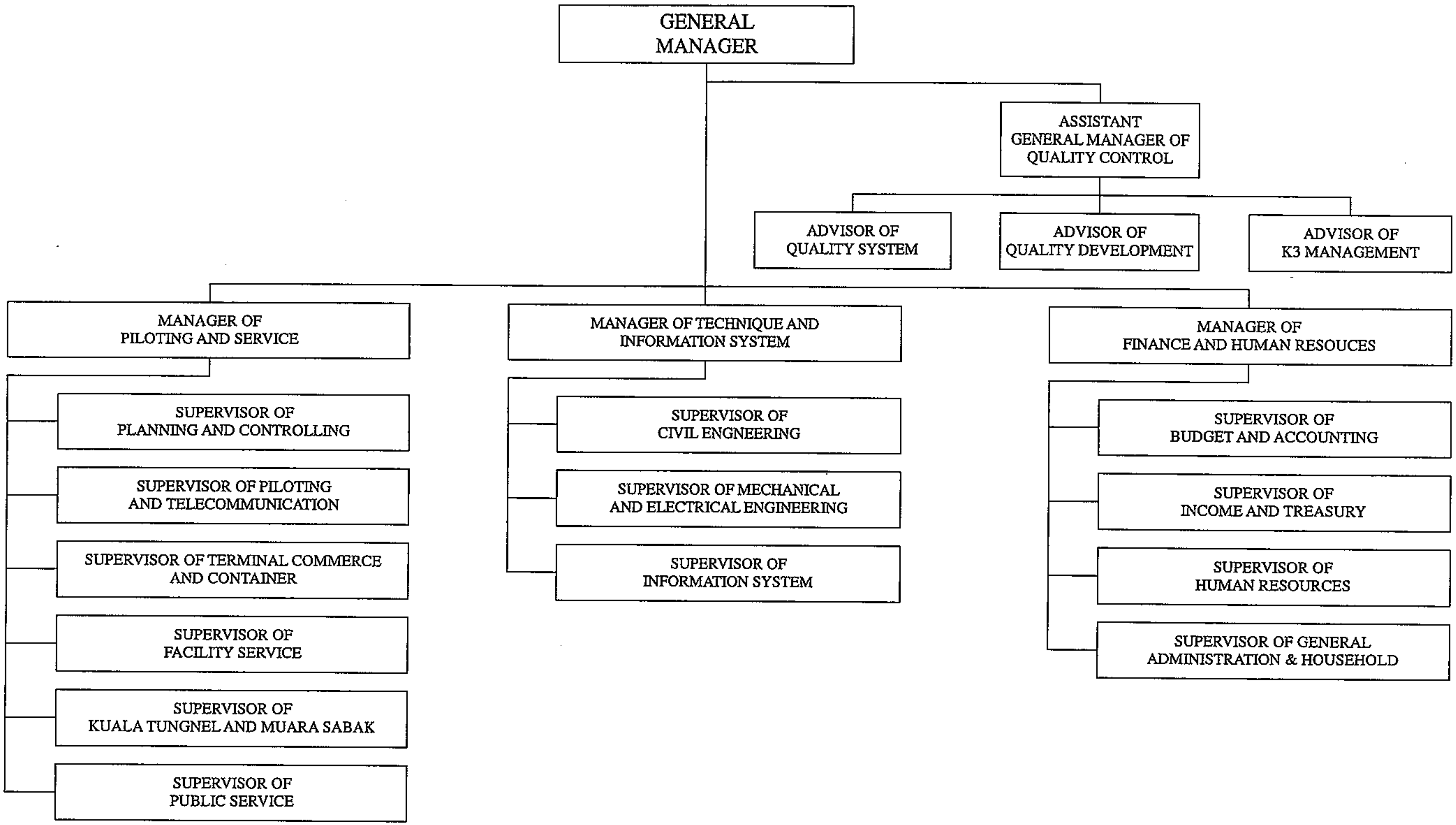


Figure 3.9.2 Organization Chart of IPC II Jambi Branch Office

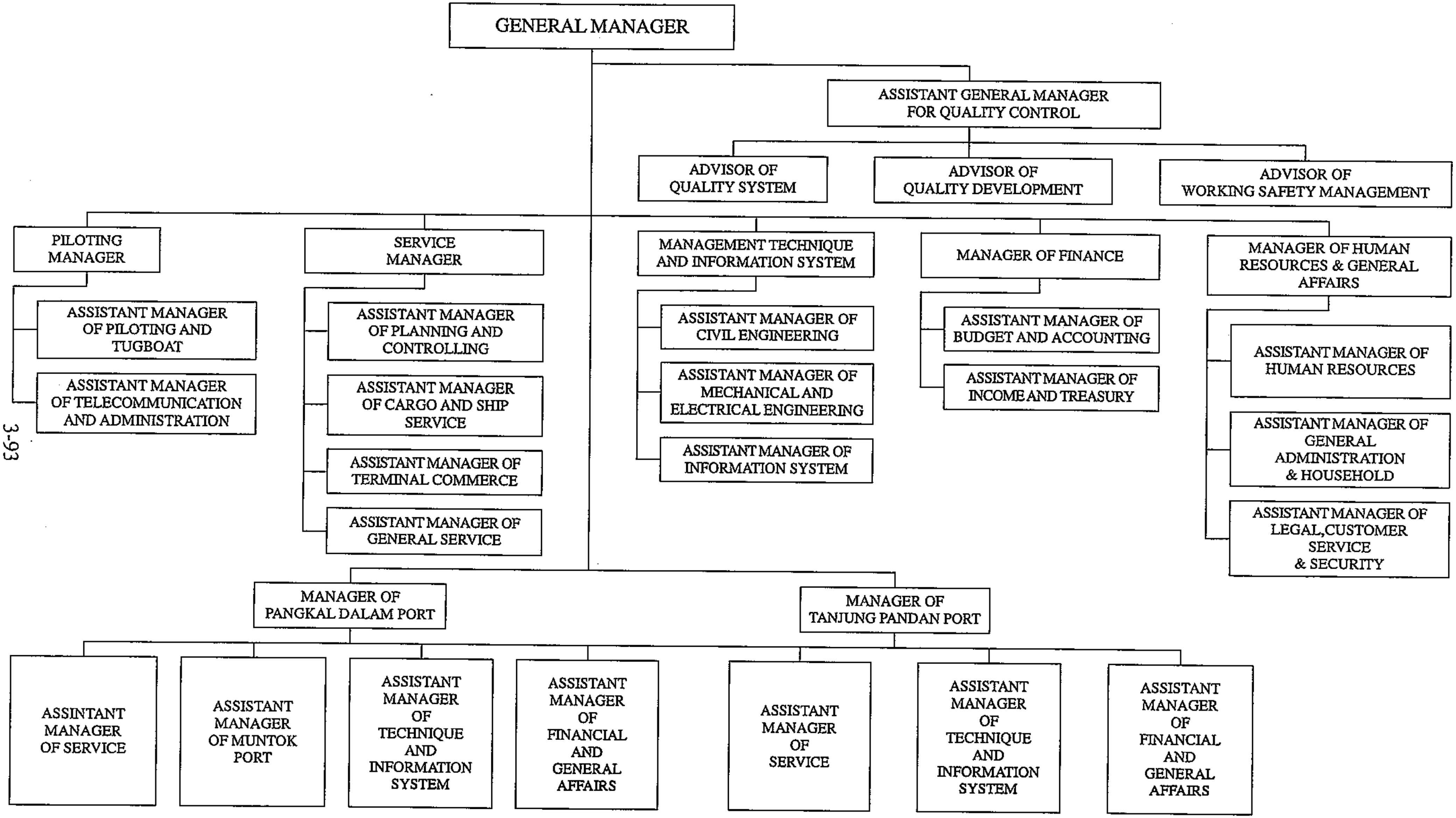


Figure 3.9.3 Organization Chart of IPC II Palembang Branch Office

3.10 Cargo Handling System and Productivity

3.10.1 Pekanbaru

Cargo handling in the public wharf in Pekanbaru is provided for 24 hours and seven days a week. However, Perawang container terminal is operated only during the daytime due to the lack of lighting. IPC branch office compiled the records and targets of port productivity in the public wharves (Table 3.10.1-3). These records are very well kept.

Table 3.10.1 Service Time in Pekanbaru

(hours/vessel)

Year / Indicator	1999 (A)	2000 (B) (Projection)	2001 (C) (Target)	C/A	B/A
Waiting Time	1.6	1.5	1.5	96.8	97.4
Postpone Time	10.1	8.1	8.0	79.4	98.8
Approach time	12.9	11.1	10.8	83.2	96.7
Berthing Time	85.4	73.2	73.2	85.6	99.9
Berth Working Time	26.0	23.9	24.0	92.2	100.2
Idle Time	0.9	1.4	1.4	155.2	96.4
Effective Time	25.1	22.5	22.6	90.0	104.4
Non-operation Time	59.4	49.3	49.2	82.7	99.8
Turn round time	109.9	93.9	93.4	84.9	99.4

Note:

Waiting time: Time from a request for entry into the channel to pilot boarding

Postpone time: Time spent at the anchorage due to the weather condition

Approach time: Time for navigation from the river mouth to the port

Berthing time: Time for a vessel at berth

Berth working time: Time from the start to the end for cargo handling

Idle time: Time for a break

Effective time: Actual time spent for cargo handling

Non-operation time: Time for a vessel at berth except for Berth working time (waiting time for tidal operation and delay due to the weather condition)

Turn round time: Time from a request for entry into the channel to the departure from the port

Source: IPC1 Pekanbaru Office

Table 3.10.2 Berth Occupancy in Pekanbaru

Year Indicators	1999 (A)	2000 (B) (Projection)	2001 (C) (Target)	C/A	B/A
Berth Throughput (t/m)	353	463	473	134.0	102.2
Shed Throughput (t/m^2)	23.9	13.8	14.3	59.7	103.2
Yard Throughput (t/m^2)	5.8	1.9	2.0	59.7	103.2
Berth Occupancy Ratio (%)	59.2	54.2	54.1	91.3	99.8
Shed Occupancy Ratio (%)	1.8	0.7	0.8	41.9	111.9
Yard Occupancy Ratio (%)	1.3	0.4	0.5	35.2	107.1

Source: IPCI Pekanbaru Office

Table 3.10.3 Productivity in Pekanbaru

Cargoes	1999 (A)	2000 (B) (Projection)	2001 (C) (Target)	C/A	B/A
General Cargo (t/gang/hour)	15.7	15.5	15.6	99.2	100.3
Bag Cargo (t/gang/hour)	21.0	21.2	21.2	100.9	100.1
Unitized Cargo	-	-	-	-	-
Liquid Bulk	-	-	-	-	-
Dry Bulk Truck Loading (t/gang/hour) Conveyor Loading (t/conveyor/hour)	 - 	 103.4 5.2	 103.4 5.5	 - 	 100.0 105.0

Source: IPCI Pekanbaru Office

The Study Team also learned that the productivity in the Siak Haska Container terminal was 10-12 boxes/hour using two mobile cranes. The maximum berthing time in the terminal is two days.

3.10.2 Jambi

Cargo handling in the public wharf in Talang Duku is provided for 24 hours and seven days a week. IPC and private companies provide stevedoring services using handling equipment owned by IPC. IPC branch office compiled the records of port productivity in the public wharves (Table 3.10.4-6). It is noteworthy that turn round time for domestic vessels dramatically increased in 1999 due to the increase in berthing time. In Talang Duku, container is handled by quay crane and ship gear and thus achieving relatively low productivity.

Table 3.10.4 Service Time in Jambi

(hours/vessel)

Indicator \ Year	1996	1997	1998	1999	2000
International Shipping					
Waiting Time	1.5	1.6	0.6	0.8	0.8
Approach Time	24.0	23.0	23.0	23.2	21.2
Berthing Time	47.3	44.1	42.5	43.4	66.2
Effective Time	23.7	24.3	11.2	19.2	26.6
Turn round Time	72.8	68.6	66.1	67.4	88.2
Domestic Shipping					
Waiting Time	1.5	1.5	0.4	1.1	1.1
Approach Time	25.0	26.0	24.0	24.0	24.0
Berthing Time	74.6	67.2	65.9	127.9	127.9
Effective Time	28.2	25.8	25.6	64.5	64.5
Turn round Time	76.1	68.8	66.3	129.1	129.1

Note:

Waiting time: Time from a request for entry into the channel to pilot boarding

Approach time: Time for navigation from the river mouth to the port

Berthing time: Time for a vessel at berth

Berth working time: Time from the start to the end for cargo handling

Effective time: Actual time spent for cargo handling

Turn round time: Time from a request for entry into the channel to the departure from the port

Source: IPC2 Jambi Office

Table 3.10.5 Berth Occupancy in Jambi

Indicators / Year	1996	1997	1998	1999	2000
Conventional Wharf					
Berth Occupancy Ratio (%)	40.7	55.9	70.7	42.3	70.7
Berth Throughput (t/m)	909	1,151	319.9	1,475	347
Container Wharf					
Berth Occupancy Ratio (%)	-	-	-	-	-
Berth Throughput (t/m)	-	-	-	-	-
Shed					
Shed Occupancy Ratio (%)	13.7	0.8	9.6	44.8	42.8
Shed Throughput (t/m^2)	1.7	15.3	1.8	3.1	15.1
Yard					
Yard Occupancy Ratio (%)	45.5	59.0	68.1	48.1	92.1
Yard Throughput (t/m^2)	4.2	4.7	4.8	4.0	9.0

Source: IPC2 Jambi Office

Table 3.10.6 Productivity in Jambi

Cargoes / Year	1996	1997	1998	1999	2000
General Cargo (t/gang/hour)					
International Shipping	34.6	19.0	20.4	21.0	18.4
Domestic Shipping	25.3	20.2	20.6	21.5	9.6
Bag cargo (t/gang/hour)					
International Shipping	23.0	30.0	3.2	24.8	20.4
Domestic Shipping	24.1	13.7	80.0	11.7	11.2
Liquid Bulk (t/gang/hour)					
International Shipping	-	-	-	-	-
Domestic Shipping	-	-	-	-	-
Dry bulk (t/gang/hour)					
International Shipping	-	-	-	-	-
Domestic Shipping	-	-	-	-	-
Container (box/crane/hour)					
Container Wharf	-	-	-	-	-
Conventional Wharf	6.0	6.0	6.0	6.0	7.0

Source: IPC2 Jambi Office

3.10.3 Palembang

Cargo handling in the public wharf in Boom Baru is provided for 24 hours and seven days a week. Container handling is done by three shifts/day and conventional cargo is handled by two shifts/day. Three gangs are available in the port. IPC and private companies provide stevedoring services using handling equipment owned by IPC. Currently, twenty percents of the container are handled by ship gears. IPC branch office compiled the records of port productivity in the public wharves (Table 3.10.7-9). Berth occupancy ration is relatively high (around 60%). IPC branch office estimates the capacity of the container terminal as 100,000 TEU/year and that of the conventional terminal as 2 million tons/year. It is noteworthy that the turn round time is steadily increasing.

Table 3.10.7 Service Time in Palembang

(hours/vessel)

Indicator \ Year	1996	1997	1998	1999	2000
International Shipping					
Waiting Time	-	-	1.2	1.5	5.0
Approach Time	12.5	13.0	13.0	12.7	15.2
Berthing Time	24.1	24.1	31.4	35.6	38.7
Non-operational Time		10.2	15.7	18.6	17.9
Berth Working Time	14.1	13.9	15.6	17.0	20.8
Effective Time	12.5	12.1	11.1	12.2	19.3
Idle Time	1.6	1.8	4.6	4.8	1.5
Turn round Time	36.6	37.1	45.5	49.8	59.0
Domestic Shipping					
Waiting Time	-	-	8.4	15.2	14.4
Approach Time	13.1	14.6	14.9	15.3	16.4
Berthing Time	56.5	55.6	51.3	43.1	47.8
Non-operational Time	32.9	33.3	32.9	23.6	22.8
Berth Working Time	23.7	22.3	18.5	19.5	25.0
Effective Time	21.1	19.6	16.9	17.0	21.8
Idle Time	2.6	2.7	2.2	2.5	3.2
Turn round Time	69.7	70.2	74.6	73.6	78.5

Note:

Waiting time: Time from a request for entry into the channel to pilot boarding

Approach time: Time for navigation from the river mouth to the port

Berthing time: Time for a vessel at berth

Berth working time: Time from the start to the end for cargo handling

Idle time: Time for a break

Effective time: Actual time spent for cargo handling

Non-operation time: Time for a vessel at berth except for Berth working time (waiting time for tidal operation and delay due to the weather condition)

Turn round time: Time from a request for entry into the channel to the departure from the port

Source: IPC2 Palembang Office

Table 3.10.8 Berth Occupancy in Palembang

Indicators / Year	1996	1997	1998	1999	2000
Wharf					
Berth Occupancy Ratio (%)	58.3	63.9	60.8	62.9	57.9
Berth Throughput (t/m)	1,641	2,190	919	1,485	1,349
Shed					
Shed Occupancy Ratio (%)	18.9	12.2	7.8	5.1	9.0
Shed Throughput (t/m^2)	9.7	4.5	1.3	3.5	17.0
Yard					
Yard Occupancy Ratio (%)	14.8	13.2	18.0	5.1	13.4
Yard Throughput (t/m^2)	17.3	21.8	41.0	36.5	41.8

Source: IPC2 Palembang Office

Table 3.10.9 Productivity in Palembang

Cargoes / Year	1996	1997	1998	1999	2000
General Cargo (t/gang/hour)					
International Shipping	18.0	19.7	22.7	35.5	27.7
Domestic Shipping	17.3	19.2	22.8	23.4	39.3
Bag Cargo (t/gang/hour)					
International Shipping	27.5	26.8	25.3	30.3	33.8
Domestic Shipping	26.8	27.4	23.7	23.4	33.9
Liquid Bulk (t/gang/hour)					
International Shipping	115.2	-	105	149.3	104.5
Domestic Shipping	178.7	188.9	185.2	199.8	47.6
Dry Bulk (t/gang/hour)					
International Shipping	84.3	-	-	-	-
Domestic Shipping	46.3	50	43.8	-	149
Container (box/gang/hour)	8	8	10	13	21

Source: IPC2 Palembang Office

3.11 Maintenance Dredging of Channels

3.11.1 Dredging in River Channels

One of the most serious difficulties facing river ports in Sumatra and Kalimantan is the large volume of the maintenance dredging of their navigation channels. A list of the commercial ports in Indonesia and their dredging volume (30 ports in the higher rank) is shown in Table 3.11.1. The 17 ports out of the higher ranked 30 ports are classified as River Ports.

Figure 3.11.1 shows a bar graph of the average volume of dredging per year (the right column of Table 3.11.1) for the upper ranked 15 ports. The 6 highlighted Study Areas (except for Pekanbaru) of this Study Project are included in the 15 ports and ranked higher. Especially, Palembang (Musi River; 2,277 x 10^3 m^3/year), Samarinda (Mahakam River; 1,481 x 10^3 m^3/year), Potianak (Kapuas Kecil River; 1,306 x 10^3 m^3/year) are the higher three out of the top five ports.

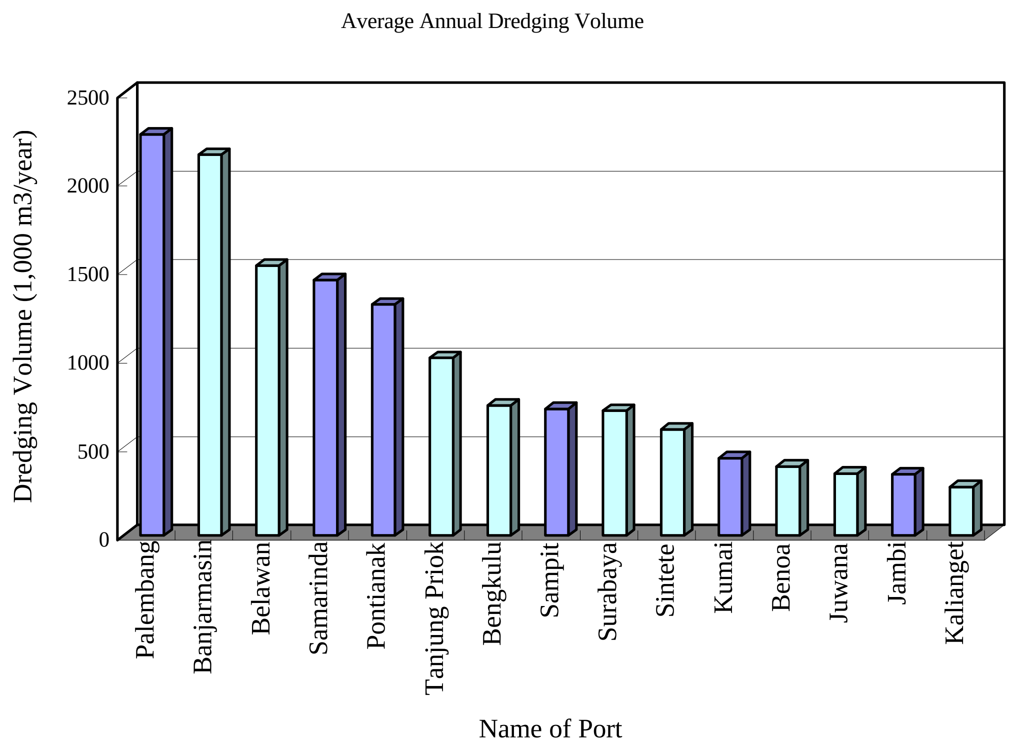


Figure 3.11.1 Average Annual Volume of Maintenance Dredging

Table 3.11.2 presents the variations over thirty years of the volume and expense of the maintenance dredging of the navigation channels managed by the budget of the central Government.

The total volume of dredging fluctuates within the range between 10 – 20 million

m^3/year and does not show a tendency of increasing within the whole period of the thirty years.

The expense for dredging in Rupiah shows an extremely high rising tendency after the fiscal year 1991. While the dredged volume was almost same in the comparison between the fiscal years of 1990 and 1998 (1990/91: 16.1 million m^3/year – 1998/99: 15.4 million m^3/year), the expense for the dredging of the government increased by three times (1990/91: 16.8 billion Rp. – 1998/99: 51.6 billion Rp.). Consequently, the expenses for the maintenance dredging have gotten a big share of the governmental budget of the port development/construction in the recent years.

According to Table 3.11.2, the unit cost of the maintenance dredging work shows a wide range of fluctuation over thirty years（52.56〜3,349 Rp./m^3; 0.139〜1.134 USD/m^3）. Especially the range of fluctuation in Rupiah has been large due to the depreciation of Rupiah against foreign currencies in the period.

The government has the ceiling price for the unit price of maintenance dredging of navigation channel (for the fiscal years 2000 and 2001).

3,880 Rp. /m^3（around 0.4 USD/m^3）for Hopper dredging

6,150 Rp. /m^3（around 0.6 USD/m^3）for Non-Hopper dredging

143,400 Rp. /mile（around 14 USD/mile）for Mobilization/Demob.

Those ceiling prices are seen as less than the market price and there have been some cases of the dredging work where the contract was barely concluded and then were supplemented with some kind of subsidy or grant aid provided from an international cooperation agency.

Table 3.11.1 Dredging of Navigation Channels in Commercial Ports in Indonesia

Source: DGSC

Unit of Volume : 1,000 m^3

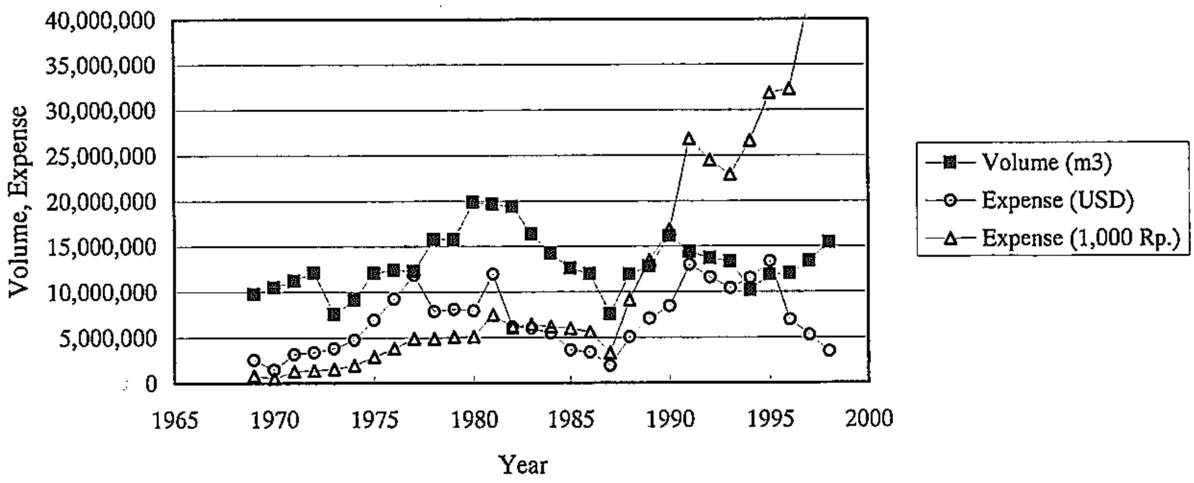
No.	Name of Port	Classi-fication	Design Dimensions of Channel (m)				Sediment	Dredger	Volume (1,000 m^3) by Pre-dredge Sounding								Average
			Length	Width	Depth	Slope	Material	Type	93/94	94/95	95/96	96/97	97/98	98/99	99/2000	2000	10^3 m^3/year
1	Palembang	River Port	25,000	120 - 150	-6.5	1:4	Silt/Sand	Hopper	1,970	2,301	2,302	2,500	2,329	2,174	2,363	2,211	2,269
2	Banjarmasin	River Port	14,000	100	-5.0	1:4	Silt	Hopper	2,802	2,332	2,175	2,270		2,502	843		2,154
3	Belawan	River Port	14,000	100	-10.0	1:5	Silt	Hopper	1,800	1,656	1,806	1,827	1,811	974	803		1,525
4	Samarinda	River Port	24,000	60 - 70	-6.0	1:6	Silt/Sand	Hopper	2,060	1,617	1,296	1,333	1,350	1,352	1,218	1,181	1,426
5	Pontianak	River Port	15,000	80	-5.5	1:4	Silt/Sand	Hopper	1,056	1,507	1,962	1,724	1,199	845	851		1,306
6	Tanjung Priok	Sea Port	2,300	120/175	-3.0/-4.0	1:4	Silt	Cutter					1,005				1,005
7	Bengkulu	Sea Port	1,700	80	-10.0	1:7	Sand	Hopper	844			1,173	193				736
8	Sampit	River Port	15,000	50	-4.5	1:4	Silt/Sand	Hopper	750		781		701		631		716
9	Surabaya	Sea Port	14,000	100	-10.0	1:8	Silt	Hopper				705					705
10	Sintete	River Port	7,000	70	-3.5	1:6	Silt/Sand	Hopper							600		600
11	Kumai	River Port	10,000	50	-5.0	1:4	Silt	Hopper	500				501			316	439
12	Benoa	Sea Port	5,000	80	-9.0/-10.0	1:2	Sand	Cutter	750	30							390
13	Juwana	River Port	3,000	40	-3.0/-4.0	1:4	Sand/Silt	Cramshell			350		350		352		351
14	Jambi	River Port	10,000	70	-4.5	1:8	Silt	Hopper	350		326	357	356				347
15	Kalianget	River Port	4,000	50	-5.0	1:4	Silt	Cutter					276				276
16	Pasuruan	River Port	2,500		-15 ～ -40	1:4	Silt	Cutter							251		251
17	Cirebon	Sea Port	2,000	70	-7.0	1:4	Silt/Sand	Hopper	219		250	250	251				243
18	Pangkal Balam	Estuary	2,000	60	-4.5	1:8	Sand	Hopper	161		142						152
19	Manado	Sea Port	500	40～175	-4.0	1:4	Silt/Sand	Cramshell							125		125
20	Tanjung Pandan	Sea Port	3,650	25	-3.0	1:4	Sand	Cutter			105						105
21	Karangantu	Estuary	2,250	80	-1.5/-2.0	1:2	Sand	Cutter							101		101
22	Muara Pandang	River Port	1,500	30/40	-4.0	1:4	Silt	Cramshell				97			101		99
23	Pekalongan	River Port	400	30/50	-3.5	1:4	Silt	Cutter				96					96
24	Tegal	Sea Port	1,300	80	-4.0	1:4	Silt/Sand	Cramshell	100		100	75	100				94
25	Gorontalo	River Port	800	variable	-6.0	1:4	Sand	Cramshell					92				92
26	Batang	River Port	800	20/40	-3.0/-4.0	1:4	Silt	Cutter				81				74	77
27	Pulang Pisau	River Port	13,500	55	-5.0	1:8	Silt/Sand	Hopper									
28	Semarang	Sea Port	3,200	80	-9.0	1:10	Silt	Hopper									
29	Probolinggo	River Port	1,800	80	-3.5	1:4	Silt	Cramshell									
30	Lembar	Sea Port	1,400	40	-5.5	1:4	Silt	Cutter									
	Total								13,363	9,443	11,596	12,488	10,514	7,847	8,241	3,782	9,186

Table 3.11.2 Dredging Volume and Expense

No.	Year	Volume (m³)	Expense* (1,000 Rp.)	Expense (USD)	Unit Cost of Dredging (Rp/m³)	Unit Cost of Dredging (USD/m³)	Rate** (Rp/USD)
1	1969/70	9,772,679	838,045	2,570,690	85.8	0.263	326.0
2	1970/71	10,484,462	551,038	1,457,773	52.6	0.139	378.0
3	1971/72	11,207,263	1,323,308	3,188,694	118.1	0.285	415.0
4	1972/73	12,100,172	1,411,657	3,401,583	116.7	0.281	415.0
5	1973/74	7,568,793	1,581,088	3,809,851	208.9	0.503	415.0
6	1974/75	9,118,026	1,968,412	4,743,160	215.9	0.520	415.0
7	1975/76	12,091,052	2,884,018	6,949,441	238.5	0.575	415.0
8	1976/77	12,413,950	3,827,689	9,223,348	308.3	0.743	415.0
9	1977/78	12,247,168	4,906,140	11,822,023	400.6	0.965	415.0
10	1978/79	15,764,843	4,888,812	7,872,484	310.1	0.499	621.0
11	1979/80	15,737,908	5,090,221	8,118,374	323.4	0.516	627.0
12	1980/81	19,841,068	5,111,073	7,936,449	257.6	0.400	644.0
13	1981/82	19,623,400	7,523,999	11,952,341	383.4	0.609	629.5
14	1982/83	19,387,117	6,151,287	6,188,418	317.3	0.319	994.0
15	1983/84	16,385,609	6,447,740	6,003,482	393.5	0.366	1,074.0
16	1984/85	14,186,449	6,201,000	5,512,000	437.1	0.389	1,125.0
17	1985/86	12,582,272	6,010,000	3,662,401	477.7	0.291	1,641.0
18	1986/87	11,972,165	5,600,800	3,394,424	467.8	0.284	1,650.0
19	1987/88	7,570,665	3,314,300	1,916,888	437.8	0.253	1,729.0
20	1988/89	11,934,050	9,125,450	5,069,694	764.7	0.425	1,800.0
21	1989/90	12,793,247	13,445,250	7,072,725	1051.0	0.553	1,901.0
22	1990/91	16,130,448	16,838,750	8,453,188	1043.9	0.524	1,992.0
23	1991/92	14,366,127	26,775,600	12,985,257	1863.8	0.904	2,062.0
24	1992/93	13,707,522	24,444,203	11,584,930	1783.3	0.845	2,110.0
25	1993/94	13,349,700	22,874,000	10,397,273	1713.4	0.779	2,200.0
26	1994/95	10,162,080	26,587,990	11,519,926	2616.4	1.134	2,308.0
27	1995/96	11,859,130	31,796,360	13,342,996	2681.2	1.125	2,383.0
28	1996/97	12,006,770	32,282,880	6,942,555	2688.7	0.578	4,650.0
29	1997/98	13,358,200	42,119,400	5,248,523	3153.1	0.393	8,025.0
30	1998/99	15,400,000	51,583,640	3,461,989	3349.6	0.225	14,900.0

Source: * DGSC
** Bank Indonesia

Yearly Variation of Dredging Volume and Expense



3.11.2 System of Channel Administration

(1) Administration System

The responsibility of administration for the port area and navigation channel is prescribed by laws (i.e., PP* No.70/1996 and KM* No.26/1998) as follows.

*	PP:	Peraturan Pemerintah (Governmental Regulation)
	KM:	Keputusuan Menteri (Ministerial Decree)

(i) DLKR (Daerah Lingkungan Kerja) = Port Working Area

DLKR (Port working area) is defined for the water area and/or land area in the port administrative area. The Public Port Corporation (PT. Pelabuhan Indonesia) has the rights and responsibility of the administration of DLKR in the commercial port and bears the expenses for the maintenance dredging of the harbour basin and navigation channels within the area of DLKR.

(ii) DLKP (Daerah Lingkungan Kepentingan Pelabuhan) = Port Interest Area

DLKP (Port interest area) is defined for the port-related, important water areas surrounding the water area of Port Working Area to support safety of ships, such as access channels and/or navigation channels. The central government has the rights and responsibility of the administration.

In the former system under PP No.11/1983, DLKP was not clearly defined for the use of water area but only for the land area. The rights and responsibility for the security and maintenance of navigation channels belonged to the central government.

The wide range of modification of system was conducted by the above-mentioned laws and decrees (PP No.70/1996 and KM No.26/1998).

The administration of the navigation channels of the Study Areas is as follows.

Samarinda:	The navigation channels along the Mahakam River belong to DLKR from Port of Samarinda to the river mouth.
Sampit, Kumai:	DLKR
Pontianak:	DLKR
Jambi:	DLKR
Palembang:	The navigation channels along the Musi River belong to DLKP from Sungai Lais to the river mouth.

(2) Sharing of Dredging Cost

In the former system under PP No.11/1983, the rights and responsibility for the security and maintenance of navigation channels belonged to the central government and the expenses for the maintenance dredging were 100 % borne by the government. Following the modification of the administration system, the navigation channels in rivers were re-defined as DLKR (except for the case of the Musi River) and the rights and responsibility of the channels were transferred to the public port corporations.

But it was judged difficult to put the new sharing system of the dredging cost into operation immediately due to the Asian Economic Crisis after the summer of 1997. Hence, the following procedures were taken as the temporary measures for the sharing of the dredging cost in the transition period.

In the period of the fiscal years 1997 – 1998, the cost of maintenance dredging of the navigation channels of the commercial ports was 100 % borne by the central government. In the fiscal year 1999, the cost of the maintenance dredging was borne 50 % by the central government and 50 % by the public port corporations only for the limited three ports (Belawan, Pontianak and Banjarmasin). And the costs for the remaining commercial ports were 100 % borne by the public port corporations.

For the fiscal year 2001, the dredging cost was decided to be 100 % borne by the central government only for the ports of Palembang and Samarinda where the dredging volume was estimated to be extremely large.

3.11.3 Dredging Program

(1) Dredging Program

DGSC of MOC establishes the yearly dredging program of the navigation channel according to the proposal from the public port corporations.

An example of the dredging program of the fiscal year 1999/2000 is shown in Table 3.11.3. Trailing suction hopper type dredgers are used in the works of the principal river ports.

Usually, pre-dredge sounding of the navigation channel is carried out prior to the dredging. The dredging work is conducted according to the results of pre-dredge sounding.

The dredging volume is examined and verified by post-dredge sounding of the channel.

Table 3.11.3 shows that the dredging works in 1999/2000 were carried out by the cost sharing between the central government (DGSC) and the public port corporation for the channels in Palembang, Pontianak and Banjarmasin.

(2) RUKINDO

The works of maintenance dredging of the navigation channels in the public port have been carried out by RUKINDO（PT(Persero) Pengerukan Indonesia） almost as its monopoly. The following is the brief history of the dredging works in Indonesia quoted from the brochure of Rukindo.

In the earlier 1960s, dredging activity in Indonesia was done by a governmental agency named Dredging Department (Dinas Pengerukan) under the Directorate General of Sea Communications. Then, in 1964, the Dredging Department became parts of the State Harbour Enterprise (PN Pelabuhan – BPP/ADPEL).

On 30 April 1983, all divisions of Dredging under BPP changed into PERUM PENDERUKAN (Public Corporation of Dredging) under Department of Communications. The form of PERUM has changed to a limited company named PT (Persero) PENGERUKAN INDONESIA on 1 October 1991.

Table 3.11.4 presents the list of the dredger fleet owned by RUKINDO.

Table 3.11.3 Dredging Schedule and Budget by Central Government of Fiscal Year 1999/2000

Source: DGSC

No.	Name of Port	Design of Channel Dredging				Dredging Volume (m^3)		Expenses		Fiscal Year 1999/2000											
		Length (m)	Width (m)	Depth (LWS, m)	Dredger Type			Dredge/Admin / Mob/Demob (10^3 Rp.)		April	May	June	July	August	Sep-tember	October	Novem-ber	Decem-ber	January	Feb-ruary	March
1	Belawan	13,000	100	-9.5	Hopper	I.	800,000	Drg.	3,104,000				I.								
								Adm.	13,814												
						II.	800,000	IPC1											II.		
2	Palembang	25,000	100	-6.0	Hopper		2,255,155	Drg.	8,750,000		Pre-dredge Sounding			Dredging of Channel							Final Sounding
								Adm.	14,998												
3	Pontianak	14,000	80	-5.0	Hopper	I.	850,000	Drg.	3,298,000					I.							
								Adm.	20,000												
						II.	850,000	IPC2											II.		
4	Sampit	16,000	50	-4.0	Hopper		631,443	Drg.	2,450,000												
								Adm.	14,526												
5	Samarinda	25,000	60	-6.0	Hopper		1,217,784	Drg.	4,725,000												
								Adm.	13,774												
6	Banjarmasin	12,500	100	-5.0	Hopper	I.	842,526	Drg.	3,269,000												
								Adm.	14,526												
						II.	1,150,000	IPC3													
7	Sintete	7,000	70	-4.0	Hopper		600,000		2,328,000												
8	Kuala Langsa	5,000	80	-7.0	Hopper		350,000	Drg.	1,358,000												
								Adm.	25,000												
9	Muara Padang	1,200	30/40	-4.0	Non-Hopper		100,000	Drg.	615,000												
								Adm.	15,000												
							1,540-mile	Mob.	220,836												
10	Karangantu	1,200	10/20/40	-2.0/-3.0	Non-Hopper		100,000	Drg.	615,000												
								Adm.	10,103												
							88-mile	Mob.	12,620												
11	Juwana	4,100	30	-3.0	Non-Hopper		350,000	Drg.	2,152,500												
								Adm.	10,000												
							315-mile	Mob.	45,171												
12	Pasuruan	1,700	30/20	-3.0	Non-Hopper		250,000	Drg.	1,537,500												
								Adm.	15,000												
							60-mile	Mob.	8,604												
13	Manado	500	45 - 90	-4.0	Non-Hopper		125,000	Drg.	768,750												
								Adm.	25,000												
							1860-mile	Mob.	266,724												
	Total								35,716,446												

Table 3.11.4 Dredgers Fleet of PT RUKINDO and their Dimensions

(1) Trailing Suction Hopper Dredgers

	Name of Ship	Year of Building	Length Overall (m)	Moulded Breadth (m)	Moulded Depth (m)	Loaded Draught (m)	Total Installed Power (HP / kW)	Dredging Depth (m)	Hopper Capacity (m^3)
1	BALI II	1993	124.40	18.04	8.05	7.00	6800/ 7,300	30	5,000
2	ARU II	1994	124.40	18.04	8.05	7.00	6800/ 7,300	30	5,000
3	IRIAN JAYA	1981	109.88	18.04	8.05	6.33	5,386	20	4,000
4	KALIMANTAN II	1981	109.88	18.04	8.05	6.33	5,386	20	4,000
5	SULAWESI II	1975	92.50	16.00	8.00	7.33	5,600	20	3,000
6	BETUAH	1977	92.00	16.00	8.00	7.33	5,600	20	3,000
7	SERAM	1981	92.00	16.00	8.00	7.30	6,000	20	3,000
8	HALMAHERA	1983	92.50	16.00	8.00	7.33	5,800	20	3,000
9	TIMOR	1980	95.00	18.40	7.00	3.00	5,300	20	2,000
10	FLORES	1983	95.00	18.40	7.00	5.00	5,300	20	2,000
11	BANDA	1982	71.10	14.00	4.90	4.05	2,130	14	1,000
12	NIAS	1984	71.10	14.00	4.90	4.05	2,130	14	1,000
13	NATUNA	1984	71.10	14.00	4.90	4.05	2,130	14	1,000
14	LOMBOK	1974	64.90	13.00	5.46	3.50	2,200	10	750

(2) Cutter Suction Dredgers

	Name of Ship	Year of Building	Length Overall (m)	Moulded Breadth (m)	Moulded Depth (m)	Diameter of Discharge Pipe (inch)	Total Installed Power (HP)	Dredging Depth (m)
1	BATANG ANAI	1994	80.00	18.50	7.00	30	12,966 kW	24.00
2	MUSI 30	1977	41.45	13.41	2.90	30	6,000	17.68
3	KAPUAS 30	1977	41.45	13.41	2.90	30	6,000	17.68
4	MAHAKAM 24	1976	41.45	13.41	2.90	24	4,500	17.68

(3) Clamshell Dredgers

	Name of Ship	Year of Building	Length Overall (m)	Moulded Breadth (m)	Moulded Depth (m)	Grab Capacity	Total Installed Power (HP)	Dredging Depth (m)
1	DANAU LAUT TAWAR	1990	54.00	23.00	4.50	25.0 m^3	1,139	25
2	SINGKARAK	1981	26.00	11.00	2.50	5.5 m^3	325	14
3	BATUR	1985	28.00	13.00	2.60	7.0 CuY	455	20
4	RANAU	1985	28.00	13.00	2.60	7.0 CuY	455	20
5	POSO	1985	28.00	13.00	2.60	7.0 CuY	455	20
6	TONDANO	1985	28.00	13.00	2.60	7.0 CuY	455	20
7	MANINJAU 93/III	1976	25.92	9.13	2.03	3.5 CuY	211	7
8	TOWUTI	1977	26.00	13.00	1.60	2.5 CuY	160	7

(4) Sand Pump Dredgers

	Name of Ship	Year of Building	Length Overall (m)	Moulded Breadth (m)	Moulded Depth (m)	Total Installed Power	Dredging Depth (m)
1	AGUNG	1996	48.10	14.66	4.10	681 kVA	40
2	MERAPI	1996	48.10	14.66	4.10	681 kVA	40

Source: Dengan Lumpur dan Pasir Kami Mengabdi; company brochure of PT (PERSERO) RUKINDO

3.11.4 Maintenance Dredging in the Channel

(1) Pekanbaru (Sungai Siak)

A 30,000 m^3 of dredging work was carried out in the navigation channel in 1998 in the vicinity of the Perawang Port. This is the only actual result of the dredging in the latest 10 years in Sungai Siak.

The necessity of maintenance dredging in the navigation channel is judged negligible.

(2) Jambi (Sungai Batanghari)

A 10 km of navigation channel for Port of Jambi is maintained by dredging in the estuary of Sungai Batanghari, and is shown in Figure 3.11.2.

The dumping area of the dredged sand/silt is established at the sea area about 12 km distant from the river mouth of Sungai Batanghari (00°54’20”S, 103°50’00”E).

As a general rule, the dumping area is set up at a location with over twenty meters water depth and over three nautical miles distant from shoreline. The current pattern in the sea area is also taken into consideration to prevent the returning of dumped sand/silt to the dredging work area.

The annual average volume of the dredging is around 350,000 m^3/year and the dredging work has been carried out for four times in the recent eight years (refer to Table 3.11.1).

The seabed material of the channel is reported as silt according to Table 3.11.1. But it is advised that the sampling of bed materials, the grain-size analysis and/or measurement of water content are not conducted in the process of the dredging works.

One of the principal problems for the study to improve is the plan and method of dredging so that sampling or measurement to understand the characteristics of the dredged materials is carried out and basic information is provided for the study.

(3) Palembang (Sungai Musi)

The total extension of the navigation channel for Port of Palembang maintained by dredging reaches about 25 km in Sungai Musi. Figure 3.11.3 presents the locations of the navigation channels.

One dumping area of the dredged sand/silt is located in the area of Outer Bar and two other dumping areas are located along the river channel. As for the dumping area inside the river channel, the deep-water pool along the river channel is employed.

The navigation channel along Sungai Musi belongs to DLKP from the river mouth to Sungai Lais and the responsibility for the maintenance and dredging of the channel belongs to the central government (DGSC).

The annual average volume of the dredging reached 2.3 million m^3/year and the dredging work has been carried out every consecutive year (refer to Table 3.11.1).

In the hearings at the Branch Office of Palembang Port (IPC2), it is stated that 85 – 90 % of the dredged volume comes from the channels understream of the Payung island and the area of Outer Bar. According to Table 3.11.3, the public expense for Palembang accounts for about 24 % of the government annual budget for the dredging for the commercial ports.

To cope with the heavy burden of the maintenance cost of the navigation channels, a measure has been implemented to share the cost by the syndicate comprising IPC2 and other companies that have their private wharves along the river channel. The actual rates of sharing in the years 1995 and 2000 were as follows (source: IPC2).

		Rate of Sharing
Year 1995	PERTAMINA（Petroleum Company）	64.4%
	Pupuk Sriwijaja (PUSRI; Fertilizer Company)	23.4%
	IPC-II（Public Port Corporation）	12.2%
Year 2000	PERTAMINA	45.5%
	PUSRI	26.5%
	IPC-II	19.0%
	PT. BUKIT ASAM（Coal Mining Company）	8.0%
	PT. SEMEN BATU RAJA（Cement Company）	1.0%

In the near future, the determination of the sharing of cost by all the stakeholders who depend on the river ports and the public river channels should be discussed and studied broadly. And also the studies for the optimization of the method of dredging (improvement of productivity, examination of excessive dredging, etc.) are necessary.

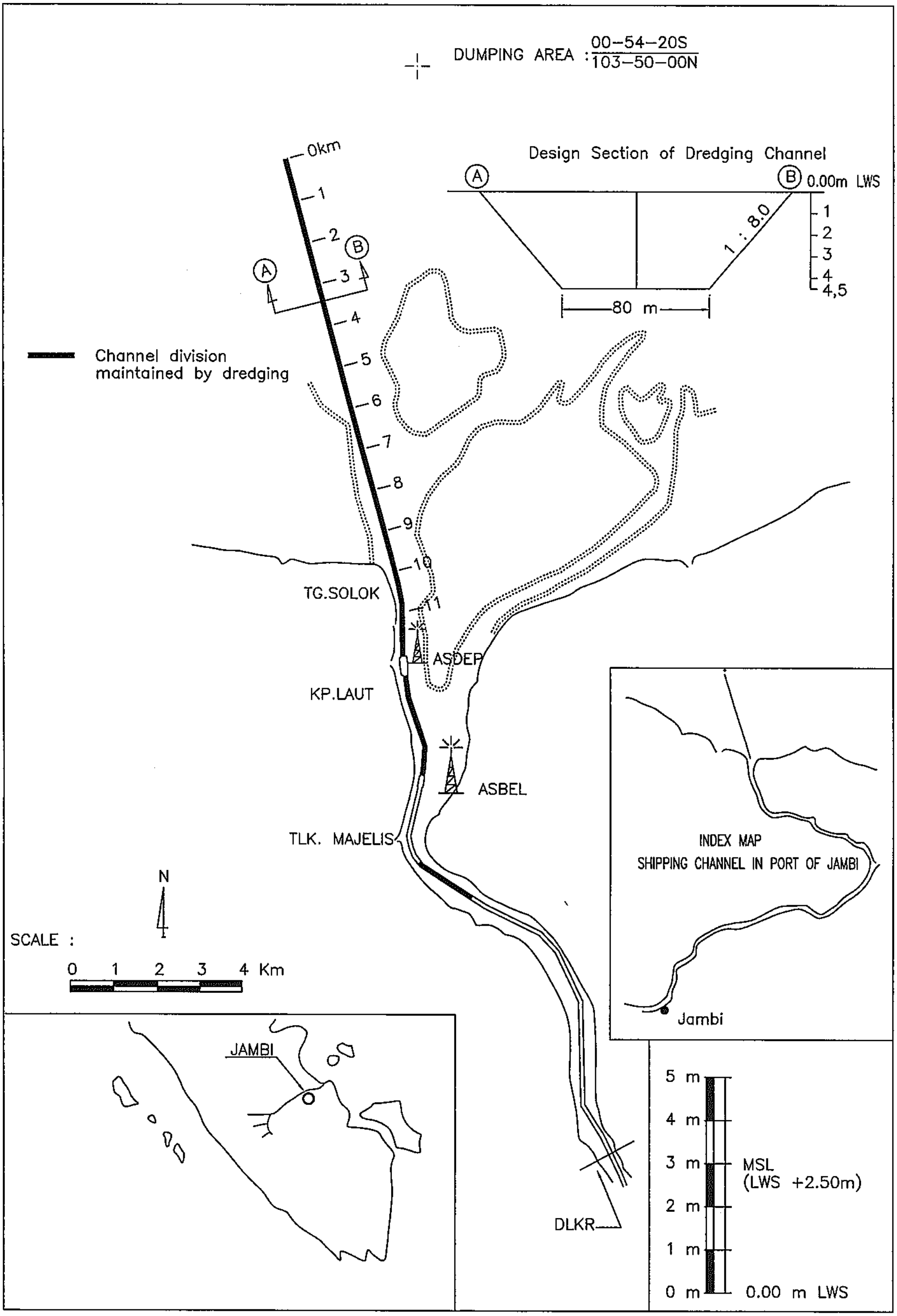


Figure 3.11.2 Channel maintained by dredging in the Estuary of Sungai Batanghari

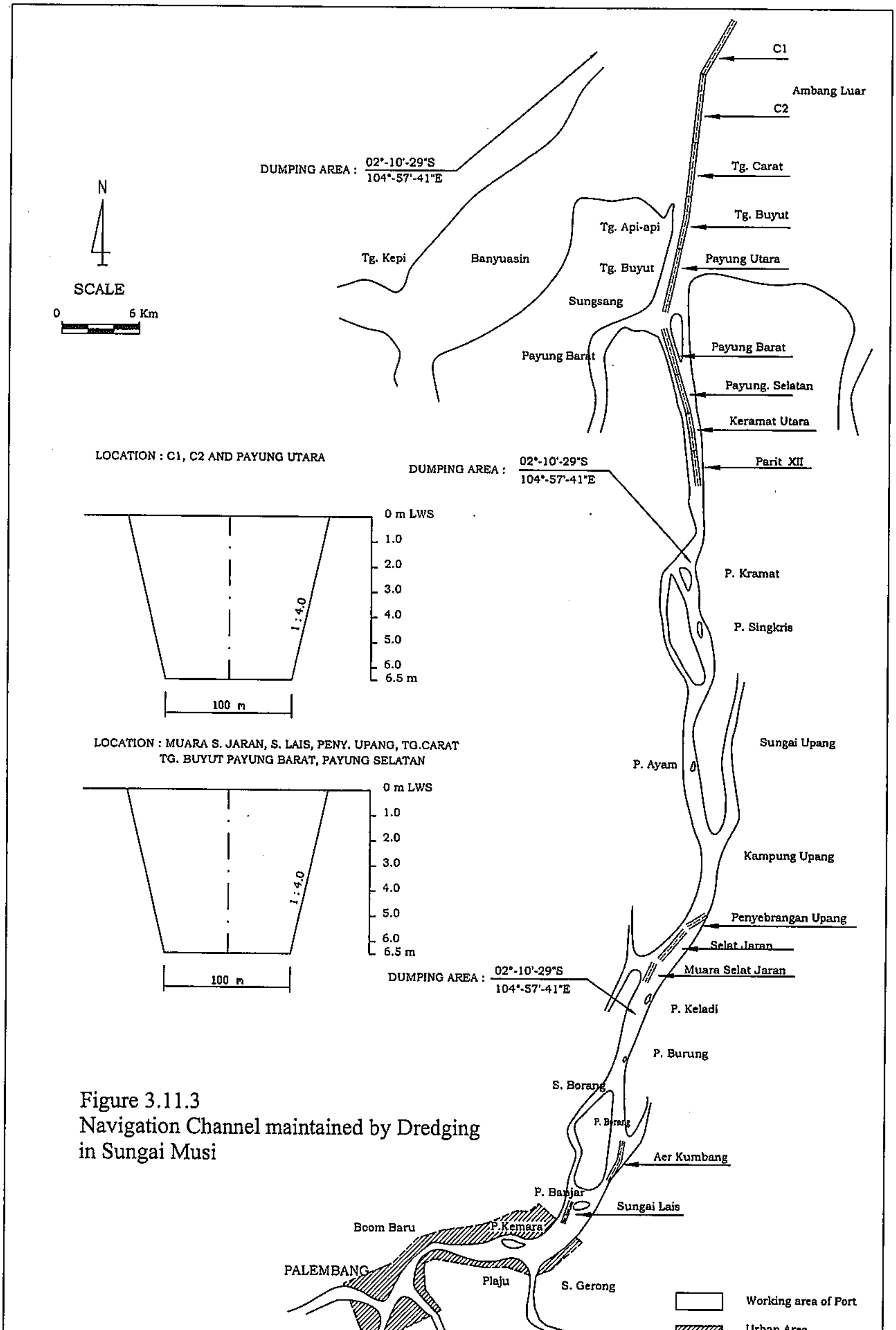


Figure 3.11.3
Navigation Channel maintained by Dredging in Sungai Musi

3.12 Structural Design

3.12.1 General

Table 3.12.1 shows the outline of existing port facilities of Study ports and previously proposed relevant project plans for alternative sites. Since all sites, except for Tanjung Apiapi (Palembang), are located along a river, the effect of marine phenomena such as wave, current, corrosion loss on steel materials by saline water and etc. are expected to be less.

On the other hand, however, another kind of issue is unavoidable; the siltation/sedimentation and river stream itself which will cause to change water depth and alignment of navigation channel. This will affect ship manoeuvrability, sailing time, scoring of riverbed in front of quay structures, and sometimes the stability of the structure. In this section an overview is presented on the present conditions of the principal river ports in Sumatra.

Table 3.12.1 Outline of Port facilities

Location		Sumatra							
		Pekanbaru		**Jambi**			**Palembang**		
Province		Riau		Jambi			South Sumatra		
Port Office		IPC-I		IPC-II					
Name of Port		**Pekanbaru**	**Perawang**	**Jambi**	**Talang Duku**	**Muara Sabak**	**Boom Baru**	**Sungai Lais**	**Tg. Apiapi**
Situation		Existing	Existing	Closed	Existing	Not used	Existing	Existing	Plan
Name of River		Sungai Siak		Sg. Batang Hari			Sungai Musi		Sg. Banyu Asin
Dist. from river mouth		178 km	134 km	157 km	147 km	15 km	111 km	105 km	
Navigation channel	Length			10 km			111 km		Natural navigational approach
	Width	150 m		70 m			120 m		
	Depth (LWS)	- 7 m		N.A.	-4.5 m		-6m		
	Side slope				1:8		1:4		
	Volume				350,000 m3/yr		2,450,000 m3/yr		
Port area					50 ha		4.6 ha		N. A.
Berthing facility	Length	278m	88 m		67 m x 3	80 m	736 m	280 m	
	Depth	-3.5/-5 m					-7 to 9.2 m	-3.5 m	
	Width		20 m		10 m		10.5-19.5 m	15 m	
	Max. Ship	1000 DWT							
	Structure	*Concrete Deck on piles *Sheet pile	Concrete deck on piles		Pontoons 2x Conc. 1x Steel, With movable access	Concrete deck on piles	Concrete deck on piles	Sheet pile wall	
Port yard	Gen. Cargo		0.2 ha				0.8 ha	0.4 ha	
	Container	0.34 ha	0.5 ha		8 ha	3 ha	3.6 ha		

(Cont'd) **Table 3.12.1 Outline of Port facilities**

Name of Port	**Pekanbaru**	**Perawang**	**Jambi**	**Talang Duku**	**Muara Sabak**	**Boom Baru**	**Sungai Lais**	**Tg. Apiapi**
CFS			N.A.	NA				N.A.
Warehouse(unit/m2)	3/1920					8972		
Passenger terminal (person)	150					196		
Power supply (KVA)	62			105				
Water supply(m3/hr)	30							
Road access	Available	Available		Available	Available	Available	Available	
Remarks		Operation started in April '99	Closed in 1997	Operation started in April '97	Not used		For local boat	

Source: 1) "Pelabuhan yang diusahakan"
2) Information,IPC-I, Cabang Pekanbaru
3) "Pelabuhan Jambi"
4) Informasi Pelabuhan Indonesia 1999
5) "Pekerjaan Study Master Plan "Muara Sabak"Jambi",ITB
6)"Pekerjaan Pengerukan alur Pelayaran didalam DLKR/DLKP untuk Pelabuhan yang diusahakan

3.12.2 Design Standard

In this report, the basis of the technical overview was the following design standards or technical reference materials.

1) Standard Design Criteria for Port in Indonesia, Jan 1984, DGSC
2) Technical Standards for Port and Harbor Facilities in Japan 1991
3) Port Development for Planners in Developing Countries, UNCTAD

3.12.3 Sub-soil Conditions

At a majority of the Study ports, sub-soil consisted of rather soft stratum. At some port sites such as Pontianak, tha hard stratum extends deeper than –60 m below LWS (Low Water Spring). In this case, it will affect the selection of berthing structure and other on-land facilities; hence, careful determination of the settlement and/or consolidation of reclaimed land will be needed. Some available information of existing soil boring is summarized in the following table for reference.

Table 3.12.2 Sub-soil Conditions of some existing Ports

Name of Port	Palembang (Perawang)	Muara Sabak (Jambi)
Soil classification and thickness (depth) of upper stratum	River-bed to -11 m: Clay - 11 m to – 30 m: Fine sand	River-bed (-4 m) to –14 m: Clay -14m to –37m: Silt and clay alternately -37 m and below: sand
N-value (SPT)	River-bed to –11 m: 2 to 3 -11 m to –30 m: 10 to 46	River-bed (-4 m) to –14 m:2 to 7 -14m to –37m: 20 to 40 -37 m and below: 30 to 40
Depth of hard stratum (LWS-m)	- 30 m	Not confirmed

Source: 1) Information of IPC1, 2) "Pekerjaan Study Master Plan Muara Sabak" Jambi" ITB

3.12.4 Water Level

The range of water level is affected not only by tide level but also by the flow of river water. The approximate water level ranges at each river mouth and proposed port site are summarized in following Table 3.12.3. The tide range of each Study port is not so large except for Jambi where water level varied much more than that of the river mouth due to flood flow. To meet the large water range, pontoon type jetties were utilized for Talang Duku Port (Jambi).

Table 3.12.3 Tidal range at each river mouth and proposed port site

Name of Port	Pekanbaru	Jambi		Palembang
	Sungai Siak	Sungai Jambi	Muara Sabak	Sungai Musi
Location	River mouth	River mouth	15 km from river mouth	River mouth
HWL			5.14	
Mean High Water Spring (m)		3.4		3.1
Zo (m)	1.8	2.5		1.9
LWL			2.90	
Mean Low Water Spring (m)		1.0		0.9

Source: 1) Daftar Pasang Surut 2001, 2) Marine chart 1788, 3476,
3) Pekerjaan Study Master Plan “Muara Sabak” Jambi 2000, ITB

Note: Zo shows the height of MSL(Mean Sea Level) above Chart datum.

3.12.5 Design Criteria

(1) Live loads

The design load conditions of existing and planned facilities are summarized in following Table 3.12.4. The data in the Table will be examined and referred to for preparing recommendations of the Study in a later stage.

Table 3.12.4 Load Conditions of existing facilities

Location		Jambi				Tg. Apiapi	Pontianak	Samarinda
		Jambi	Talang Duku	Muara Sabak			Quay No.7	
		Existing	Existing	Existing	Plan	Plan	Existing	Existing
Uniform load on concrete deck	Ton/m2	3.0	3.0		5.0	5.0 (C/C) 3.0 (G/C)	4.0 (C/C)	3.0
Uniform load on wooden deck	Ton/m2			0.5				
Uniform load on warehouse floor	Ton/m2							3.0

(Cont’d)

(Cont'd) Table 3.12.4

Location		Jambi	Talang Duku	Muara Sabak		Tg. Apiapi	Pontianak Quay No.7	Samarinda
				Existing	Plan			
Top loader (concentration on 60x60 cm)	Ton						40.0	
Container Gantry Crane load (sea side)	Ton/m						36.4	
Container Gantry Crane load (land side)	Ton/m						26.4	
Wind load (kg/m2)					40			
Ship berthing velocity	cm/sec				15 to 20		12.5	
Ship berthing angle	0						10	

Source: 1) "Port of Jambi" IPC-II

2) "Alternative of Samarinda Port Development"IPC-IV

3) "Facilitas Pelabuhan Samarinda"IPC-IV

4) Information of IPC-II

5)"Review Study kelayakan Plabuhan Tanjung Api-api" BAPPEDA Sumatra Selatan

Notes 1) G/C: general cargo, 2) C/C: container cargo

In order to introduce appropriate container handling system, uniform load on the quay concrete deck and connected landside container yard will be determined in the later part of the Study. Depending on the forecast scale of cargo volume, the number of layers of in container stacks or general cargo storage height will be determined, so that the productivity on the unit land area (container yard or general cargo storage) will be maximized.

(2) Seismic Load

A precise seismic load condition on the existing port facilities was not obtained from each Port except for Muara Sabak. The design seismic factor is, therefore, estimated by using regional seismic coefficient for each port site as follows.

Table 3.12.5 Estimated Seismic Coefficient for each Port

Name of Port	Pekanbaru	Jambi	Jambi	Palembang
			Muara Sabak	
Number of Seismic Zone	5	5		5
Regional Seismic Coefficient	0.03	0.03		0.03
Factor for subsoil condition 1/	1.2	1.2		1.2
Coefficient of Importance 2/	1.5	1.5		1.5
Design seismic coefficient	0.054	0.054	0.045 3/	0.054

Notes: 1/ Class 3 subsoil (poor or deep deposits), 2/ Classification of structure(Special class), 3/ Source:"Pekerjaan Study Master Plan "Muara Sabak" jambi"ITB

(3) Ship berthing velocity

As to the ship berthing velocity, a little bit higher speed is recommendable to secure safe berthing against the momentum of the ship mass resulting from the river stream. So far as budget or quay structure (strength) allows, 15 to 20

cm/sec of design berthing speed is preferable.

3.12.6 Dimension of Navigation Channel

The width of existing navigation channels are summarized in previous Table 3.12.1. Hence for example, if container vessels of the size 3000 to 4000 DWT were assumed to ply the navigation channel, the following details would be determined.

Average 3000 to 4000 DWT container ships:
1) LOA (length overall): 85 to 95 m
2) Beam: 13.2 to 14.4 m
3) Draft (full): 5.9 to 6.4 m
4) Loading capacity: 200 to 250 TEU

The required width of a safe navigation channel (W) will be obtained by one of following three methods:
1) Japanese design standard: W= 1.0 x LOA=1.0 x (85 to 95 m)=85 to 95 m (infrequent trips)
2) Indonesian Design Criteria: W=(4B to 7B)+30 m=83 to 131 m
3) UNCTAD handbook: W=6B+ 30 m=109 to 116 m

The above required width can be compared with that of the existing channel, which is good only for a one-way voyage. Considering the rather long length of the existing navigation channels, the width of some channels is insufficient for unrestricted access to the port and prevention of accidents mid channel.

3.12.7 Structural Type of Port Facilities

As summarized in Table 3.12.1, most existing quay facilities are “Concrete deck on piles” type. Some use batter/raking piles to resist lateral force. Many variations on materials of foundation piles were observed such as 1) Square section R/C (reinforced concrete) pile, 2) Square section P/C (pre-stressed concrete) pile, 3) Cylindrical section centrifugal P/C pile, and 4) Steel pipe pile. A determination will be made on the materials of the foundation piles taking the effects of steel corrosion by seawater into consideration during the succeeding study.

In some ports, steel sheet pile walls are being utilized for retaining wall and quay structure. In Pontianak, concrete U-shaped sheet pile type was adopted for retaining wall on landside of Quay wall. In Pekanbaru and Sungai Lais a steel sheet pile wall was adopted for local ship quay structures.

3.12.8 Cargo Handling Equipment and Port Service Boats

The number of existing cargo handling equipment and port service boats are summarized by specific capacities in Table 3.12.6. In addition to this equipment, some other equipment is owned and working for cargo handling gangs of the private sectors of each port.

Table 3.12.6 Existing Equipment

Location			**Sumatra**							
			Pekanbaru		**Jambi**			**Palembang**		
Province			Riau		Jambi			South Sumatra		
Port Office			IPC-I		IPC-II					
Related Port			**Pekan baru**	**Perawang**	**Jambi**	**Talang Duku**	**Muara Sabak**	**Boom Baru**	**Sungai Lais**	**Tg. Apiapi**
Existing/Plan			Existing	Existing	Closed	Existing	Not used	Existing	Existing	Plan
Cargo Handling equipment (unit)	Mobil crane (unit)	4 ton	1							
		15 ton						1		
		25 ton						1		
		35 ton						2		
		50 ton				1				
	Forklift (unit)	2 ton	1					2		
		3 ton	1					2		
		5 ton	2							
		10 ton				1		1		
		15 ton				1		1		
	Side loader	15 ton								
	Top loader	40 ton						1		
	Head truck	40 ton				1		1		
	Chassis	20 ton								
		40 ton				2		4		
	Gantry crane	30.5 ton								
Service vessel (unit)	Tug Boat					2		1		
	Pilot Boat							4		
	Mooring Boat		3 x82 HP					2		
	Line Boat									
	Speed Boat									
	Pontoon					5		2		

Source: 1) "Pelabuhan yang diusahakan"
2) Information,IPC-I, Cabang Pekanbaru
3) "Pelabuhan yang diusahakan"
4) "Pelabuhan Jambi"
5)"Informasi Pelabuhan Indonesia" 1999

Among the Study ports, only Pontianak utilizes a container gantry crane, while all others are still using mobile cranes or top-loader/forklift for container handling. Although it is understandable that each Port branch office wants to obtain a gantry crane and yard transfer crane system, the future container cargo handling system for each port should be examined on the basis of the future port development stages, which depend on the scale of the future container cargo volume for each Study port.

Most probably, the container handling system will be one of the following systems in consonance with the future container cargo volume:

1) Ship gear --- Top loader /Reach stacker or mobile crane --- outside trailer
2) Ship gear --- Trailer truck --- Top loader/Reach stacker or mobile crane --- outside trailer
3) Ship gear --- Straddle carrier --- outside trailer
4) Quay Gantry crane --- Straddle carrier ---outside trailer
5) Quay Gantry crane --- Yard trailer truck --- Yard Transfer crane (RTG: Rubber Tired Gantry crane, or RMG: Rail Mounted Gantry crane) --- outside trailer

Aside from the above lack of the port facilities, however, it should be kept in mind that the port congestion in many Study ports are being caused by the following major cargo handling activities:

1) Container stripping is made in the port yard, sometimes stripping and/or staffing works were observed even on the apron. (lack of in-land container depot)
2) Due to lack of empty container yard, stored empty containers occupied large port space.
3) Mixed use of cargo handling space for general and container cargos.
4) Mixed use of local wooden boats with low productivity and bigger ships which should have much higher productivity.

3.13 Conditions of Construction Procurement

3.13.1 General

For the purpose of estimation of construction cost, unit price of each element such as labour, major construction material and equipment are to be determined on the basis of the regional unit prices collected in the field survey in the Study Areas.

The basic costs of imported products are to be estimated using the average exchange rate of the currencies (Rupiah, Japanese Yen, US Dollar, etc.) based on the fluctuation of the half-year period prior to the estimation.

The basic costs of the construction works and unit prices are to be studied and the differences are compared among the provinces concerning the availability of materials, labor, construction equipment and accessibility to the sites.

The capacity and capability of the local contractors are to be checked with respect to their experiences of marine construction works considering the dimensions of the development and port facilities.

3.13.2 Findings in the Each Region

(1) Jakarta and Surabaya (Java)

Many construction companies exist which have experiences in the construction of the port facilities. Those contractors have large numbers of construction equipment, experienced engineers and skilled workers. Almost all the construction materials are available in the Java region.

In the most cases, the construction material/equipment/labour will be mobilized from this region to the construction site in the local region.

(2) East Coast of Sumatra, West, Central and East Kalimantan

Some branch offices of the construction companies in this region exist which have experiences in port facilities. The large-scale construction equipment will be mobilized from Jakarta Medan or Surabaya. The major construction materials such as structure steel, cement and sheet piles will be provided from the Java region.

3.13.3 Basic Cost of Construction Work

(1) Basic Cost of the Works

The breakdown of unit costs of the construction works are to be prepared by accumulating costs of labour, materials, equipment and also the indirect costs such as general temporary works, overheads profit and so on.

While, the cost of the works such as building works, fabrication of cargo handling equipment, supply of utilities and demolition works are to be hindcast on the basis of the empirical prices collected from the major contractors which have experiences in the regions. The unit cost of cargo handling equipment will include the costs of design, manufacturing, workshop tests, delivery and installation.

Price of imported products such as fender systems, bollard and navigation aids are to be estimated based on the CIF Jakarta price and adjusted considering import tax and some mobilization fee to the construction site.

(2) Depreciation Periods of Port Facilities

The depreciation periods of port facilities are to be assumed based on the report “Taksiran Umur Ekonomis Tetap” (source: IPC2, 1995) summarized below.

Table 3.13.1 Depreciation Period of Port Facilities

Port Facilities	Year	Remarks
Revetment and Quay	50	
Cargo Handling Equipment	20	
Building	50	Permanent
Navigation Aids	10	
Fender System	10	

3.14 Natural Conditions of Study Areas

3.14.1 Pekanbaru (Sungai Siak)

(1) Position

Port of Pekanbaru is located on Sungai Siak (Riau Province) about 90 miles (165 km) upstream from the river mouth (00º32’29”N, 101º26’21”E). The entrance and navigation channel to the port is via Selat Bengkalis (Bengkalis Strait) and Sungai Siak (Siak River).

(2) River basin and discharge

Topography of the river basin of Sungai Siak is flat lowland and swamp covered by mangrove (bakau) forest still remaining undeveloped around Pekanbaru. The elevation of the urban area of Pekanbaru is 3-5 m above mean sea level (MSL).

Sungai Siak has a catchment area of 12,474 km^2 (Figure 3.14.1) and total length of the main stream (including the branch stream) 572 km. The average yearly discharge is given 15,744 x 10^6 m^3/year (Source: Kantor Menteri Negara Pekerjaan Umum; 2000).

The width of the river channel varies 75 - 100 m, the water depth of the channel ranges from 3-5 m (at the river mouth confluence at Selat Bengkalis) to 15-20 m (at mid stream). The extension of the navigable channel is seen as 261 km (source: Dinas Pekerjaan Umum, Propinsi Riau).

(3) Climate (Figure 3.14.4)

Climate in Pekanbaru has rainy season (November to April) and dry season (May to October). In rainy season, average rainfall in the area is 150 – 250 mm with total 15-20 rainy days per month. It is usually fine weather in dry season with rainfall of 50 – 100 mm and 7-12 rainy days per month.

(4) Tide and waterlevel fluctuation

Average tidal range is 2.20 m at spring tide and 0.60 m at neap tide. The tidal form is mixed semi-diurnal. Amplitude (cm) of tidal constituents at Sungai Siak is as follows (source: Tide Table; Dinas Hidro-Oseanografi, 2001).

M_2: 68, S_2: 40, N_2: 12, K_2: 11, K_1: 9, O_1: 25,

Number of tidal type $F = (K_1 + O_1)/(M_2 + S_2) = 0.315$ (mixed semi-diurnal)

Water level fluctuation in the river channel has the range of 1.5-2 m at Pekanbaru (Figure 3.14.7) and still maintains semi-diurnal tidal characteristics.

(5) Current

Maximum current speed (2.5 knots) in the river channel occurs at ebb tide about 2.5 hours before low water. At flood tide, maximum current is 2 knots and occurs about 2.5

hours before high water (source: Informasi Pelabuhan; Dinas Hidro-Oseanografi, 2001).

3.14.2 Jambi (Sungai Batanghari)

(1) Position

Port of Jambi is located on Sungai Batanghari (Jambi Province) about 85 miles (155 km) upstream from the river mouth (01º35’15”S, 103º50’48”E). The entrance channel to the port is facing Selat Berhala (Berhala Strait) and was relocated by dredging from the old channel at the neighboring east shoal.

(2) River basin and discharge

Topography around the port area is flat lowland and swamp formed by alluvial deposit. The elevation of the urban area of Jambi is 8-10 m above MSL.

Sungai Batanghari is the largest river in Sumatra; it has a catchment area of 44,554 km^2 (Figure 3.14.2) and stretches over three provinces (Jambi, West Sumatra and Riau). The total extension of the main stream (including the branch) is 691.5 km. The width of the river channel varies 300 - 500 m, the water depth of the channel ranges 6-7 m.

Average normal discharge of Sungai Batanghari in rainy season is about 3,400 m^3/sec and the minimum discharge in dry season is 300 m^3/sec. The average yearly discharge is given as 46,826 x 10^6 m^3/year (Source: Kantor Menteri Negara Pekerjaan Umum; 2000).

(3) Climate

Oceanic tropical climate is dominant in this area. Climate in Jambi seems to have rainy season (November to April) and dry season (May to October).

The dry season is June and July in the area and sometimes has rainfall of 80-95 mm per month. The biggest of rainfalls are in November/December and in March/April when the rainfall averages 300-400 mm per month.

(4) Tide and water level fluctuation in river

Average tidal range at the river mouth (Kuala Niur) is 3.5 m at spring tide and 0.7 m at neap tide. The tidal form is mixed semi-diurnal. Amplitude (cm) of tidal constituents at Kuala Niur is as follows (source: Tide Table; Dinas Hidro-Oseanografi, 2001).

M_2: 78, S_2: 19, N_2: 12, K_2: 9, K_1: 67, O_1: 48, P_1: 5, M_4: 6, MS_4: 7,
Number of tidal type $F = (K_1 + O_1)/(M_2 + S_2) = 1.186$ (mixed semi-diurnal)

Maximum current speed (2.5 knots) in the river channel occurs at ebb tide.

Yearly water level fluctuation in the river channel is rather big in Sungai Batanghari and has its range of 5-6 m at Talang Duku (Jambi) between dry season and rainy season. In the rainy season, the high water level following flood discharge continues for 3 – 4 weeks

(Figure 3.14.8).

3.14.3 Palembang (Sungai Musi)

(1) Position

Port of Palembang is located on Sungai Musi (South Sumatra Province) about 105 km upstream from the river mouth (02º58’48”S, 104º46’36”E). The estuary area faces Selat Bangka (Bangka Strait) and the large Outer Bar area is formed by silt sedimentation. The entrance channel to the port is narrow and maintained by dredging.

(2) River basin and discharge

Topography from the urban area of Palembang to the coastline is flat lowland and swamp formed by alluvial deposit. The elevation of the urban area of Palembang ranges 0-20 m above MSL.

Sungai Musi has a catchment area of 77,234 km^2 and it accounts for 70 % of the area of the province. The water depth of the river channel is generally more than 5 m below LWS and the width of the river channel is 300 - 600 m.

Average normal discharge of Sungai Musi (at Boom Baru) in rainy season is about 3,500 m^3/sec and the minimum discharge in dry season is 1,800 m^3/sec. The average yearly discharge is given as 78,260 x 10^6 m^3/year (Source: Kantor Menteri Negara Pekerjaan Umum; 2000).

(3) Climate

Climate in Palembang seems to have two rainy seasons in a year (i.e., March – July and October – January). In the main rainy season from October to January, it has rainfall of 250 – 350 mm per month

(4) Tide

Average tidal range is 3.80 m at spring tide. The tidal form is diurnal. Amplitude (cm) of tidal constituents at the river mouth is as follows (source: Tide Table; Dinas Hidro-Oseanografi, 2001).

M_2: 27, S_2: 13, N_2: 5, K_2: 4, K_1: 80, O_1: 60, P_1: 23,
Number of tidal type $F = (K_1 + O_1)/(M_2 + S_2) = 3.50$ (Diurnal)

(5) Current

Maximum current speed (2-3 knots) in the river channel occurs at ebb tide and the characteristics of current is diurnal similar to the tide. The current of the river without effect of tide has maximum speed 0.6 knots.

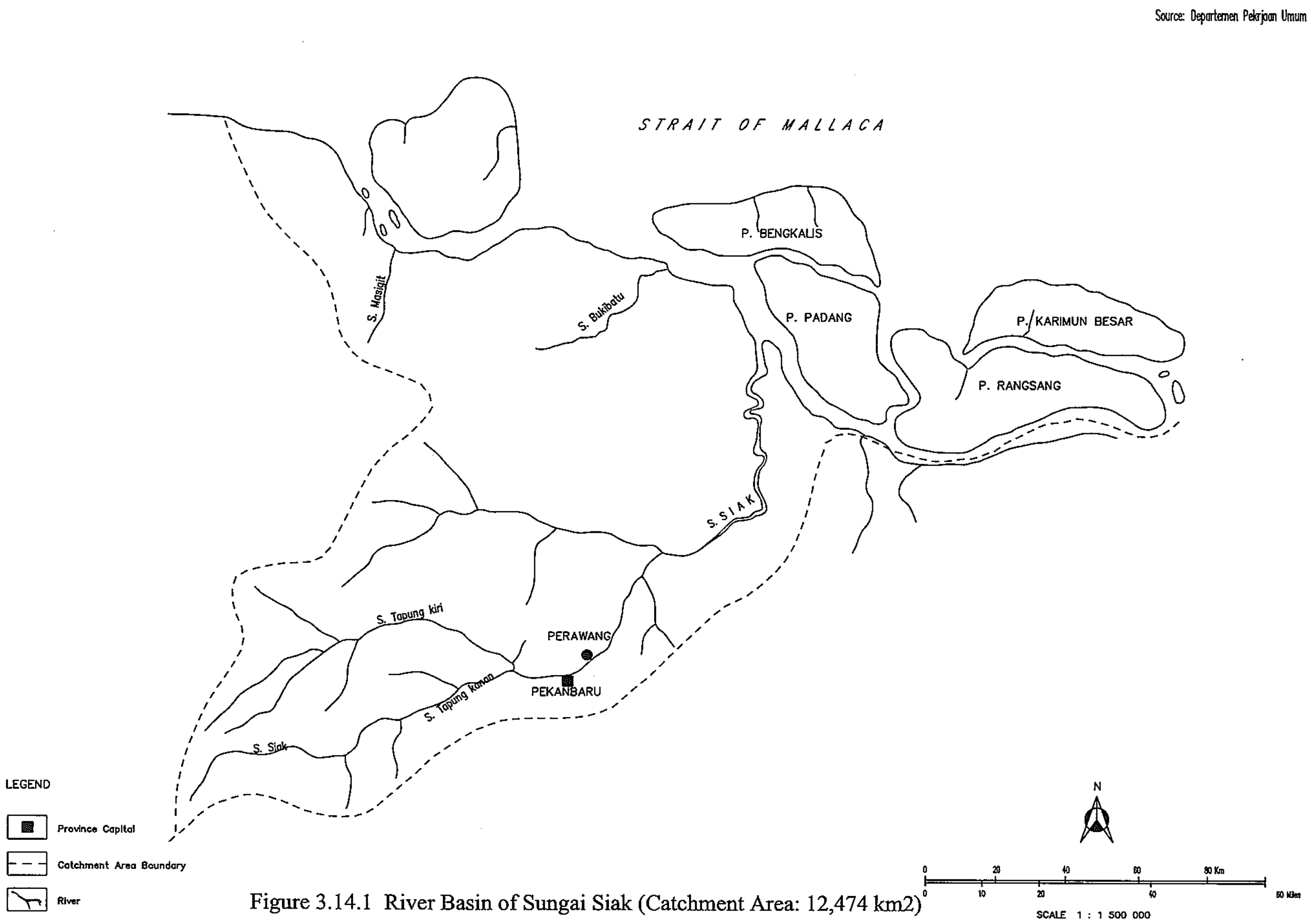


Figure 3.14.1 River Basin of Sungai Siak (Catchment Area: 12,474 km2)

Source: Departemen Pekerjaan Umum

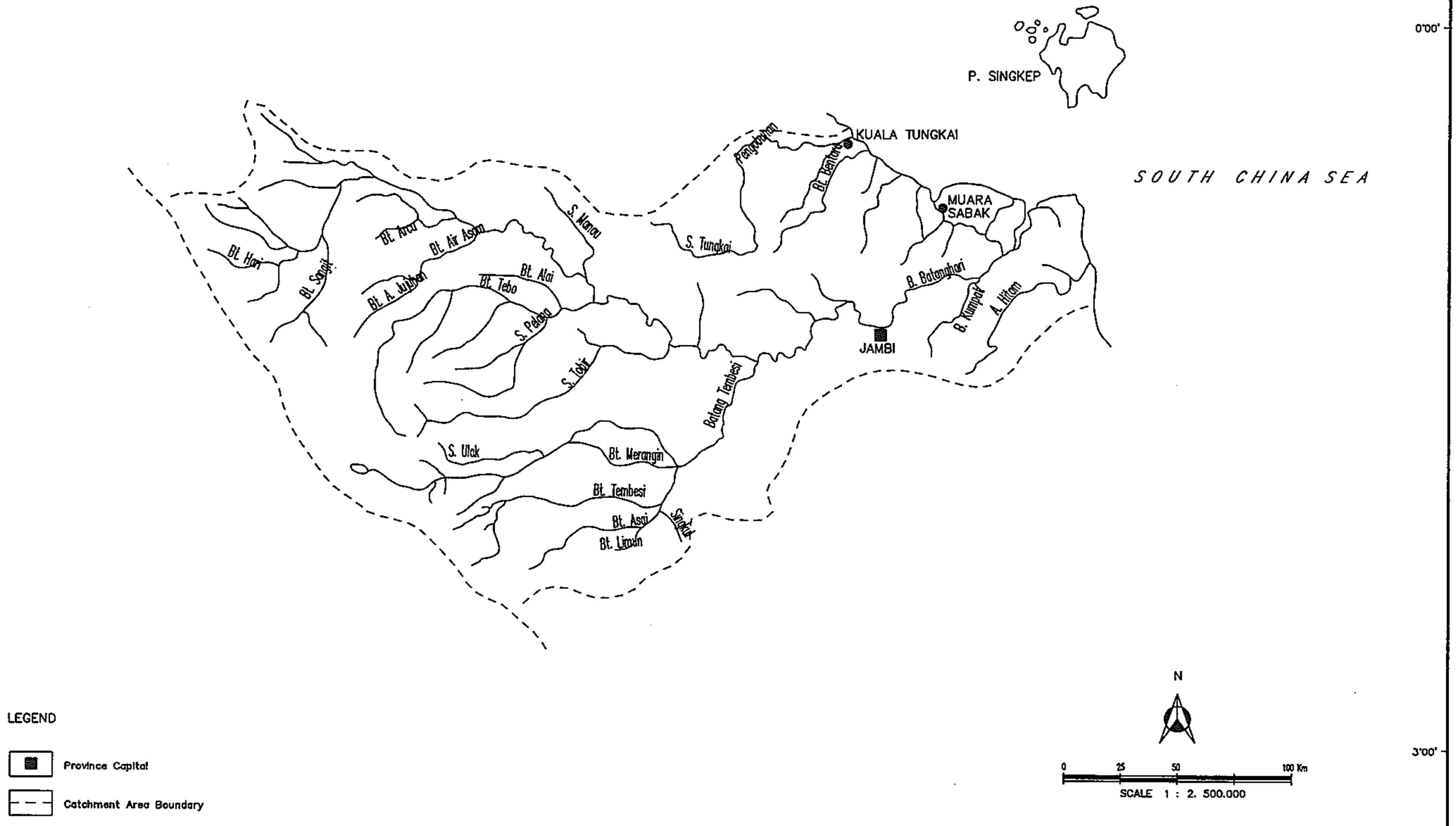


Figure 3.14.2 River Basin of Sungai Batanghari (Catchment Area: 44,554 km2)

Source: Departemen Pekerjaan Umum

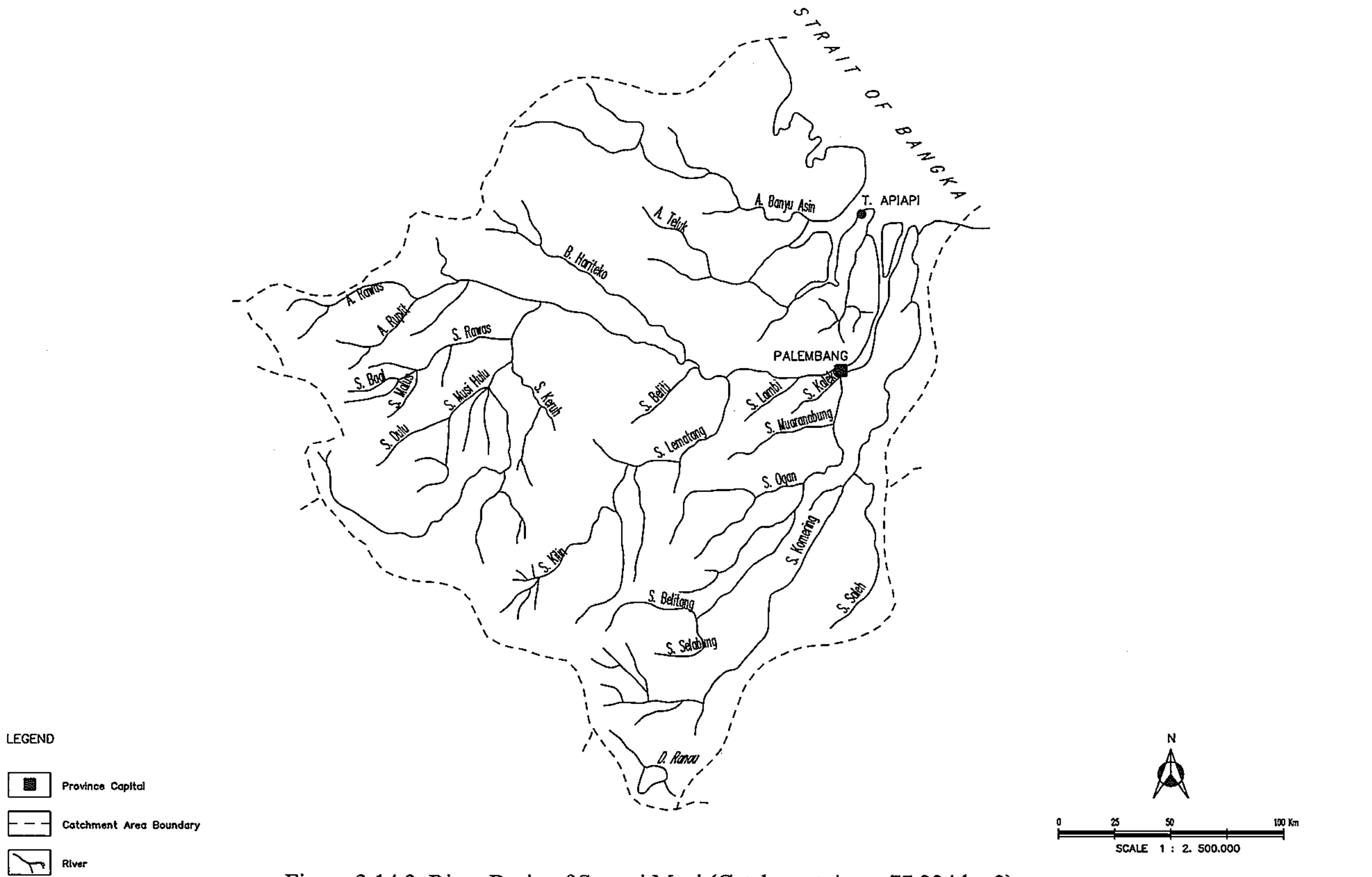


Figure 3.14.3 River Basin of Sungai Musi (Catchment Area: 77,234 km2)

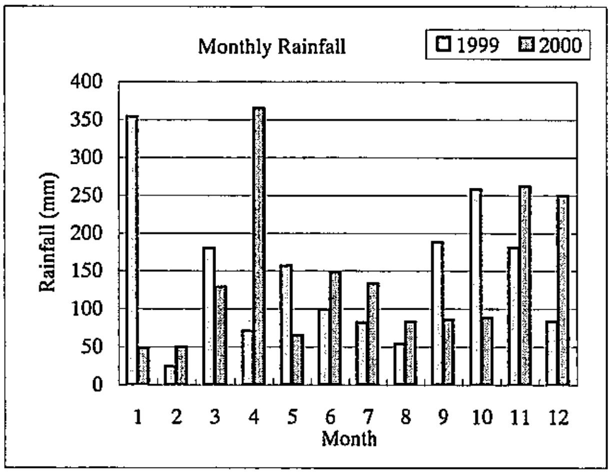
Pekanbaru

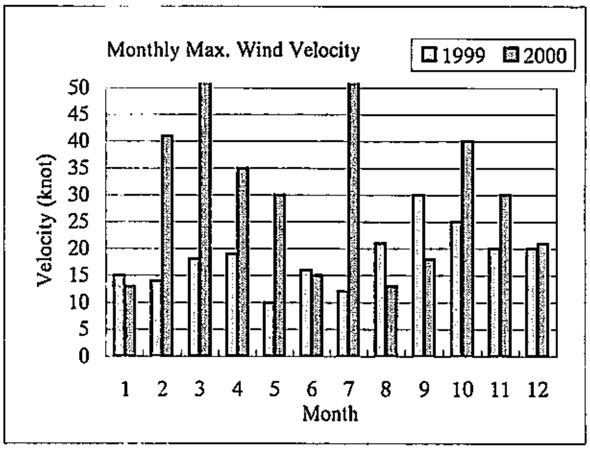
Item	Unit	1999												Total	Average
		1	2	3	4	5	6	7	8	9	10	11	12		
Temparature (Max.)	°C	31.8	33.8	32.6	33.7	32.9	33.4	32.8	32.0	32.9	32.7	32.4	31.5		32.7
Temparature (Min.)	°C	22.1	22.4	22.6	23.3	22.7	22.5	22.2	22.3	22.2	22.8	22.4	23.1		22.6
Humidity (Max.)	%	97	97	97	95	98	95	95	97	97	98	96	96		96.5
Humidity (Min.)	%	62	53	59	53	59	56	55	60	61	58	57	58		57.6
Rainfall	mm	354	24	180	71	157	99	82	54	188	258	181	84	1,732	144.3
Wind velocity (Max.)	knot	15	14	18	19	10	16	12	21	30	25	20	20		18.3
Dominant Wind Direction		N	N	N	N	N	N	N	N	N	N	N	NW		

Item	Unit	2000												Total	Average
		1	2	3	4	5	6	7	8	9	10	11	12		
Temparature (Max.)	°C	30.9	32.3	33.4	33.3	34.6	32.9	33.9	32.9	33.8	34.0	32.5	33.1		33.1
Temparature (Min.)	°C	20.1	22.3	22.2	22.8	23.1	22.1	22.2	22.4	22.4	22.9	22.6	23.0		22.3
Humidity (Max.)	%	96	95	96	98	96	96	95	95	96	96	96	96		95.9
Humidity (Min.)	%	61	55	52	56	52	59	52	58	56	50	75	55		56.8
Rainfall	mm	49	50	129	365	65	148	134	83	86	88	262	250	1,709	142.4
Wind velocity (Max.)	knot	13	41	66	35	30	15	66	13	18	40	30	21		32.3
Dominant Wind Direction		NE	NE	NW	NW	N	N	S	N	--	NW	NW	NW		

Note -- No data

Data source Badan Meteorologi dan Geofisika, Departemen Perhubungan





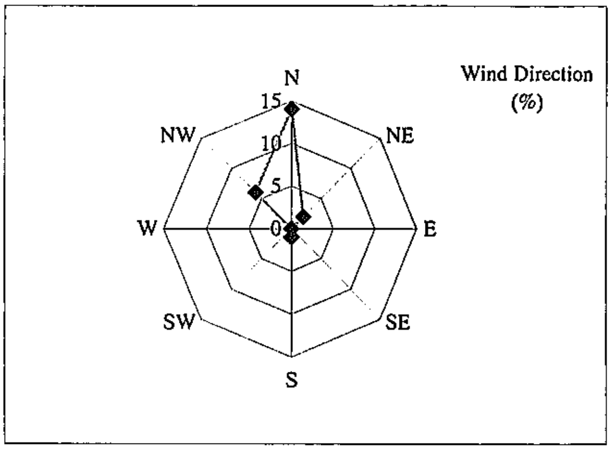


Figure 3.14.4 Climate in Pekanbaru

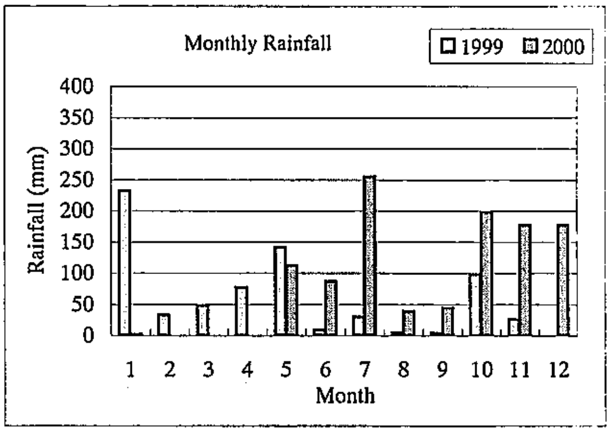
Jambi

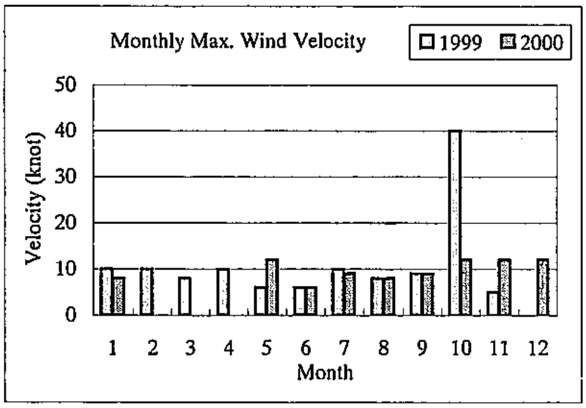
Item	Unit	1999												Total	Average
		1	2	3	4	5	6	7	8	9	10	11	12		
Temparature (Max.)	°C	30.8	30.1	31.1	31.9	31.8	32.4	32.5	32.5	31.8	31.4	31.5			31.6
Temparature (Min.)	°C	23.4	23.3	23.1	21.0	23.2	22.7	22.8	22.1	23.0	22.6	22.8			22.7
Humidity (Max.)	%	96	96	97	97	98	97	97	96	96	96	97	--		96.6
Humidity (Min.)	%	69	67	71	65	66	65	55	55	56	62	63	--		63.1
Rainfall	mm	232	33	48	77	141	9	30	5	4	98	26		703	63.9
Wind velocity (Max.)	knot	10	10	8	10	6	6	10	8	9	40	5			11.1
Dominant Wind Direction		NW	N	C	C	C	C	NE	SE	C	C	C	S		

Item	Unit	2000												Total	Average
		1	2	3	4	5	6	7	8	9	10	11	12		
Temparature (Max.)	°C	30.8	--	--	--	32.3	31.4	31.9	31.7	32.5	32.2	32.1	30.7		31.7
Temparature (Min.)	°C	22.8	--	--	--	23.2	23.6	22.1	22.2	22.5	22.8	22.0	23.2		22.7
Humidity (Max.)	%	94	--	--	--	97	98	97	97	97	97	97	98		96.9
Humidity (Min.)	%	63	--	--	--	66	66	64	61	61	59	63	68		63.4
Rainfall	mm	2	--	--	--	112	87	255	39	44	198	177	177	1,091	121.2
Wind velocity (Max.)	knot	8	--	--	--	12	6	9	8	9	12	12	12		9.8
Dominant Wind Direction		NW	--	--	--	S	C	S	S	S	C	C	NW		

Note --: No data; C: Calm

Data source Badan Meteorologi dan Geofisika, Departemen Perhubungan





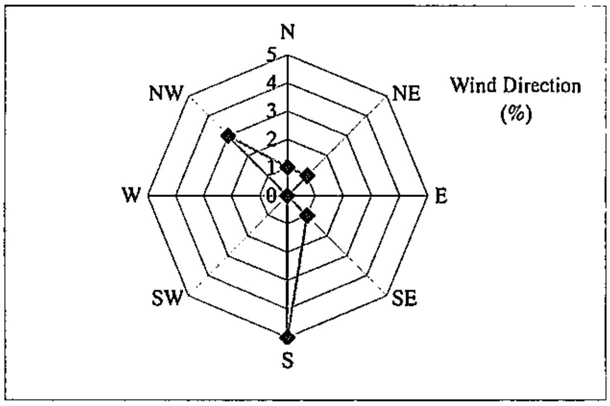


Figure 3.14.5 Climate in Jambi

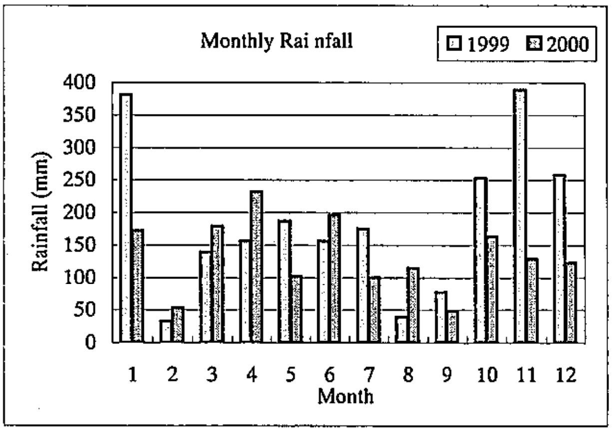
Palembang

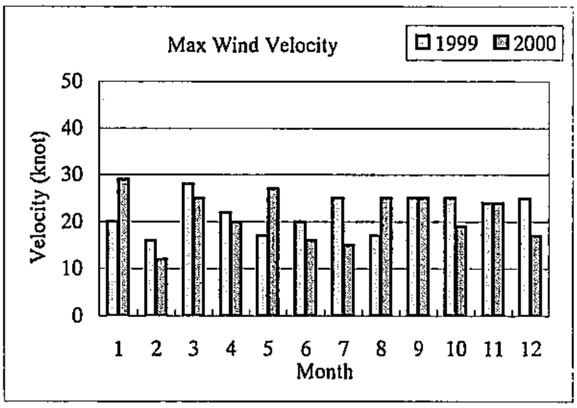
Item	Unit	1999												Total	Average
		1	2	3	4	5	6	7	8	9	10	11	12		
Temparature (Max.)	°C	30.8	33.2	31.8	32.8	31.9	32.6	31.5	32.4	32.7	31.9	31.5	30.5		32.0
Temparature (Min.)	°C	23.2	24.0	23.4	23.8	23.6	23.3	22.6	22.5	22.6	22.5	23.1	23.4		23.2
Humidity (Max.)	%	97	96	97	96	97	97	96	96	96	97	97	96		96.5
Humidity (Min.)	%	65	56	60	55	61	54	56	52	51	61	61	65		58.1
Rainfall	mm	381	32	139	156	187	156	175	39	77	253	389	258	2,242	186.8
Wind velocity (Max.)	knot	20	16	28	22	17	20	25	17	25	25	24	25		22.0
Dominant Wind Direction		NW	NW	NW	N	SE	S	SE	SE	SE	N	NW	NW		

Item	Unit	2000												Total	Average
		1	2	3	4	5	6	7	8	9	10	11	12		
Temparature (Max.)	°C	30.1	31.1	32.2	32.6	31.6	30.8	31.9	32.0	33.1	32.6	31.9	31.1		31.8
Temparature (Min.)	°C	23.1	22.7	22.5	23.1	23.8	23.4	23.1	23.7	22.6	23.1	23.2	23.3		23.1
Humidity (Max.)	%	97	97	97	97	97	97	97	96	97	97	97	96		96.8
Humidity (Min.)	%	67	58	60	60	57	62	58	57	56	59	63	65		60.2
Rainfall	mm	172	53	179	232	102	196	100	115	48	163	129	123	1,612	134.3
Wind velocity (Max.)	knot	29	12	25	20	27	16	15	25	25	19	24	17		21.2
Dominant Wind Direction		NW	N	N	N	SE	S	SE	SE	SE	W	W	W		

Note -- No data

Data source Badan Meteorologi dan Geofisika, Departemen Perhubungan





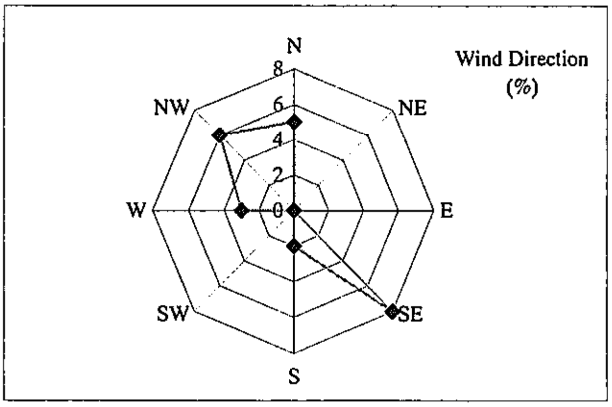
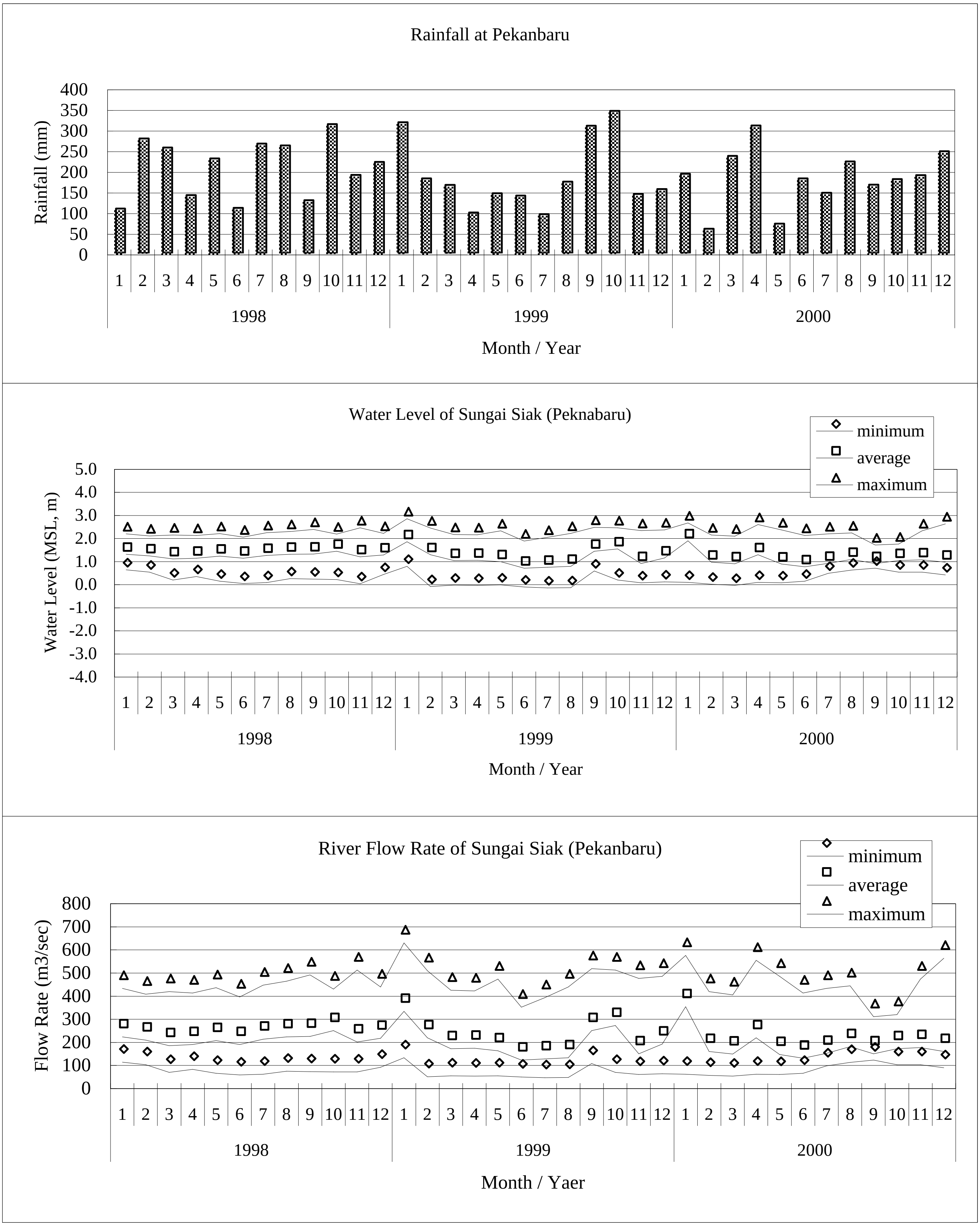


Figure 3.14.6 Climate in Palembang



Source: Dinas PU

Figure 3.14.7 Rainfall and Water Level Fluctuation of Sungai Siak (Pekanbaru)

Source: Kantor Cabang Talang Duku, Jambi, IPC2

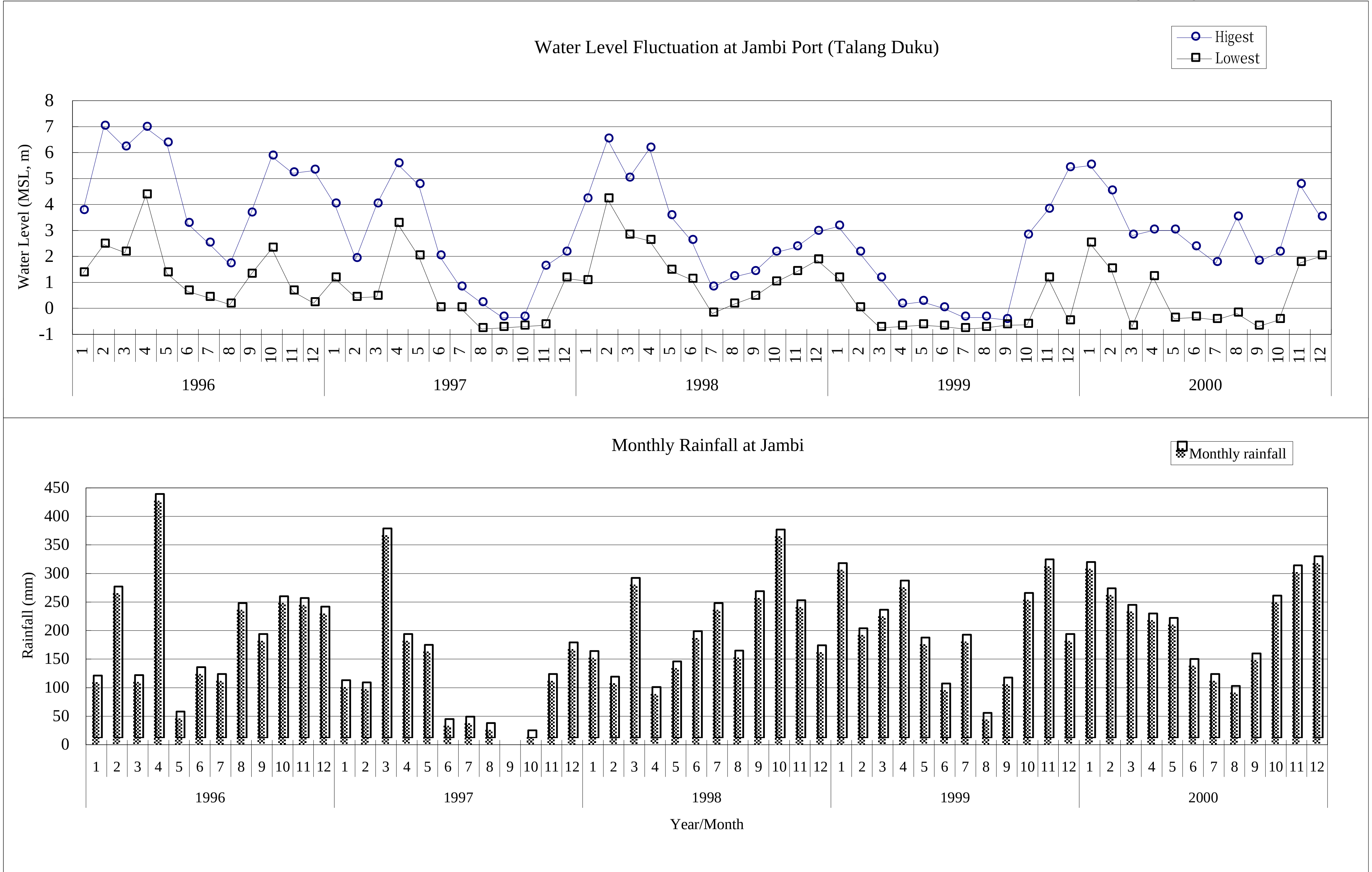


Figure 3.14.8 Fluctuation of Water Level (Talang Duku) and Rainfall (Jambi)

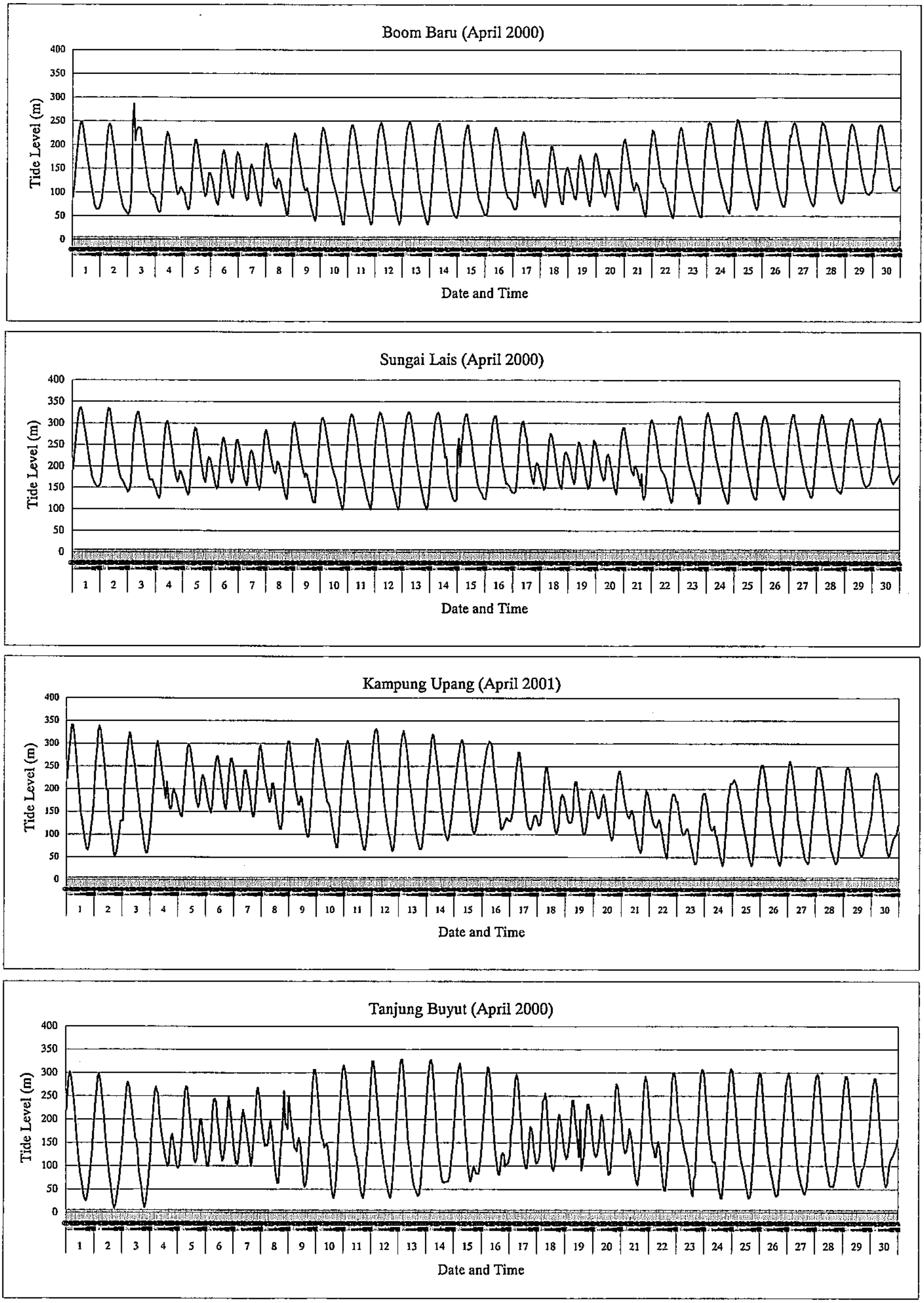


Figure 3.14.9 (1) Tide Record along Sungai Musi (April 2000)

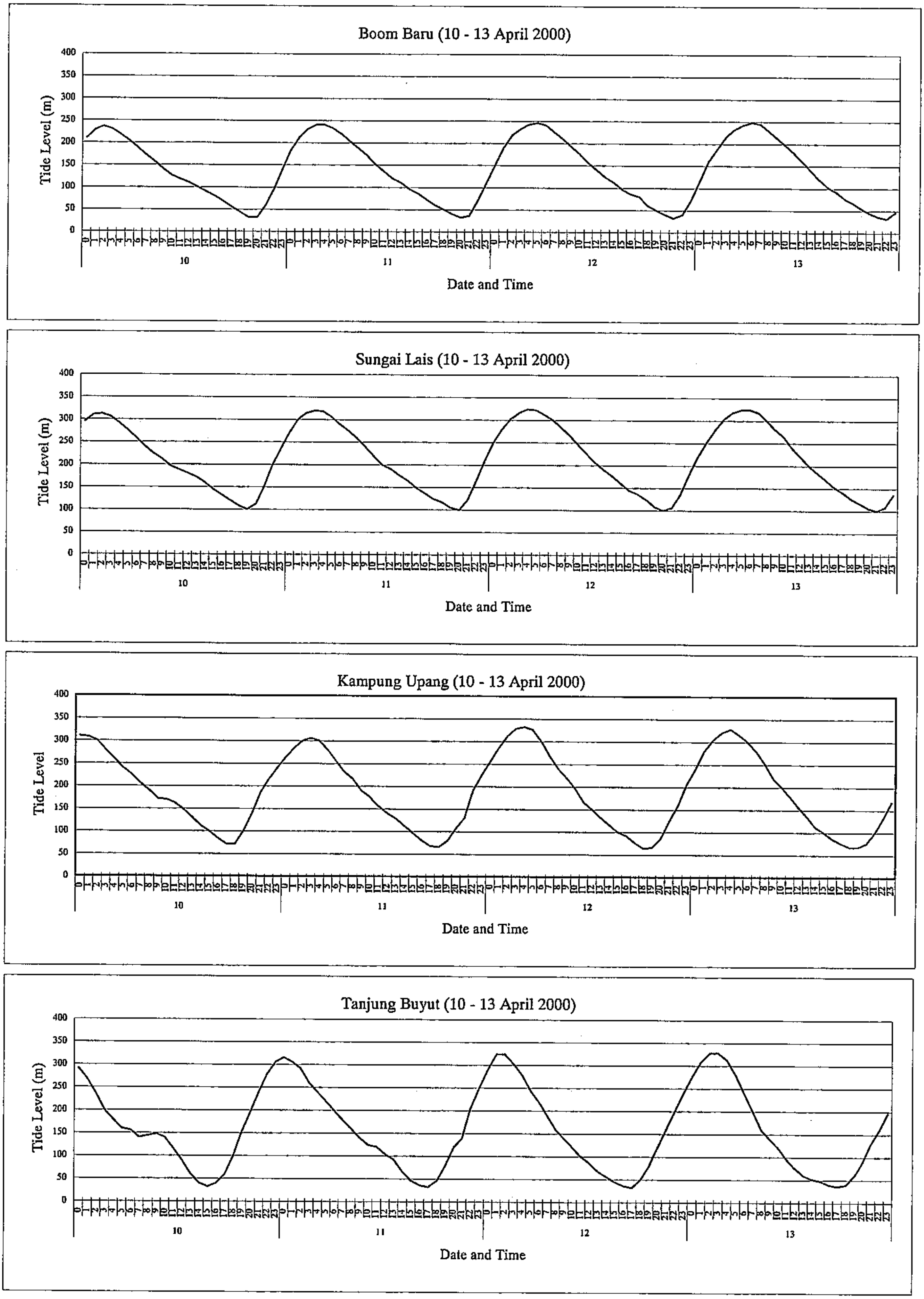


Figure 3.14.9 (2) Phase Difference of Tide Records along Sungai Musi

3.15 Environmental Outline of East Coast of Sumatra

3.15.1 Formation Process of Coastal configuration

The large swamp area located landward from coastline is characteristic in the provinces of Riau, Jambi, and South Sumatra in the east coast of Sumatra Island.

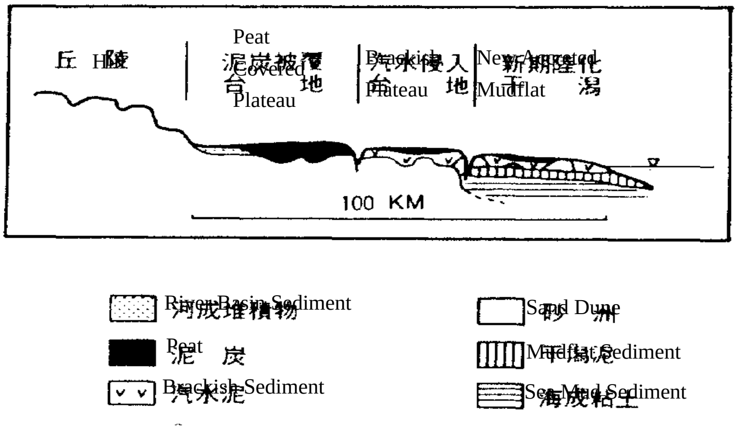


Figure 3.15.1 Schematic Profile of East Coast

Mangrove communities, mainly mangrove species of Api-Api (family Ververaceae), distribute on mudflat at estuaries (New Accreted Mudflat in Figure 3.15.1). Since the mudflat at the estuaries slopes very gently, mud sedimentation was hastened. Then, a marvelous Api-Api forest took root on the coast of Riau, Jambi, and South Sumatra provinces.

Sinca nipa palm communities distribute along the river in brackish area (Brackish Plateau in the figure), people living in the area use its long leaves for roof thatching.

The vast fresh water swamps distribute in the plateau covered with peat (see Figure 3.15.1), forming the following forests: 1) lowland forest, 2) peat swamp forest, and 3) fresh water swamp forest. These 3 types of forest area occupy 82 % of whole Jambi province. This tendency is the same as in Riau, and South Sumatra provinces. The three study areas in Pekanbaru, Talang Duku, and Palembang are located at the edge between the Plateaus covered with peat to Hill.

The formation process of the coastal swamp forest is shown in Figure 3.15.2. This process generally comes under mangrove formation, and also for the Batanghari river and the Mahakam river.

The land accretion can be recognized in the behaviors of mangrove species distributions. Some mangrove formations occur around the estuary of river. These mangrove forests are distributed in ecological zone strip-shape, which implies that each mangrove species distribute different type of forest strips from the sea to landward depending on the specific characteristics and frequency of inundation, salinity contents in the forest floor (species genus: *Avicennia* (Api-Api), *Sonneratioa*, *Rhizophora*, *Buruguiera*).

Figure 3.15.2 explains that the pioneer mangrove species Avicennia forms mangrove forest at the mouth of river first. The flow velocity of the river decreases by friction with the mangrove floor. Thereafter, soil sedimentation begins on the forest floor. The land level gradually rises with soil sedimentation; then, behind strip species form a mangrove forest there. Pioneer species Avicennia(Api-Api) further advances seaward.

Recent research in this area indicated that the rate of advancement of shoreline can be estimated at 20 m per year.

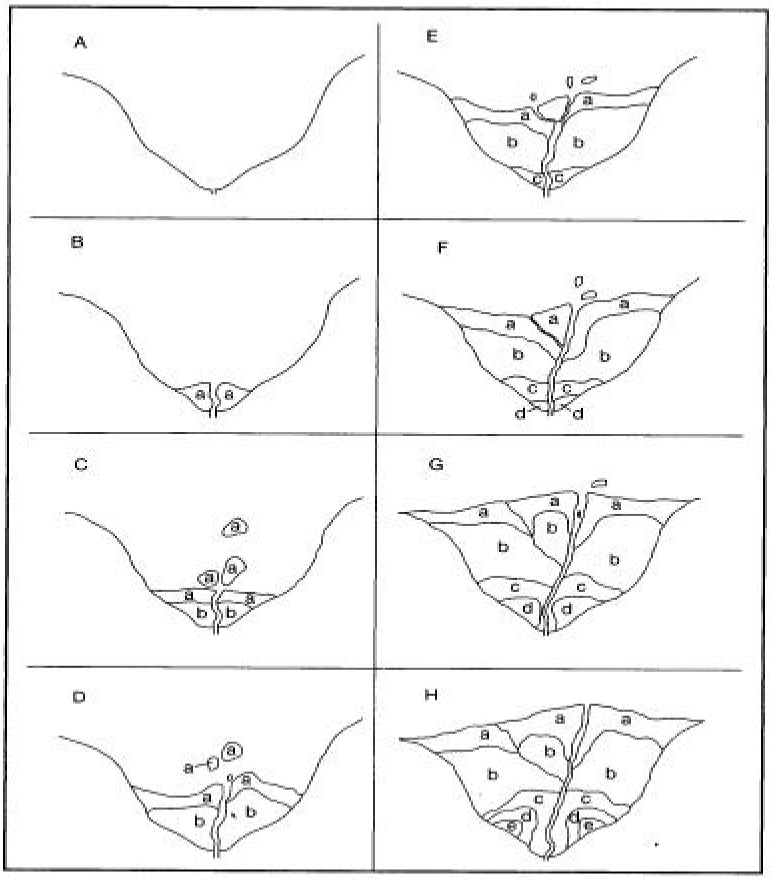


Figure 3.15.2 Formation of coastal Peat swamp forest
(Source: The Ecology of Sumatra)

A –: an Estuary final rise in sea level
B – H: Deposition of alluvium, colonization by mangrove forest.

- a- mangrove pioneer(*Avicennia*),
- b- late mangrove species*(Buruguiera*),
- c- peatswamp forest on thin peat and slight brackish soils,
- d- mixed peat swamp forest on thicker peat soils above the level of adjacent rivers,
- e- dwarfed forest on thick peat.

Avicennia and *Buruguiera* are the genus name of mangrove species.

3.15.2 Deforestation Process in Sumatra

Forest areas in Sumatra have decreased sharply as a result of forest exploitation. Figure 3.15.3 shows the deforestation situation in this area. Rapid forest exploitation began in 1950s'. The forest area is forecast to be exhausted in 2020s' without any countermeasures.

Mountainous forest is defined as forest communities occurring in mountain areas higher than 2000m. Swamp forest occurs in peat swamp, with Vast Peat Swamps Spread in the Provinces along the east coast of Sumatra as mentioned previously. Some kinds of Depterocarpus and Legminosae (pea family) are dominated in this type of forest.

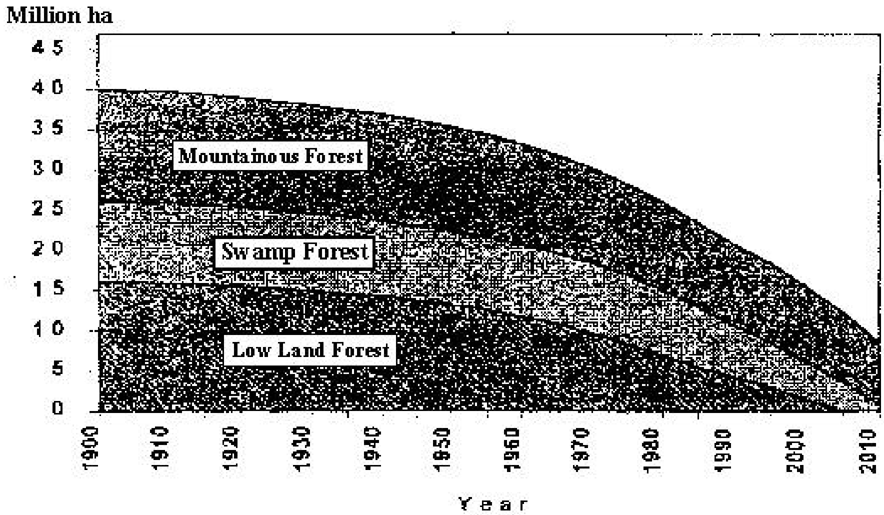


Figure 3.15.3Deforestation Process in Sumatra

Source: World Bank, Forest Resources in Indonesia 1997

Low Land forest is the largest forest formation among the 3 kinds of forest types. The forests around Pekanbaru, Jambi, and Palembang are defined as this type of forest. The family Depterocarpus is the dominant species in this forest type and emergent trees grow to over 70 m high. Lowland forests are the most timber productive forest among these three types.

3.15.3 Environmental Outlines in each Study Area

(1) Pekanbaru (Siak River)

Marvelous natural forests of mangrove Api-Api are distributed from the estuary of the Siak River to Kampaar River along the coast. The forest is specified as a provincial natural mangrove conservation area. There are five natural conservation areas in Riau province at present.

(2) Jambi (Batanghari River)

Mangrove area and tropical peat swamp distribute landward from the estuary of Batanghari River. Soil property in this area is not suitable for paddy fields because of high salt contents of brackish water. Rapid forest degradation by conversion from primeval forest to oil palm plantation has caused soil erosion at the river basin from 1960s', which is supposed to be a source of riverbed sedimentation.

Lowland forest occupies the largest area (60%) of the vegetation in Jambi Province. Peat swamp forest, mountainous forest, mangrove forest, and fresh water swamp are next in order after lowland forest. 22 plant species are listed as protected species. 28 species of mammal, 1 in fish, 4 in reptile, 25 in bird are also protected.

Jambi provincial government has conducted measurement of water quality sampled from 14 points in Batanghari River for 5 parameters quarterly each year. The results of the measurement show COD, BOD, pH, SS and Coliform do not exceed the environmental standards of Jambi Province. Water quality grade in Batanghari River is categorized as fair or good throughout the year. pH values at downstream are higher caused by the saline water, while pH values upstream are lower caused by acid forest soil in the river basin.

The Berbak protected area is one of the precious swamp forest area spread out on the right bank of river. Five protected areas distribute in the Province of Jambi. Some rare birds (Brahminy kite and Sea eagle) have been observed during the study team survey.

(3) Palembang (Musi River)

Since the outer bars spread widely and the sea is shallow for some distance from the shore, soil sedimentation at the estuary of Musi River is intensive. Consequently, vast Api-Api forest spread around the estuary the same as other two rivers (Siak river and Batanghari river). Regarding the Api-Api forest along the east coast of Sumatra, it is not an exaggeration to say that Api-Api forest along the coasts are the most majestic of this species forest in the world, especially the forest in Tg. Api-Api.

5 natural protected areas are defined in South Sumatra Province. Precious species hornbill and crocodile have been observed in the Musi River basin before. From the results of interviews, these species don't inhabit around the proposed study area. Some rare birds (Brahminy kite and Sea eagle) were observed during the Study Team survey.