CHAPTER 2

PRESENT CONDITION OF THE STDY AREA

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2.1 Natural and Other Conditions

2.1.1 General

The official name of the nation is the Republic of Indonesia in English (hereinafter referred as "Indonesia"). Indonesia is situated between Long.94°45'E and 141°05'E, and between Lat.6°08'N and 11°15'S. The capital city of Indonesia is Jakarta. The area of whole nation of Indonesia is around 1,937,000 km^2 consisting mainly of the Sumatra island, the Java island, the Nusa Tengara islands, the Kalimantan island, the Sulawesi island, the Maluku island and the Irian Jaya.

Indonesia has 27 provinces as of 1997. Central Java Province is one of them situated between Long.108°30'E and 111°30'E, and between Lat.5°30'S and 8°30'S. The capital city of Central Java Province is Semarang City which is one of municipalities (it is called as "Kotamadya Semarang" in Indonesian language). The area of the Province is around 32,550 km^2 consisting of several regencies and some municipalities as mentioned below, and located in the central part of the Java island neighbored West Java Province in the westward and East Java Province in the eastward. Central Java Province faces to the Java sea in the northward and the Indonesia sea in the southward.

Central Java Province has 29 regencies (called as "Kabupaten" in Indonesian language) and 6 municipalities ("Kotamadya") as of 1997. The Municipality of Semarang (hereinafter called as "Semarang City") is one of those municipalities functioning as the capital city of Central Java Province as mentioned above situated between Long.109°35'E and 110°50'E, and between Lat.6°50'S and 7°10'S. The area of Semarang City is around 370 km^2 consisting of several districts ("Kecamatan") facing to the Java sea.

2.1.2 Climatic Characteristics

The Garang river basin is located in the northern central region of Java Island, where monsoon and trade wind give strong influence and two(2) distinct seasons, namely rainy season and dry season.

The average annual rainfall amounts approximately 2,482 mm according to the climatological data at BMG-Semarang station (refer to Table 2.1.1 and Fig.2.1.1). The amount of 70

percent out of annual rainfall falls during rainy season from November to April. Usually, January has the largest quantity of rainfall and August has the least.

Areal distribution of rainfall is illustrated by isohyetal lines shown in Fig.2.1.1. Annual rainfall in lowland area near the seashore averages some 2,100 mm, but the amount in highland area near Mt.Ungaran exceeds 3,000 mm.

Temperature ranges between 23 'C and 34 'C and annual temperature averages 27 'C. Humidity range is between 70 % and 84 %, and the average is 77 %. Temperature and humidity in this area are very high throughout the year with annual pan evaporation as high as 1,610 mm.

Monthly pan evaporation parallels monthly maximum temperature, and runs counter to monthly rainfall. Maximum pan evaporation (5.7 mm/day) occurs in September near the end of dry season, and minimum pan evaporation (3.3 mm/day) in January in the middle of rainy season.

2.1.3 Geomorphology and Geology

Geomorphology

The study area is located in the northern slope of Mt. Ungaran which has an altitude of 2,050 m. The area can be divided into three topographical types: mountainous region, hilly region and alluvial plain.

(1) Mountain Region

Mountainous regions ranging widely in elevation from about 300 to 2,050 m bound the catchment area of the study area of the southern, western and eastern parts. Small plateaus characterized by the volcanic region are distributed here and there. Rivers in this mountainous region are characterized with steep slope and long and slender catchment area. Volcanic rocks are commonly distributed in this region.

(2) Hilly region

Hilly region widely extend in the study area with elevations of about 50 to 300 m which have the distinctive feature of an undulated plateau and a steep-walled valley. This geographical feature is in the young stage of development. The catchment area of river in this region is long and slender, same as in the mountainous regions.

Volcanic rocks and sedimentary rocks of marine origin are distributed.

(3) Alluvial Plain

Alluvial plains with elevation of about 0 to 50 m extend along shorelines and rivers in the study area. Rivers in this region are characterized with meandering and wide and gentle valley. Flood plain deposit, coastal plain deposit and shallow marine deposit are distributed in this region.

The Garan Rive originates from Mt. Ungaran and flows approximately from south to north in the study area. In the mountainous and hilly regions the river is characterized with steep slope because of the short stream length and large difference in ground elevation. In addition, the catchment area is long and slender. The geographical feature of this area is still in the young stage development, with the vertical erosion being stronger than horizontal erosion.

Geology

The regional geology and stratigraphy in and around the study area are shown in Fig. 2.1.2 and Table 2.1.2. Geology of this area is roughly divided into three categories; volcanic rock, sedimentary rock which is marine in origin, and alluvial deposits which cover these basement rocks. Volcanic rocks consist of lahar, lava flow of Mt. Ungaran, Notopuro Formation and intrusive rock Sedimentary rocks consist of Damar Formation, Kalibiuk Formation, Banyak Member and Penyatan Formation.

Stratigraphy

(1) Volcanic Rocks

(a) Lahar

Lahar is distributed along the west and north slope of Mt. Ungaran and covers the old lava flow. Lahar is interplayered with andesitic lava flows which are abundant but with limited distribution near Mt. Ungaran. Lahar deposit (mudflow) is composed of poorly sorted volcanic rock debris with angular to poorly rounded boulders as much as 2.0 m in diameter.

(b) Lava from Flow of Mt. Ungaran

This lava flow which is generally well jointed is augite-hornblende andesite,

unconformably overlying Notopuro Formation, and distributed around Mt. Ungaran.

(c) Notopuro Formation

Notopuro Formation consists of volcanic breccia, lava flow, tuff, tuffaceous sandstone and claystone. The distribution of Notopuro Formation is mostly flow breccia and lahar intercalated with small lava flow and fine to coarse-grained tuff. This unit locally include tuffaceous sandstone and claystone, sedimented horizontally and widely distributed in the foot of Mt. Ungaran and unconformably covered with new lahars and new lava flows.

Volcanic Lahar in the study area, composed of augite-olivine andesite, was supplied from Mt. Ungaran. Fresh volcanic breccia is well consolidated with a few joints having sufficient soundness to support a dam of less than 70 m in height. The ground surface of volcanic rock is deeply weathered to form reddish-brown soil. Larger boulders may be fresh and hard, or of a weathered rind. This unit is deposit generally 50 meters thick in the northeast to more than 200 m in the west, reflecting in part the irregular topography it was deposited on. New lahars, new lava flows and Notopuro Formation form the geographical feature of the mountains region.

(d) Intrusive Rock

Intrusive rocks are distributed in the north and east of Mt. Ungaran, intruded with Notopuro Formation, and form small hills which are very steep exemplified by the peaks of Mt. Mergi (the highest), Mt. Kalong, Mt. Siwakul and Mt. Turun. Augite-hornblende andesite is found at Mt. Turun and augite-olivine andesitic basalt, at Mt. Mergi (Van Bemmelen, 1941). However, rocks at Mt. Mergi turned out to be andesite according to a recent investigation (Ir.Kardiyono, 1991).

The youngest strata intruded are marine beds of Middle Miocene to Pliocene age, but intrusive rocks may be considerably younger (Robert E. Thaden and others, 1975). These intrusive rocks may be utilized as construction materials like aggregate and rock/riprap material.

(2) Sedimentary Rocks

(a) Damar Formation

Damar Formation can be divided into four zones, the transition zone, the lower zone, the middle zone and the upper zone. The transition zone was deposited in the Upper Pliocene and consists of black clay with calcareous concretion and tuffaceous sandstone with marine mollasse. The lower zone was deposited in the Lower Pliocene and consists of conglomerate with calcareous concretion and tuffaceous sandstone. The middle zone is composed of laharic deposits characterized with gravels of lahars augite-olivine andesite, cross-bedded tuffaceous sandstone, conglomerated and lapilli claystone, sandstone and andesitic conglomerate characterized with laharic deposits.

Damar Formation forms a hilly geographical feature and is distributed along the coastal plain and near the flood plain. This formation mainly consists of tuffaceous sandstone with conglomerate, volcanic breccia and tuff that is weakly consolidated and not suited for the basement rock of a dam. Rockfalls and small landslides are observed here and there.

(b) Kalibiuk Formation and Banyak Member

These two formations are marine in origin and related contemporaneous heterotopic facies. Kalibiuk Formation is mainly composed of blush to greenish grey claystone with marl, sandstone including mollasse, conglomerated and limestone. On the other hand, Banyak Member consists of alternation of various sandstones. Kalibiuk Formation is distributed in the downstream of Kreo River, Kripik River and Garang River and in the eastern and westerns parts of the study area. Banyak Member is merely distributed in the eastern part of the study area.

These formations are unconformably overlain by Notopuro Formation and Damar Formation and locally interfingered with Damar Formation. These formations are weakly consolidated and are not suitable for this marine bed is most troublesome, because it has little strength and tends to slide or creep when wet.

(c) Penyatan Deposits

This formation is distributed west of the study area and consists of sandstone, breccia, tuff and claystone.

(3) Alluvial Deposits

Alluvial deposits consist of recent river deposits, flood plain deposits and shallow marine deposits. River deposits mainly consist of unconsolidated sand and gravel intercalated of unconsolidated sand and are generally 1 to 3 m thick. On the other hand, flood plain deposits, generally 2 to 10 m thick, are mainly composed of unconsolidated clay, sand and gravel, but contain a greater amount of silt and clay than river deposits. The shallow marine deposit is explained in 5.2. Attention should be paid on the gravel content of each deposit in the selection of construction materials.

Geological History of Study Area

The geological history of the study area has started from the Tertiary Period. The study area is in the shallow marine from the Miocene Epoch of the Tertiary Period to the Pleistocene Epoch of the Quaternary Period. Penyatan Formation, Banyak Member, Kalibiuk Formation, Lower Damar Formation and Lower Notopuro Formation have sedimented in this sedimentary environment. At the same time, volcanic activity had occurred in and around the study area and supplied the Upper Damar and Upper Notopuro Formation with volcanic product. In addition, folding and faulting activity was caused by this volcanic activity.

In the Pliocene Epoch of the Quaternary Period, volcanic activity of Mt. Ungaran occurred along the North Serayn Mountains south of the study area.

2.1.4 River Features and Characteristics

River Features

Garang River flows from Mt.Ungaran to the north, meeting its two (2) major tributaries, Kripik and Kreo rivers, about 12 km and 10 km upstream from the river mouth, respectively (refer to Fig. 2.1.3). The whole catchment area of Garang River is about 204 km^2 which includes the catchment area of 70 km^2 for Kreo River and 34 km^2 for Kripik River. The total river lengths of Garang, Kreo and Kripik rivers are about 36 km, 24 km and 8 km respectively

Simongan Weir located about 5.3 km upstream from the river mouth is the major river structure of Garang River supplying river water for Semarang River from the right bank and the city drainage channel from the left bank. The downstream from the weir is called West Floodway (Banjir Kanal Barat), and the flood discharge from Garang River flows into Java Sea through the floodway.

A densely populated area spreads out in the lower reaches from the confluence of Kreo River, particularly the downstream from Simongan Weir. On the other hand, the upper reaches with a higher ground elevation is used as either cropland or forest area and is sparsely populated.

River Characteristics

The general river characteristics of Garang River is schematically presented in Fig. 2.1.4 and described below.

(1) Riverbed profile

Garang River is roughly classified into four (4) river reaches, namely, very gentle floodplain channel in the downstream, relatively gentle midstream, steep stream in a hilly area and very steep stream in a mountain area. Simongan Weir exists at the lowermost end of Garang River giving a riverbed elevation difference of about 5 m between upstream and downstream as shown in Fig. 2.1.5. The name of river downstream from Simongan Weir changes its name to West Floodway. The river flow in the downstream from the Weir is completely affected by tide. The riverbed profiles of four river reaches are shown below:

River Stretch	Length	Riverbed slope	Features
River mouth to Simongan Weir	5 km	flat to 1/5,000	Very gentle
Simongan weir to confluence with Kreo	5 km	1/2,000	Medium gentle
Confluence point to 30 km point	20 km	1/100 to 1/50	Steep
Upper most reaches from 30 km point	5 km	1/50 to1/5	Very steep

(2) River Form

A number of meandering sections are found in the upstream from the confluence with Kreo River, especially, Kreo River has a lot of meandering in the lower reaches. The midstream between the confluence with Kreo River and Simongan Weir is relatively straight except one (1) meander. However, a short cut channel has been excavated for

this meandering portion after the 1990 flood by using OECF sector loan. West Floodway channel downstream from Simongan Weir is fairly straight.

(3) Riverbed Material

West Floodway, which is the downstream channel of Simongan Weir, is an alluvial floodplain. The riverbed material in this portion, therefore, is silt transported as washload. In the river stretch between Simongan Weir and Toll Road Bridge, the riverbed material consists of silt, fine sand and coarse sand, while the riverbed in the stretch from the Toll Road Bridge to the confluence with Kreo River contains a lot of coarse sand and gravel. In the upper portion from the confluence the riverbed is formed by sand gravel and boulders.

Land Use along the River and Riverside Activity

(1) West Floodway

The land on both sides of the channel is highly utilized as the residential, commercial/official and industrial areas. New residential areas have been developed on the reclaimed land at the river mouth area, and the land reclamation is still being undertaken by the private land developers. The existing floodplain with a large open space is used as farm land, sports ground, fish pond and so on. Riverside activities such as fishing, rolling boats and salt loading/unloading are found as well.

(2) Garang River (Simongan Weir to Confluence with Kreo River)

Residential and commercial areas and cultivated lands spread on the right bank, while industrial zone and residential area lies along the left bank. There are some open spaces on the floodplain , and they are used as farm land (including aquatic plants), sports ground, factory yard and so on. Small scaled manual sand mining is widely undertaken by the local people on the riverbed.

(3) Upper reaches of Garang and Kreo rivers (upstream from Confluence)

Mainly, lands along the river are used as farm lands, paddy fields and small scale plantations. Cobble stone and boulder mining activities are found in some places.

2.1.5 River Structures

Simongan Weir

(1) Features of Existing Weir

Simongan Weir, located at about 5.3 km upstream from the river mouth was constructed at the end of the 19th century and now used as the intake facilities for municipal water supply (PDAM) and for maintenance discharge of Semarang River and irrigation channel flowing in the left bank downstream urban area.

The weir is a solid overflow structure crossing the river channel and providing the intake with minimum water level for the said water use purposes. The weir comprises a main diversion structure with a length of 62 m, intake gates and flushing gates at both right and left sides of the weir. The main diversion structure has a ogee type crest shape with a bigger crest width and is made of cemented bricks. The structural features are presented in Fig. 2.1.6.

Due to the structural overage and heavy scouring in the upstream riverbed, rehabilitation works were done many times up to the present time.

Channel maintenance water shown in the table below is diverted from the weir reservoir through the intake structures at both right and left banks.

Season	Right Bank For Semarang River	Left Bank for drainage channel
Dry Season	500 l/s (average)	100 l/s (average)
Rainy Season	700 l/s (average)	150 l/s (average)

The intake gates are manual operate sluice type gate, and the shape and size of gates are shown in Fig. 2.1.6.

The existing Simongan Weir of fixed type forms an obstruction during flooding event and causes substantial inundation upstream of the weir. This weir, therefore, needs to be reconstructed to a gated weir to meet the flood control policy.

(2) Operation of the Weir

Simongan Weir is managed by District Office of Provincial Public Works (Cabang Dinas) in terms of its gate operation and maintenance of facilities. The intake gates and flushing gates are operated according to the following rules.

(a) The reservoir water level is maintained at the same elevation of EL.+5.200 (TTG elevation) as that of weir crest during non flooding time..

(b) Closing operation for intake gates is commenced when the reservoir water level rises by 50 cm or more above the weir crest.

(c) The flushing gates are fully closed during both flooding and non flooding times except the opening operation for flushing sediment after flooding.

For the operation of intake gates the rating curves established are used.

(3) Hydraulics at the Weir

Flood discharge capacity of the weir is estimated as shown in Table. 2.1.3. The flow capacity at the operation deck level (EL.+8.50 m) is about 810 m^3/s.

Not only a serious riverbed degradation in the downstream but also a heavy lowering of upstream riverbed is found according to the river survey results as shown in Fig. 2.1.7. This is due to the local scouring under the recurrent floods in the long time range. Accordingly, it is considered that excess seepage beneath the weir body has been occurring, bringing instability of the structure. In this sense, the existing weir should be reinforced or reconstructed urgently.

Bridges

There exist six (6) bridges spanning over West Floodway/Garang River downstream from the confluence of Garang and Kreo rivers. Profiles of the bridges are presented in Fig. 2.1.8.

(1) Structural Features

Below are the structural data of the existing bridges regarding location, structural type, dimensions, embedment length of piers and average width of river channel.

Name of Bridge *1	Location from River Mouth (m)	Structural Type	Span, Total Length (m)	Embedding Length of Pier (m)	Width of River Channel (m)
North Ring Road	1,175	PC I-Girder	5 spans 160.0	0 (center pier) 3 m or more	155
Railway Bridge	3,700	Warren Truss	3 spans 97.5	No data	90
National Road Bridge (2)	4,110	PC I-Girder	3 spans 76.1, 78.0	No data	88
Old Simongan Bridge *3	5,160	Plate Girder	8 spans 77.2	No data	90
Toll Road Bridge	8.980	PC I-Girder	7 spans 252	No data	150

*1 Each bridge is named after the name of street or area for this project tentatively.

*2 This bridge is now being expanded in width by constructing abutments and piers with the same structural dimensions as the existing one.

*3 This bridge will be demolished after the New Simongan Bridge has been constructed at the immediate upstream of the existing Simongan Weir.

(2) Flow Capacity of Channel at the Bridges

Based on the non-uniform flow calculation the flow capacity of channel under the bridge girder is estimated as follows:

Name of Bridge	Elevation of underside of Girder	Flow Velocity (m/s) *2	Flow Capacity (m^3/s)
North Ring Road Bridge	2.50	1.94	1,046
Railway Bridge	3.50	2.53	685
National Road Bridge (2)	4.23, 4.14	2.26	635
Old Simongan Bridge	6.31	2.51	850
Toll Road Bridge	18.17	2.40	More than 1,000

*1 All elevations are based on the datum of TTG (Mean Sea Level at Tanjung Priok in Jakarta).

*2 This is a flow velocity when the design flood discharge of 790 m^3/s flows in the river channel.

(3) Structure and Requirements of River Channel

(a) North Ring Road Bridge

This bridge is a newly constructed having a bigger bridge length and higher elevation of girder. It is considered that a sufficient freeboard against the design flood discharge is already provided. The riverbed around the center pier is seriously scoured and the embedding length of the foundation is almost 0 m. Some countermeasures will be necessary to prevent further local scouring around the center pier.(refer to Fig.2.1.8(1/3))

(b) Railway Bridge

This bridge was constructed during the rule of Holland in the early 20th century. Due to the structural overage, the old trusses were replaced by the new ones in the recent years. The original foundation structures have been used up to the present time with some reinforcements. The flow capacity at

the bridge is estimated at 685 m^3/s which is a little bigger than the 10-year probable flood. To pass the proposed design discharge with a freeboard of 1.0 m, the bridge must be raised. (refer to Fig.2.1.8(1/3))

(c) National Road Bridge (2 bridges)

The flow capacity is estimated to be 635 m^3/s which is nearly the discharge of 10-year probable flood. The water level at this section is raised by the backup effect due to the downstream narrow channel as shown in the water level profile (refer to Fig. 2.1.8(2/3)). This narrow channel portion, hence, is required to be widened and lined with concrete of masonry in order to lower the probable high water level. The protection works for the abutment and piers are necessary as well.

(d) Old Simongan Bridge

The structural stability of this bridge is considered quite low especially during flooding event. According to the regional plan of Semarang City, the new Simongan Bridge is supposed to be constructed at about 300 m upstream from the existing Simongan Weir instead of the existing one as shown in Fig. 2.1.8(2/3). Consequently, the existing bridge will be demolished. The construction of the new bridge is scheduled to be commenced in 1999 and completed in 2000.

(e) Toll Road Bridge

This bridge does not become flow restrictions at all. However, as the bridge piers are affected by the swift flood flow, protection works for the riverbed around the piers will be required (refer to Fig.2.1.8(3/3)).

Other River Structures

(1) Earth Dike and Flood Wall

Based on the design flood of 25-year return period (Q=740 m^3/s), the main channel improvement works such as channel excavation and construction of earth dike and floodwall were almost completed for West Floodway/Garang River. (The earth dikes and floodwalls in the upstream of Simongan Weir have been constructed on the basis of a 100-year flood of 1,100 m^3/s after the 1990 flood.) Fig. 2.1.9 shows the location

of the existing earth dikes and floodwalls built so far, and present conditions are described below:

(a) River Mouth to North Ring Road Bridge

There is no earth dikes and floodwalls in this river stretch.

(b) North Ring Road Bridge to Railway Bridge

The continuous floodwalls with a total length of about 2,550 m are constructed along right and left river banks. They are stone masonry made with bamboo pile foundation. Since most floodwalls on the left bank are faced with the swift main flow of flood, the area in front of the wall is tend to be scoured easily. Some scouring prevention measures should be taken, or the floodwalls shall be strengthened.

It can be pointed out that the high floodwalls could be barriers separating people in the area from good river environment. This situation should be taken into consideration in the river improvement plan.

(c) Railway Bridge to Simongan Weir

Both left and right river banks are relatively high in ground elevation. For some portions high road embankments play an role of river dikes.

(d) Simongan Weir to Confluence of Garang and Kreo rivers

For the congested area in the right bank side, floodwalls made of concrete or masonry are provided on the river bank parallel with the main roads which run along the river. On the other hand, for the non-congested upstream area earth dikes are built on right bank. Some portions of existing floodwall are endangered due to the heavy local scouring on the river side. Reinforcement of the floodwall/dike should be made together with bank protection.

(2) PDAM Intake Facilities

(a) Intake Capacity

The existing PDAM water intake structure is located 1.2 km upstream of Simongan Weir on the right bank of the river course. This facility was

constructed in 1960 aiming at supplying municipal water with a maximum capacity of 580 l/s. To meet the increasing water demand, the capacity was raised to 980 l/s in 1995. General date regarding intake capacity is as follows.

Item	Data
Maximum Pumping Capacity	980 liter/s
Normal Intake Discharge (every month)	900 liter/s
Intake Structure	Sluice Gate and Pumps
Number of Pump	12 pumps
Type of Pump	Centrifugal & Submersible
Operation of Intake	24 hours-operation

(b) Structure

A sluice gate with a dimension of 2.5 m x 2.5 m is provided in front of the intake basin as shown in Fig. 2.1.10. The bottom elevation of intake gate is EL.+3.62 m which is about 1.4 m below the crest of Simongan Weir.

Due to the river course direction, flood flow tends to attack the uperstream/downstream river banks of the intake structure, resulting in heavy scouring/erosion on river banks. The proper bank protection will be required.

(3) Drainage Facilities

An inventory survey on drainage outlet was conducted in this review study, 49 drainage box culverts/pipes and ditches with channel width of more than 0.5 m were identified along the river bank of West Floodway/Garang River. Location and structural features are tabulated in Table 2.1.4 and shown in Fig. 2.1.9. Of the total drainage outlets 11 drainage box culverts/pipes are equipped with gates. Flap gates are employed for the most drainage outlets. Some gates seem to have trouble in closing and opening operations due to the heavy sedimentation in/around drainage outlet and the overage of gate itself.

To prevent inland drainage area from flooding caused by the backwater effect of the main stream, gates should be equipped for the remaining drainage outlets.

(4) Water Transmission Pipe

The location of PDAM water transmission pipes crossing the river channel and

buried in the ground nearby the river banks are shown in Fig. 2.1.9. These pipes may be affected by river improvement works such as channel widening and deepening. Necessary countermeasures in coping with them should be taken into account in the detail design.

2.1.6 Environmental Condition

Solid waste management and river water quality are significant parameters showing present environmental conditions in Semarang City and the Garang river basin. These can be described as follows;

(1) Solid Waste Management

Semarang Municipality assumes responsibility for solid waste management. Garbage collection service is provided every day with city-owned equipment such as 75 arm load-typed trucks and 4 dump trucks. In addition 7 trucks and one(1) compactor truck are also mobilized on contract basis from the private companies. The number of daily trips for the truck will be five(5) on the average to over the area where containers or garbage bins are placed at the designated location. The garbage collection rate is estimated at 55 %, which is rather a small share to deal with solid waste management. The rest remain disposed in improper places. It can be noticed that some open ditches or canals are full of domestic refuse which may cause clogging the flow and generating stench.

The landfill site is located on the left bank of Kreo River at about 1.7 km downstream from the proposed dam site (refer to Fig.2.1.11). According to the information from the City Cleaning Agency (Dinas Kebersihan Kotamadya), it started in 1992 as an authorized landfill site, but no record is available since monitoring has not been carried out for the first 3 years. In 1995 truck scale was installed at site to facilitate management system, and it is reported that the amount of garbage dumped here is estimated to be 1,130 m^3 a day. However attention should be paid to the fact that all types of garbage generated in the City are brought here and disposed of, that means it contains not only domestic refuse, but also industrial waste and medical waste as well.

In view of these facts the Municipality is conducting the study to construct a new landfill site as part of SSUDP. In the meantime the present disposal site is planned to be improved in the hope that it can be used until the year 2002. The improvement plan is shown in such a way that the sanitary landfill method be applied from the environmental point of view. In this sense, water pollution control should be taken into consideration.

As an environmental management strategy, the sanitary landfill site is absolutely necessary to be constructed in other appropriate location. The major reasons are described as follows;

(a) The location of the present site is so close to Kreo River that the water quality is potentially affected by the leachate or by-products of the disposed waste;

(b) Water intake facilities managed by the Regional Government Water Supply Enterprise (PDAM) is located at 8.5 km downstream from the site. If water is polluted by hazardous waste, it may affect human health;

(c) The topographic feature provides a large open space in the valley for the dumping site, but it will be filled to the capacity in next 5 years; and

(d) The managing system needs to be improved and strengthened to control people who bring and dispose the waste in illicit way.

The solid waste shall be collected and treated in proper way as it is provided in the Decree of the Government No.12, 1995 regarding Storing and Collection of Hazardous Waste. However, it is practically neglected due to the inefficient control system and lack of public concern. Consequently, solid waste management program should be formulated at an early stage possible as one of the major components of the Urban Development Plan.

Besides the construction of new landfill site, it is important to take two key points into account, which certainly lead the project to the successful way; firstly, it is people's participation in the program, and secondly, institutional strengthening. Both can be achieved in joint efforts between residents and administration agency, and it may be required to perform tough activities in order to gain understanding and collaboration of the citizens.

(2) Water Quality of Garang River

In collecting information on water quality of Garang River, two (2) approaches are considered. The first one is Clean River Project (Proyek Kali Bersih: PROKASIH), which is promoted as a nationwide campaign to clean the river and to create better environment in the river basin. Secondary, PDAM, which is an enterprise owned by the Regional Government dealing with the treatment and supply of potable water. The details are described as follows;

(a) PROKASIH

Since there is no sewerage system in Semarang City, all wastewater is discharged into the open channels at the extreme end, resulting in the pollution of water resources. Under such critical conditions, the Local Government and Municipality have taken an action to watch carefully the river water quality in an effort to improve river environment. Environmental Office of the Semarang Municipality (BAPEDALDA II.) has been undertaking monitoring work for the water quality of Babon River under PROKASIH since 1994. Monitoring is also carried out for the industrial wastewater discharged into Babon River. Six (6) companies have been selected for this purpose.

Environmental Bureau in the Provincial Government is in charge of PROKASIH, too covering three(3) rivers such as Bengawan Solo, Kupang-Sambong and Garang. As for Garang River, monitoring started in 1989 by taking water samples to analyze water quality.

According to the report of the Environmental Bureau, the water quality of Garang River represented by BOD, COD and DO is gradually improved after breaking through the most critical period between August and September in 1994. It is remarkable that COD is high in every location. BOD and COD values in the upstream are slightly better than those in the downstream, but in recent years, these values show constantly not more than 8 mg/*l* and 50 mg/*l* respectively, without resort to the location and season.

All of the nine (9)-selected factories are equipped with the treatment plant for liquid waste. However, some of them are reported to be not managing well their treatment. Those companies are identified as tiles, textile, pipes and steel manufacturers. BOD, COD and TSS are regarded as key parameters for PROKASIH to evaluate the quality of wastewater. In the last fiscal year (1995/96), however, BOD and COD have been reduced by 56.17 % and 54.23 % respectively from the previous year, while TSS was only 23.89 % of reduction. This outcome is certainly attributed to the efforts made by the selected manufacturers under PROKASIH.

It shall be noted that there are 89 registered industrial companies in the Garang river basin, so that the above selected factories are only minor sources of pollution, and if the river environmental issue needs to be further discussed, a complete monitoring system may be required to cover the whole river basin.

(b) PDAM

Water intake facilities are located on the right bank of Garang River at about one (1) km upstream from the Simongan Weir. Sample is taken every day and analyzed after the water has been pumped up to the reservoir at Gajahmungkur. Monthly report is compiled based on the weekly analysis covering 20 key parameters. The 1996 report shows the following characteristics of the raw water quality;

(i) Throughout the year both BOD and DO meet requirements of standard Group B (6 mg/*l* and 3 mg/*l*) established by the Ministry of Health in 1990.

(ii) The turbidity is constantly high. The maximum value is recorded at 878 NTU at the beginning of December and the minimum is 40 NTU in August. However, the value sometimes shows enormous increase in flooding period as it is over 3,000 NTU.

(iii) Ammonia (NH_3) concentration is overwhelming the standard (0.500 mg/*l*) throughout the year. 6.190 mg/*l* is the highest concentration shown at the beginning of December and 0.665 mg/*l* is the lowest in February.

(iv) Sulfide(H_2S) concentration is recorded high only in the rainy season, showing more than 6 times as much as the standard value (0.1 mg/l) in the first week of December.

(v) High concentration of Cadmium is constantly observed in the sample water, showing 0.05 mg/*l* as the highest, while 0.01mg/*l* as the lowest which is just limited value.

(vi) The concentration of Chromium in the middle of November is 0.139 mg/*l* which is the highest level of the year. High concentration is also observed in August and September showing nearly the limit of 0.050 mg/*l*.

(vii) Other hazardous substances to the human health such as Cyanide, Copper and Zinc have been observed in certain period. Cyanide reached limited value (0.1 mg/*l*) in July, and Copper concentration was over the standard requirement (1.0 mg/*l*) in December.

Based on the weekly analysis data on BOD, COD and DO for the last five(5) years, monthly average value of each parameter is graphically shown in Fig.2.1.12 with its fluctuation throughout the year. Although BOD has never been over the limit of 6 mm/*l*, it tends to show a gradual increase from 1995. The analysis results show that COD is characterized by its large fluctuation. No limit is specified for COD in the water standard Group B, but its value is generally high and shows sometimes ten(10) times as high as BOD. In the meantime, DO has been recovered since 1995 to meet the minimum requirement of 3 mmg/*l*.

2.1.7 Land Use Pattern

(1) Existing Land Use

Fig. 2.1.13 shows land use pattern of Garang River basin which was elaborated on the basis of available land use maps from Provincial Development Planning Board (BAPPEDA) of Semarang City as well as the related regencies.

The land use map for the river basin consists of seven (7) classifications such as agricultural land, water area, conservation area, industrial area, business area, housing area and others. The agricultural land includes paddy, upland fields and plantation. It covers predominantly large area (52.9 %) which consists of mainly small-scaled farmlands extending over the upper river basin. This pattern is particularly dominant in the area administered by the two regions. The housing area ranks second in land use share followed by the conservation area. These are 21.9% and 19.8% respectively. In the meantime, it is notable that both business and industrial area have minor shares (0.5% and 0.3%) in the basin. The land use pattern is summarized in the following table.

Land Use Pattern of Garang River Basin

Classification	Area (ha)	Share (%)
Agricultural Land	10,813	52.9
Water Area	110	0.5
Conservation Area	4,033	19.8
Industrial Area	58	0.3
Business Area	103	0.5
Housing Area	4,467	21.9
Others	846	4.1
Total	20,430	100.0

According to the land use map of Semarang City prepared in 1993 by BAPPEDA, housing area covers about 13,540 ha of land corresponding to 36.4% of the total area, whereas agricultural land and conservation area are estimated at 10,720 ha and 6,750 ha accounting for 28.8% and 18.1% respectively. It should be noted that the industrial zone is concentrated in coastal area, but it is minor portion showing as small as 2.8% of the total land.

(2) Future Land Use

Future land use map targeted at 2005, the housing area is increased by 2,930 ha from the 1993-based land use to 16,470 ha, which is nearly 44% of the whole area of the municipality. Meanwhile, the agricultural land shows drastic change in its area because it is reduced by 65% from 1993 amounting to 3,730 ha. The other characteristic changes in the land use pattern during the same period is a triple increase in both industrial area and "others". It is noted that category "others" involves transportation facilities, university campus, warehouse, mixed facilities (housing area combined with commercial and business center) and so on.

Fig. 2.1.14 present the land use of Semaran municipality in 1993 and the proposed land use for the year 2005 respectively, and its summary is tabulated below.

Land Use Pattern of Semarang Municipality

Classification	Land Use in 1993		Future Land Use (2005)	
	Area (ha)	Share (%)	Area (ha)	Share (%)
Agricultural Land	10,723	28.8	3,730	10.0
Water Area	3,068	8.3	590	1.6
Conservation Area	6,752	18.1	8,185	21.8
Industrial Area	1,043	2.8	3,250	8.7
Business Area	684	1.8	652	1.7
Housing Area	13,538	36.4	16,467	43.9
Others	1,421	3.8	4,600	12.3
Total	37,229	100.0	37,474	100.0

Note: The difference in total area between the two periods is caused by the reclaimed land in the coastal zone.

2.2 Socio-Economic Condition

2.2.1 Population and Labor Force

(1) Population

According to the statistical data, population in Indonesia has increased from 147 million in 1980 to 198 million in 1996 with 1.87 % of an annual average population growth ratio as for these 16 years shown in Table 2.2.1. The annual average population growth rate was decreased from 1.98 % during the period between 1980 and 1990 to 1.69 % between 1990 and 1996.

Average family size of whole Indonesia was also decreased from 4.86 persons per household (HH) in 1980 to 4.27 persons per HH in 1996 through 4.52 persons per HH in 1990.

Population of Central Java Province was 29,881 thousand in 1996 as shown in the above mentioned table. However, the population of regencies and municipalities in Central Java Province was reported only up to 1995 even by the newest provincial level statistical data named as "the Central Java in Figures" (Jawa Tengah Dalam Angka).

In 1995, the population of Central Java Province was 29,653 thousand as shown in Table 2.2.2 with 1.04 % the annual average increasing ratio for 15 years since 1980. The annual average population growth rate was decreased from 1.19 % during the period between 1980 and 1990 to 0.74 % between 1990 and 1995. Average family size of Central Java Province was also decreased from 4.53 persons per HH in 1990 to 4.51 persons per HH in 1995 .

In Semarang City, the population was 1,252 thousand in 1996 according to the municipality level statistical data named as "the Semarang City in Figures" (Kotamadya Semarang Dalam Angka) with 1.21 % of annual average increasing ratio from 1,096 thousand in 1985. This annual population increasing ratio was increased from the said one to 1.47 % since 1990, and 2.06 % since 1993 as shown in Table 2.2.3. It seems that Semarang City is under developing municipality. It is supported by population density shown as, for example, the higher density of 15,814 person per km^2 in a district of Semarang Tengah than that of 14,068 persons per km^2 in Jakarta, and those in other districts as Semarang Selatan, Gayamsari, Semarang Timur, Candisari, Semarang Utara are almost near that of the said Jakarta's one. The Semarang Legislative Assembly has agreed a legislative bill on a new administration unit system submitted by the Mayor of Semarang in 1992. Therefore, the number of districts has been set as 16 districts from 9 districts since 1993 to ease to govern taking into account of the above mentioned population growth.

On the other hand, the family size in Semarang City has decreased from 4.86 persons per HH in 1985 to 4.50 persons per HH in 1996. But, this rate is still slightly higher than that in average of whole Indonesia as 4.27 persons per HH in the same year shown in Table 2.2.1.

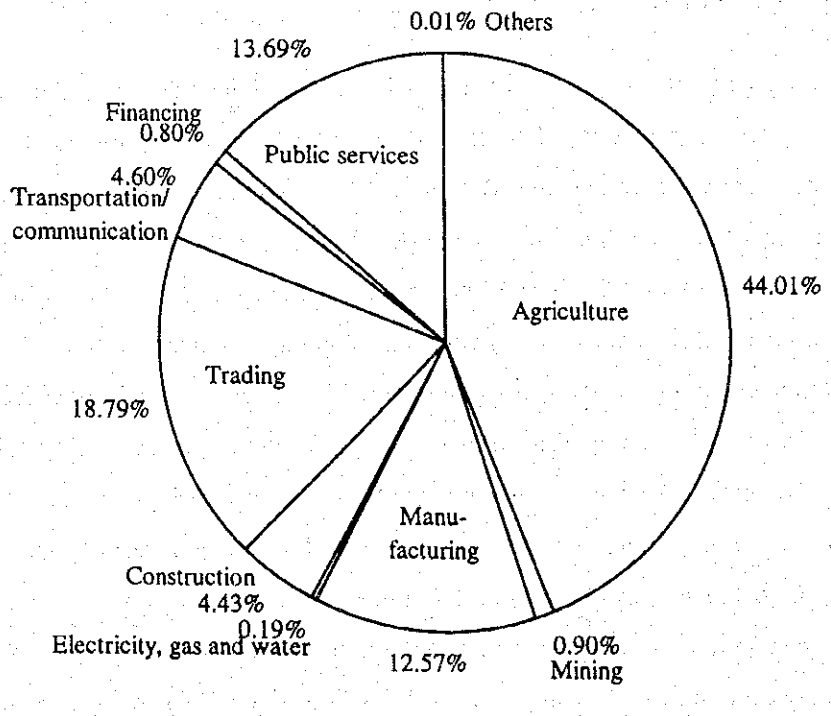
(2) Labour Force

Among the household population who are 10-years and over in age of 110 million in 1985, 153 million in 1995 and 154 million in 1996 in Indonesia, the economic active population was 60 million, 86 million and 90 million with participation rates of 54 %, 57 % and 58 % respectively as shown in Table 2.2.4.

The actual labour force among the economic active population in Indonesia mentioned above in 1985, 1995 and 1996 was fluctuated as 58 million, 80 million and 86 million with the employed rate of 97 %, 93 % and 95 % respectively. Thus, the unemployed rates in Indonesia were 3 % in 1985, 7 % in 1995 and 5 % in 1996.

Following figure shows the share rates of actual labour forces by industrial group in both sexes in Indonesia as of 1996:

Percentage of Labour Force in Indonesia by Industrial Group



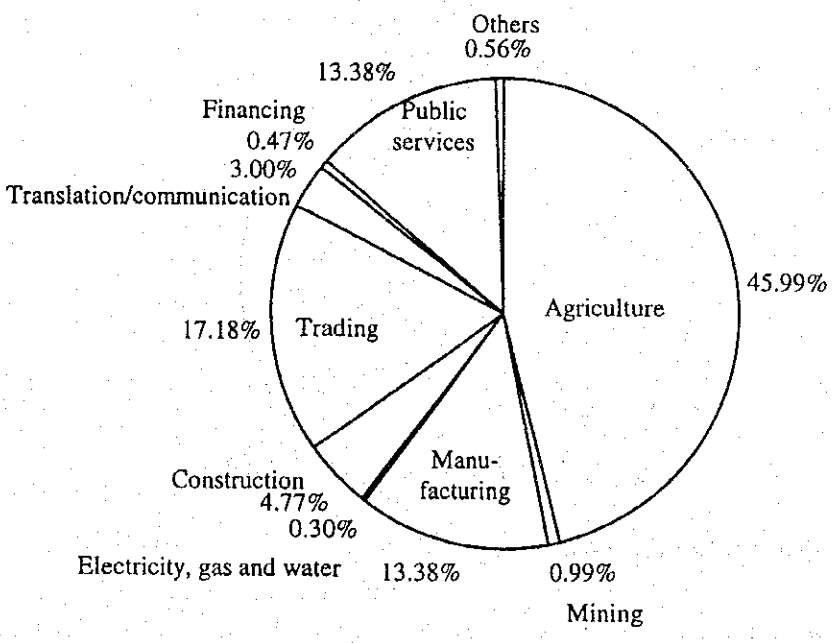
As shown in the above figure, Indonesia is still the agricultural established country from the viewpoint of the labour force as indicated at 44 % in its share rate to the total labour force as of 1996.

On the other hand, among the household population who are 10-years and over in age of 18 million in 1980, 21 million in 1988 and 24 million in 1995 in Central Java Province, the economic active population was 10 million, 13 million and 15 million with participation rates of 55%, 63 % and 62 % respectively as shown in Table 2.2.5.

The actual labour force among the economic active population in Central Java Province mentioned above in 1980, 1988 and 1995 was fluctuated as 10 million, 13 million and 14 million with the employment rate of 99 %, 98 % and 96 % respectively. Thus, the unemployment rates in Indonesia were 1.34 % in 1980, 2.02 % in 1988 and 3.96 % in 1995.

Following figure shows the share rates of actual labour forces by industrial group in both sexes in Central Java Province as of 1995:

Percentage of Labour Force in Central Java Province by Industrial Industrial Group



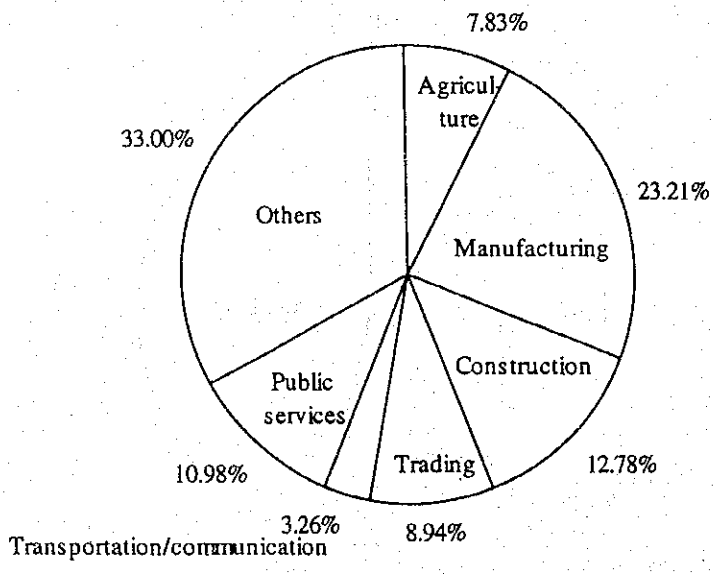
Sharing pattern of labor forces by industrial group in Central Java Province is almost the same with that in Indonesia as shown in the above figure, namely Central Java Province is also the agriculturally established province from the viewpoint of the labor force as indicated at 46 % in its share rate to the total labor force as of 1995.

However, Semarang City shows a different pattern. Among the household population who are 10-years and over in age of 836 thousand in 1985, 894 thousand in 1990, 993 thousand in 1995 and 1,016 thousand in 1996 in Semarang City, the economic active population was 511 thousand, 632 thousand, 841 thousand and 822 thousand with participation rates of 61 %, 71 %, 85 % and 81 % respectively as shown in Table 2.2.6.

The actual labour force among the economic active population in Semarang City mentioned above in 1985, 1990, 1995 and 1996 was fluctuated as 452 thousand, 415 thousand, 678 thousand and 655 thousand with the employment rate of 88 %, 66 %, 81 % and 80 % respectively. Thus, the unemployment rates in Semarang City were 12 % in 1980, 34 % in 1990, 19 % in 1990 and 20 % in 1996.

Semarang City has no statistical data on actual labour force by industrial group in detail. So following figure shows the share rates of economic active population by industrial group in both sexes in the Municipality as of 1996:

Percentage of Economic Active Population in Semarang by Industrial Group



Mining industry in Semarang City does not appear in the statistical data summarized as the said table. The share rate of agriculture is only 8 %, while that of manufacturing shows at 23 % which is almost two times comparing with that in whole Indonesia and whole Central Java Province. The rate of trading is only 9 %.

Transportation and communication shares at 3 % which is rather low comparing with that in whole Indonesia, but is almost the same with that in whole Central Java Province.

It seems that those sharing patterns reflect a function of Semarang City as the capital city of Central Java Province. A group not be able to be classified as a specific industrial group named as "others" with 33 % of share rate looks to reflect the city-diversity too.

Unemployment rate is rather high in Semarang City comparing with that of whole Indonesia and whole Central Java Province as 20 % as mentioned above. This is also a fatal phenomenon in such a city gathering a lot of people who are seeking opportunities to work.

Table 2.2.7 shows a distribution situation of the said economic active population by district (Kecamatan). According to this table, there is no any agricultural active population except fisheries in the central area of Semarang City as the districts of Semarang Timur, Semarang Utara, Semarang Tengah, Semarang Selatan, Candi Sari, and Gajah Mungkur. For fisheries, the district of Semarang Utara has the highest activity, especially almost of the people living in the village of Bandar Harjo are engaged in fisheries at present, so the village is called as "fishers' village ("Kampung Nelayan" in local language)" in general in Semarang City. Districts of Gayam Sari and Semarang Barat are also located around the central area of Semarang City, but those districts have a little agricultural active population. Some of these districts concern directly with this Project.

2.2.2 General Economic Features

(1) Gross Domestic Products

Gross domestic product (GDP) in Indonesia is shown in Table 2.2.8 by current price level, and 1993-constant price level for last 3 years since 1994.

According to the said table, an economic activity group of manufacturing is the highest contribution factor to GDP as 25 % in share rate at current price level in 1996, while the second contribution factor is the group of wholesales & retail trade, restaurant & hotels as 17 % in share rate at current price level in the same year. The third one is the agriculture, livestock &fisheries as 17% at current price level in 1996.

On the other hand, an economic activity group of manufacturing shows the highest growth ratio as 23 % per annum and the group of electricity, gas & water is the second one as 20 % per annum since 1994 at current price revel, but in the case of 1993-constant price, this ranking has been reversed as the group of electricity, gas & water:14 % per annum, and the group of manufacturing:11 % per annum from the viewpoint of annual average growth ratio of GDP.

The economic active groups of construction, banking, insurance & real estate also show high growth as 22 % and 13 % per annum at current price level.

GDP in Indonesia was. Rp.533 trillion as of 1996 at current price level and Rp.414 trillion as of 1996 at 1993-constant price level with the annual average growth ratio 18.05 % and 8.10 % at current price level and at 1993-constant price level respectively.

On the other hand, GDP per capita was. Rp.2,685 thousand as of 1996 at current price level and Rp.2,089 thousand as of 1996 at 1993-constant price level with 16.21 % and 6.42 % of annual average growth rates at current price level and at 1993-constant price level.

Gross regional domestic product (GRDP) in Central Java Province is shown in Table 2.2.9 by current price level, and 1993-constant price level for the year of 1994 and 1995.

According to the said table, an economic activity group of manufacturing is the highest contribution factor to the GRDP as 32 % in share rate at current price level in 1995, while the second contribution factor is the group of agriculture as 23 % in share rate at current price leveling the same year.

On the other hand, the economic activity groups of agriculture, manufacturing, electricity/gas/water, wholesale/retail trade/restaurant/hotels show the almost same high level of growth ratio at around 20 % per annum at the current price level from the viewpoint of annual average growth rates of GRDP.

GRDP in Central Java Province was. Rp.47 trillion as of 1995 at current price level with 18.62 % of the annual growth rates at current price level.

On the other hand, GRDP per capita was lower than that in average in whole

Indonesia as Rp.1,570 thousand as of 1995 at current price level with 17.81 % of annual growth rate at current price level.

GRDP in Semarang City is shown in Table 2.2.10 by current price level, and 1993-constant price level for the year of 1994 and 1995.

According to the said table, an economic activity group of wholesales & retail trade, restaurant & hotels is the highest contribution factor to the GDP as 33 % in share rate at current price level in 1995, while the second contribution factor is the group of manufacturing as 29 % in share rate at current price level.

On the other hand, an economic activity groups of manufacturing shows the highest rate of growth rate at 25 % per annum at the current price level. The group of mining and quarrying shows the second growth rate but is amount of products was quite low, so its contribution rate is negligible small. Therefore, significant second growth rate is that in the economic activity group of wholesales & retail trade, restaurant & hotels as 20 % at current price level. It seems that these figures reflect an actual situation of Semarang City where is one of municipalities under industrializing, and under developing in trading of such products from that industry. These figures support the sharing pattern of economic active population in Semarang City mentioned in previous Clause.

GRDP in Semarang City was. Rp.5.3 trillion as of 1995 at current price level with 18.99 % at current price level.

On the other hand, GRDP per capita was quite high comparing with those in average in whole Indonesia and in whole Central Java Province as Rp.4,305 thousand as of 1995 at current price level with 16.43 % of annual growth rate at current price level. This reflects that Semarang City is a quite attractive municipality for local people and, this is a motivation of the people who want to get more income by moving to anywhere between cities.

(2) Government Finance

Table 2.2.11 shows a movement of the Government budget since 1993/94 up to 1998/99 of fiscal year. According to this table, the scale of state budget came up from Rp.62 trillion in 1993/94 to Rp.147 trillion. Increasing ratios against previous were had come at 11.9 % in 1994/95, 11.9 % in 1995/96, 16.1 % in 1996/97, and

11.6 % in 1997/98 up to the present fiscal year. However, it was changed with quite high rate as 45.6 % in 1998/99 because that the Government of Indonesia has revised its original budget scale following recommendations of the International Monetary Fund (IMF).

On the other hand, the Government's real finance was increased with rather big scale comparing with the budget scale as Rp.60 trillion in 1992/93, Rp.67 trillion in 1993/94, Rp.72 trillion in 1994/95, and Rp.83 trillion in 1995/96 in revenue as shown in Table 2.2.12. The scale of expenditure amount of the Government has changed as Rp.61 trillion, Rp.69 trillion, Rp.72 trillion and Rp.82 trillion in the same respective fiscal year. The change rates against previous year in revenue and in expenditure were 11.5 % and 13.6 % in 1993/94, 8.2 % and 5.3 % in 1994/95, and 14.3 % and 13.8 % in 1995/96.

The main sources of revenue are taxes as 79 % in 1995/96 sharing to the amount of the total revenue consisting of income tax, value added tax on good and services, import duties, excise duties, export tax, property tax, and so on. The amount of revenue from oil and natural gas has shared at only 20 % in the same fiscal year. However, The amount of revenue from oil and natural gas will share at 30 % to the total budget scale in 1998/99 according to the said coming budget scale announced by the Government.

A share rate in percentage of development expenditure was quite high as 36 % with Rp.30 trillion to the amount of total expenditure in 1995/96 as indicated in the above table.

The real finance of Central Java Province was increased from Rp.134 billion in 1992/93 to Rp.303 billion in 1995/96 in revenue with change rates against previous fiscal year of 25.7 % in 1993/94, 36.1 % in 1994/95 and 32.4 % in 1995/96 as shown in Table 2.2.13.

The main sources of revenue are also taxes as 76 % in 1995/96 sharing to the amount of the total revenue consisting of local taxes as tax on motorized vehicles, motor car transfer duties, unpaid taxes and fine taxes. No data was available on expenditure in the finance of Central Java Province this time.

The real finance of Semarang City was increased from Rp.68 billion in 1992/93 to Rp.139 billion in 1995/96 in revenue and, from Rp.67 billion to Rp.135 billion in

expenditure in the same fiscal year with change rates against previous year of 30.2 % in revenue and 34.5 % in expenditure both in the fiscal year of 1995/96 as shown in Table 2.2.14. No complete data on financial situation in Semarang City was available for the fiscal year of 1993/94, so changes could not cleared for 1994/95.

The main sources of revenue are local originated revenues consisting mainly of local taxes, retribution, and fees/fares from local Government corporation and official services and, the contribution and local aid as from the central Government 28 % and as 25 % respectively in 1995/96.

A share rate in percentage of development expenditure was also quite high as 40 % with Rp.53 billion to the amount of total expenditure in 1995/96 as indicated in the above table.

2.2.3 Industrial Perspective

Industrial Features

As mentioned in the aforementioned clauses, people of around 50 % of actual labour force have been engaged in agricultural sector in Indonesia and in Central Java Province since 1985, and they are still 40 % or more even in 1996, while people of 13 % of labour force are engaged in manufacturing in Indonesia and Central Java Province, and 19 % and 17 % of labour force are engaged in trade & hotels sector in Indonesia and Central Java Province respectively.

On the other hand, people of only 8 % of economic active population are engaged in agriculture in Semarang City, but 23 % of them are engaged in manufacturing in 1996.

From the viewpoint of GDP, the economic activity groups of "manufacturing" and "wholesale & retail trade, restaurant & hotels" are the highest contribution factor to the GDP as 42.2 % and 41.4 % in share rate at current price level and 1993-constant price level respectively in 1996 in Indonesia. Also in Central Java Province, the economic activity groups of "manufacturing" and "wholesale & retail trade, restaurant & hotels" are the highest contribution factor to the GDP as 52.6 % and 52.8 % in share rate at current price level and 1993-constant price level respectively in 1995. Furthermore, the economic activity groups of "manufacturing" and "wholesale & retail trade, restaurant & hotels" are the highest contribution factor to the GDP as 61.8 % and 61.2 % in share rate at current price level and 1993-constant price level respectively in 1995 in Semarang City.

This is to say that, even people engaging in agriculture are more than ones engaging in manufacturing and trading, the factor which is significant to the economic activity in Indonesia and in Central Java Province is the activity of manufacturing and trading. This is supported by the economic situation in Semarang City. As mentioned above, even Semarang City is a local city, the economic active population classified in manufacturing and trading is higher than that in agriculture and, GRDP in Semarang City is dominated by the economic activity of manufacturing and trading reflecting a function of the city where is the capital city of Central Java Province as industrial- and trading-oriented city in local.

Now, the manufacturing situation will be discussed as an economic activities in Semarang City comparing with that in Indonesia and in Central Java Province.

Overall Economic Activities

Table 2.2.15 shows numbers of registered total establishments and permanent employees, and some figures concerned in Indonesia for the period from 1993 to 1996. Industrial sector is classified by 9 kinds of economic activities based on their products as "food, beverage & tobacco", "textile, wearing & leather products", "wood & wooden products", "paper & paper products", "chemical, petroleum, rubber & plastic", "non-metalic mineral products", "basic metal products", "fabricated metal, machinery and transport equipment", "not elsewhere specified products".

As shown in the said table, number of registered establishments has increased from 2.5 million firms in 1993 to 2.8 million firms in 1996 consisting of large and medium scale firms, small scale firms and, household scale firms. Here, large scale firms employ more than 50 persons, medium scale firms employ persons ranging from 20 persons to 50 persons, small scale firms employ persons ranging from 5 persons to 20 persons, and household scale firms employ less than 5 persons.

Among them, the top two economic activity groups are the group of "food, beverage & tobacco" and "wood & wooden products" in number with share rates of the both around 35 % and 34 % respectively in 1996 against the total number of establishments. These sharing pattern has been kept since 1993. And the third one is the group of textile, wearing & leather products with share rate of 15 %. Consequently, the number of persons engaged is also the most in the activity group of food, beverage & tobacco with share rates of 30 %. But, the economic activity group of textile, wearing & leather products is the second top in number of persons engaged as 22 %, and the group of wood & wooden products has became the third

one as 20 % in sharing in the same year.

It means that the firm scale of textile, wearing & leather products is larger in general than that of wood & wooden products. Average number of persons engaged may be estimated at 3.3 persons per firm in the group of food, beverage & tobacco (consisting of 172.0 persons/firm in large and medium scale firms, 7.8 persons/firm in small scale firms, and 1.9 persons/firm in household scale firms), 5.9 persons per firm in textile, wearing & leather products (consisting of 297.0 persons/firm, 9.8 persons/firm, and 1.3 persons/firm respectively), and 2.3 persons per firm in wood & wooden products (consisting of 185.0 persons/firm, 8.2 persons/firm, and 1.4 persons/firm respectively) as of 1996.

On the other hand from the viewpoint of salaries and wages, the economic activity group which shows a highest share rate to its total amount in Indonesia is the group of textile, wearing & leather products as 23.7 %, the second highest one is the group of fabricated metal, machinery & transport equipment as 17.9 %, and the third one is the group of food, beverage & and tobacco as 16.9 % in 1996. Therefore, it seems that the most attractive working environment for people is in the group of textile, wearing & and leather products in the whole Indonesia.

The per capita expenditure for salaries and wages in the groups mentioned above may be estimated at Rp.2,041,000 per person per annum in the group of textile, wearing & leather products (consisting of Rp.2,850,000 per person per annum in large/medium scale firms, Rp.1,033,000 in small scale firms, and Rp.170,000 in household scale firms), Rp.4,778,000 per persons per annum in the group of fabricated metal, machinery and transport equipment (consisting of Rp.6,143,000, Rp.1,239,000 and Rp.727,000), and Rp.1,077,000 per persons per annum in the group of food, beverage & tobacco (consisting of Rp.2,982,000, Rp.688,000 and Rp.135,000) in 1996.

Number of persons engaged includes enterpreneurs (owners and officials of establishments), therefore, the above mentioned expenditure for salaries and wages is not all to pay out for employees, but only a part of it.

From the viewpoint of gross output, the group of food, beverage & tobacco shows the most amount as Rp.63 trillion with share rate of 23.0 % to the total amount of gross output of Rp.274 trillion in 1996 consisting of 21.0 % in large/medium scale firms, 39.8 % in small scale firms and, 47.8 % in household scale firms. The economic activity groups of textile, wearing & leather products, and fabricated metal, machinery & transport equipment are

almost the same scale in amount of gross output as Rp.53 trillion and Rp.54 trillion respectively with share rate of 19.3 % (consisting of 19.4 % in large/medium scale firms, 24.9 % in small scale firms, and 11.4 % in household scale) and 19.6 % (consisting of 21.1 %, 3.5 % and 5.4 %) respectively in 1996.

The share rate of the gross output of household scale firms in food, beverage & tobacco is higher than those in the group of textile, wearing & leather products, and in the group of fabricated metal, machinery & transport equipment as mentioned above. According to these figures, it seems that the economic activity group of food, beverage & tobacco is suited for small scale business as household scale.

Table 2.2.16 shows numbers of registered total establishments and permanent employees, and some figures concerning to the large and medium scale firms in Central Java Province for the period from 1993 and in 1996. Industrial sector is also classified by 9 kinds of economic activities based on their products by the same manner in Indonesia as mentioned above.

As shown in the said table, number of registered establishments has increased from around 2,730 firms in 1993 to 3,061 firms in 1996 consisting of large and medium scale firms only which reaches almost the 15 % in number of the total large/medium scale establishment in Indonesia.

Among them, the top two economic activity groups are the group of "food, beverage & tobacco" and "textile, wearing & leather products" in number with share rates of the both around 33 % and 24 % respectively in 1996 against the total number of establishments. These sharing pattern has been kept since 1993. And the third one is the group of wood & wooden products with share rate of 13.1 % in the same year. However, the number of persons engaged which show the highest share rate to the total number of persons engaged is that in the activity group of textile, wearing & leather products with share rates of 40 % and, the economic activity group of food, beverage & tobacco is the second highest in number of persons engaged as 27 %.

It means that the firm scale in textile, wearing & leather products is larger than that in food, beverage & tobacco in number of persons engaged. Average number of persons engaged may be estimated at 128.7 persons per firm in the group of food, beverage & tobacco, 268.0 persons per firm in textile, wearing & leather products , and 119.8 persons per firm in wood & wooden products as of 1996.

On the other hand from the viewpoint of salaries and wages, the economic activity group

which shows a highest share rate to its total amount in Central Java Province is the group of textile, wearing & leather products as 38.3 %, the second highest one is the group of food, beverage & tobacco as 25.2 %, and the third one is the group of chemical, petroleum, rubber & plastic products as 11.4 % in 1996. Therefore, it seems that the most attractive working environment for people is in the group of textile, wearing & and leather products in Central Java Province too.

The per capita expenditure for salaries and wages in the groups mentioned above may be estimated at Rp.1,534,000 per person per annum in the group of textile, wearing & leather products, Rp.1,506,000 per persons per annum in the group of food, beverage & tobacco, and Rp.1,814,000 per persons per annum in the group of chemical, petroleum, rubber & plastic products in 1996.

From the viewpoint of gross output, the group of textile, wearing & leather products shows the most amount as Rp.6.7 trillion with 49.1% in share rate to the total amount f gross output of Rp.13.6 trillion in 1996. The economic activity groups of food, beverage & tobacco is the second one in amount of gross output as Rp.3.6 trillion with share rate of 26.8 %, and the third one is the group of chemical, petroleum, rubber and plastic products as Rp.1.1 trillion with share rate of 7.8 % in 1996.

Table 2.2.17 shows numbers of registered total establishments and permanent employees, and some figures concerning to the large and medium scale firms in Semarang City for the period from 1991 and in 1994. Industrial sector is also classified by the same manner in Indonesia and Central Java Province as mentioned above. The data in 1995 and 1996 was not available for Semarang City.

As shown in the said table, number of registered establishments has increased from around 251 firms in 1991 to 291 firms in 1994 consisting of large and medium scale firms only which reaches almost the 10 % in number of the total large/medium scale establishment in Central Java Province.

Among them, the top one economic activity group is the group of "food, beverage & tobacco" in number of 73 firms with share rate of around 25 % in 1994 against the total number of establishments. Number of other economic activity groups as "textile, wearing & leather products", "paper & paper products", "chemical, petroleum, rubber & plastic products", and "fabricated metal, machinery & transport equipment" are almost the same as 48 firms, 38 firms, 55 firms, and 35 firms with their share rates of 16 %, 13 %, 19 %, and

12 % in 1994. These sharing pattern has been kept since 1991. However, the number of persons engaged which show the highest share rate to the total number of persons engaged is that in the activity group of textile, wearing & leather products with share rates of 27 % and, the economic activity group of chemical, petroleum, rubber and plastic products is the second highest in number of persons engaged as 25 %. The third one is the group of food, beverage and tobacco as 17 % in share rate of number of persons engaged in to the total number of persons engaged in 1994.

It means that the firm scale in latter groups is larger than that in food, beverage & tobacco in number of persons engaged. Average number of persons engaged may be estimated at 151.2 persons per firm in the group of food, beverage & tobacco, 367.1 persons per firm in textile, wearing & leather products, 293.8 persons per firm in chemical, petroleum, rubber & plastic products as of 1994.

On the other hand from the viewpoint of salaries and wages, the economic activity group which shows a highest share rate to its total amount in Semarang City is the group of chemical, petroleum, rubber & plastic products as 24.9 %, the second highest one is the group of textile, wearing & leather products as 22.3 %, and the third one is the group of food, beverage & tobacco as 18.6 % in 1994. Therefore, it seems that the most attractive working environment for people is in the group of chemical, petroleum, rubber & plastic products in Semarang City.

The per capita expenditure for salaries and wages in the groups mentioned above may be estimated at Rp.1,861,000 per person per annum in the group of chemical, petroleum, rubber & plastic products, Rp.1,525,000 per persons per annum in the group of textile, wearing & leather products, and Rp.2,032,000 per persons per annum in the group of food, beverage & tobacco in 1994.

From the viewpoint of gross output, the group of food, beverage & tobacco shows the most amount as Rp.513 billion with 25.7% in share rate to the total amount f gross output of Rp.1,999 billion in 1994. The economic activity groups of chemical, petroleum, rubber & plastic products is the second one in amount of gross output as Rp.441 billion with share rate of 22.0 %, and the third one is the group of textile, wearing & leather products as Rp.376 billion with share rate of 18.8 % in 1994.

This is to say that, the group of food, beverage & tobacco is the most important factor for economic activities in Semarang City from the viewpoint of productivity and of amount of

salaries and wages received by persons engaged ("expenditure for salaries and wages" from the viewpoint of entrepreneur) in large/medium scale firms.

Table 2.2.18 shows the actual permanent working population classified by the scale of establishment by district and economic activity group in Semarang City in 1994. According to this table, around 20 %, 18 % and 13 % of working population are engaged in the district of Genuk located in north-eastern area of Semarang City, in Semarang Barat and in Ngaliyan. There are several specified industrial zone in Genuk, Semarang Barat and Ngaliyan according to the information from Semarang City.

Furthermore, according to the information from Semarang City and site investigation, there are lot of household scale industry like food makers, repair and spare parts shops for motor cycles, bicycles, electric apparatus for daily use, and so on. But, these are quite small scale in capital, and usually these industries have only family workers with no employees. And they do not appear in number of firms, number of persons engaged in, and their products.

Infrastructure

(1) Roads

In Indonesia as of 1996, there are 385,836 km of road in total consisting of 28,006 km of state level road, 54,025 km of provincial level road and 303,805 km of regency level road as shown in Table 2.2.19 with an expanding rate of road network of 3.85% per annum since 1991. These roads consist of 181,745 km of asphalt paved roads, 173,465 km of non-asphalt paved roads and 30,626 km of non-paved roads with expanding rates of 5.05 %, 3.49 % and -0.35 % respectively since 1991.

In Central Java Province as of 1995, there are 24,265 km of road in total consisting of 1,206 km of state level road, 2,580 km of provincial level road, 18,311 km of regency level road, and 2,168 km of municipality level road as shown in Table 2.2.20 with an expanding rate of road network of 2.86 % per annum since 1991. These roads consist of 10,879 km of asphalt paved roads, 7,909 km of non-gravel paved roads, 3,990 km of earth paved roads and 1,487 km of others with expanding rates of -8.42 %, 25.83 %, 13.72 %, and 22.19 % respectively since 1991.

Number of bridges has been increased from 2,133 bridges consisting of 65 state level bridges and 1,498 provincial level bridges in 1991 to 3,081 bridges consisting of 1,007, and 2,074 respectively in 1995 with 9.63 % of annual increasing rate in total

since 1991.

In Semarang City as of 1996, there are 1,013 km of road in total consisting of 967 km of asphalt paved roads, 10 km of non-gravel paved roads, 13 km of earth paved roads and 22 km of others with expanding rates of 8.95 %, -53.51 %, -38.06 %, and 100.00 % respectively since 1991 as shown in Table 2.2.21.

As indicating the figures mentioned, the gravel and earth paved roads has gradually decreased and, asphalt paved roads has increased. It means that the road network has been improved during these years.

(2) Railways

For the railway network in Indonesia, number of passengers has increased from 62 million people in 1991 to 152 million people in 1996 with 19.49 % of annual increasing rate, and total length of passengers' trip (pax km) has increased from 9,758 million km in 1991 to 15,813 million km in 1996 with an increasing rate of 10.13 % per annum reflecting a capacity of embarkation of trains in Indonesia.

Number of passengers in Java and Madura island shares 98 % to the total passengers as 149 million people, and pax km shares 96 % to the total length of passengers' trips as 15,218 km in 1996. Namely, people living in Java and Madura islands are highest railway users comparing with other islands reflecting high transportation capacity of the railway facilities including trains in Java and Madura islands.

Freight transportation by railway has also increased from 13.7 million tons of loaded cargo in 1991 to 18.1 million tons in 1996 with increasing rate of 5.64 % per annum, and gross length of tonnage transported has increased from 3.5 billion km in 1991 to 4.4 billion km in 1996 with 4.68 % of annual increasing rate too.

Capacity of railway transportation in Central Java Province has increased from 7.0 million in passengers in 1991 to 9.2 million in 1995 with the rate of 7.05 % of annual increasing since 1991, and from 1.1 million tons in freight transported in 1991 to 1.7 million tons in 1995 with 11.35 % of annual increasing rate since 1991.

Capacity of railway transportation in Semarang City has increased from 411 thousand in passengers in 1991 to 492 thousand in 1996 with the rate of 3.68 % of annual increasing since 1991, and from 325 thousand tons in freight transported in 1991 to

613 thousand tons in 1996 with 13.54 % of annual increasing rate since 1991 too.

(3) Sea Port

Indonesia is an island country, so it has a lot of sea ports. But statistical data is not available completely. According to the newest statistical data named "Statistical Year Book of Indonesia 1996", total handling volume of sea borne cargo was 519 million tons consisting of 310 million tons of loaded cargo and 209 million tons of unloaded cargo in 1995 in whole Indonesia.

There are 5 major seaports in Central Java Province named as Tanjung Mas Seaport in Semarang City, Cilacap Seaport in the Regency of Cilacap, Tagal Seaport in the Regency of Tegal, Jepara Seaport in the Regency of Jepara, Juwana Seaport in the Regency of Juwana. Total handling volume of sea borne cargo has been increased from 29 million tons consisting of 11 million tons of loaded cargo and 18 million tons of unloaded cargo in 1991 to 30 million tons consisting of 10 million tons of loaded cargo and 20 million tons of unloaded cargo in 1995 with annual increasing rate of -0.66 % in loaded cargo and 1.96 % in unloaded cargo since 1991. Number of ships arrived has also increased from 5,831 ships in 1991 to 8,018 ships in 1995 with 8.29 % of annual increasing rate since 1991.

There is only one sea port in Semarang City named as the Tanjung Mas Sea Port as mentioned above. Total handling volume of sea borne cargo has been decreased from 4.9 million tons consisting of 0.9 million tons of loaded cargo and 4.0 million tons of unloaded cargo in 1991 to 3.5 million tons consisting of 1.3 million tons of loaded cargo and 2.2 million tons of unloaded cargo in 1996 with annual increasing/decreasing rate of 7.05 % in loaded cargo and -11.13 % in unloaded cargo since 1991, also the number of ships arrived has also decreased from 3,399 ships in 1991 to 3,321 ships in 1996 with -0.46 % of annual decreasing rate since 1991.

(4) Air Port

Indonesia as an island country has also a lot of airports because that the air transportation system is a quite important way for passengers and cargo to transport too, and for some other purposes. Number of aircraft in Indonesia has increased from 835 consisting of 320 belonging to the Government and 515 belonging to private air companies in 1991 to 910 consisting of 330 belonging to the Government and 580 belonging to the private companies in 1995 with increasing rate of 2.17 % per annum

in total.

Among them, general aviation is the highest operation as 419 of aircraft with 46 % of share rate to the total aircraft with increasing rate of 0.98 % per annum since 1991. Scheduled operation shares at 31 % to the total aircraft in 1995 with 6.42 % of annual increasing rate also since 1991.

There are 4 airports in Central Java Province named as Achmad Yani Airport in Semarang City, Adi Sumarno Airport in Surakarta, Tuggul Wulung Airport in Cilacap and Karimunjawa Airport in Jepara.

For air transportation, number of aircraft arrived and departure has increased from 7,753 and 7,757 in 1991 to 11,623 and 11,648 in 1995 with 10.65 % and 10.70 % of annual increasing rates, while number of passengers arrived and departure has also increased from 250 thousand persons and 349 thousand persons in 1991 to 538 thousand persons and 520 thousand persons in 1995 with the annual increasing rates of 21.01 % and 10.47 % since 1991.

Also Semarang City has one airport named as Achmad Yani Airport as mentioned above. For air transportation, number of aircraft arrived and departure has increased from 5,618 and 5,621 in 1991 to 9,902 and 9,894 in 1996 with 12.00 % and 11.97 % of annual increasing rates, while number of passengers arrived and departure has also increased from 157 thousand persons and 255 thousand persons in 1991 to 430 thousand persons and 414 thousand persons in 1996 with the annual increasing rates of 22.36 % and 10.24 % since 1991.

(5) Postage Services

Number of facilities for postage services are 315 of general post offices, 834 of supplementary post office, 3,393 auxiliary post office and 1,838 of mailing houses in 1996 with annual increasing/decreasing rates of -0.44 %, 3.74 %, 6.97 % and 5.53 % respectively since 1991.

(6) Telephone and Telegram

General telex office has increased from 98 offices in 1991 to 183 offices in 1996 in Semarang City with 16.90 % of annual increasing rate, but the capacity of its connection has increased only from 800 lines in 1991 to 1,000 lines in 1996 with annual increasing rate of 5.74 % since 1991.

There are two kinds of telephone facilities as automatic connection offices and manual connection offices. However, there is no any manual connection office in Semarang City since 1995. Capacity of automatic telephone connection offices has increased from 67,343 lines in 1991 to 154,801 lines in 1996 with actual connection recorded from 46,716 line in 1991 to 109,540 lines in 1996 increasing at 23.14 % per annum in capacity and 23.74 % per annum in actual connection. The automatic telephone office ha increased from 8 offices in 1991 to 22 offices in 1996 in Semarang City.

2.2.4 Family Economy

Table 2.2.22 shows a situation of household income and expenditure by commodities of consumption as of 1996 based on the result of Living Expenditure Survey in Central Java in 1996 made by the Statistic Office of Central Java Province, and as of 1997 based on a result of Property Survey made by JICA Study Team this time.

According to this property survey this time, the income level of household in the study area may be Rp.810 thousand per household (HH) per month as of 1997, however the amount of expenditure may be a sum of around Rp.1,285 thousand per HH per month in the same year. Therefore, the actual income level also should at least be the same amount of expenditure per HH per month which is called as the estimated income level. In the study area, number of economic active persons per HH per month may be estimated at 1.94 persons as shown in the said table. Therefore, an average per capita income per month can be calculated at Rp.662 thousand at the present.

The expenditure level of the study area is almost double comparing with that of the whole Semarang City reflecting situation of the center of the city zone of it where is a vital area for retail trading. Namely, prices of all daily articles and services are usually expensive in the central area of the city zone. The share rate of expenditure for food is rather low as 24.05 % to the total expenditure, but that for housing shares at 41.06 % which is quite high comparing that of the whole Semarang City.

Generally speaking, the amounts of expenditure for fuel, lighting and water range from 2.5 % to 5.0 % in average to the total income in developing countries. From this viewpoint, such amount of expenditure shares as rather high at around 7.3 % to total monthly income in the study area. Especially, the amount of expenditure for electricity and water share at 2.6 %,

and 1.3 % respectively to the income with amounts of Rp.34,000 and Rp.16,500 per HH per month.

According to an information from State Electricity Corporation (PLN = Perusahaan Listrik Negara), the average actual unit price of electricity may be estimated at Rp.155 per kWh for domestic electricity sales, and the average electricity volume used by household is counted at 76 kWh per month in 1997. So the average amount to be paid for electricity can be calculated at Rp.11,780 (= Rp.155/kWh x 76 kWh) per month per HH. This amount shares at 1.7 % to the amount of total expenditure (= estimated income level) of Rp.688 thousand in the whole Semarang City which is reasonable amount of expenditure according to the said general speaking.

The above said monthly expenditure of Rp.34,000 per month per HH for electricity is quite high comparing with the above mentioned amount of Rp.11,780 per month per HH. Even if this figure reflects the situation of the central area of the city zone, this amount of expenditure for electricity can be said as a limited amount for ordinary households.

2.2.5 Price Fluctuation

(1) Consumer Price Indexes

Table 2.2.23 shows consumers' price indexes in Indonesia and Semarang City since 1993 and 1992 respectively. According to this table, the annual average increasing ratios of general, food, housing, clothing, and miscellaneous are 8.62 %, 11.20%, 7.95 %, 6.52 % and 6.99 % in Indonesia since 1993 respectively, and 7.62 %, 9.46 %, 6.37 %, 4.78 % and 7.29 % in Semarang City since 1992 respectively..

(2) Foreign Currency Exchange Rates

The fluctuation of exchange rates against US Dollars and Japanese Yen during the period from 1992 to December 1997 is shown in Table 2.2.24.

According to this table, the annual decreasing ratio of Indonesian Rupiah against US Dollar is 7.57 % per annum and that against Japanese Yen is decreased with a rate of 8.02 % per annum for the period from 1992 to 1997. The exchange rate of Rupiah against US$1 may be estimated at Rp.2.971, and that against Japanese ¥100 is Rp.2,437 as of 1997.

2.2.6 Relationships with Other Related Projects

In order to improve the living conditions of the rapidly increasing urban population, the Government of Indonesia intends to focus on three principal aspects regarding the provision of urban services in local Governments as:

- Expansion of basic, low-cost urban infrastructure and services in a planned and coordinated manner;
- Decentralization of the planning and much of the implementation of urban development to local Government and to strengthen the higher levels of Government to enable them to provide the technical assistance, training and project appraisal support; and,
- Stimulation of increases in local revenue to help finance new investments and improve operation and maintenance of existing facilities at the local level, and to seek measures for long-term finance.

In Central Java Province, there are 6 packages of development plan based on the said Governmental intention. Package A is for development of the Special Municipality of Yogjakarta (Daerah Istimewa Yogjakarta) and its surrounding area, Package B is for development of the municipalities of Semarang and Surakarta named as "Semarang-Surakarta Urban Development Program (SSUDP)". The other four packages are for development of the other area classified by four regions in Central Java Province.

The package which is likely to relate this Project among them is the SSUDP which is under executing financed by the World Bank (IBRD = the International Bank for Rehabilitation and Development) targeted to complete its whole works by 1999. The finance by the World Bank for this SSUDP includes 9 major programs as (1) to improve the urban roads and transport, (2) to supply water and to distribute it, (3) to drain storm water and to control floods in urban area, (4) to make solid waste collection and disposal systems, (5) to improve human waste disposal (sewerage and on-site sanitation facilities), (6) to make multi-sectoral programs for villages (Kampung = low income area) for improvements and market investments, (7) to make programs for the development and strengthening of local institutions, (8) to make programs to increase local revenue generation, and (9) to give technical assistance for implementation of the said programs.

On the other hand, the Study made by JICA Team this time consists of three components as (1) West Floodway/Garang River Improvement, (2) Jatibarang Multipurpose Dam Construction, and (3) Urban Drainage System Improvement in the central area of Semarang City.

According to an information from the Project Office of SSUDP in Semarang City, there is no any overlapping works in the SSUDP programs of (3), (4) and (5) mentioned above with a component of JICA's study for the urban drainage system improvement in the central area of Semarang City because the scheme is completely different.

The SSUDP has a plan to take some volume of water from Garang River. The design of the Jatibarang Multipurpose Dam of the Project is already taken this water use program in the future into account, so there is no any impact each other between them.

2.3 Floods and Flood Control Works

2.3.1 Major Floods and Flood Damages

The recent major floods which brought a tremendous damages to the areas along West Floodway/Garang River occurred in 1963, 1990 and 1993. The inundated area and damages/calamities of the above floods were confirmed by the Ministry of Public Works and the Semarang City Office as presented in the table below, and the inundation areas of 1990 and 1993 floods are shown in Fig. 2.3.1.

Year and Month	1973 February	1990 January	1993 February
Inundation Area			
(1) Location (Seriously affected area)		Panjangan area	Sampangan area
(2) Affected Area (ha.)	175	145	200
(3) Number of Affected Houses	420	540	230
(4) Number of Affected House Holds	-	186	17
(5) Inundation Depth (Max. m)	-	2	2.5
(6) Inundation Duration (Average hour)	2.5	3	4
Flood Calamities			
(1) Death	-	47	2
(2) House Collapsed	35	25	60
(3) House Damaged	120	126	145
(4) Public Building	5	15	5
Estimated Flood Damage (Rp)	4 billion	8.5 billion	6.9 billion

Source: Sub Dinas Pengairan, PU, Central Java.

The serious flood overflow occurred particularly along the downstream of Garang River between the confluence of Kreo River and Simongan Weir associated with the destruction of river dike. Also, the flood overflow occurred in the left bank area of the midstream near National Road Bridge in West Floodway.

2.3.2 River Flow Capacity

The flow capacity of the existing channel is estimated for West Floodway and Garang River by the non-uniform flow calculation method using the results of the channel survey conducted in 1997 under the JICA Study Team. Furthermore, the water level profile under probable floods is estimated as well.

Conditions on Calculation

Newly surveyed channel cross sections are used for the calculation, and typical cross sections are presented in Fig. 2.3.2. The other necessary conditions for the non-uniform calculation are as follows:

Return Period (year)	Probable Discharge (m^3/s)	Water Level *1		Manning's Roughness Coefficient *4
		River *2 Mouth (EL. m)	Simongan *3 Weir (EL. m)	
100	1,010	0.25	9.30	0.035
25	790	0.25	8.51	0.035
10	640	0.25	8.25	0.035

*1 All elevations are based on the datum of TTG (Mean Sea Level at Tanjung Priok in Jakarta.

*2 Mean high water level (MHWL) observed at Semarang Harbor in 1997 (refer to " 2.1.11 Plan for River Channel")

*3 Waterhead of overflow discharge at the weir. (Refer to Table 2.1.3)

*4 This is defined as the average figure of the entire channel section.

Flow Capacity

(1) West Floodway (River mouth to Simongan Weir)

The channel flow capacity for the full section up to dike/riverbank crown of West Floodway is presented in Fig. 2.3.3 and evaluated as follows:

(a) For the downstream stretch from North Ring Road to the river mouth, the flow capacity ranges from 200 m^3/s to 1,200 m^3/s. The stretch where the land

reclamation has been completed on both banks, has a high flow capacity more than 800 m^3/s, while the lowermost stretch near the river mouth is quite low in flow capacity because of the low elevation of river banks.

(b) For the stretch between Railway Bridge and North Ring Road, although the flood walls are provided, the flow capacity does not reach 800 m^3/s. The lowest capacity is about 400 m^3/s (about 4-year return period). When the freeboard of 1.0 m is applied for the flood walls, the flow capacity is estimated at 200 m^3/s to 400 m^3/s.

(c) For the stretch between Railway Bridge and Simongan Weir, the figure indicates a high capacity of 800 m^3/s or more except for a portion immediately upstream of Nationl Road Bridge. The high flow capacity is due to the higher bank elevation and riverbed degradation.

(2) Garang River (Simongan Weir to Confluence of Garang and Kreo rivers)

Fig. 2.3.4 shows the flow capacity of Garang River, and the following are found.

(a) The flow capacity is relatively high at 800 m^3/s or more throughout the whole river stretch except a few portions. This high flow capacity is attributed to the high earth dikes and floodwalls constructed after 1990 flood.

(b) If the freeboard of 1.0 m is applied for the existing dikes and floodwalls, the average flow capacity decreases to about 600 m^3/s.

(c) In the upstream from Toll Road Bridge, the flow capacity is as low as about 600 m^3/s.

Water Level Profile

(1) West Floodway (River mouth to Simongan Weir)

As shown in the Fig. 2.3.5(1/2), a probable high water level of 10-year return period exceeds the existing dike crown level in the stretch between North Ring Road Bridge and 1,500 m upstream point from the bridge for both right and left sides of the channel. Accordingly, the existing channel flow capacity of West Floodway is evaluated to be less than a 10-year return period.

The channel stretch between Railway Bridge and National Road Bridge form a narrow channel causing a back water effect in the upstream.

(2) Garang River (Simongan Weir to Confluence of Garang and Kreo rivers)

The earth dikes and floodwalls constructed/raised after the 1990 flood are high enough to confine the 25-year return period flood within their dike crown for the whole stretch (Refer to Fig. 2.3.5(2/2)). The dike crown of the right bank is higher than even the probable high water level of 100-year return period.

Since the higher earth dikes and floodwalls have been constructed in the river stretches, the higher flood water level tends to occur. Accordingly, the probable high water level of 25-year return period is higher than the existing inland ground level by 1.5 to 2.5 m. It means that higher dike crown has potential flood damage at the time of dike collapse.

2.3.3 Previous and Ongoing Flood Control Works

The river improvement/rehabilitation works for West Floodway/Garang River had been executed under the Central Java River Improvement and Maintenance Project by DINAS PU PENGAIRAN. In 1994 this project was taken over by JRATUNSELUNA River Development Project Office. The improvement works for the River were almost completed in accordance with the river improvement plan given below. The major works undertaken so far are shown in Table 2.3.1 and Fig. 2.1.9.

Immediately after the serious flood in January 1990, of which flood discharge is estimated to be around 1,000 m^3/s at Simongan Weir, the comprehensive river improvement works was commenced for the river stretch from Simongan Weir up to the confluence of Kreo River (about 4.3 km). Reconstruction/modification of Simongan Weir was not included in the Works. The design scale and discharge of the river improvement works applied were 100-year return period and 1,100 m^3/s, respectively. It is herein noted that the probable discharge of 100-year return period is estimated at 1,010 m^3/s in this Study instead of the 1,100 m^3/s.

River Improvement Plan for West Floodway/Garang River

Name of River	West Floodway		Garang River
Improvement Stretch	River Mouth to Railway Bridge	Railway Bridge to Simongan Weir	Simongan Weir to Toll Road Brid.
Return Period (year)	25		25 (100)
Design Discharge	740		740 (1,100)
Longitudinal Profile of River Channel			
Design Bed Slope	1/8,330	1/2,660	1/1,610
Design High Water Level (average slope)	1/1,500	1/1,650	1/1,170
Design High Tide (EL.m)	SPB 1.00 m		
Design Dike/Flood Wall Crown (EL. m)	about 1/1,200	-	1/1,170
Free Board of Dike/Flood Wall (m)	1.7～1.8	-	1.0
Cross Section of River Channel			
Cross Sectional Form	Combined Double Section	Single Section	Combined Double Section
Width of Channel Bed (m)	75	55	35～50
Depth of Low Water Channel	1.5 to 2.5 m	2 to 3 m	2 to 3 m
Side Slope of Low Water Channel	1 : 2	1 : 2	1 : 2
Crown Width of Earth Dike (m)	-	-	3～4
Flood Retaining Wall	-		
Type	Buttress, Gravity	-	Buttress, Gravity
Embedding Length (m)	0.8	-	0.8
Foundation	Log Pile	-	Log Pile