

CHAPTER 3

PRESENT CONDITION OF THE BASIN AND BASIC ANALYSIS

3.1 General Natural Conditions

The general natural condition described in this section mainly refers to the Musi River Basin Study in 1989, updating the information and data.

3.1.1 Topography

The Musi River Basin covers a total of 59,942 km² in the south of Sumatra Island between 2°17' and 4°58' South latitude and between 102°4' and 105°20' East Longitude. It covers most of South Sumatra Province, and only small parts of the Bengkulu, Jambi and Lampung provinces as shown in the Location Map.

The topography of the Musi River Basin can be broadly divided into five zones; namely, from the west, the Mountain Zone, the Piedmont Zone, the Central Plains, the Inland Swamps and the Coastal Plains. The Mountain Zone comprises the northwestern to southwestern part of the study area and is composed of valleys, highland plateaus and volcanic cones. The Piedmont Zone is an approximately 40 km wide transition belt between the Mountain Zone and the Central Plains. It is an undulating to hilly area with some flat plains. The central plains consist of three sections, uplands, flood plains and river levees. The Inland Swamps comprise the natural river levees and back swamps. The back swamps are less elevated than the river level and flooded during the rainy season. The Coastal Plain comprises the lowlands along the coast and the deltaic northeastern lowlands, naturally covered with peat swamp forest.

3.1.2 Geology

According to modern interpretation, the Indian Ocean plate is presently sliding at a rate of 6 cm per year underneath the Island of Sumatra. The movement started in the middle of the Tertiary period (Miocene). As the Barisan Range buckled upwards, the corresponding downward thrust formed a deep channel to the west of Sumatra. Buckling increased in the quaternary in the Barisan Range. A Northwest to Southeast rift opened through the Ranau Lake and follows the crest of the range. The movement is lateral, shearing Sumatra in two. Volcanic activity gained momentum through the quaternary and culminated with the explosion of the Ranau crater and the formation of breccias, lava outflows and ash tuffs.

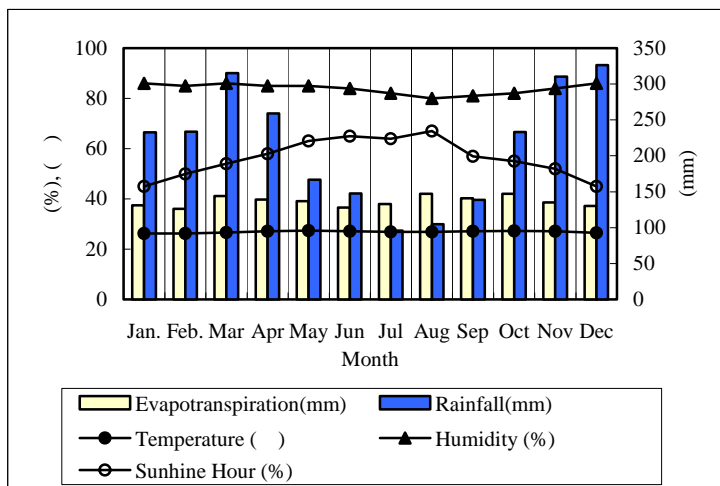
Regional geology is as follows: The geology consists of the oldest formations of undifferentiated intrusive and metamorphic rocks of Pre-Tertiary age from Eocene to Pliocene and the quaternary formations comprising undifferentiated volcanic rocks of Pleistocene and Holocene, and swamp deposits and alluvium. Surface geological materials are classified for the purpose of land and soil classification as peat, alluvium, detritus sedimentary, volcanic sedimentary, acid igneous rocks, basic igneous rocks, marble and limestone, and other metamorphic rocks.

3.1.3 Meteorology

The meteorological conditions in the Musi River Basin are affected by tropical monsoon, which give hot and humid climate through the year to this area. The meteorological condition is shown in **Figure 3.1.1**.

Mean annual rainfall varies between less than 2,000 mm in the coastal plain and 3,500 mm in Lahat located in the eastern foot of the Barisan Range; it is everywhere higher than the annual potential evapotranspiration, which is in the range of 1,200 mm to 1,500 mm (Musi River Basin Study, 1989). Rainfall is in excess of evapotranspiration during most of the year.

Relative humidity is high throughout the year between 60% and 90%. Mean daily temperature shows little seasonal variation, around 28°C with a mean minimum of about 20°C and a mean maximum of 35°C at altitude



lower than 150 m above sea level. Day duration varies little from 12 hours all the year long in relation to the low latitude. South-easterly winds prevail during the dry season, normally occurs from May to October, and westerly winds during the rainy season, normally occurs from November to April.

Figure 3.1.1 Meteorological Condition at Palembang

3.1.4 Hydrology

The lower Musi River, downstream stretch from the confluence of the Komerling River has an average flow of about 2,500 m³/s with fluctuations in dry and wet seasons between 1,400 and 4,200 m³/s. Normally, the flow of the Musi River and its tributaries has the highest peak between February and March, and the lowest between July and September.

The water level of the Musi River is +1.2 m above mean sea level as the highest and +0.0 m as the mean in the dry season. In the rainy season, the water level of the Musi River is +1.8 m above mean sea level as the highest and +1.0 m as the mean. The maximum spring tide level could reach +3.3 m at the Talang Buyut Station at the Musi River estuary. Generally, maximum spring tides occur in December and June and lower spring tides occur in March and September.

3.1.5 Groundwater

In the Barisan Range, an unknown but presumably substantial potential of groundwater exists for new and extended schemes exploiting spring sources and shallow aquifers. In the Piedmont Zone, groundwater potential seems to be less significant. Deep aquifers are less likely to bear any major potential for groundwater exploitation. The Pre-Pleistocene Peniplains including the surroundings of Palembang are in general not suited for groundwater exploitation from deep formations.

3.1.6 Soils

Six soil units classified for the Musi River Basin are: Organosol, Regosol, Alluvial, Rendzinas, Podzolic, and Andosol. Organosols are formed on deposits of peat and are distinguished by depth and decomposition of the peat. These are sub-classified by the degree of peat deposits decomposition into Fibric Organosols, Hemic Organosols, and Sapric Organosols. Regosol are soils having no diagnostic horizons or none other than an horizon (topsoil) which is pale and contains little organic matter. The largest continuous extent of Regosols occurs in the Belitang area in the Southeastern part of the Study Area. These soils are formed in sediments of volcanic origin, recently deposited, probably as mixed alluvial and mass-movement deposits.

Alluvial soils are formed on recent alluvial deposits and are therefore associated with the courses of rivers and streams and also with coastal areas. Rendzina covers small areas in the basin. Podzolic soils are the most widespread soils in the catchment area, because they result from the dominant soil forming process on dry-land sites at low elevations, i.e. the leaching of clay and its translocation to lower parts of the soil to form argillic horizons. Andosols are recent volcanic soils generally with weakly developed surface horizons and cambial horizons overlying volcanic materials, either consisting of more than 60 % of volcanic materials.

The soil suitability for agriculture depends on texture, structure, permeability, acidity and nutrient status. For wetland paddy the soil type is of lesser importance, due to the special reducing soil conditions in the wetland paddy fields, which limit soil acidity and make nutrients more available to the plants. The only problematic soils are the potential acid sulphate soils in the tidal swamp area which possess toxic compounds for the rice plants. Only few of the soils possess an intrinsic fertility high for dry-land crops, such as the alluvial, the Andosols and the Rendzinas. Moderately to marginally fertile are the Regosols, the Lithosols and the Oxisols. Infertile are the Podzolic Soils, the Gleysols and the Organosols, these soils cannot be used for agricultural purposes without major inputs. These soils are, however, suitable for tree crops where there is sufficient drainage. There is a wide variety of soils, in the study area, suitable for tree crops in addition to those recommended for dry land food crops. Coffee can be grown in great variety of soils from deeply weathered tropical Latosols to those associated with coastal sandy loams. Rubber is also suited to a variety of different soils from shallow to deep clays, gravels and lateritic soils. Oil palm gives the better yields in deep, friable and well drained soils.

3.2 Socioeconomic Conditions

The restructuring of the local autonomy is underway in South Sumatra Province. Since the restructuring was conducted quite recently, almost all the available data on socioeconomy are still based on the previous administrative systems, thus the previous administrative division is used to grasp the socioeconomic condition of the study area. The relation of the previous system and the latest one is summarized in **Table 3.2.1**.

Table 3.2.1 Restructuring of Autonomy in South Sumatra Province

Previous Administrative Division	New autonomy as of September 2002
Kotamadya Palembang	Kotamadya Palembang
Kab. Musi Banyuasin	Kab. Musi Banyuasin
	Kab. Banyuasin
Kab. Muara Enim	Kab. Muara Enim
	Kotamadya Perabumulih
Kab. Lahat	Kab. Lahat
	Kotamadya Pagaralam
Kab. Musi Rawas	Kab. Musi Rawas
	Kotamadya Lubuk Linggau
Kab. Ogan Komering Ilir	Kab. Ogan Komering Ilir
Kab. Ogan Komering Ulu	Kab. Ogan Komering Ulu

3.2.1 Administrative System

The Musi River Basin stretches over four provinces. South Sumatra, Bengkulu, Jambi occupy approximately 96%, 3.6%, 0.4% of the total basin area, respectively, while Lampung occupies the small areas along its provincial boundary. Kabupaten and Kotamadya in the South Sumatra Province are as listed in **Table 3.2.1**. The map showing the administrative boundaries is presented in **Annex 3.2.1**. Study area for each Kabupaten is shown in **Table 3.2.2**.

3.2.2 Population and Labor Force

According to the latest population census 2000, Indonesia had a population of 205.8 million, which is the fourth most populous country in the world after China, India, and the United States. This population increased by 27.3 million as compared with the census 1990. During 10 years from 1980 to 1990, the average annual growth rate of the population was 2.0 % but that from 1990 to 2000 slowed down to 1.4 %. **Table 3.2.3** shows area, population by sex, population density, number of household, and average family size of the Regencies and Municipality in South Sumatra Province in 2000.

Table 3.2.2 Area by Kab. (km²)

Province / Regency	Musi River Basin
South Sumatra	
Ogan Komering Ulu* ¹	10,762
Ogan Komering Ilir	5,349
Muara Enim	8,909
Lahat	6,839
Musi Rawas	13,261
Musi Banyuasin	12,212
Palembang	235
Bengkulu	
Rejang Lebong	2,130
Jambi	
Batang Hari & Others	245
Total South Sumatra	57,567
Total Study Area	59,942

*1 include Lampung Province

Table 3.2.3 Population Density, and Average Family Size of South Sumatra

Regency/Municipality	Area (km ²)	Population			Population density (person/km ²)	Number of household (1,000)	Average family size (person/family)
		Male (1,000)	Female (1,000)	Total (1,000)			
Palembang	401	719.0	732.4	1,451.4	3,623	293.8	4.9
Ogan Komering Ulu	13,661	590.0	569.7	1,159.7	85	251.3	4.6
Ogan Komering Ilir	21,387	489.8	486.3	976.2	46	222.6	4.4
Muara Enim	9,575	358.9	358.8	717.7	75	161.9	4.4
Lahat	7,252	338.5	331.6	670.1	92	146.2	4.6
Musi Rawas	21,513	323.7	318.1	641.8	30	140.5	4.6
Musi Banyuasin	26,099	624.2	616.2	1,240.4	48	272.9	4.5
Total	99,888	3,444.1	3,413.3	6,857.4	69	1,489.2	4.6

Source: Sumatera Selatan Dalam Angka 2001, BPS Sumatera Selatan

Population of the Musi River Basin has been estimated by sub-basin as presented in **Table 3.2.4**.

Table 3.2.4 Population by Sub-basin of the Musi River Basin

Sub-basin	Population (1,000)	Household (1,000)	Sub-basin	Population (1,000)	Household (1,000)
Musi	2,758	592	Kelingi	152	33
Komering	1,125	249	Lematang	623	139
Ogan	918	200	Semangus	79	18
Harileko	114	25	Padang	182	38
Rawas	161	34	Total	6,338	1,377
Lakitan	226	50			

The economically active population of South Sumatra Province in 2001 was 3.1 million people or 44% of total population in the province. Unemployment rate in 2001 was 4.4%. The working population by industry in South Sumatra shows that about 66% of workers are engaged in agricultural sector in the province, while 14% are engaged in commercial sector such as trade, hotels and restaurant, and 9% for public services.

3.2.3 National and Regional Accounts

Gross Domestic Product (GDP)

Gross Domestic Product (GDP) of Indonesia in 2001 was Rp.1,490,974 billion (approx. US\$ 145 billion) and per capita GDP in the same year was Rp.7.1 million (approx. US\$ 690). Due to depreciation of Rupiah through the economic crisis, GDP and per capita GDP in 2001 are only 60 % of those in 1996 when converted into US dollars.

Annual growth rate of GDP in 1996 was 7.8% and that of per capita GDP was high at 5.9%. However, because of the crisis, - 13% of a large negative growth was occurred in 1998. Meanwhile, per capita GDP also recorded negative growth for two consecutive years of 1998 and 1999.

Gross Regional Domestic Product (GRDP) of South Sumatra Province

Gross Regional Domestic Product (GRDP) of South Sumatra Province in 2001 was Rp.45,383 billion (approx. US\$ 4.4 billion), which accounted for 3.0% of GDP of Indonesia. Per capita GRDP in the same year was Rp.6.5 million (approx. US\$ 630), which is 8.4% lower than that of Indonesia.

Real economic growth for last 7 years remains 1.9% p.a. with oil/gas, and 1.0% p.a. without oil/gas due to grave impact of the crisis. Per capita GRDP of South Sumatra Province without oil/gas was Rp.4.3 million (US\$417), which was 30% lower than that of Indonesia, Rp.6.1 million (US\$594).

Mining sector has increased its share in GRDP since 1996 and accounted for one third of total GRDP in 2001. Conversely, other sectors have reduced their shares gradually during the same period. This shows that economy of South Sumatra Province has increased dependence on mining sector, especially on oil/gas, again taking a cue from the economic crisis.

Gross Regional Domestic Product (GRDP) of the Regencies in the Musi River Basin

GRDP of the regencies and municipalities in the Musi River basin has been estimated at Rp.40 trillion (US\$4.7 billion) in 2000 or 3.1% of the national GDP. Palembang, Muara Enim, and Musi Banyuasin are the greatest contributor for GRDP of the basin accounting for 23%, 25%, and 22% of total GRDP, respectively.

OKU, Muara Enim, Musi Rawas, and MUBA are oil-producing regencies. The differences of GRDP of these regencies between with and without oil/gas are very large. GRDPs of Muara Enim and MUBA in 2000 were Rp.9.6 trillion and Rp.8.6 trillion, respectively. However, those without oil/gas were only Rp.3.1 trillion, and Rp.4.5 trillion, respectively.

Per capita GRDP without oil/gas may be more relevant to see people's livelihood since oil/gas revenue have little impacts on the regional economy. Palembang's per capita GRDP is the largest at Rp.5.6 million among the regencies, while that of Musi Rawas is the smallest at Rp.2.7 million.

Table 3.2.5 Per Capita GRDP without Oil/Gas by Regency

Regency/ Municipality	GRDP Per Capita at Current Price (Rp.1,000)							
	1993	1994	1995	1996	1997	1998	1999	2000
Palembang	1,701	1,942	2,261	2,691	3,051	4,454	5,046	5,612
Ogan Komering Ulu	886	1,030	1,199	1,356	1,548	2,323	2,532	2,785
Ogan Komering Ilir	938	1,066	1,251	1,469	1,682	2,358	2,698	2,986
Muara Enim	1,477	1,550	1,860	2,337	2,953	3,891	4,271	4,360
Lahat	1,018	1,160	1,372	1,550	1,890	2,774	3,024	3,369
Musi Rawas	910	1,068	1,218	1,406	1,663	2,274	2,386	2,665
Musi Banyuasin	1,219	1,360	1,591	1,806	2,058	2,941	3,262	3,628
Rejang Lebong	1,165	n.a.	1,714	1,872	2,003	3,298	3,445	n.a.

Source: Produk Domestik Regional Bruto, BPS each regency

Per Capita GRDP without Oil/Gas by Regency is presented in **Table 3.2.5**. In Palembang, service and manufacturing are the dominant industries, which accounted for 57% and 42%, respectively. The manufacturing industry includes large-scale oil refinery and fertilizer factories. OKU, which is located upstream area of Ogan and Komering River basin, has relatively balanced industrial structure. Crop production accounted for 24% of total GRDP, while those of oil production and trade accounted for 18% and 16%, respectively. In OKI, which is located at middle stream area of Ogan and Komering River basin, agriculture is the dominant industry in the regency accounting for 44% of its GRDP. Especially, the contribution of non-food crop is large at 16%, while that of food crop such as rice is 11%.

Muara Enim is located at the center of South Sumatra Province and which occupies major part of Lematang, a part of Ogan and Musi River basins. The regency has a characteristic industrial structure, which is dominated by mining represented by oil/gas production. The mining sector accounted for 79% of the regency's GRDP. Lahat is located at southwestern part of South Sumatra province, and it occupies the upstreammost part of the Musi, upstream part of Lematang, upstream small part of Semangus and Kelingi River basins. Agriculture is the dominant industry, which accounting for 46% of the regency's GRDP. Especially, production of non-food crop such as rubber, coffee, and oil palm is large at 26% of total GRDP. Trade is the second largest economic activity in the regency accounting for 16%.

Musi Rawas is located at western part of South Sumatra Province. It occupies almost all the area of Rawas and Lakitan River basins, downstream part of Kelingi, upper-middle reaches of Musi, and downstream part of Semangus River basins. Mining represented by production of oil/gas is the largest industry in the regency accounting for 35%. Production of food and non-food crops, and trade are also large at 8%, 13%, and 11%, respectively.

MUBA is located at northwestern part of South Sumatra Province. It occupies almost all areas of Harileko and Padang River basins, and lower-middle reaches of the Musi River basin. Northeastern half of the regency is not the Musi River basin. Mining and manufacturing are the dominant industries accounting for 36% and 30%, respectively. Of these, production of oil and its refinery industries are large at 35% and 13% of the regency's GRDP, respectively. Since the regency is located in the downstream area, agricultural production including crop, forestry and fishery is quite large.

Rejang Lebong is located at north central part of Bengkulu Province. The upstreammost part of the Musi and Kelingi River basins are occupied by the regency. Agriculture and services are the dominant industries, which accounting for 58% and 35%, respectively. Especially, production of food crops is large at 34% of total GRDP, while that of non-food crops is 19%.

External Debt

Indonesia is classified as a severely indebted low-income country by World Bank according to economic condition of income and indebtedness. The total debt

outstanding declined from US\$150.8 billion at end-1999 to US\$141.8 billion at end-2000 by 6%. The debt in 2000 accounted for 99% of the gross national income (GNI). Of this, US\$108 billion or 76% was procured as long-term debt, mostly for capital investment. Total debt service aggregated to US\$18.8 billion in 2000. In the year, the debt-service ratio (DSR), a kind of country risk assessment factors, was 25.5%, which was the lowest in this decade. However, this figure is still in a critical position, because it is beyond the level of 20%, critical level of DSR.

3.2.4 Industries

Agriculture

At the end of Repelita IV (1984-1989), South Sumatra Province achieved self-sufficient in food (rice production) with a production of 1,282,483 tons from cultivation areas of 443,830 hectares. Since then, the province has contributed to the national food stock. In perpetuating self-sufficiency of food, especially rice, in Repelita V (1989-1994) the province tried to improve the production of food crops and the farmers' income, as well as the community's nutrition.

In 2000, the production of paddy was 1,964,700 tons from 579,600 hectares, which accounted for 3.8% of total production and 4.9% of total cultivation area of Indonesia. Musi Banyuasin, OKU, and OKI are the biggest rice producer in the area with 564,700 tons, 374,100 tons, and 414,400 tons, respectively. Since more than half of paddy cultivation land is still depending on rain, crop production varies largely from year to year depending on climate.

In the Musi River basin, other food crops are also cultivated such as maize, cassava, sweet potato, peanuts, and soybeans. Rubber, oil palm, coffee, and coconut are the major cash crops cultivated in South Sumatra Province. Especially cultivation area of rubber is large at 868,700 ha, which is larger than paddy cultivation area of 505,300 ha. The rubber production of 465,400 tons accounted for 30% of the national production. Production of oil palm and coffee are also large at 905,600 tons and 141,100 tons, which accounted for 14% and 27% of national production, respectively.

Fishery

Fishery production of the regencies in the Musi River Basin was 137,200 tons in 2001. Catch of 50,400 tons were from marine fishery, 72,905 tons from inland fishery, and 13,831 tons from brackish water pond. Average annual growth of the production is 7% p.a. during 5 years from 1996 to 2001.

Manufacturing Industry

Manufacturing industry had served as an engine of economic growth in the region before the economic crisis. However, it was badly hit by the crisis in 1997/98, and more recently has had to cope with recession in major export markets. The manufacturing sector had grown fruitfully until 1996. After the economic crisis, recovery of the sector is quite weak, especially that of non-oil/gas manufacturing is very slow.

Tourism

South Sumatra Province had 18,600 foreign and 260,500 local tourists in 2001. The number of tourists fluctuates year by year depending on events or festivals taken place in the province. Musi River tour is one of the tourists attractions in Palembang area. Tourists can enjoy the unique scenery of floating houses, Benteng Kuto Besak (the fort of Big Town under development), Ampera Bridge, and the tiny delta of Kemaro Island, island of Viharas the famous place for Buddhist pilgrims.

Services

The supply of electricity and its infrastructure in South Sumatra is served by District IV of the State Electricity Company (PLN) using inter connection system with Bengkulu and Lampung provinces. The supply of electricity is also carried out by electricity undertaken permit holders of both private companies and cooperatives. Electricity was supplied for 625,300 households, which was 41% of total household in the province. In Lahat and Palembang, the ratios of electricity user are very high at 99% and 88% respectively, while those in OKU and MUBA are low at 16% and 11%. PLN supplies electricity for 95% of consumer and only 5% of consumer use non-PLN electricity.

Municipal water companies (PDAM) are responsible for delivering water supply service in urban areas. PDAM is financially autonomous, and its budget is distinct from that of local government. **Table 3.2.6** shows drinking water distribution by regency in 2001.

Table 3.2.6 Drinking Water Distribution in 2001

Regency	(1,000 m³)	Regency	(1,000 m³)
Palembang	1,559.5	Lahat	1,381.4
OKU	2,518.0	MURA	2,214.3
OKI	1,128.3	MUBA	931.5
Muara Enim	2,953.7	Total	12,686.9

Source: Sumatra Selatan Dalam Angka 2001, BPS Sumatera Selatan

According to the latest socioeconomic survey in South Sumatra Province (Susenas 2000), households that use water supply for drinking water were only 17.7%, while those in Palembang were 69.6%. The most dominant sources of drinking water were protected and non-protected well, which accounted for 38% and 21%, respectively. River water is used as drinking water by 12.8% of household. In MUBA, 29.5% of households use rainwater for drinking in order to avoid saline groundwater.

Table 3.2.7 Source of Drinking Water in 2000 (%)

Regency	Water supply	Ground-water	Protected well	Non-protected well	Protected spring	Non-protected spring	River water	Rain water	Other
Palembang	69.6	0.8	11.2	10.3	-	-	5.8	1.1	1.3
OKU	7.2	0.5	50.0	18.4	3.3	1.6	18.3	0.1	0.6
OKI	5.5	1.1	39.0	17.8	0.1	0.3	29.9	4.2	2.0
Muara Enim	11.0	0.6	37.6	33.3	5.6	0.8	7.9	0.3	2.9
Lahat	5.8	1.2	54.5	18.1	7.0	0.9	12.5	-	0.2
MURA	9.8	0.3	42.6	29.6	1.8	2.0	13.7	-	0.2
MUBA	2.4	0.5	41.4	11.8	0.1	0.2	13.6	29.5	0.6
Total	17.7	1.2	38.0	21.0	1.8	0.8	12.8	5.6	1.0

Source: Keadaan Social Ekonomi Masyarakat Sumatera Selatan 2000, BPS Sumatera Selatan

The regional economic crisis caused severe inflation in 1997/1998 driven by depreciation of Rupiah. The **prices** of food rose more than 100% from 1997 to 1998, while those of housing and clothing rose significantly at 41% and 79%, respectively. In 1999, the prices of almost all categories still rose quite significantly between 13 to 31%. In 2000, stabilization of the prices appeared but they rose again in almost all the categories in 2001. The same trend of the high inflation has been continuing in 2002.

Bank Indonesia is the central bank of the country. After a long period of peg system of Rupiah to US dollar in the 1970s and 1980s, the government introduced a managed float aimed at maintaining the competitiveness of Indonesia's non-oil/gas exports. The Asian economic crisis, occurred in the middle of August 1997, has forced the government to allow Rupiah to float freely. Average annual **foreign exchange rates** against U.S. Dollar and Japanese Yen are summarized in **Table 3.2.8**.

Table 3.2.8 Foreign Currency Exchange Rate

Currency	1996	1997	1998	1999	2000	2001	Sep. 16, 2002
One U.S. Dollar	2,342	2,909	10,014	7,855	8,422	10,261	9,035
One Japanese Yen	22	24	77	77	78	84	74.05

Source: Country Profile 2001, the Economic Intelligence Unit (EIU)

Country Report 2001, the Economic Intelligence Unit (EIU)

Sep.16, 2002: Bank Indonesia, TT, middle rate

Note: 1996 - 2001: Annual average rates

3.2.5 Projection of Socioeconomic Framework to the Target Year

Socio-economic framework to the target year 2020 has been projected in this sub-section.

Population Projection

In this study, the future population is projected based on "Proyeksi Penduduk Indonesia per Kabupaten/Kotamadya 1990-2000", and the population growth target set in the PJP-II was referred. The verification of the population projection 1990-2000 showed that the projected population in 2000 is very close to the results of the Census 2000.

Therefore, the same growth trends by regency have been estimated by linear regressions for the projection of the future population. The base for projection was set from the Census 2000. The estimated future population by regency is summarized in **Table 3.2.9**.

Table 3.2.9 Population Projection and Annual Growth Rates (1,000 people)

Regency/Municipality	2002	2005	2010	2020
Palembang	1,506 (2.1%)	1,598 (2.0%)	1,752 (1.8%)	2,058 (1.5%)
Ogan Komering Ulu	1,202 (1.7%)	1,263 (1.6%)	1,365 (1.5%)	1,568 (1.3%)
Ogan Komering Ilir	1,019 (2.1%)	1,083 (2.0%)	1,189 (1.8%)	1,403 (1.5%)
Muara Enim	749 (2.1%)	795 (2.0%)	873 (1.8%)	1,028 (1.5%)
Lahat	690 (1.3%)	717 (1.3%)	763 (1.2%)	853 (1.1%)
Musi Rawas	672 (2.3%)	717 (2.2%)	794 (2.0%)	946 (1.6%)
Musi Banyuasin	1,309 (2.9%)	1,422 (2.7%)	1,609 (2.4%)	1,984 (1.9%)
Total	7,146 (2.1%)	7,565 (1.9%)	8,344 (2.0%)	9,840 (1.7%)

The annual growth rate of population at the target year 2020 is 1.7%, which is higher than the target growth rate in PJP-II (0.88%). However, since the population growth rate of South Sumatra Province in the recent years was approximately 0.8% higher than that of whole Indonesia, it will not be practical to assume sharp drop in population growth of the province.

Economic Growth Target

In order to formulate the economic growth target until the target year 2020, GRDP without oil/gas is selected with the following reasons:

- Price of oil/gas is largely affected by external factors,
- Even after the fiscal decentralization, the revenue accruing from oil/gas industries are not net regional receipt, but large part of it is transferred into the central government account, and
- The absorption of labor force in the oil/gas sectors is relatively low and their contribution to regional welfare is insignificant.

Three scenarios are conceived as follows:

- Scenario 1: "Low growth due to slow economic recovery"
- Scenario 2: "Moderate growth due to sound economic recovery"
- Scenario 3: "Fast growth due to rapid economic recovery"

Projection process is made from provincial down to regency level. GRDP without oil/gas is projected breaking down into four sectors; agriculture, mining, manufacturing, and services. Economic growth target of the Government presented in PROPENAS and that of the South Sumatra Province were referred to decide that in the present Study as shown in **Table 3.2.10**.

Table 3.2.10 Economic Growth Target of the Scenarios

Item	Unit	Scenario 1	Scenario 2	Scenario 3
Agriculture	% p.a.	3.4	3.4	3.4
Mining	% p.a.	1.9	1.9	1.9
Manufacturing	% p.a.	1.8	2.8	4.2
Services	% p.a.	3.2	5.0	7.5
Total	% p.a.	2.8	3.9	5.6

The results of estimation of the future GRDP are presented in **Table 3.2.11**.

**Table 3.2.11 Results of Future GRDP Estimation
(without oil/gas, 2000 constant price)**

Regency/ Municipality	Actual GRDP in 2000 (Rp. bn)	Scenario 1		Scenario 2		Scenario 3	
		GRDP in 2020 (Rp. bn)	Growth 2000-2020 (% p.a.)	GRDP in 2020 (Rp. bn)	Growth 2000-2020 (% p.a.)	GRDP in 2020 (Rp. bn)	Growth 2000-2020 (% p.a.)
Palembang	8,147	13,973	2.7	18,858	4.3	28,621	6.5
OKU	3,230	5,807	3.0	6,967	3.9	9,285	5.4
OKI	2,916	5,266	3.0	6,205	3.8	8,078	5.2
Muara Enim	3,129	5,211	2.6	5,986	3.3	7,526	4.5
Lahat	2,258	4,108	3.0	4,815	3.9	6,231	5.2
Musi Rawas	1,710	3,061	3.0	3,623	3.8	4,740	5.2
MUBA	4,501	7,885	2.8	9,429	3.8	12,466	5.2
Total	25,890	45,311	2.8	55,883	3.9	76,947	5.6

Based on the population projection and the future GRDP projection, per capita GRDP at the target year has been estimated as shown in **Table 3.2.12**. Since the estimation was made based on GRDP without oil/gas, the results are rather undervalued.

**Table 3.2.12 Future Per Capita GRDP
(without oil/gas, 2000 constant price)**

Regency/ Municipality	Actual Per capita GRDP in 2000 (Rp.1,000)	Scenario 1		Scenario 2		Scenario 3	
		Per capita GRDP 2020 (Rp.1,000)	Growth 2000-2020 (% p.a.)	Per capita GRDP 2020 (Rp.1,000)	Growth 2000-2020 (% p.a.)	Per capita GRDP 2020 (Rp.1,000)	Growth 2000-2020 (% p.a.)
Palembang	5,613	6,790	1.0	9,163	2.5	13,907	4.6
OKU	2,785	3,703	1.4	4,443	2.4	5,921	3.8
OKI	2,987	3,753	1.1	4,423	2.0	5,758	3.3
Muara Enim	4,360	5,069	0.8	5,823	1.5	7,321	2.6
Lahat	3,369	4,816	1.8	5,644	2.6	7,304	3.9
Musi Rawas	2,665	3,236	1.0	3,830	1.8	5,011	3.2
MUBA	3,629	3,974	0.5	4,752	1.4	6,283	2.8
Total	3,776	4,605	1.0	5,679	2.1	7,820	3.7

3.3 Land Use and Watershed Management

3.3.1 Land Classification

The land system classification for the Musi River Basin was executed through the Regional Physical Planning Program for Transmigration (RePPPProT) in 1976. Then, European Communities updated it through Musi River Basin Study in 1989. According with above two studies, the land of the Musi River Basin is grouped into seven major landforms; namely, Mountains; Steep Hills; Hillocky Land; Undulating and Rolling Plains; Inter-mountain Plains; Inland Riverine Plains; and Flood Plains and Swamps.

Each landform consists of several land systems. The land systems are classified through GIS analysis with Geology, Topography, Soil, and Vegetation from Satellite Images, Aerial Photograph Interpretation, and Reconnaissance Field Surveys. Totally forty-two land systems have been separated in the study area.

European Communities executed the most recent land evaluation in Musi River Basin Study in 1989. The main factors considered in the evaluation processes are Climate, Elevation, Slope, Inundation Area, Soil Depth, Soil Texture, Soil Drainage, and Soil Fertility. Through above land suitability analysis, land system suitable for each type of agriculture land is identified. The agriculture land type includes Dryland Arable Farming, Wetland Rice, Major Tree Crops (Oil Palm, Rubber, Coconut, Cocoa and Coffee), and Other Crops (Clove, Pepper, Sugarcane, Pineapple, Cashew and Banana). The suitability levels were separated into 5 classes. S1 (Highly Suitable), S2 (Moderately Suitable), S3 (Marginally Suitable), S (Suitable for Tree Crop under Estate Management Only), and N (Not Suitable).

3.3.2 Historical Changes in Land Use

The land use map (scale 1:500,000) in 1980 was collected from BAPPEDA map album. JICA study team converted this paper map to digital GIS data by digitization work, and the area of each land use type was summed up through GIS analysis. It shows almost 19% of whole Musi River Basin (11,605 km² of 59,354 km²) was covered by natural forest in 1980.

The land use data (scale 1:50,000) in 2000 was also collected from BAPPEDA. It was made by BPN through a BAPPEDA project. All the data was separated to 150 map sheets by 1:50,000 index map. JICA study team fixed diversity errors from features and projection, appended all the data together and regenerated it to GIS database which can be used for analysis by GIS tool. Also, for comparing with land use in 1980, the land use types were also reclassified by JICA study team.

To compare the land use 1980 and land use 2000, it is easy to find that the natural forest area was dramatically dropped from 19% in 1980 to 7% in 2000. Conversely, other agriculture land, sort of rice field, mixed garden and agriculture plantation are increased. The **Figure 3.3.1** shows the land use changes during 1980 and 2000.

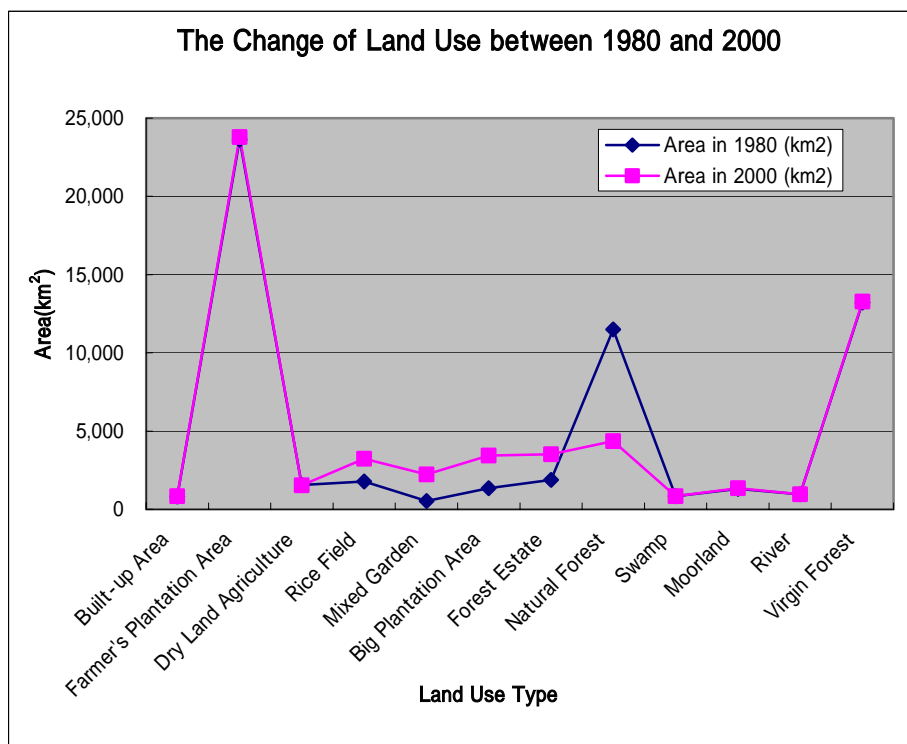


Figure 3.3.1 Comparison of Land Use in 1980 and 2000

3.3.3 The Processes of Forest Disappearance

This section is discussed for the whole area of South Sumatra Province. The total area of South Sumatra Province is about 87,225 km², and the total Musi River Basin is about 59,354 km². The overlapped area of the Province and Musi river basin is about 56,543 km². More than 95% of Musi river basin is included in South Sumatra Province.

In 1980, the total forest area in South Sumatra Province is about 43,721 km². The protection forest is about 11,826 km², and the production forest is about 31,895 km².

For development of local economy during 1980s, the government contracted with some private companies to log the forest in some production forest areas in a definite period. About 7,797 km² production forests in South Sumatra Province were made to be logging area. It occupied nearly 25% of the production forest, as well as 18% of whole forest area. However, much of logging area is outside of the Musi River Basin. It was also separated to active and expired area by the contract term. The active and expired logging contract in the Musi River Basin are 238 km² and 1,106 km², respectively, and those out of the Musi River Basin in South Sumatra Province are 3,542 km² and 2,911 km², respectively.

The current forest was interpreted from LANDSAT TM satellite image in 2000. It was found the total forest area in South Sumatra Province is only 14,141 km². It is more clear to see the forest disappearance during 1980 and 2000 by breaking down the total forest to protection and production forest as shown in the following table.

Table 3.3.1 Reduction in Forest Area from 1980 to 2000

Forest Type	Forest Area in 1980(km²)	Forest Area in 2000(km²)
Protection Forest	11,826	7,404
Production Forest	31,895	6,737
Total	43,721	14,141

To overlay the forest in 2000 with the forest in 1980, legal logging area, and transmigration area, it is easy to find following two illegal logging phenomena.

- (1) A large part of forest in middle land and low land was destructed. And the forest destruction areas are usually the transmigration areas. Therefore, the reasons of forest destruction in these areas can be considered as illegal logging, slash and burn farming for developing agriculture land.
- (2) The protection forest areas in high land are also reduced fast. Through the field survey, JICA study team found there are a lot of land use changes from forest to tree crops agriculture in high land. People who live in this area usually burn the forest and mountain to make coffee land.

3.3.4 Present Watershed Management Conditions

Forest Regeneration

Due to above forest destruction status, the government of South Sumatra Province made a forest land use plan in 1999 for expanding forest estate area. The plan includes expanding the forest area from 14,141 km² to 35,440 km² within 15 years (refer to **Figure 3.3.2**). A total of 20,663 km² area is for production forest in Lahat, OKI, OKU, MURA, MUBA, Muara Enim area, and 14,777 km² is for protection forest in OKI, MUBA and high land. For this purpose, several forest estate projects have been implemented. The forest estate projects are being conducted by private estate company with a total area of 4,129 km² (refer to **Figure 3.3.3**).

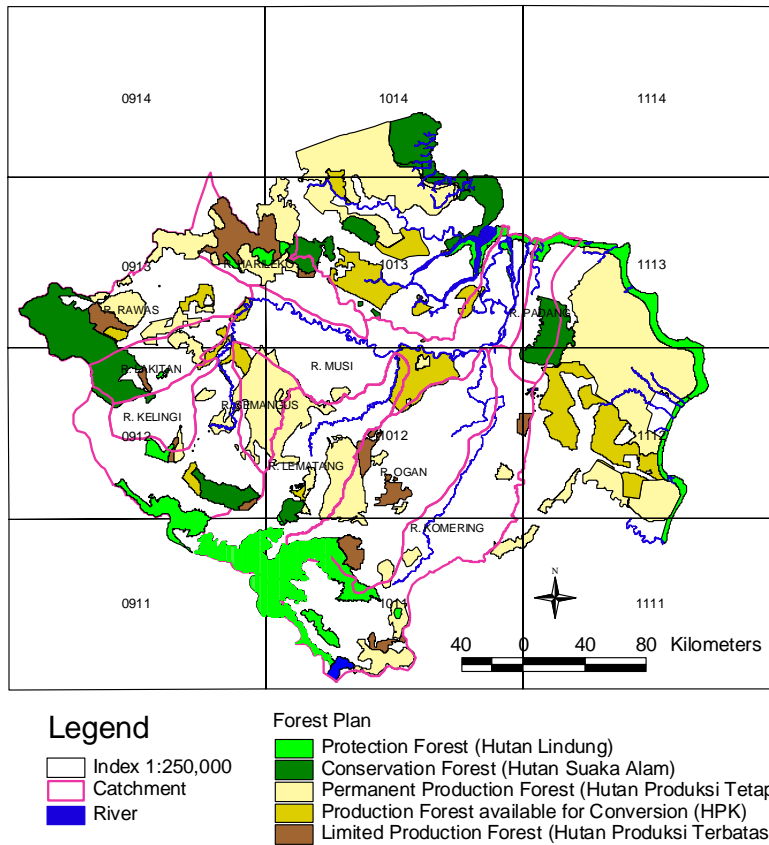


Figure 3.3.2 Current Forest Planning

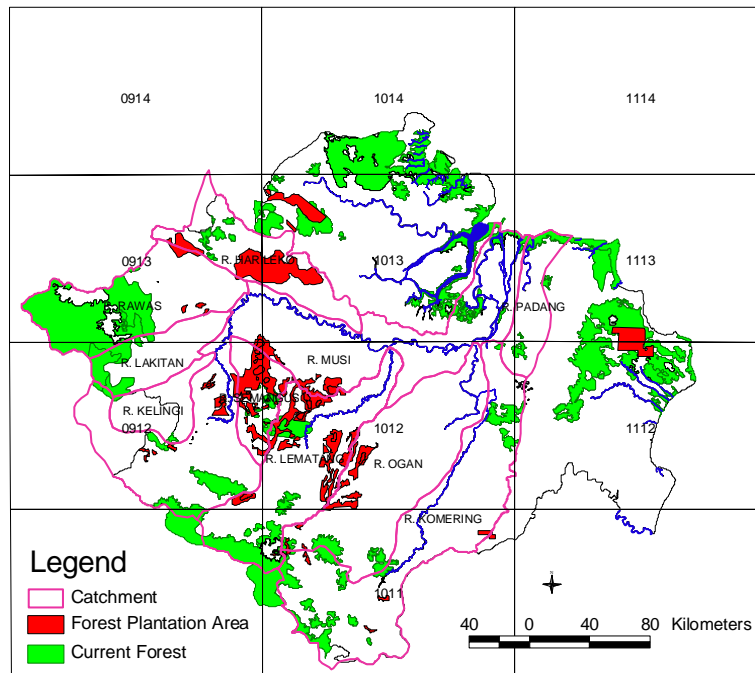


Figure 3.3.3 Forest Estate Area and Current Forest

Spatial Planning Organization and Laws

The spatial planning **organization** of South Sumatra Province involved many government agencies under the province governor. BAPPEDA plays as the coordinator that adjusts the interdepartmental cooperation and manages the meeting for discussing all topics on spatial planning. The member of agencies, mostly Water Resource Services of the Province acts as the major body for implementing and practicing the water utilization, flood control, and water environment plan.

The spatial planning was mentioned in the **constitution** in 1945. It mentioned that the space is one of unlimited natural resource. In order to perform optimal development result, to increase the prosperity and society welfare without ignoring the continuity and balance of living environment, the spatial management should be empowered and integrated in effectively and efficiently.

The law number 24 on **national spatial planning guideline** was set up in 1992. Based on this guideline, the direction of space development, management and utilization must be qualified with environment and humanity. The spatial planning should be formulated hierarchically that starts from general/macro level to detail/micro level. Subsequently, the national spatial planning coordinating board set up a national spatial planning regulation in 1997 (RTRWN: Rencana Tata Ruang Wilayah Nasional, PP No.47, 1997: Peraturan Pemerintah Nomor 47 Tahun 1997). It is a preservation criterion on management and utilization plan of national space including airspace, land, water, sea, underground water, and coastal area.

The **regional regulation** number 5 at the First Level of South Sumatra was set up in 1994. It is the first skeleton regulation in South Sumatra Province for matching the balance eternally between development and environment. It is a basic policy and direction compass on utilization strategy and space development for the second level region to measure development program in spatial planning.

3.3.5 Future Spatial Plan

Based on the law number 24, 1992 and province regulation number 5, 1994, the spatial plan of South Sumatra Province was established in 1992 and then revised in 1999. The expired time of this plan is 2014. However, considering the current economic situation of Indonesia, this spatial plan can be fully considered to revise again without big update. Therefore, it is possible to use this spatial plan as in 2020.

In 1994, Palembang Municipality made the first spatial plan for target years from 1994 to 2004. Five years late in 1998, this spatial plan was reviewed and evaluated through a contract project with Regional Development Bureau of Palembang Municipality. After the evaluation and analysis, a new spatial plan 1999 to 2009 was designed, however, the data used in the new spatial plan was the same as the one in the old plan 1994 to 2004. Considering the current economic status of Indonesia and the annual budget of Palembang municipality, the spatial plan 1999 to 2009 for Palembang municipality can be also considered to revise again to 2020 without much update.

3.4 Natural Environment

3.4.1 Natural Ecosystems and Human Impacts

Ecosystems of South Sumatra Province

Natural Ecosystems of South Sumatra Province directly reflects its geology and geomorphology. The World Wildlife Fund recognizes five Ecoregions in South Sumatra Province: Sumatran freshwater swamp forests, Sumatran lowland rain forests, Sumatran montane rain forests, Sumatran peat swamp forests, and Sunda Shelf mangroves (Figure 3.4.1).



Note: Number after the ecoregion names refers to the index in the original source.

Source: The World Wildlife Fund "Terrestrial Ecoregions of the Indo-Pacific: a conservation assessment"
Island Press, 2001

Figure 3.4.1 Ecoregions of Southern Sumatra

Sumatran Lowland Rain Forests

Among the ecoregions of South Sumatra Province, this region is experiencing the most severe pressure from human activities, such as agriculture, estate, forestry production, mining, and urban and industrial development. Decrease and fragmentation of habitat must have caused regional extinction of most of the fauna that require large piece of native habitat, or that avoid human activities in many areas.

Lowland rain forests in the Province can be divided into three sub-regions by geological character: peneplain with tertiary marine sediment, rolling hills with volcanic sandy tuffs, and mountain foot area with volcanic quaternary sediment. Of these, sandy tuff shows low fertility, and is most susceptible against soil erosion. Important mineral resources, e.g. oil, natural gas and coal are deposited in this area, thus development of the region is expected to continue.

Sumatran Freshwater Swamp Forests

Freshwater swamp forests grow on fertile alluvial soils. The Sumatran freshwater swamp forests used to contain many of the endangered and characteristic Sumatran species found in the lowland rain forests. The forests are highly productive and have been cleared by logging and agriculture to establish plantations and agricultural field. The rich soil and good access to fresh water made the region the most suitable area for rice farming.

Sumatran Peat Swamp Forests

The peat swamp forests in Sumatra are less threatened than the freshwater swamp forests because of the poor productivity and difficulty of access. In recent years, however, significant areas of peat swamp forests have been burned, and only a few blocks of habitat remain in the Province. Negative factors such as acid soil, land subsidence, and soil erosion prevent high yield from the rice field, coco palm and other estate.

(1) Acid Soil (pyrite)

In many places in peat swamp, FeSO_4 is accumulated in clay under the peat. When such clay is drained and exposed to air by cultivation, H_2SO_4 is released into the water. Technology applied to cope with this situation is to drain the acid with water for 5 to 10 years, and wait for the acid to be washed away. During the period, farmers must endure lower yield.

(2) Land Subsidence and Soil Erosion

When peat swamp is drained, the accumulated dead trees are compressed, and the ground subsidized, sometimes as low as beneath the water level. Regular cultivation also oxidizes the peat and oxidized peat soil decomposes into water. When vegetation cover over the peat is destroyed, the soft organic deposit and clay underneath is easily eroded with water movement into rivers and canals. Land subsidence and sedimentation in canals make the acid leaching process difficult.

(3) Illegal Land Clearance and Wasted Land

With such a difficult soil to negotiate, popular activities in agricultural development in this region is to try for rice farming for a few years, and when difficulty occurs, abandon the land for new land. Remain in the behind is acid

grassland or pond useless for farming, and will not naturally be rehabilitated as peat swamp forest.

(4) River Bank Erosion

River and canal bank erosion occurs at many places. Where the river makes curve, outside bank tends to be eroded by the power of flowing water. In addition to such natural cause, waves created by high-speed vessels is said to disturb stability of riverbank.

(5) Proposed Port Development

The access road, rail and other infrastructure for the proposed port at Tanjung Api Api will cross the peat swamp forest. On the ground with dynamic activities of water by day, month and year, impacts from such linear infrastructure on wildlife, vegetation, water quality and quantity may be serious, if the water movement is disturbed by the construction and the structure itself.

Sunda Shelf Mangroves

The Sunda shelf mangroves are some of the most biologically diverse mangroves in the world. Most part of mangrove forest in South Sumatra Province is designated as “Protected Forest” bearing special characteristics functioning mainly for protection of water source, flood protection, erosion control, saline water intrusion prevention, and soil fertility maintenance.

Sumatran Montane Rain Forests

Sumatra’s montane forests contain far higher levels of mammal and bird endemism than the lowland forests, in part because of their longer periods of isolation and distinctive forest types. At the current rate of deforestation in lower area, the only remaining natural forests in Sumatra may be the hill and montane forests of this ecoregion. This ecoregion is extremely fragile and sensitive to disturbance. The Kerinci Seblat National Park is the largest reserve in Sumatra covering 796,000 ha.

3.4.2 Urban and Industrial Environment

BAPEDALDA of Municipalities and Ministry of Trade and Industry are responsible for handling industrial waste. The Ministry of Energy and Mineral Resources is responsible for handling wastes from related facilities.

There are a few industrial facilities that may cause serious environmental pollution if not provided good management. Mining of coal, oil, and other minerals, pipelines, and oil refinery may pollute soil, groundwater, and surface water with toxic chemicals. Food factories, palm oil factories, fertilizer plants, and saw mills may pollute surface water with organic materials.

3.4.3 Laws and Institutions for Environmental Management

Related Offices

Under the Ministry of Forestry, there are five offices in South Sumatra Province, including Balai Konservasi Sumber Daya Alam (BKSDA), that are responsible for nature conservation and rehabilitation of forests. Also, Provincial Department of Forestry has staff and equipment for forest inventory, planning, management, preservation and rehabilitation. Planning work is coordinated with the Provincial BAPPEDA. There are not many NGOs in nature conservation sector in South Sumatra Province. The Wetland International has been working to create the Sembilang Conservation Forest as national park.

Protected Areas

There are two national parks in South Sumatra Province. One is the Kerinci Seblat National Park in Musi Rawas Regency designated in 1982 as the first gazetted National Park in Indonesia. The other one is Sembilang National Park converted from a Wildlife Reserve of 380,000 ha in 2001. There are two types of protected areas, conservation forest and protection forest, in addition to national park (Table 3.4.1).

Table 3.4.1 Definition of Forest Areas in South Sumatra Province

National Park (TN)	Taman Nasional	
Conservation forest (HK)	Hutan Konservasi	Area for biodiversity conservation of flora and fauna and its ecosystem.
Nature protection forest (HSA)	Hutan Suaka Alam	Within the conservation forest, area for biodiversity conservation of flora and fauna and its ecosystem and functioning also as buffer system of living creatures.
Nature conservation forest	Hutan Pelestarian Alam	Within the conservation forest, area for protection of buffer system of living creatures, biodiversity conservation of flora and fauna, and sustainable utilization of bio-natural resource and its ecosystem.
Protection forest (HL)	Hutan Lindung	Area for protection of water source, flood protection, erosion control, saline water intrusion prevention, and soil fertility maintenance.
Production forest (HP)	Hutan Produksi	Area for forest production managed by government (concession may be available).
Forest without designation		Private forest

Source: Law No. 41, 1999, Tentang Kehutanan

Conservation forest is where biodiversity and ecosystem are to be conserved. Conservation forest is consisted of nature protection forest (HSA), as core areas and surrounding buffers, and nature conservation forest that can be used by people in sustainable manner. Conservation forest is also called as conservation area (Kawasan Konservasi) in Law No.51, 1990. Protection forest is, on the other hand, aimed to conserve water resource and soil fertility of the area and downstream. In South Sumatra Province, there are ten conservation forests and 18 protection forests. The total of designated protected area is 1,251,423 ha, that is 12 % of the total area of the Province (Table 3.4.2).

Table 3.4.2 Protected Areas in South Sumatra Province

	Area of Regency ha	Conservation Forest		Protection Forest		Protected Forest Total HK+HL ha	Protected area %	Distribution
		HK	ha	HL	ha			
Musi Banyuasin	2,619,100	342,479		68,823		411,302	16%	33%
Ogan Komering Ilir	2,136,700	4,828		105,159		109,987	5%	9%
Ogan Komerin Ulu	1,467,900	50,950		151,021		201,971	14%	16%
Muara Enim	957,500	9,440		71,700		81,140	8%	6%
Lahat	771,900	52,829		141,100		193,929	25%	15%
Musi Rawas	2,151,300	251,252		1,842		253,094	12%	20%
Total	10,104,400	711,778		539,645		1,251,423	12%	100%

Source: Statistik Kehutanan, Propinsi Sumatera Selatan, 2001

Protected Species

Based on several ordinances, currently there are 64 species listed as protected animal species of South Sumatra Province. Although fish species are not included in the list, many mammals listed use habitat close to water. Water birds are also important components of the list. Protection and conservation of healthy water ecosystem is important for the sustainability of the existence of these species.

Forestry

Forest area, estate, and agriculture field are managed by separate offices at the National and Provincial level. Management of extension offices (Penyuluh) of these departments is transferred from Province to Regency and Municipality in 2001. Since then, such offices are consolidated in some areas for more efficient and comprehensive communication with farmers. Such local office conducts general consulting for farmers. Provision of information regarding soil conservation is a part of such consultation.

(1) Logging Concession and Illegal Logging

There are 65 production forests, 2,522,034 ha in total, in the Province (**Table 3.4.3**). Of these, three are forests with artificially planted trees, Acacia, for pulp and paper industry. The rest of the production forests are for selective cutting of logs. Based on a national policy to rehabilitate tropical forests in the country, all logging concession has been stopped by 2002 until further announcement. Therefore, legally, there should not be any log production from the production forests besides the production from the three acacia forests. Logging from forests on private land is monitored by villages. All trees that are cut, sold and moved from the place of origin are mandated to receive certification from the village chief.

With above condition, any logs that are cut in production forest without logging concession, and that are cut from private land without certification from the village chief is classified as "illegal logging". Naturally, any logs cut from protected areas are also "illegal". Illegal logging tends to occur where there is good road for transportation of the logs. Very steep slopes in mountain area discourage the loggers.

Table 3.4.3 Designated Forest Area in South Sumatra Province

Province	Area	HK	HL	Production Forest HP	HK+HL+HP ha	Forest %	Other land use ha
Musi Banyuasin	2,619,100	342,479	68,823	848,777	1,260,079	48%	1,359,021
Ogan Komerin Ilir	2,136,700	4,828	105,159	843,899	953,886	45%	1,182,814
Ogan Komerin Ulu	1,467,900	50,950	151,021	111,613	313,584	21%	1,154,316
Muara Enim	957,500	9,440	71,700	286,107	367,247	38%	590,253
Lahat	771,900	52,829	141,100	53,628	247,557	32%	524,343
Musi Rawas	2,151,300	251,252	1,842	378,010	631,104	29%	1,520,196
Total	10,104,400	711,778	539,645	2,522,034	3,773,457	37%	6,330,943

HK: Conservation Forest, HL: Protection forest

Source: Statistik Kehutanan, Propinsi Sumatera Selatan, 2001 page IV-1

The concession system itself has had some problems. The ITTO (International Tropical Timber Organization) technical mission to Indonesia in 2001 recognized that cutting permits can be issued by various authorities (district, provincial and central). There have even been cases where cutting permits have been issued covering the same area by different authorities to different parties. Such confusion and intense forest use caused serious decrease of forest cover, averaging 100,000 ha per year, within the designated forest area between 1995 and 2000 (Table 3.4.4).

Table 3.4.4 Forest Cover Decrease 1995-2000 (ha)

Province	1995	2000	Difference	Year average
Musi Banyuasin	734,780	695,897	-38,883	-7,777
Ogan Komerin Ilir	337,068	150,739	-186,329	-37,266
Ogan Komerin Ulu	115,531	22,010	-93,521	-18,704
Muara Enim	204,152	123,547	-80,605	-16,121
Lahat	130,727	97,015	-33,712	-6,742
Musi Rawas	381,270	313,970	-67,300	-13,460
Total	1,903,528	1,403,178	-500,350	-100,070

Source: Statistik Kehutanan, Propinsi Sumatera Selatan, 2001 page IV-8

(2) Reforestation, Rehabilitation and Guideline for Sustainable Forestry

Reforestation Fund (DR) is collected from concessionaires by the Ministry of Forestry. The money is expected to be used for new planting in concession area or in area damaged by fire, for conservation of forest and wildlife, or for social forestry projects.

Concessionaires, in current system, receive the Reforestation Fund when they obtain secondary forests tagged as "logged over and degraded". The ITTO mission states that once the payment from the government has been received, the concessionaires lose interest to plant. The ITTO recommends that the money should be made available only after the work of planting, or more strictly, after certain length of suitable management.

AMDAL Process

Water related activities that are subject to environmental impact assessment (Analisa Mengenai Dampak Lingkungan, AMDAL) are described in KEP 11/MENLH/3/94. The

assessment process will involve related departments and the Regencies. There will also be a need to consult with BAPEDALDA to determine the type of AMDAL that will be required. The approach to BAPEDALDA will be through a formal meeting involving both the consultant who will be preparing the AMDAL and the owner of the project.

3.4.4 Existing and Potential Environmental Issues

Environmentally healthy watershed can be described by many indicators. Major indicators applicable to the Musi River basin are listed below.

- Laws, regulations, institutions, and working system are coordinated under common vision of sustainable management of watershed.
- Information on environmental condition is provided to public, and environmental education for residents in all sectors and age classes is realized.
- Use of land and resource is planned and regulated in the manner to avoid expansion of degraded, wasted land, to avoid pollution of environment, to provide healthy living environment for people within the sustainable capacity of local environment, and to maximize the production of natural resources in the long term.
- Such land use plan is published and accessible to all.
- Resource development and industry are planned and managed in the manner to minimize the use of resources (to maximize the efficiency of resource use), to minimize the use of toxic substances, to minimize emissions to air and water.

Comparing the above indicators with existing conditions, as well as with proposed policies and plans for the basin, the Team recognizes following existing and potential environmental issues.

- Existing threat from activities in forestry, estate, and agriculture to natural environment and water resource (expansion of waste land and erosion, and poor species diversity in forestry, estate and agriculture, etc.)
- Existing and potential impact from water development
- Needs for strong and coordinated conservation policy
- Environmental research, education, and public participants

3.5 Water Quality

3.5.1 Relevant Information of Water Quality

Classification of River System

The Musi River Basin can be divided into ten river systems (see **Table 3.5.1**). Each river system consists of one to eight sub-basins.

Table 3.5.1 Divided River Systems and Sub-basins

No.	Code-No.	River Name	Sub-basins
1	MU	Musi Main	From upper reach to down reach, MU1 to MU8
2	KO	Komering	From upper reach to down reach, KO1 to KO2
3	OG	Ogan	From upper reach to down reach, OG1 to OG2
4	HA	Harileko	
5	RA	Rawas	From upper reach to down reach, RA1 to RA2
6	LA	Lakitan	
7	KE	Kelingi	
8	LE	Lematang	From upper reach to down reach, LE1 to LE3
9	SE	Semangus	
10	PA	Padang	

In order to clarify issues related to river water quality, these river systems can be classified into four categories, as shown in **Table 3.5.2**.

Table 3.5.2 Classification of River Systems

Category	Name	Corresponded Sub-basins
A	Normal High-Midland Area	All the sub-basins except the ones below
B	Specific Midland Area	KO2
C	Urban Area of Palembang City	OG2, MU7
D	Lowland Area	MU8, PA

Existing Water Use

The total population of the Study Area amounts to approximately 6.3 million people. Of these, approximately only less than 5% are presently supplied from piped water, while more than 95% exploit surface water. Most water-consuming industries are located in or around Palembang City and do not use groundwater to any substantial extent.

Health Conditions (Waterborne and Water-Related Diseases)

Many waterborne and water-related diseases have been counted in the Study Area. Based on the statistical data, there is a high risk of diarrhea, skin disease and eye infection. These statistics intensify the need to break the various disease transmission cycles and provide adequate quantities of clean water along with appropriate sanitation systems separate from the water sources.

3.5.2 Pollution Sources

Domestic Wastewater

In the Study Area, or even in Palembang City, no sewerage system has been constructed. Furthermore, a high percentage of people in the Musi River Basin live in riverine areas. Domestic wastewater is currently discharged into rivers with no treatment or with septic tank through the small ditches or channels. Domestic pollution load in each sub-basin was estimated based on the population discussed in Section 3.2 and the assumed unit load of 20 g/person/day as given in **Table 3.5.3**.

Table 3.5.3 Domestic Pollution Load Generation

No.	Sub-basin	Population ($\times 10^3$)	Domestic Pollution Load Generation (BOD kg/day)
1	Musi	2,758	55,160
2	Komering	1,12	22,500
3	Ogan	92	18,360
4	Harileko	114	2,280
5	Rawas	161	3,220
6	Lakitan	226	4,520
7	Kelingi	152	3,040
8	Lematang	623	12,460
9	Semangus	79	1,580
10	Padang	182	3,640
Total	-	6,335,005	126,760

Industrial Wastewater

All the analysis data of factory effluent are not available for this Study because of confidentiality; therefore, available data is very limited. Analysis data collected in the Clean River Project are available. Based on the above data, the BOD pollution load generation by river system has been estimated, as shown in **Table 3.5.4**.

Table 3.5.4 BOD Pollution Load Generation of River System

(Unit: BOD kg/day)

MU	KO	OG	HA	RA	LA	KE	LE	SE	PA	Total
31,138	3,649	7,119	3,855	1,784	748	297	8,442	689	2,269	53,404

Non-point Pollution Source and Total Pollution Load Generation

Figure 3.5.1 explains the concept of pollution load generation and runoff stage. The existing pollution load runoff of BOD in dry season by each point and non-point source was calculated, as shown in **Table 3.5.5**.

As can be seen in the Table, point pollution load shares a large ratio of the total existing pollution load runoff of BOD (82%). Hence, the reduction of point pollution load would be effective for the improvement of river water quality.

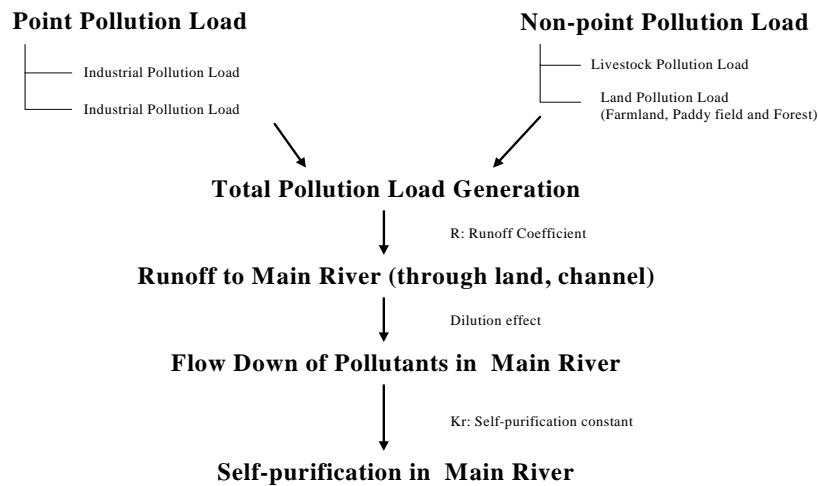


Figure 3.5.1 Concept of Pollution Load Generation and Runoff

Table 3.5.5 Total BOD Pollution Load Runoff

Source	MU	KO	OG	HA	RA	LA	KE	LE	SE	PA	Total	(%)
Point (domestic)	55.2	22.5	18.4	2.3	3.2	4.5	3.0	12.5	1.6	3.6	126.8	55.8
Point (industry)	31.1	3.6	7.1	3.9	1.8	0.7	0.3	8.4	0.7	2.3	60.0	26.5
Sub-total	86.3	26.1	25.5	6.1	5.0	5.2	3.3	20.9	2.3	5.9	186.8	82.3
Non-point (livestock)	4.9	8.2	3.7	0.6	1.2	0.6	0.2	3.0	0.5	0.5	23.5	10.4
Non-point (land)	4.7	3.0	2.6	0.7	1.4	0.7	0.7	1.9	0.4	0.4	16.5	7.3
Sub-total	9.7	11.2	6.3	1.3	2.7	1.2	0.9	4.9	0.8	0.9	40.0	17.7
Total	96.0	37.3	31.8	7.4	7.7	6.5	4.2	25.8	3.1	6.8	226.7	100

(Unit: ton/day)

3.5.3 Present Water Quality Condition

Present River Water Quality

Available water quality data in the Musi River Basin are very limited. They include those observed by BAPEDALDA in 2001, and those observed through Clean River Project during 1993-1998, etc. The water quality is characterized as follows:

- (1) The level of organic pollution in the Musi River Basin is low because BOD and COD are found in low concentrations.
- (2) Solid contents (TSS) in some sections are partially increased. Highest values are found in the mountain areas, confluence points of Lematang River with Enim River that flows through devastated land, and the coal mining area where this pollution has obviously originated.
- (3) DO concentrations in the Musi River are moderate. In the middle river section, it is below 6.0 mg/l, which is the standard for drinking water resources.
- (4) Fecal coliforms are found in concentrations that exceed the allowable limits, which indicate pollution caused by domestic wastewater.

- (5) Very low pH values are detected in the small rivers that originate in peat swamps. High content of acids are naturally formed; high acidity is unfavorable for water uses such as drinking, washing or irrigation.
- (6) Pesticides are detected (DDT in the Musi River and beta BHC in the Lematang River). Although the detected concentrations are below the allowable limits, the evidence of pesticides in the rivers that serve as drinking water resources should be further analyzed.
- (7) Toxic substances such as heavy metals, cyanide and phenol were analyzed for the Ogan and Komering rivers in 2001. Average values of these toxic substances show that toxic substances were not detected or in very small concentrations compared with the standard quality.

Averages of major water quality data of each river system are given in **Table 3.5.6**.

Table 3.5.6 Average River Water Quality

Parameter	Musi Main (MU)	Komering (KO)	Ogan (OG)	Harilek (HA)
pH (-)	6.7	7.6	6.7	6.4
DO (mg/l)	5.4	6.2	6.5	4.9
BOD (mg/l)	< 2	< 2	-	-
COD (mg/l)	29.7	12.8	15.8	20
TSS (mg/l)	47	53	57	40
Fecal Coliform (N/100ml)	1500	2900	4400	-
BHC (mg/m ³)	< 0.066	< 0.066	< 0.066	-
DDT (mg/m ³)	0.59	< 0.066	< 0.066	-
Parameter	Latikan (LA)	Kelingi (KE)	Lematang (LE)	Rawas (RA)
pH (-)	7.4	7.2	7.1	7.1
DO (mg/l)	6.0	4.9	6.2	6.1
BOD (mg/l)	-	-	< 2	-
COD (mg/l)	20	40	19.2	40
TSS (mg/l)	30	30	190	32
Fecal Coliform (N/100ml)	-	-	3500	-
BHC (mg/m ³)	-	< 0.066	0.13	-
DDT (mg/m ³)	-	< 0.066	< 0.066	-

Note: Average of all the data in each sub-basin

Water Quality Standards

Relevant **laws and regulations on water quality** are as follows: The Government of Indonesia had enacted “Regulation Number 82 of Year 2001 concerning Water Quality Management and Water Pollution Control.” In compliance with this national regulation, the Governor of South Sumatra prescribed the standards of river water and wastewater effluents. South Sumatra Province categorized target river water quality into four classes; namely, Classes I (for drinking or other uses), II (for water recreation needs and agriculture), III (for agriculture, livestock, industrial, and hydropower generation), and IV (for agriculture and other uses with the same criteria). The Decision of the South Sumatra Governor stipulates the standard water quality of each class, and regulates 45 parameters as criteria.

In South Sumatra Province, the permissible limits of industrial wastewater quality and maximum pollution load discharged into rivers are prescribed in the Decision of the South Sumatra Governor. According to this Decision, 32 types of industry should comply with the regulations. Factories have to monitor their industrial wastewaters by themselves, analyze with their own small laboratories and submit the analysis results to BAPEDALDA. BAPEDALDA has been observing the wastewater quality of 60 factories once to four times a year for the purpose of cross-check.

PDAM has a quality standard to control the water quality of piped water, and performs periodical analyses of water quality before and after treatment.

Existing Water Quality Monitoring System

BAPEDALDA has been analyzing surface water, industrial wastewater effluent, domestic wastewater effluent, and agricultural effluent of the Study Area since 1985. The water quality monitoring was focused on the industrial wastewater effluent until 2000. The frequency of water quality sampling is once to four times a year. The river water quality monitoring survey for the whole Musi River Basin was done only in 2001. Therefore, the existing river water quality data available from BAPEDALDA is too limited in scope.

Relevant institutions for water quality monitoring are as follows: BAPEDALDA organizes water quality monitoring under the finance provided by municipal and central governments. Provincial BAPEDALDA has a central laboratory used for the environmental monitoring. At present, 12 staffs are assigned in the central laboratory, which has been designated as the reference laboratory in South Sumatra Province. The Municipal BAPEDALDA of Palembang also has a newly established laboratory and 20 staffs are assigned for laboratory work.

According to the existing equipment line-up of BAPEDALDA, general parameters including heavy metals could be analyzed. However, no GC or GCMS necessary for the analysis of toxic substances such as insecticides, herbicides, pesticides, etc., has been provided; hence, activities on environmental monitoring are very limited at present. The laboratory of Municipal BAPEDALDA of Palembang only analyze pH, BOD, COD, TSS and NH₃-N. The main activity of monitoring is to make a cross-check of factory effluent; hence, when the analyses of additional parameters such as heavy metals, pesticides and other toxic organic substances are required, they are entrusted to a government laboratory or a private laboratory (Sucofindo) where high-level equipment is installed and well maintained.

3.5.4 Specific Issues to be Solved

Existing Specific Issues

According to the study results, the specific issues with regard to water quality in each category are summarized in **Table 3.5.7**.

Table 3.5.7 Existing Specific Issues

Classification	Category A: Normal High-Midland Area	Category B: Specific Midland Area	Category C: Urban Area of Palembang City	Category D: Lowland Area
River Water	High fecal coliform Toxic substance (pesticides) High turbidity	Sedimentation Low flow (Reduction of dilution effect) Toxic substance (pesticides) High fecal coliform	Low pH Toxic substance (pesticides) High fecal coliform Highly polluted channels in Palembang	Saline intrusion Low pH Brackish water
Water Use (Drinking water)	Direct use of river water Use of highly turbid river water	Lack of water in dry season	Low quality of shallow groundwater Lack of water in dry season	Low quality of shallow groundwater Lack of water in dry season
Pollution Source	Erosion from devastated land Agricultural pollution source Domestic wastewater	Domestic wastewater Agricultural pollution source	Large number of factories Large quantity of domestic wastewater Soil in peat swamp containing pyrite (FeS)	Large number of factories Soil in peat swamp containing pyrite (FeS)

Reduction of Pollution Load

As mentioned before, total pollution load consists of point pollution load and non-point pollution load. It is very difficult to reduce the generation of non-point pollution load because the pollution sources are widely scattered. Hence, the reduction of point pollution load should be essentially considered.

A sewerage treatment system can largely reduce the domestic pollution load. Palembang prepared a master plan for improvement of domestic wastewater in 1990. However, the master plan was not a full-scale project for the whole urban area of Palembang. The target area was limited, and the project has not progressed due to the lack of funds and low affordability of people in Palembang. For the improvement of water quality in Palembang, a comprehensive plan is necessary.

Improvement of industrial wastewater treatment system is also effective. Industrial pollution load in the Study Area shares a large ratio in the total pollution load generation. Generally, large factories have wastewater treatment plants such as the activated sludge system; however, plant maintenance has not been well managed and the efficiency of treatment is low. Therefore, improvement of the industrial wastewater treatment system is necessary.

Necessary Reinforcement of Water Quality Monitoring Network

The water quality monitoring is essential for the water quality management in the Study Area and monitoring results should be widely utilized in relevant institutions and open to the general public. The existing water quality monitoring activities are not sufficient to cover the whole Musi River Basin. BAPEDALDA has a plan for water quality monitoring; however, the plan has not been well-functioning due to the shortage of budget and monitoring equipment.