

Ministry of Transportation
The Republic of Indonesia

**The Study
on
Development of Regional Railway
System of Central Java Region
in
The Republic of Indonesia**

**Final Report
(Main Report)**

February 2009

JAPAN INTERNATIONAL COOPERATION AGENCY

ORIENTAL CONSULTANTS CO., LTD.

EID

JR

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PREFACE

In response to a request from the Government of the Republic of Indonesia, the Government of Japan decided to conduct “The Study on Development of Regional Railway System in Central Java Region” and entrusted to the study to Japan International Cooperation Agency (JICA).

JICA selected and dispatched a study team headed by Mr. Tomokazu Wachi of Oriental Consultants Co., Ltd. between January and December, 2008.

The team held discussions with the officials concerned of the Government of the Republic of Indonesia and conducted field surveys at the study area. Upon returning to Japan, the team conducted further studies and prepared this final report.

I hope that this report will contribute to the promotion of this project and to the enhancement of friendly relationship between our two countries.

Finally, I wish to express my sincere appreciation to the officials concerned of the Government of the Republic of Indonesia for their close cooperation extended to the study.

February, 2009

EIJI HASHIMOTO,
Vice President
Japan International Cooperation
Agency

February 2009

Mr. Eiji Hashimoto
Vice President
Japan International Cooperation Agency
Tokyo, Japan

Letter of Transmittal

Dear Sir,

We are pleased to submit herewith the Final Report of the Study on Development of Regional Railway System of Central Java Region in the Republic of Indonesia.

The Study was undertaken in the Central Java region from January 2008 through December 2009 by the Study team organized by Oriental Consultants Co., Ltd. under contract with JICA.

The report consists of a Summary Report and a Main Report. Through analysis on the past and the existing socio-economic situation, the current condition of various modes of transportation and facilities and operation and regulatory issues of railway system, present railway transportation problems have been identified. Based on the understanding on the planning issues and railway development project ideas discussed with stakeholders, a long-term regional railway system development plan was established. Priorities were given to each project and projects were selected and arranged in time sequence: namely, short-term, intermediate-term and long-term implementation plans. The commuter railway services in the metropolitan areas, airport link and freight transport on the Semarang – Solo – Yogyakarta corridor were further examined in the case study.

We would like to express our sincere gratitude and appreciation to all the officials of your agency. We also would like to send our great appreciation to all those who extended their kind assistance and cooperation to the Study: in particular Ministry of Transportation as well as Governments of Central Java Province and Yogyakarta Special Province as well as the counterpart agency and counterpart personnel who assisted the Study team.

We hope that the result of this study will contribute to enhance the railway development in the Central Java region.

Very truly yours,

Mr. Tomokazu Wachi
Team Leader, JICA Study Team
The Study on Development of Regional

**THE STUDY ON
DEVELOPMENT OF REGIONAL RAILWAY SYSTEM
OF CENTRAL JAVA REGION
IN THE REPUBLIC OF INDONESIA**

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LIST OF ABBREVIATIONS

AC	Air-conditioned
Acc.	Accumulated
ADA	American with Disabilities Act
AET	Airport express train
Ag.	At grade
AL	Airport link
AMDAL	Indonesian Environmental Impact Assessment (<i>Analisis Mengenai Dampak Lingkungan</i>)
ANSI	American National Standards Institute
ASS	Auxiliary sub-stations
AT	Automatic transmission
ATS	Automatic train stop
B/C	Benefit-cost ratio
BAPPEDA	Regional Development Planning Board (<i>Badan Perencanaan Pembangunan Daerah</i>)
BAPPENAS	National planning agency
BEP	Break-even point
BOD	Biological oxygen demand
BPH Migas	Oil and gas regulatory body (<i>Badan Pengatur Hilir Minyak dan Gas Bumi</i>)
BPS	Statistical Bureau (<i>Badan Pusat Statistik</i>)
BRT	Bus rapid transit system
Bru	Brumbung
CBD	Central business district
CBI	Computer based interlocking
CCTV	Closed-circuit television
CDM	Clean development mechanism
CF	Cash flow
CFR	Romanian National Railway Company
CHF	Container handling facilities
CJR	Central Java Railway
CJRR	The Study on Development of Regional Railway System of Central Java Region in the Republic of Indonesia
CO	Carbon monoxide
CO ₂	Carbon dioxide
COD	Chemical oxygen demand
COMBAT	Computer and Microwave Balise Aided Train Control System
CPI	Consumer price index
CPPPL	Note of traffic offense case (<i>Catatan pemeriksaan perkara pelanggaran lalu lintas</i>)
CT	Commuter train
CTC	Centralized train control
DAOP IV	Regional Operational Division IV (Semarang) of PT. Kereta Api (Persero)
DAOP V	Regional Operational Division V (Purwokerto) of PT. Kereta Api (Persero)
DAOP VI	Regional Operational Division VI (Yogyakarta) of PT. Kereta Api (Persero)
dBA	A-weighted decibels
DDA	Disability Discrimination Act

DEL	Diesel electric locomotive
Dem	Demak
DGR	Directorate General of Railways
DHL	Diesel hydraulic locomotive
DIY	Yogyakarta Special Province (<i>Daerah Istimewa Yogyakarta</i>)
DKI Jakarta	Special Capital Territory of Jakarta (<i>Daerah Khusus Ibukota Jakarta</i>)
DMU	Diesel multiple unit
DO	Dissolved oxygen
DPO	Disabled persons organization
DRI	Direct reduced iron
DT	Double track
DTS	Data transmission system
EIRR	Economic internal rate of return
Elev.	Elevated
EMU	Electric multiple unit
EN	European Norm
Ex.	Express train
FC	Freight corridor
FEU	Forty-foot equivalent unit
FOB	Free on board
GBHN	Guidelines for National Development
GDP	Gross domestic product
GGW	Type of wagon with capacity of 30t
GOI	Government of Indonesia
GPS	Global positioning system
GRDP	Gross regional product
GW/GR	Type of wagon with capacity of 15t
HC	Hydrocarbon
IBRD	International Bank for Reconstruction and Development
ICD	Inland container depot
IDR	Indonesian Rupiah
IEE	Initial environmental examination
IMO	Infrastructure Maintenance and Operation
INT	Intercity train
ISO	International Organization for Standardization
ITP	PT. Indocement Tunggul Prakarsa Tbk.
JETRO	Japan external trade organization
JICA	Japan International Cooperation Agency
JLSS	South-South Line Road (<i>Jalan Lintas Selatan-Selatan</i>)
JV	Joint venture
Kab.	Regency (<i>Kabupaten</i>)
Kaltim	PT. Pupuk Kalimantan Timur
Ken	Kendal
kL	kilo liter
Kla	Klaten

KLH	Ministry of Environment (<i>Kementerian Negara Lingkungan Hidup</i>)
KRDE	Electric diesel train
LARAP	Land acquisition and resettlement action plan
Lc.	Local train
LOE	Local government owned enterprise
LPG	Liquefied petroleum gas
M	Rail car with traction motors
MLIT	Japanese Ministry of Land, Infrastructure, Transport and Tourism
MMI	Modified mercalli intensity
MOR	Chinese Ministry of Railways
MoT	Ministry of Transport (<i>Departmen Perhubungan</i>)
MOU	Memorandum of understanding
Mp	Motor rail car with pantograph and transformer, converter and inverter
MW	Mega watt
NATM	The New Austrian Tunneling Method
NGO	Non governmental organizations
NJOP	Market land price for taxation (<i>Nilai jual obyek pajak</i>)
NO ₂	Nitrogen dioxide
NO _x	Nitrogen oxide
NPV	Net present value
NSTRR	North Semarang Toll Ring Road
O&M	Operation and maintenance
O ₃	Ozone
OCC	Operation control center
OCS	Overhead catenary system
OD	Origin-Destination
PAX	Passenger
Pb	Lead
PC	Prestressed concrete
Pelindo III	PT. (Persero) Pelabuhan Indonesia III
Pertamina	PT. Pertamina (Persero)
PHPDT	Peak hour peak direction trips
PIU	Project implementation unit
PKL	Local activity center
PKN	National activity center
PKW	Regional activity center
PPCW	New flat-type wagon
PPP	Public-private partnership
PROPENAS	National development plan of Indonesia (<i>Rancangan program pembangunan nasional</i>)
PSO	Public Service Obligation
PT. KA	PT. Kereta Api (Persero)
PT. KS	PT. Krakatau Steel
Pusri	PT. Pupuk Sriwidjaja
PWD	Persons with disabilities
R50	Type of rail with unit weight of 50 kg/m

R54	Type of rail with unit weight of 54 kg/m
REPELITA	Five-year development plan of Indonesia (<i>Rencana pembangunan lima tahun</i>)
ROW	Right of way
RTRW	Regional spatial plan (<i>Rencana Tata Ruang Wilayah</i>)
RTW	Railway tank wagon
SCF	Standard conversion factor
Sem	Semarang
SEZ	Special economic zone
SG	PT. Semen Gresik (Persero) Tbk.
SO2	Sulfur dioxide
SOE	State-owned enterprise
Sol	Solo
SP	Stated preference
SPM	Suspended particulate matter
Sra	Sragen
SRT	State Railway of Thailand
S-S-W	Semarang - Solo - Wonogiri
S-S-Y	Semarang - Solo - Yogyakarta
Sta.	Station
TAC	Track Access Charge
TATRAWIL	Transportation Development Plan (<i>Studi Penyusunan Tataran Transportasi Wilayah</i>)
TAZ	Traffic analysis zone
TAZARA	Tanzania-Zambia Railway
Tc	Trailer car with driving cabin
TDS	Total dissolved solids
TEU	Twenty-foot equivalent unit
Tg. Emas	Tanjung Emas port
Tg. Intan	Tanjung Intan port
TOD	Transit oriented development
TPKS	Semarang Container Terminal (<i>Terminal Peti Kemas Semarang</i>)
TPS	Traction power supply
TSP	Total suspended particles
TSS	Total suspended solids
TSS	Traction sub-stations
TSSS	Transport sector strategy letter
TT	Tourism train
TTS	Travel time saving
UG	Underground
UHF	Ultra high frequency
UMP	Minimum wage of province (<i>Upah Minimum Propinsi</i>)
UR	Urban railway
USD	United States dollar
VOC	Vehicle operating cost
W	with
w/o	without

Wat	Wates
WHO	World Health Organization
WS	Wayside
WTI	West Texas Intermediate
Yog	Yogyakarta

1. BACKGROUND

The current railway transportation in the Central Java region has been facing various problems. The railway passenger transport has been decreasing in demand in competition with low cost air carriers and private passenger cars and buses on the expressway. Furthermore many customers of railway freight transport have also shifted to trucks and trailers due to longer travel time and unreliability of operation.

Although the current business circumstance of railway transportation is not bright by any means, it is of great importance to revitalize railway transport to support social and economic activities in the Central Java region that consists of Central Java Province and Yogyakarta Special Province (DIY). The new Railway Law 23, 2007 allows local government and private sector participation in railway transportation business. Taking this opportunity given under the new law in order to revitalize the railway transportation in the region, the Study addresses the question of how regional railway system will be materialized and how efficient railway operation can be achieved. The role of each stakeholder in regional railway services was examined and the viable institutional arrangement was proposed.

2. SOCIO-ECONOMIC SITUATION OF CENTRAL JAVA REGION

(1) Current Socio-Economic Situation

According to the regional spatial plan (*Rencana Tata Ruang Wilayah*) in Central Java Province and Yogyakarta Special Province, Semarang, Solo, Yogyakarta, Kudus, Cilacap and Purwokerto are designated as priority cities, namely national activity centers. Of these, Semarang, Yogyakarta and Solo are the main cities in the Central Java region which are leaders in regional politics and economics. Semarang and Yogyakarta are capital cities of the provinces. Solo is also the center of the regional economy and a former capital city. In addition, these three cities play roles of gateway to/from other regions and countries because they have their own international airport. Owing to such circumstance, population is accumulating in these cities.

Urban areas tend to indicate large gross regional domestic product (GRDP) compared to other Kabupaten/Kota, but this difference depends upon the type of industry. Secondary and tertiary sectors such as trade, service, and manufacturing contribute to larger GRDP than primary sector which includes agriculture, fishery, and mining. In Semarang, trade is dominant because of the international port, Tanjung (Tg.) Emas. Yogyakarta is also the center of economic activities such as education, services and trade. Solo is one of core cities for the regional industry such as manufacturing, textiles, wood products, cement, and mining.

(2) Socio-Economic Framework

The Central Statistical Bureau (BPS) estimates that the population in Central Java Province and DIY is around 32.1 million and 3.3 million, respectively, totaling 35.4 million for the Central Java region. While the population growth in West Java is remarkable, the growth in the two provinces of the Central Java region is much lower, and nearly 0% growth is expected for 2020 and afterwards.

3. OVERVIEW OF EACH TRANSPORT SECTOR IN CENTRAL JAVA REGION

(1) Road

In Indonesia, there was little development of the railway after Independence. As a result, road traffic has become dominant in land transport in line with motorization, and the number of automobiles has been rapidly increasing except during the economic crisis. On average, the annual rate of increase of vehicles is as high as over 10% in both provinces. This rapid motorization has brought the major cities many urban problems such as traffic congestion and environmental pollution. Traffic congestion on the roads around and between the major cities such as the road connecting Semarang and Solo is becoming worse year by year. Traffic congestion seems to be most serious on Semarang – Yogyakarta, Semarang – Solo, Semarang – Rembang, and Solo – Yogyakarta corridors.

In the north Java corridor (Brebes – Tegal – Pemasang – Pekalongan – Semarang – Demak – Kudus – Pati – Rembang), some road sections already have four lanes. By the end of 2008, the section between Semarang and Losari (western border of Central Java Province) is planned to be all four-lane roads and

the work is currently underway. The remaining sections on the north corridor (i.e., Semarang – Kudus – eastern border of Central Java Province) are also planned to be widened in the near future, and will be four lanes or at least two lanes with 2 m hard shoulders.

In addition to the current toll roads in Semarang, there are plans for toll roads in the Central Java region with the following sections given high priority.

- Cirebon (West Java) – Tegal – Pekalongan - Semarang
- Semarang – Solo – Madiun (East Java)
- Yogyakarta – Solo

At present, in order to reduce the road damage caused by overloaded trucks, regulation against overloading is being enforced in accordance with the phased schedule. At each weighbridge, overloaded trucks within the designated maximum percentage are still allowed to go by paying retribution; however, overloaded trucks over the maximum percentage are forced either to reduce the load on the spot or to return to the origin place. The control of overloading is gradually being tightened, and no overloading (i.e., 0% overloading) will be allowed in 2009. As the regulation against overloading becomes stricter, the unit transport cost of goods is expected to increase. Along with the soaring fuel prices, it will be a disadvantage for trucks in terms of modal competition for freight transport. On the other hand, it will be a great opportunity for railways to draw attention of shippers and forwarders as a more cost-efficient mode of transport.

(2) Bus

Each city has intercity bus terminals from which relatively frequent bus services connecting the city with Jakarta or major cities in the region are operated. In the Central Java region, there are around 200 daily bus services connecting Tegal, Semarang, and Solo. While use of motorcycles is very popular for individual, short-distance travel, buses are major mode of travel for a longer distance because the fare is generally reasonable due to the high competition among bus companies. Furthermore, for intercity, inter-provincial bus service, upper and lower limits of the economy class fare have been regulated by the government.

In addition to the major developments for the intercity bus transportation including new bus terminals and intercity bus routes, a new bus rapid transit (BRT) system is being developed in the metropolitan regions of the Study area. The one in Yogyakarta, called Transjogja, began its operation in February, 2008, and a similar BRT system is planned for the cities of Semarang and Solo as well. In each city, development of BRT is designed to enhance the accessibility to the main transportation terminals including railway stations.

(3) Railway

As of 2006, total 4,675 km of railway is currently in service in Indonesia. Among others, 3,370 km (or 72%) of the railway in service is in Java Island. Including the railway lines that are not in service, total railway length in Indonesia is 8,067 km, 6,076 km (or 75%) of which are in Java Island. In the Central Java region, there are three Railway Management Bureaus, or DAOP (*Daerah Operasi*), which are under the control of PT. Kereta Api (PT. KA).

In the Central Java region, there is a plan to eventually double-track the entire sections of Java north trunk line (Cirebon – Tegal – Semarang – Surabaya), Java south trunk line (Kroya – Yogyakarta – Solo), and the linking north-south line (Cirebon – Purwokerto – Kroya). The section of Kutoarjo – Yogyakarta – Solo has already been double tracked, and double-tracking the section of Kroya – Kutoarjo is now underway with a yen loan. As for the Java north trunk line, most of the sections have been or will be double-tracked under the GOI's own budget. The sections of Brebes – Tegal and Pemalang – Petarukan have already been double-tracked, and double-tracking the sections of Losari – Brebes and Tegal – Pekalongan will be finished by 2011. Double-tracking the section of Cirebon – Losari is also planned in the near future.

1) Passenger Transport

Passenger transport in the Central Java region is mainly through the operation of long-distance trains, and it has been the core business for PT. KA. Meanwhile, in Central Java local (business or economy) trains also operate between Semarang – Solo (Pandanwangi), Semarang – Solo – Sragen (Banyubiru), Solo – Yogyakarta (Prameks), Tegal – Semarang (Kaligung), and Yogyakarta – Kutoarjo (Prameks). As for fare box ratios (i.e., ratio of revenue to operating cost) of the short-distance train services, Prameks and

Kaligung are showing a gain; in particular, the profitability of Prameks, which has the highest frequency of service (seven times a day with approximately 1.5-hour headway), is the most remarkable of all the short-distance train services. As a result, significant shares of local train passengers are observed in Semarang (DAOP IV) and in Yogyakarta/Solo (DAOP VI).

2) Freight Transport

Total volume as well as ton-km of goods transported by rail has been decreasing in Java Island. Reduced freight carrying capacity due to a policy of prioritizing passengers and poorer service because of aging rolling stock including locomotives have resulted in low utilization ratio of train cars, and the ratio of freight revenue is on the decline. The aged train cars, coupled with insufficient maintenance, have resulted in reduced operation speed, and the freight business is being taken away by trucks which are essentially more suitable for small-lot, door-to-door transportation service. As more toll roads are constructed and travel times between major cities in the Central Java region by road are shortened, the competitive position of the railway may be further weakened.

Another reason for the weakening of rail freight business is the low transportation tariff that is often negotiable; consequently, necessary improvements cannot be made due to insufficient revenue and profits. Furthermore, since the railway sector currently has fundamental problems such as train delays and frequent accidents, it is important to provide more reliable services by improving infrastructure, communication and signaling systems, shortage of rolling stock, institutions, human resources, etc.

Major commodities transported by railway in DAOP IV (Semarang) are sand and fertilizer. However, since the middle of 2006, fertilizer is no longer transported by rail to Tg. Emas Port. In DAOP V (Purwokerto), fuel and cement are the major commodities that are transported by railway. Significant amount of fuel is transported by railway from the refinery in Cilacap to Tegal. In DAOP VI (Yogyakarta), fuel is also a major commodity transported by railway as well as quartz sand. From Cilacap to Yogyakarta, aviation fuel is transported by railway. As for containers, although there are some transported by railway especially in DAOP IV, the volume is relatively small. It is also necessary to enhance the inter-modality by revitalizing railway facilities in Tg. Emas Port as well as dry ports at Yogyakarta and Kalijambe.

(4) Airport

Although there is some yearly fluctuation, the annual average growth of the number of passengers on the major air routes in the Central Java region between 2000 and 2006 is as high as 25%. Therefore, railway passenger demand for long distance train routes such as Jakarta – Semarang, Jakarta – Yogyakarta, and Jakarta – Solo is facing strict competition from lower airfares due to the deregulation of the airline sector. Annual volume of cargos handled at the three major airports in the Central Java region has also been remarkably growing since 2000.

According to the master plan of Adi Sutjipto (Yogyakarta) Airport, along with expansion and development of the runway, taxiways, and apron parking area, the passenger terminal is planned to be moved north toward the existing Yogyakarta – Solo railway line. A new railway station, taking over old Maguwo station, has been constructed and the station will be integrated with the new passenger terminal building. This plan is included in Phase 2 (2007 – 2008), and new Maguwo station started operation in June, 2008. In addition to the existing local business class train (Prameks), new railway services linking the airport and Yogyakarta/Solo are expected to be provided after completion of the new passenger terminal and railway station.

For Ahmad Yani (Semarang) Airport, there is also a master plan with two-phase development including extension the runway and construction of new terminal facilities. Although there is a railway track which passes by the airport, an extension railway line needs to be constructed in order to access the existing railway because the new passenger terminal building is planned on the north of the runway, that is, apart from the existing railway.

As for Adi Sumarmo (Solo) Airport, a master plan study has been done by PT. (Persero) Angkasa Pura I. New terminal building is planned to be constructed. At present there is no railway nearby the airport, and so far, there is no plan to link the airport by railway.

(5) Port

As of 2006, total annual container throughput at Tg. Emas (Semarang) Port is about 370,000 TEUs, and the volume has been increasing year by year. Meanwhile, the total volume of non-container cargos which

mainly consist of domestic inter-island cargos is about 3.7 million tons (as of 2006) excluding fuel, and recently the volume has also been growing. More than 90% of the inter-island cargos are unloaded cargos including oil fuel, timber, fertilizer, cooking oil, cement, and so on. However, Tg. Emas Port was damaged by submergence in 2003. No drastic measures have been taken yet since then, and the railway to the container yard is no longer used. However, it is hoped that the railway transportation will be revived for handling cargos, more specifically, containers.

A master plan of Tg. Emas Port has recently been prepared for the next 25 years along with phased improvement plans considering national port affair regulations, regional/city spatial plans, and environmental aspects. Bulk cargo area including coal is planned to be moved to the west of the port (toward the existing marina) in order to expand the existing container terminal and general cargo area. In the short-term development plan (2008 – 2012), the development area includes additional berths (2 x 150 m) and a container yard (6 ha). In accordance with the port expansion and improvement, growth in the handling volume is expected for most commodity types. Among others, rapid and stable growth of container volume is expected for both import and export.

4. ANALYSES ON PRESENT RAILWAY FACILITY AND OPERATION

(1) Operational Problems and Countermeasures

	Problems	Countermeasures
Line capacity	* Insufficient line capacity	* Providing efficient and reliable train control system * Improving facilities in bottlenecked sections * Double tracking
Safety	* Frequent railway accidents (collisions, derailment, etc.)	* Controlling travelling speed at bottlenecked sections * Introducing efficient and reliable train control system * Improving deteriorated facilities
Time Punctuality	* Frequent delays of departure and arrival	* Improving facilities in bottlenecked sections * Introducing efficient and reliable train control system * Procuring rolling stocks in good condition * Optimizing train operation schedule and management
Travel Time of Freight Train	* Long travel time	* Increase line capacity * Change priority on freight train in rural section
Integration with Port, Dry port	* No railway in Tg. Emas Port. * No dry port	* Installing railway line in Tg. Emas Port and Solo dry port in cooperation with freight forwarders
Business Promotion	* Passive approach * Few resources for marketing	* In cooperation with private companies * Installing competition among railway operators
Comfort	* Dirty inside the train * Noise * Temperature and lack of air circulation * Shaking and unsteadiness * Lack of Air conditioner * Inadequate lighting apparatus * Large steps between train and platform * Vendors	* Renovating or replacing rolling stock * Improving track facilities * Installation of air conditioner * Frequent maintenance of lighting apparatus * Raising level of platform
Security	* Accidents due to illegal crossing and structures * Broken window	* Prohibiting illegal crossings and improving fencing * Frequent maintenance
Frequency	* Low frequency	* Installation of a train composed with 3 class coaches
Timetable	* Low service level for local trains * Classed service * Ignorance of intermediate stations * Ignorance of transfer passengers	* Improve line capacity * Stops all trains at terminal stations * Installation of a train composed with 3 class coaches * Timetable in consideration of transfer passengers
Ticket Sales	* A few outlets * Inconvenient telephone booking system	* Increase of travel agencies * Internet booking system with variety of options of payment
Information Service	* Only station-based information service	* Up to date information service with variety of media
Mode Integration	* No integration with intercity bus services	* Cooperation w/ local authority to allow bus to stop at stations

Source: JICA Study Team

(2) Facility Problems and Countermeasures

	Problems / Bottlenecks	Countermeasures
Track	* Insufficiently and inadequately maintained tracks * Aged or disordered tracks	* Introducing sufficient and adequate maintenance program * Rehabilitating aged or disordered tracks
Signal & Telecom.	* Disorder of signaling facilities due to inadequate and insufficient maintenance * Difficulties in procuring spare parts from overseas * Inefficient operation with manual signaling system	* Rehabilitating signaling facilities * Developing maintenance skill * Standardizing signaling system * Introducing automatic signaling system
CTC	* Absence of CTC system in Tegal – Jerakah * Different CTC system between two Semarang stations	* Introducing CTC system * Standardizing CTC system
Level Crossing	* Unsecured illegal crossings * Dangerous crossings without surveillance	* Prohibiting illegal crossings * Surveillance at accident-prone level crossings
Bridge	* Constraints in travel speed to pass aged bridges	* Rehabilitating aged bridges
Station	* Waterlogging at Semarang Stations	* Introducing efficient drainage and pumping system * Elevating critical section of the line
Rolling Stock	* Slow travel speed (long distance and freight trains) * Frequent disorder (aged cars) and low operating rate * Insufficient rolling stock to provide frequent operation * Ground pollution and contamination due to leaked fuels and lubrication oils	* Reorganizing operation schedule * Introducing sufficient and adequate maintenance program * Procuring additional rolling stock * Optimizing train operation schedule * Cleaning up and renovating maintenance yards
Maintenance Facilities and Activities	* Aged or disordered maintenance equipment * Aged or disordered tracks in maintenance yards * Insufficiency of preventive maintenance works	* Providing necessary maintenance equipment * Rehabilitating aged or disordered tracks * Introducing a periodic maintenance environment
Structures	* Illegal structures invading structure gauge	* Prohibiting illegal structures
Mode Integration	* Abandoned spur lines	* Rehabilitating access lines (if required to be integrated)

Source: JICA Study Team

(3) Regulatory Problems and Countermeasures

While there is the PSO (Public Service Obligation) system of compensation to PT. KA for operation of non-profitable passenger services by the central government, due to lack of financial resources the government is unable to fully compensate PT. KA for the losses incurred in operating these services. This shortfall must be compensated by cross-subsidy from other PT. KA services. The study also found that many goods are moved for long distances by road because of poor railway freight services, cited by several customers during interviews as long transit times, insufficient freight wagons and locomotives and outdated infrastructure that results in frequent delays. Many industries are paying higher transport prices for road transport, because of the absence of reliable and efficient rail freight service. The rail freight tariff is not controlled by government, though most of PT. KA's customers are parasitical organizations.

Transport regulatory reform is one way to improve this situation and to attract additional capital investments to railways and to permit more innovative railway management structures to more effectively deal with attracting freight traffic to the railways. Passage of Law 23 of 2007 and the subsequent draft enabling legislation is the first step towards developing a stronger railway system in the country and eliminate many of the economic distortions now present.

With regard to passenger services, there will continue to be the need to compensate operators for losses incurred in operating economy passenger trains. It is proposed that there should be a greater involvement of private sector railway operators/managers that would be responsible for operating some passenger services on regional railways. With a properly-structured performance and incentive contract (these contracts would be tied to the payment of a management fee), a private railway operator should be able to operate passenger services efficiently at minimum cost, and attracting the maximum number of passengers.

In fact, the participation of the private sector in operating passenger trains may result in increased financing sources for the passenger rail subsidy. One of the criteria for selecting the private railway manager/operator could be the level of operating subsidy required; the qualified bidder requiring the lowest level of subsidy may be selected. This technique could actually reduce the level of operating subsidy, by inviting private sector operators to manage passenger services, with one of the criteria for selection the subsidy required. The qualified company requiring the lowest subsidy (consistent with service standards) may be selected.

5. OBJECTIVES FOR REGIONAL RAILWAY SYSTEM DEVELOPMENT

The railway is a more economically efficient mode of transport than road, in terms of fuel efficiency and utilization of economic resource costs; there are potentially large economic benefits if the movement of goods and passengers can be diverted from road to rail transport. In the Revitalization Program on Indonesian Railways by the Ministry of Transport (MOT), the following were included as stated goals:

- Increase the role of railway in freight transport
- Increase the role of railway in passenger transport
- Reduce the burden on road transport

The analysis of the present transportation problems and the planning issues in the Central Java region have resulted in the identification of four major principles, which the railway transportation system development needs to pursue. These principles include: (i) efficiency improvement; (ii) equity to all members of society; (iii) environment betterment and (iv) safety enhancement.

(1) Efficiency in Transportation System

For improvements of the energy efficiency of total transportation system in the Central Java region, it is effective to promote railway transportation and facilitate modal shift from passenger cars and various types of buses to trains. Even though mass transit system consumes more energy for operation of each unit, it can save the energy consumption per person-km, because of its higher transport capacities and greater energy efficiency than private vehicles.

In Semarang, Solo and Yogyakarta metropolitan areas, development of efficient transport system is of great importance to support economic activities. Railway transit system has an advantage over private modes of transport in terms of travel costs and lesser consumption of space in the context in urban area.

Traffic congestion in the metropolitan areas has not been severe but the situation will get worse as urbanization proceeds. It is proposed to establish an efficient and convenient public transportation network to prevent shifting to private modes of transportation. Railway transportation should play the primary role in the public transportation network. The following two integrations should be taken into consideration for developing railway system development:

- Integration with Other Modes of Public Transportation
- Integration with Urban Development

(2) Equity in Transport to All Members in the Society

1) Low Income Household

A minimum level of transportation service should be provided to all members of the society. In the Central Java region, the mobility of the low-income group is limited due to their insufficient income. Railway transport has been playing a role for providing transportation service for the poor. The tariff for economy class passenger trains is determined by the Central government and the current railway operator PT. KA receives a subsidy as PSO to compensate for the operation loss of an economy class train.

The service level of economy class train, however, is very low with deteriorated and badly maintained train cars. This decreases the attractiveness of railway service and results in reducing railway passenger demand. The service standard should be clearly defined and the gap between fare revenues and cost to fulfill the service in accordance with the standard should be paid to the railway operator from the government. If this cannot be committed to by the government, it will be difficult to attract private sectors to railway business.

2) Physically Challenged

At present availability of the railway facilities for the physically challenged is still very limited in the region. It is sometimes difficult to ride on the trains due to the gap between floor of train and ground even for able-bodied people. Since it is essential to provide a satisfactory mode of transportation for all members in the society, it is recommended to develop transportation facilities for the physically challenged.

(3) Environmental Betterment: Global Warming

Global warming is an urgent issue in the world, and many countries have been making efforts to reduce greenhouse gases. In the transportation sector, passenger cars, buses and trucks are producing the greatest amount of greenhouse gases. To deal with this problem, a common countermeasure is promoting diversion from passenger cars, buses and trucks to more environment-friendly mode of transport such as railway.

(4) Transportation Safety

Causes of railway accidents occurring from January 2004 up to May 2006 were examined. Although more than half of the railway accidents were made by internal and external human errors, 22% of the accidents were caused by failure of infrastructure and 19% by disordered rolling stock.

Since railway accidents are caused by various kinds of factors, various countermeasures should be taken to reduce them. The majority of the existing rolling stock of PT. KA is not in good condition since they are old and maintenance is insufficient. Due to the limited revenue, PT. KA cannot afford to buy new rolling stock or tools/equipment. To tackle the railway safety issue, not merely rolling stock, but also infrastructure should be upgraded and improved. Despite efforts in improving railway infrastructure by the central government, the railway facilities still need further upgrading and rehabilitation. Many railway accidents have occurred at level crossings due to lack of careful driving practices of public road transport and so on. In this regard, railway crossings in urbanized areas, where commuter railway services are proposed, should be elevated as much as possible to reduce conflict with road traffic.

6. FORECAST OF FUTURE RAILWAY DEMAND

(1) Forecast of Railway Passenger Demand

Future growth rates of railway passenger demand are targeted at around 3.8% - 4.4% per annum. In 2030, the annual number of railway passengers in the Central Java region is expected to increase from the current 9.5 million (as of 2007) to 24.4 million passengers.

While an overall great modal shift to the railway may be unrealistic, growth of the passenger demand caused by the modal shift can be well expected from individual railway projects focusing on certain railway corridors due to the population and economic growth in the Study area. The modal shift that will be caused by individual railway projects is expected to add to the above-mentioned number of railway passengers. For modal shift, the Study Team assumes that, for intercity trips with both origin and destination along the new railway project corridor, some 70%, 10%, and 10% of the existing bus, car, and motorcycles users respectively will shift to the new railway service after its operation. Actual modal shift from each mode may vary depending on the type of service (e.g., with or without air-conditioning) provided by the new railway. Furthermore, a considerable number of additional intercity trips may be induced by the new railway service. As for commuter railways, detailed modal shift is analyzed based on the stated preference (SP) Survey, and is discussed in the Case Study.

(2) Projection of Container Volume by Railway

There is a potential of utilizing the railway for freight transport, if the necessary construction and rehabilitation of the railway facilities are conducted including the access to Tg. Emas Port. Among other reasons, if a new dry port in Solo and the dry port in Yogyakarta are planned to be connected to the railway, it can be assumed that a significant share of containers from/to Solo and Yogyakarta will be transported by railway. In this Study, achievable railway market shares for containers have been set as 50% for Solo dry port and 70% for Yogyakarta inland port.

(3) Projection of Other Freight Volume by Railway

1) Cement

Among the three major cement companies, at present, only Holcim has a plant in the Central Java region. Transport route goes via the south Java corridor from Cilacap, where the cement plant is located, east to Yogyakarta, Solo, and towards Surabaya. Not only truck but also railway is utilized to transport the cement. Some wagons that are used to transport cement to Solo and Semarang areas are utilized to transport quartz sand on the way back to the plant in Cilacap. In this Study, future demand growth of

cement in the Central Java region has been set as 3% including the volume of cement transported by railway.

2) Quartz Sand (Silica)

Quartz sand (silica), which is another important raw material for cement, is mined in the region. Railway is also used to transport quartz sand. It is usually transported from the place of mining to the place where it is consumed. PT. KA regards the route of Bojonegoro – Gundih – Solo – Yogyakarta – Cilacap as the main corridor to transport sand. For projection of the future growth in the demand of sand transported by railway, trend of GRDP in the mining and quarrying sector in the Study area was considered. As such, an annual growth rate of 6% (and 5% from 2013) has been assumed for projection of future demand of sand transported by railway.

3) Fertilizer

As for the future demand, while transport of fertilizer from Semarang may not be expected, the Study Team assumed that the current fertilizer transport from Cilacap by railway would be maintained in the future as well. For projection of the future growth in the demand of fertilizer transported by railway, trend of GRDP in the agriculture sector in the Study area was considered. An annual growth rate of 3% (and 2.5% from 2013) has been assumed for projection of future demand of fertilizer transported by railway.

4) Fuel

Most fuel consumed in the region is refined in Cilacap by PT. Pertamina (Persero), a state-owned oil and gas company, and transported between the depots by pipeline, railway, truck, or ship. As for future fuel transport, since PT. Pertamina plans to connect all the depots by pipeline, the remaining possibility of fuel transport by railway tank wagon (RTW) is aviation fuel. Assuming that aviation fuel transport from Cilacap to Rewulu (and to Adi Sutjipto and Adi Sumarmo Airports by special truck called Bridger) will continue in the future as well, the Study Team estimates the future transport volume in accordance with the growth in air travel demand that is planned by each airport.

5) Coal

In the Central Java region, coal is not actually transported by railway at present. However, the potential for transporting coal by railway is possible in three conceivable cases. One is transporting coal from Tg. Emas Port (Semarang) to Solo by railway in order to supply coal to be used for small power plants of the textile factories in Solo and its vicinities. A second case is transporting coal from Kendal Port (near Semarang) to Kabupaten Kulonprogo (near Wates) via Solo and Yogyakarta for a planned steel/iron factory targeting start of the production in 2015. Third, there is potential to transport coal from Tg. Intan (Cilacap) Port to Karangandri, where a coal steam power plant with a capacity of 600 MW is in operation.

7. REGIONAL RAILWAY MASTER PLAN

(1) Long Term Regional Railway System Development Plan

1) Commuter Trains

To support efficient urban functions of the major cities of the Central Java region, commuter trains should be introduced on the existing or new railway lines. When commuter rail service starts, it would be better to avoid level crossings in the urbanized area, since traffic volume on the crossing streets is large and frequent train operation may lead to traffic congestion on the road network in the city. Track elevation inside the city of Semarang would be the first priority to get the line functioning as commuter rail. In the Semarang metropolitan area the following lines have been proposed: a) Semarang – Kendal Commuter Line, b) Semarang – Demak Commuter Line, and c) Semarang – Brumbung Commuter Line. Also in Solo the following lines have been proposed: a) Solo – Klaten Commuter Line and b) Solo – Sragen Commuter Line, while in Yogyakarta a) Yogya – Klaten Commuter and b) Yogya – Wates Commuter.

2) Urban Railways

In city areas three rail systems are proposed: Semarang Monorail, Solo Tramway and Bantul Tramway.

3) Airport Links

Two airport rail links are proposed to enhance convenient access to the airports in the region. These are Semarang airport link which will provide 4 km branch line to the planned relocated location of a new air

terminal. Solo airport link connects the existing railroad and the airport terminal and allow “direct-through” operation to Solo and Yogyakarta. .

4) Intercity Trains

Redevelopment of this intercity train on the Semarang – Magelang - Yogyakarta corridor basically traces the old alignment between Semarang and Yogyakarta. The corridor consists of: a) Yogyakarta – Magelang Line, b) Magelang - Ambarawa Line, c) Ambarawa – Kedungjati Line, d) Semarang – Tegal Line, e) Semarang – Cepu Line and f) Demak – Rembang Line. Improvement of the Semarang –Solo existing line has also been proposed and this line would be utilized for freight transport as well.

5) Freight Trains

The project aims to improve the reliability of freight service by track rehabilitation and improvement of overall traffic control system over the whole alignment, including: a) Semarang – Solo Freight Corridor (109 km) and b) Solo – Wonogiri Freight Corridor. In addition, four accesses to important freight facilities are proposed. These access lines include: a) Semarang Port Access, b) Kendal SEZ Access, c) Kalijambe dry port Access and d) Yogyakarta Dry Port Access.

6) Tourist Train

The railway lines for tourism in the region are proposed. Improvement of railway system and railway museum in Ambarawa would attract more railway amateurs and also the development of a branch line to Borobudur from the proposed intercity railway corridor between Yogyakarta and Magelang provides better access to the world heritage site.

(2) Railway-Related Development Projects

Integrated development of railway system and urban/housing development along the commuter railway line is recommended to strengthen the financial viability of the railway system development by: a) internalizing development benefits of improving railway service from increase in land value in housing development and b) increasing fare box revenue which is brought about by increase of railway passenger demand by developing housing along the railway line.

(3) Preliminary Evaluation of the Projects

Sequence of the proposed railway projects have been examined from technical point of view. Some projects have to be started after the completion of other projects and some projects partially share railway tracks or stations. This sequence of the projects has been taken into consideration when giving priority to the projects. Considering these relationships and also features of these projects, they are consolidated into 20 packages.

The benefits of railway system development projects estimated in this preliminary evaluation include Vehicle Operating Cost (VOC) saving, Travel Time Cost Saving, Reduction of Traffic Accidents, Reduction of CO₂ and reduction of road damage. VOC and travel time cost savings from both railway passengers and drivers of parallel road are included. The results of preliminary economic evaluation are presented in the following table and implementation of several projects seems difficult to justify from economic point of view under the current condition of the projects.

Preliminary environmental impact evaluation shows negative impacts to social environment are expected from development of commuter and intercity train operation based on the survey on air quality, noise, vibration, water quality and right of way (ROW) and public hearing. In addition, serious or some pollution would be brought about by commuter train, intercity train, urban railway and airport link development projects.

Preliminary Economic Evaluation

Project Name	NPV (Mill. Rp.)	EIRR	B/C	Priority
Commuter Train				
1-1 Semarang Commuter	-	8.6%	0.765	A-
1-2 Solo Commuter	-	8.2%	0.870	A-
1-3 Yogya Commuter	728,457	15.0%	1.355	A+
Urban Train				
2-1 Semarang Monorail	-	-	0.365	B
2-2 Solo Tramway	-	2.3%	0.437	B
2-3 Bantul Tramway	-	1.0%	0.339	B
Airport Link				
3-1 Semarang Airport Link	-	-	0.229	C
3-2 Solo Airport Link	-	-	0.047	C
Freight Train				
4-1 Semarang Solo Yog Freight Corridor	131,932	13.1%	1.078	A
4-2 Solo Wonogiri Freight Corridor	-	-	0.253	B
4-4 Kendal SEZ	-	-	0.305	B
Intercity Train				
5-1 Yogya - Magelang Intercity	-	0.3%	0.265	B
5-2 Borobudur Access	-	-	0.125	C
5-3 Magelang - Ambarawa Intercity	-	-	0.141	C
5-4 Ambawara - Kedungjati Intercity	-	-	0.212	C
5-5 Semarang-Tegal Intercity	-	-	0.476	B
5-6 Semarang-Cepu Intercity	-	-	0.160	C
5-7 Demak-Rembang Intercity	-	3%	0.433	B

Source: JICA Study Team

*: 'Demak-Rembang Intercity' includes benefit of freight transport between Demak-Rembang transportation.

Based on the project sequence in terms of technical aspects, preliminary economic evaluation and initial environmental examination, priorities were given to the proposed projects and the projects were divided into short-term, medium-term and long-term implementation programs as listed in the table below.

Project Phasing of Central Java Region (million USD in 2008 Price)

Project Packages	Route (km)	Project (km)	Capital Cost	Cost per km
Short Term Projects				
1-1 Semarang Commuter	43	34	106.2	3.1
1-3 Yogya Commuter	58	58	129.5	2.2
Sub Total	101	92	235.7	2.6
Medium Term Projects				
1-2 Solo Commuter	58	58	143.9	2.5
3-1 Semarang Airport Link	9	4	32.7	8.2
4-1 Semarang - Solo - Yogya Freight Corridor	115	101	121.6	1.2
4-3 Kendal SEZ Access	5	5	20.9	4.2
5-5 Semarang - Tegal Intercity	150	150	45.0	0.3
5-6 Semarang - Cepu Intercity	140	140	36.0	0.3
Sub Total	477	458	400.1	0.9
Long Term Projects				
2-1 Semarang Monorail	12	12	181.0	15.1
2-2 Solo Tramway	6	6	51.9	8.6
2-3 Bantul Tramway	15	15	111.1	7.4
3-2 Solo Airport Link	7	8	69.3	8.7
4-2 Wonogiri - Solo Freight Corridor	36	36	25.8	0.7
5-1 Yogya - Magelang Intercity	47	47	177.7	3.8
5-2 Borobudur Access	7	7	11.7	1.7
5-3 Magelang - Ambarawa Intercity	37	37	125.4	3.4
5-4 Ambarawa - Kedungjati Intercity	37	37	76.3	2.1
5-7 Semarang - Demak - Rembang Intercity	110	107	360.3	3.4
Sub Total	314	312	1190.4	3.8
Grand Total	892	862	1826.1	2.1

Source: JICA Study Team

(4) Institutional Setup for Regional Railway Company

1) Types of Travel Flow and Responsibility of Central / Local Governments

Roles and responsibilities of central, provincial and kota/kabupaten governments are as follows: The central government is responsible for inter-provincial traffic, provincial governments are responsible for inter-kabupaten/kota traffic, and kota and kabupaten governments are for traffic within their territory.

2) Privatization of Railway Transportation Industry

Six different techniques/models for improving the efficiency of railway operations, ranging from minimal private sector involvement (improving the operating efficiency of freight trains by PT. KA) to total control over railway operations and maintenance (railway concessions), are listed by increasing intensity of private sector involvement:

- Operation of more efficient freight trains
- Separation (“outsourcing”) of non-core activities from the national railway
- Private companies (typically freight forwarders) contracting trains operated by the national railway
- Private trains operating on infrastructure of the national railway (“Open Access”)
- Private sector operation of light density railway lines
- Railway operating concession

3) Establishment of Regional Railway Company

A Central Java Railway (CJR), which is responsible for railway operations over regional lines on the corridor of Semarang – Solo – Yogyakarta, is proposed. The primary functions to be undertaken by CJR would be train operation (with train and engine crews as CJR employees) while infrastructure maintenance and train control would remain with PT. KA.

Management of CJR will be a joint public – private partnership. The railway manager would likely be a partnership between an Indonesian freight forwarder and an overseas railway operator for freight railways. In the case of commuter railways, a private sector partner will include a property developer. The presence of government representatives will be reflected primarily in the definition of the passenger train service CJR must provide; the railway will be essentially managed and operated by the private sector railway manager. PT. KA is shown as an optional participant in the organization.

Financing of needed capital improvements in the track and signaling systems would be from a combination of central and provincial government sources. Funding for rolling stock and some minor infrastructure improvements would be from the railway operator (CJR). CJR would reimburse PT. KA for track maintenance and train dispatching through payment of a track access charge (maintenance and train control fee) and for the capital improvements to the infrastructure paid by the provincial government, a track access charge would be paid. PSO from central government and a possible additional amount from the provincial government will cover any remaining shortfall.

4) Recommended Approach to Improve Railway Efficiency

We recommend a dual approach: (i) begin the process to create CJR by drafting the MOU between MOT and the provinces of Central Java and Yogyakarta to create a regional railway organization; and (ii) establish the pro-rail policy in the Directorate General of Railways (DGR). This pro-rail transport policy by MOT will be designed to increase public awareness of the efficiencies of rail transport as well as to provide some financial incentives for companies to use rail transport to a greater extent. With regard to the operation of more efficient freight trains, a joint task force should be established between DGR and PT. KA to investigate the steps that need to be taken to improve the efficiency of freight train operation.

8. CASE STUDY: SEMARANG – SOLO – YOGYAKARTA CORRIDOR

(1) Commuter Railway Service Development Plan

1) Yogya Commuter Railway Service

Yogya commuter railway is a high priority project. Since the section between Wates and Klaten of the Yogya commuter railway has been double tracked, additional investment is relatively small compared to the other projects and this project does not have illegal occupants in the ROW of the railway line.

2) Semarang Commuter Railway Service

Semarang commuter railway indicates high priority in economic evaluation. However, due to the required double tracking work and the proposed track elevation, it will take time for implementation. Urban drainage project is now being implemented and after six years from now, the areas enclosed by east and west *Bajir Kanal* and the harbor road will be flooding free area. They will build dikes parallel to the harbor road; thus, close coordination should be needed.

3) Solo Commuter Railway Service

Solo commuter railway brought a lower economic evaluation result compared to Yogya and Semarang commuter services. This is partly attributable to the fact that Solo – Sragen section is less developed and this section is still single track. Therefore, investment will be necessary for double tracking. However, Solo – Klaten section is already double tracked so that Yogya commuter railway may be extended to Solo before the whole section of Solo commuter railway is completed.

(2) Airport Link Development Plan

Both Semarang airport link and Solo airport link are important to provide railway service for airport users. The projected air passenger demands for both airports are however not large enough; thus, the project appears to be less feasible in an economic sense. Thus, it is proposed to combine the service with commuter railway to reduce the cost burden on common items. Combining the services will also reduce the high peak ratio of passenger demand.

(3) Freight Railway Service Development Plan

Solo – Semarang freight corridor development also indicates high priority in economic evaluation but it needs track elevation of railway line in Semarang city which is included in Semarang commuter railway project; thus the project should wait until the track elevation work is completed. The railway freight corridor development includes dry port development in Solo Kalijambe as well as Yogyakarta; thus, coordination between dry port operator and freight railway operator is required.

9. CONCLUSIONS AND RECOMMENDATIONS

(1) Institutional Setup for Central Java Regional Railway System Development

Insufficient management capability on railway business and lack of discipline of employees are regarded as a cause of inefficient railway service provision. At the same time, deteriorated railway infrastructure and aged rolling stock are also a cause of unsatisfactory level of railway service. The central government has limited budget for railway infrastructure development and improvement, while PT. KA is also suffering from shortage of revenue. Therefore, it is essential to expand funding sources for investment. Since the new railway law allows local governments and private sector to be involved in the railway business, participation of new business entities will support to increase available funds for railway development.

1) Organization Structure

It is recommended to establish a CJR with strong private sector participation, to strengthen railway service, make it more competitive, and to provide an additional source of capital investment funds to grow the railway business in Central Java. The Rail Operator would be the strong driving force of CJR and come from the private sector. There are several alternative ways to structure this concept as described below.

- i) Establish a Local Government Owned Enterprise (LOE) to develop and administer a performance based contract for the Rail Operator. The Rail Operator would likely include an Indonesian freight

forwarder and an overseas organization experienced in railway operations. PT. KA would maintain and control the railway line and the Rail Operator would market the freight business, operate trains (freight and passenger if commuter service is included), collect revenue and manage the railway business aggressively to increase rail market share and increase operating efficiency.

- ii) Establish an LOE responsible for train operations which would be a joint venture with the private rail operator. Composition of the rail operator would be similar to that described in the first alternative.
- iii) Establish a joint venture between PT. KA, individual shippers and the private rail operator. Under this third alternative, there would be no change in the structure or manner in which track access fees are administered or paid.

2) Bidding Process for Rail Operator

CJR operator (Rail Operator) will be selected from interested private companies through a process of competitive bidding. Service levels will be determined by the provincial government and all bidders must agree to achieve at least, these standards of service. An important component of the bidding selection criteria would be the requirement that the Rail Operator purchase rolling stock necessary to support the service; bidders could offer to make additional investments in the line. Bidding criteria could include items such as track access charge to pay to PT. KA and the government (central and provincial), passenger fare level and management fee. In this way, the desired service levels would be achieved at the lowest possible cost and with the greatest efficiency.

3) Recommended Institutional Alternative

Three institutional alternatives were presented for the proposed CJR. While it is possible to establish the railway along the lines of any of these three, their impacts on the objectives of establishing this organization will likely be different. These objectives include creating an organization structure favorable for private sector involvement that would lead to increased freight traffic by rail through innovative rail operating and marketing practices as well as efficient operation of rail commuter systems in accordance with the performance contract with the provincial government. This private sector involvement would likely include an Indonesian freight forwarder and a rail operator from overseas. Involvement of the private sector would also provide an additional source of project finance for purchase of locomotives and rolling stock, as well as possibly some additional investments in the railway system. Perception of risk by the private sector company will have a direct impact on their willingness to participate and to make these investments. The likelihood of positive private sector influence and financial contribution would be the greatest under Alternative i) or ii); it is unlikely that Alternative iii) would produce a successful private sector contribution.

(2) Conditions to Materialize Railway System Development

In the financial analysis of the Study, it is assumed that the initial investment cost for railway infrastructure development will be paid as Track Access Charge (TAC), taking depreciation of facilities into account. It is also assumed that this TAC is paid by railway operators according to train car * kilometers of passenger trains, freight trains and the existing trains operated by PT. KA. Financial feasibility appears good for the Semarang – Solo freight transport corridor; however, if the other railway system development cannot be achieved and if they cannot share the TAC, the cost burden to the freight corridor development will become heavier and viability of the freight corridor will be worse. This implies that financial viability of the projects is obtained only if all the proposed projects are implemented and they share the initial investment costs among the projects.

Freight demand of railway transport was projected based on the transport plan of materials and products of shippers; thus, reliability of forecast is high. On the other hand, container transport demand carried by railway depends on the comparative advantage of railway transport service over road transport. In this regard, it is important to develop industrial estate next to the dry port, and redevelop the railway branch line to the container yard in the port to reduce time and cost due to double handling. It is important to attract shippers by reducing disadvantages of railway freight transportation through minimizing loading and unloading time and cost at both ends. These developments require coordination among the relevant agencies. DGR and Transportation Bureau of local government should take lead to materialize these developments. Furthermore, a new regional railway company should undertake aggressive marketing to increase container demand.

In the Study, urban commuter railway services are proposed in the three metropolitan areas (Semarang, Solo and Yogyakarta) where urban transportation problems are expected to be more severe. It should be

noted that the railway passenger demand would be increased not only by railway service improvement but also by integrated railway system development with urban redevelopment in the city center and housing development along the railway corridor. These urban developments would increase not merely railway passenger demand and subsequent revenue from ticket sales but also increase profits from real estate business. This is a commonly practiced mechanism to absorb development benefit as revenue from property business in Japan. Railway business in Indonesia is not able to adequately maintain and upgrade the railway infrastructure and rolling stocks merely with railway transport revenue since this amount is limited. Consequently, it is fundamentally required to expand the revenue base for railway system improvement. To implement housing development and urban development, first of all, the change of land use in the spatial plan at local level is required. To develop the surrounding areas of railway stations local government should develop station plazas, park and ride facilities, access roads to the stations and road network in the surrounding area in collaboration with a real estate company. Without such supports from central and local governments, the railway system development will not be materialized and the expected effects would not be achieved.

In addition, conditions for private sector to enter the railway transportation business should be clearly defined in order to attract them. For instance, the method of calculation of subsidy should be clearly defined; otherwise the private sector will regard it too risky and they will be reluctant to participate in the business.

As mentioned above, to materialize the proposed railway projects, it is indispensable to implement the following measures by relevant agencies in a timely manner.

Actions to be taken to Materialize Proposed Railway Projects

Agency	Timing	Action
DGR, MOT	Prior to establishment of Provincial Government Owned Enterprise	To establish task force to define a role of central and provincial governments in regional railway system development
	Prior to commuter railway service and Prior to the start of the Semarang - Tegal and Semarang – Cepu intercity passenger train service	To speed up double tracking on the Java north main line.
	Prior to start of Semarang commuter railway service	To give priority for double tracking to Kendal - Semarang - Brumbung section
	Prior to the start of Semarang – Solo freight railway transport	To improve railway infrastructure on the Semarang – Solo corridor in collaboration with Provincial government
	Prior to start of Semarang – Solo freight railway transport	To coordinate with relevant agencies(Directorate General of Highways, Ministry of Public Works, Dinas PU, Pelindo III, Power Plant, Kota Semarang Government, regarding Tg. Emas Port access line
Provincial Government	Prior to the start of regional railway service	To establish Provincial government owned enterprise (Central Java Railway Company) To formulate railway service standard and quantity and quality of the required railway service in the region.
	Prior to the start of Semarang – Solo – Yogyakarta freight railway transport	To develop integrated dry port and industrial estate near railway line
Kabupaten/Kota Government	Prior to the start of the commuter railway service	To make modification on land use plan which enables housing development along the railway corridor To develop station plaza and access road to the railway station
Private Railway Company	Prior to the start of railway service	To purchase of rolling stock To develop housing area along the railway corridor To develop urban facilities in the center of the city To purchase loading/unloading equipment for freight transport

(3) Next Action

To materialize the regional railway system development projects recommended in the Study, it is recommended to establish a task force team with DGR, MOT and Central Java and Yogyakarta Provincial Governments for creating a CJR company. The task force team should define the roles and responsibilities of central government and provincial government for regional railway system development.

Chapter 1 Introduction

1.1 Background

The railway operator, PT. Kereta Api (Persero) (PT. KA) has experienced both passenger and freight demand drop in recent years, although in 2006 and 2007 passenger demand slightly increased. Railway passenger demand for long distance trains such as Jakarta-Surabaya, Jakarta-Yogyakarta has been facing severe competition with lower airfares due to the deregulation of the air transport sector. The number of passengers on the major air routes in the Central Java region also shows a high growth. Although annual fluctuation is observed to some extent, the annual average growth between 2000 and 2005 is high at 31%. The travel time between Jakarta and Bandung is now only about two hours with the direct toll road connection. The travel time is shorter than the 2.5 hours of the fastest express train. Due to this change in the situation, many passengers who had previously traveled by train have switched either to cars or buses passing through the toll road. Consequently, the number of railway passengers on this route has significantly decreased.

In the metropolitan areas of the Central Java Region, intervals of railway stations are long and so train operation is not targeting travelers in urban areas; rather the railway services are for inter-city passenger travels. Traffic congestion in the cities like Semarang, Solo (Surakarta) and Yogyakarta is not very severe at present because the majority of trips are made by motorcycles; however, these trips will be made by private passenger cars in the future when people can afford to buy cars. To avoid such future traffic congestion, promotion of railway transportation as a trunk system of the public transportation should be enhanced.

The freight volume of railway transportation has also recently been decreasing. Most locomotives and wagons are antiquated therefore they are taken out of service. The freight trains are also often delayed due to problems of rolling stock and disordered railway track. The lower priority given to freight trains than passenger trains causes further delay in arrival of freight trains. Lack of reliability of train operation has reduced the attractiveness to use the railway for transporting materials and products. Another disadvantage of railway freight transport is double handling of cargoes at origin and destination stations. This double handling of cargoes increases not merely travel time but also handling cost at both ends. Consequently many producers and shippers have shifted from railway to road transport. At present various kinds of bulky commodities such as cement, fertilizer, sand, coal and so forth are carried by trucks

and trailers. Railway transport is more suitable for transporting these kinds of bulky cargoes, and in fact transport cost of railway is cheaper than trucks.

In addition, the Central and Local governments have been tackling the overloaded truck problem for long time since overloaded trucks severely damage roads and the cost of road repair and rehabilitation is very expensive. In 2008, Directorate General of Land Transport started a program to reduce overload on the roads by setting the schedule for reducing tolerance of overloading from 100% to 0% by the end of 2008. Utilization of railway transport for transport of cargoes, in particular bulky cargoes, would reduce road damage.

Although the current business circumstance of railway transportation is not bright by any means, it is of great importance to revitalize railway transport to support social and economic activities in the Central Java Region. The new Railway Law 23, 2007 allows local government and private sector participation in railway transportation business. Taking this opportunity given under the new law, in order to revitalize the railway transportation in the region, the Study addresses the question of how the regional railway system can be materialized and how efficient railway operation can be achieved. The role of each stakeholder in regional railway services were examined and the viable institutional arrangement was explored.

1.2 Stages of the Study

The Study was primarily divided into the following three stages:

Stage 1 - Analysis on Present Conditions

Stage 2 - Long-term Regional Railway Development Plan

Stage 3 - Case Study.

In Stage 1, the present situation of the railway transport and relevant sectors was analyzed and social and economic activities in the Central Java Region were examined. At the same time problems related to railway transport were identified through analysis and discussions with relevant agencies.

In Stage 2, from May to August 2008, based on the problems identified and railway development project ideas discussed with stakeholders, a long-term regional railway system development plan was established. In the preparation of the master plan, railway system development projects were evaluated from the following viewpoints: technical feasibility, economic feasibility and environmental aspects. Priorities were given to each project and projects were selected and arranged in time sequence: namely, short-term, intermediate-term and long-term implementation plans.

In Stage 3, the commuter railway services in the metropolitan areas, airport link and freight transport on the Semarang – Solo – Yogyakarta corridor were further examined by case study.

Table 1.2.1 Stages of the Study

Stage	Period	Contents of the Study
Stage 1	January to March 2008	Analyses on Present Situation of the Railway Transport
Stage 2	May to August 2008	Establishment of Long-term Regional Railway System Development Plan
Stage 3	October to December 2008	Case Study and Establishment of Implementation program

1.3 Contents of the Report

In Chapter 2, the past and the existing socio-economic situation of the Central Java Region is analyzed to grasp regional development trends. The trends in the metropolitan areas are also explored to grasp the present urbanization trend of major cities: Semarang, Solo and Yogyakarta. Environmental aspects such as natural environmental situation of the region and the current situation of pollution are also studied.

The existing transportation facilities and network of various modes of transportation are examined to grasp the present supply of transportation services in Chapter 3. The present transportation services provided by relevant transportation sectors are also examined and their performance is assessed.

In Chapter 4 the present railway facility and operation is analyzed to grasp the problems in railway transportation in the region. First the present condition of the railway infrastructure and rolling stock is studied and performance of passenger and freight transportation services is assessed. The present railway transportation problems are exhibited in this chapter.

In Chapter 5, the future socio-economic framework of the region is reviewed and growth of metropolitan areas is examined based on the review of the regional development plans and the development policy of the Central Java Region. At the same time, relevant transportation system development plans and programs are reviewed.

The planning issues are identified in Chapter 6, based on the understanding of the present situation and taking into account future perspectives of the region. Then four objectives for regional railway system development are identified from the viewpoint of regional development as well as urban transportation.

Chapter 7 deals with future passenger demand and freight demand on the railway network. Railway passenger demand is projected for individual railway services such as commuter railway, intercity passenger train, airport access link and urban railways, while freight demand is estimated by container volume and other bulky cargo volume.

Potential railway projects are selected and service profile and requirement of the railway system are studied in Chapter 8. The project costs are estimated based on the required facilities and equipment and operation and maintenance cost. For commuter railway projects, it is proposed to integrate housing development

along the railway corridor and urban development in the center of the cities. Projects are prioritized based on logical project sequence, economic evaluation and preliminary environmental impact evaluation. Then alternatives of institutional setup on regional railway company are proposed and evaluated in the context of the Central Java Region.

In the long-term regional railway system development plan, the Yogyakarta – Solo - Semarang corridor is selected as a priority corridor. Chapter 9 deals with three major railway system developments of the priority corridor as a Case Study. These include: a) commuter railway service development plan, b) airport link railway service development plan, and c) freight railway service development plan. Passenger and freight demand on the selected corridor are examined and railway service and system is re-examined and the profile and required cost are estimated. Toward materialization of the proposed railway projects, the institutional setup for railway operation is studied based on the financial analyses of each project.

Finally, in Chapter 10, the recommendations regarding the regional railway system development of the Central java Region are presented.

Chapter 2 Present Socio-Economic Situation of Central Java Region

Region

Information and data was collected and reviewed on the current socio-economic situation in and around the Central Java region.

2.1 Current Socio-economic Situation

2.1.1 General Condition

(1) Geographic Condition

The Study area, approximately 260 km², is defined to cover two provinces in the Central Java region, namely, Central Java Province and Yogyakarta Special Province (or *Daerah Istimewa Yogyakarta*, DIY). It is located between East and West Java Provinces. The area is divided into north and south parts by mountains, some higher than 3,000 m.



Figure 2.1.1 Topography of the Study Area

(2) Major Cities and Transportation Network

The geographic characteristics have an influence on settlements and the transportation network. Many cities tend to be built in flat coastal and lowland areas in order to avoid steep slopes. In such circumstance, transportation networks including road and railway are also well developed in parallel with the coast in the east-west direction. Roads and railways north to south are limited and less developed. Figure 2.1.2 shows major cities including capitals of provinces, kota and kabupaten, and the transportation network.



Figure 2.1.2 Study Area Map

(3) Administrative Condition

The study area consists of 2 provinces, 7 kotas and 33 kabupatens, and 644 kecamatans. Total area was approximately 35,729 km² in 2005 or equivalent to 30% of the entire Java Island. Administrative boundaries are shown in Figure 2.1.3.

Table 2.1.1 Administrative Units in the Study Area

Province	Area (km2)	Kota	Kabupaten	Kecamatan
Central Java Province	32,544	6	29	566
Yogyakarta Special Province	3,185	1	4	78



Figure 2.1.3 Administrative Boundaries in the Study Area

(4) Population

Population in the study area has been gradually growing the same as entire country. The rate of population growth has become smaller year by year. During 1970 to 1980, the growth rate in the study area marked high ratio, more than 2.00%. However since 1980, the growth rate has been decreasing and making difference compared to the national average. According to the data, population seems to migrate to West Java. Population and population growth by kabupaten over three decades are shown in Table 2.1.2.

Table 2.1.2 Population and Population Growth by Kota/Kabupaten 1970 – 2000

Province Kota/Kabupaten	Area (km2)	Population				Growth Rate		
		1971	1980	1990	2000	70-80	80-90	90-00
Indonesia	1,890,754.00	119,208,229	147,490,298	179,378,946	206,264,595	2.39%	1.98%	1.41%
Study Area	35,729.91	23,091,538	28,141,980	30,970,527	33,505,922	2.22%	0.96%	0.79%
Central Java	32,544.11	20,602,994	25,391,999	28,057,916	30,385,445	2.35%	1.12%	0.89%
Cilacap	2,138.50	1,063,987	1,334,438	1,441,749	1,562,875	2.55%	0.86%	0.90%
Banyumas	1,327.59	985,649	1,227,817	1,342,152	1,402,448	2.47%	0.99%	0.49%
Purbalingga	777.65	552,575	671,197	746,014	762,439	2.18%	1.18%	0.24%
Banjarnegara	1,069.74	569,611	678,083	760,348	826,378	1.96%	1.28%	0.93%
Kebumen	1,282.74	885,950	1,037,826	1,142,572	1,153,960	1.77%	1.07%	0.11%
Purworejo	1,034.82	603,814	694,370	721,490	706,799	1.56%	0.43%	-0.23%
Wonosobo	984.68	504,245	600,924	661,583	697,555	1.97%	1.07%	0.59%
Magelang	1,085.73	762,322	935,150	1,003,381	1,048,170	2.30%	0.79%	0.49%
Boyolali	1,015.07	678,502	785,915	864,977	866,137	1.65%	1.07%	0.01%
Klaten	655.56	952,711	1,086,309	1,172,976	1,108,798	1.47%	0.86%	-0.62%
Sukoharjo	466.66	475,357	604,766	690,554	727,832	2.71%	1.48%	0.59%
Wonogiri	1,822.37	875,336	953,361	1,020,865	981,889	0.95%	0.76%	-0.43%
Karanganyar	772.20	430,357	609,718	699,830	750,519	3.95%	1.54%	0.78%
Sragen	946.49	605,792	764,609	839,057	849,852	2.62%	1.04%	0.14%
Grobogan	1,975.85	836,213	1,020,231	1,161,477	1,222,881	2.23%	1.45%	0.57%
Blora	1,794.40	586,713	697,908	746,728	799,428	1.95%	0.75%	0.76%
Rembang	1,014.10	348,743	443,068	490,566	554,301	2.70%	1.14%	1.37%
Pati	1,491.20	702,177	971,449	1,058,385	1,100,224	3.67%	0.96%	0.43%
Kudus	425.17	425,891	537,083	603,953	690,428	2.61%	1.31%	1.50%
Jepara	1,004.16	541,005	700,812	771,503	905,666	2.92%	1.07%	1.80%
Demak	897.43	535,108	644,634	776,871	924,236	2.09%	2.09%	1.95%
Semarang	946.86	636,538	708,602	766,209	823,160	1.20%	0.87%	0.80%
Temanggung	870.23	427,510	557,901	600,518	646,741	3.00%	0.82%	0.83%
Kendal	1,002.27	617,612	700,798	773,669	851,882	1.41%	1.11%	1.08%
Batang	788.95	426,874	531,155	598,823	623,457	2.46%	1.34%	0.45%
Pekalongan	836.13	546,992	652,727	744,621	729,330	1.98%	1.47%	-0.23%
Pemalang	1,011.90	767,546	949,191	1,070,199	1,221,111	2.39%	1.34%	1.48%
Tegal	879.70	856,511	1,102,782	1,171,330	1,310,732	2.85%	0.67%	1.26%
Brebes	1,657.73	996,948	1,266,670	1,416,851	1,690,864	2.70%	1.25%	1.98%
Kota Magelang	18.12	99,543	123,091	117,793	123,750	2.39%	-0.49%	0.55%
Kota Solo	44.03	385,105	459,257	515,234	526,392	1.98%	1.29%	0.24%
Kota Salatiga	52.96	67,771	79,854	86,371	104,085	1.84%	0.88%	2.09%
Kota Semarang	373.67	639,060	995,652	1,126,265	1,400,911	5.05%	1.38%	2.45%
Kota Pekalongan	44.96	109,512	132,560	137,899	367,206	2.14%	0.44%	11.50%
Kota Tegal	34.49	103,414	132,091	215,103	323,009	2.76%	5.57%	4.62%
DIY	3,185.80	2,488,544	2,749,981	2,912,611	3,120,477	1.12%	0.58%	0.69%
Bantul	506.85	568,618	634,442	696,905	781,012	1.22%	0.94%	1.15%
Kulon Progo	586.27	370,629	380,685	372,309	370,944	0.30%	-0.22%	-0.04%
Sleman	574.82	588,304	677,323	780,334	901,377	1.58%	1.43%	1.45%
Gunung Kidul	1,485.36	620,085	659,486	651,004	670,433	0.69%	-0.13%	0.29%
Kota Yogyakarta	32.50	340,908	398,045	412,059	396,711	1.74%	0.35%	-0.38%

Source: Census Population Data, Statistical Bureau (*Badan Pusat Statistik, BPS*)

Population density in the study area is as high as in other provinces in Java Island. Figure 2.1.4 shows population density by kecamatan in 2006, with the kecamatans of high density tending to be located along the major roads linking the cities. Besides, population, annual growth rate, and density by kota / kabupaten in the Study area are listed in Table 2.1.2. The population grew slightly between 2000 and 2005.

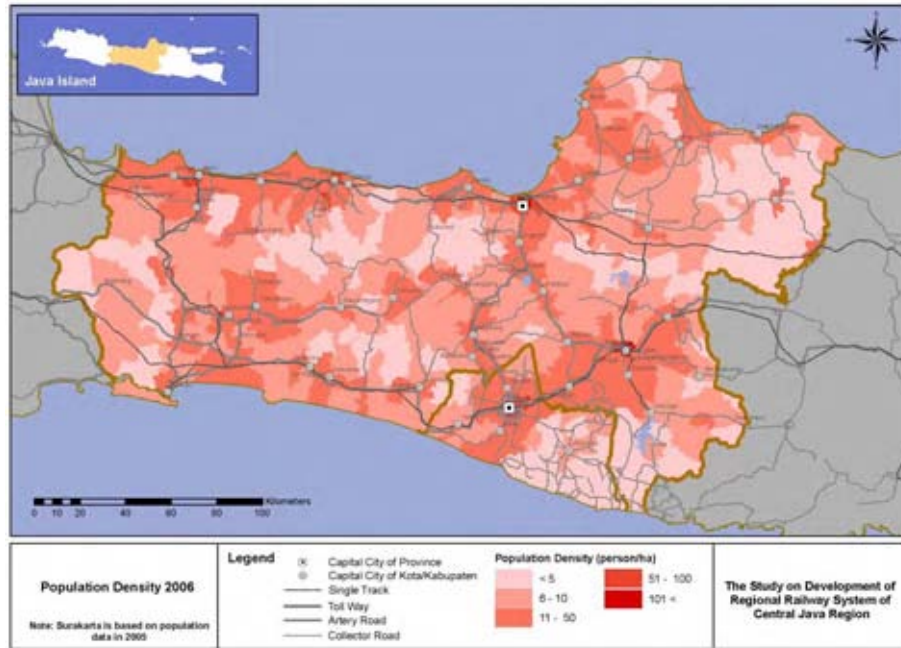


Figure 2.1.4 Population Density by Kecamatan in 2006

(5) Land Use

Existing land use is shown in Figure 2.1.5. Settlements are widely distributed especially in lowland and coastal zone. Except for such settlement area, most of the land is agricultural land or forest in the Study area.

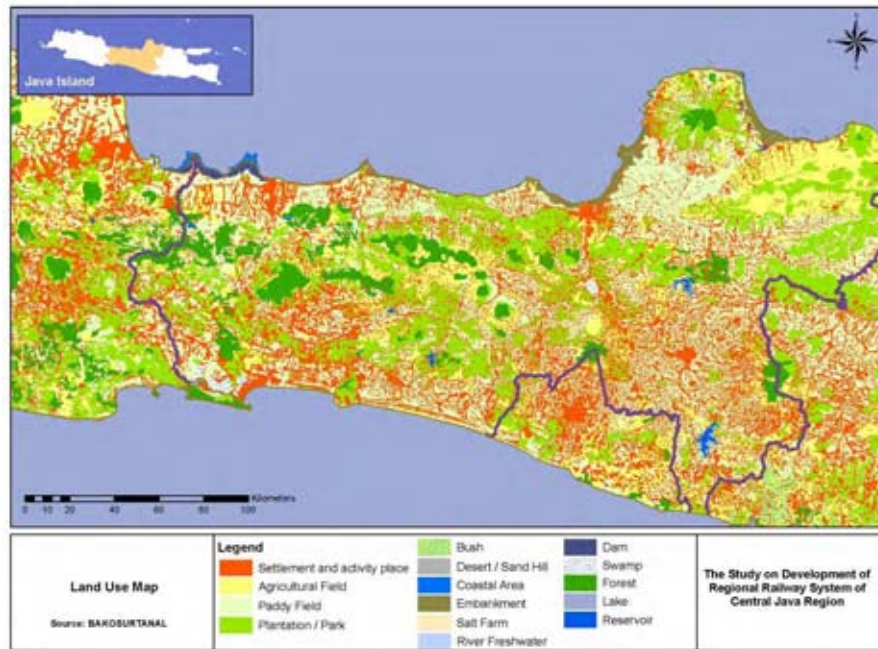


Figure 2.1.5 Existing Land Use

2.1.2 Socio-economic Conditions

GRDP of the Central Java region has been increasing steadily. Table 2.1.3 shows GRDP, annual growth rate and GRDP per capita by kabupaten, 2005-6.

Table 2.1.3 GRDP and GRDP per Capita by Kabupaten (constant 2000 price)

Province Kota/ Kabupaten	GRDP (mil.Rp.)		Growth Rate 05-06	GRDP per Capita 2006 (000.Rp)
	2005	2006		
Central Java	123,658,578	128,854,206	4.20%	4,004
Cilacap	10,145,144	10,602,338	4.51%	6,538
Banyumas	3,598,399	3,759,548	4.48%	2,552
Purbalingga	1,921,654	2,018,808	5.06%	2,472
Banjarnegara	2,277,618	2,375,975	4.32%	2,764
Kebumen	2,364,469	2,460,673	4.07%	2,045
Purworejo	2,321,543	2,442,927	5.23%	3,405
Wonosobo	1,570,348	1,621,132	3.23%	2,155
Magelang	3,245,979	3,405,369	4.91%	2,953
Boyolali	3,456,062	3,600,898	4.19%	3,880
Klaten	4,158,205	4,253,788	2.30%	3,777
Sukoharjo	3,941,788	4,120,437	4.53%	5,064
Wonogiri	2,426,038	2,524,760	4.07%	2,579
Karanganyar	4,188,330	4,401,302	5.08%	5,504
Sragen	2,322,239	2,442,570	5.18%	2,852
Grobogan	2,579,283	2,682,467	4.00%	2,035
Blora	1,678,274	1,742,963	3.85%	2,101
Rembang	1,825,561	1,926,563	5.53%	3,375
Pati	3,609,798	3,770,331	4.45%	3,236
Kudus	10,647,408	10,903,735	2.41%	14,261
Jepara	3,411,159	3,554,051	4.19%	3,359
Demak	2,471,259	2,570,574	4.02%	2,525
Semarang	4,481,358	4,652,042	3.81%	5,222
Temanggung	1,994,173	2,060,633	3.33%	2,965
Kendal	4,277,354	4,423,061	3.41%	4,778
Batang	1,972,777	2,022,301	2.51%	2,991
Pekalongan	2,600,856	2,710,378	4.21%	3,235
Pemalang	2,762,252	2,865,095	3.72%	2,131
Tegal	2,809,340	2,957,779	5.28%	2,102
Brebes	4,346,424	4,551,197	4.71%	2,578
Kota Magelang	890,399	908,764	2.06%	6,993
Kota Solo	3,858,170	4,067,530	5.43%	7,930
Kota Salatiga	722,064	752,149	4.17%	4,392
Kota Semarang	16,190,469	17,055,212	5.34%	11,616
Kota Pekalongan	1,701,324	1,753,505	3.07%	6,451
Kota Tegal	1,002,822	1,054,499	5.15%	4,411
DIY	16,908,504	17,538,347	3.73%	5,175
Bantul	3,234,173	3,299,646	2.02%	3,750
Kulon Progo	1,465,477	1,524,848	4.05%	4,076
Sleman	5,080,563	5,309,219	4.50%	5,266
Gunung Kidul	2,728,389	2,830,583	3.75%	4,142
Kota Yogyakarta	4,399,902	4,574,051	3.96%	10,323

Source: Dalam Angka 2006 in Central Java Province and DIY, BPS

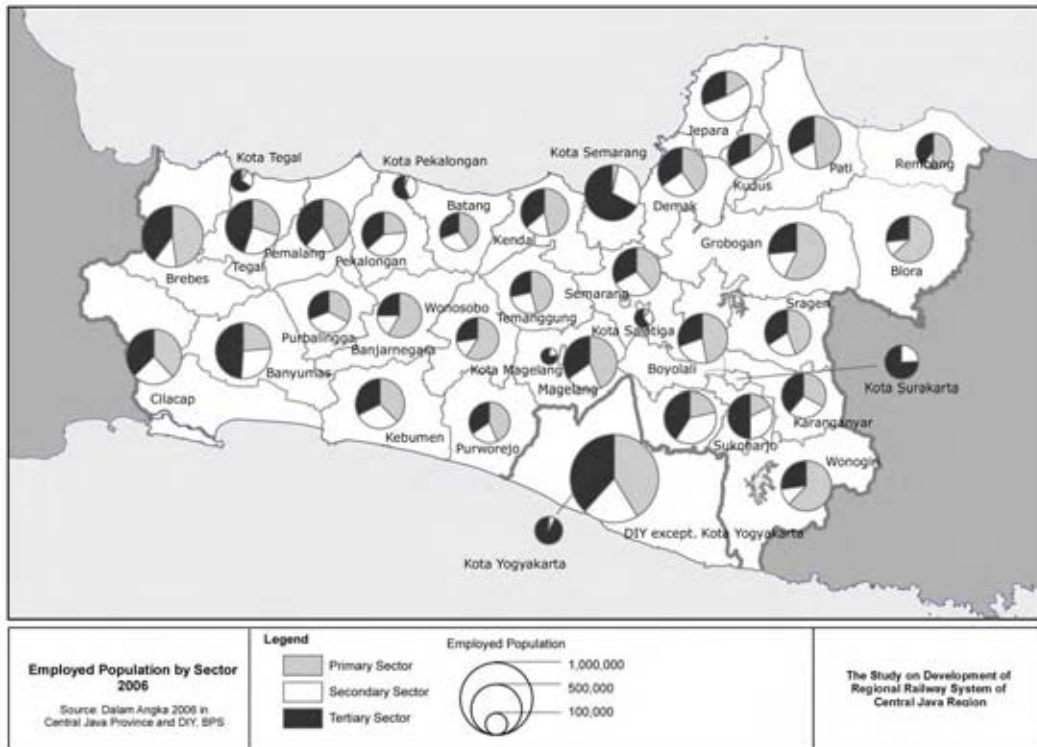


Figure 2.1.7 Employed Population by Sector 2006

In terms of per capita GRDP, Kota Semarang, Kudus, and Cilacap are largest. Kota Semarang has a variety of economic activities such as trade, services, and commerce. In particular, Tanjung Emas plays an important role in economic development. In Kudus, industries of paper products, furniture, and stationary are dominant. In Cilacap, industries of cement and fishery products make up the main portion of regional industry. These products are exported to foreign countries and command large export value.

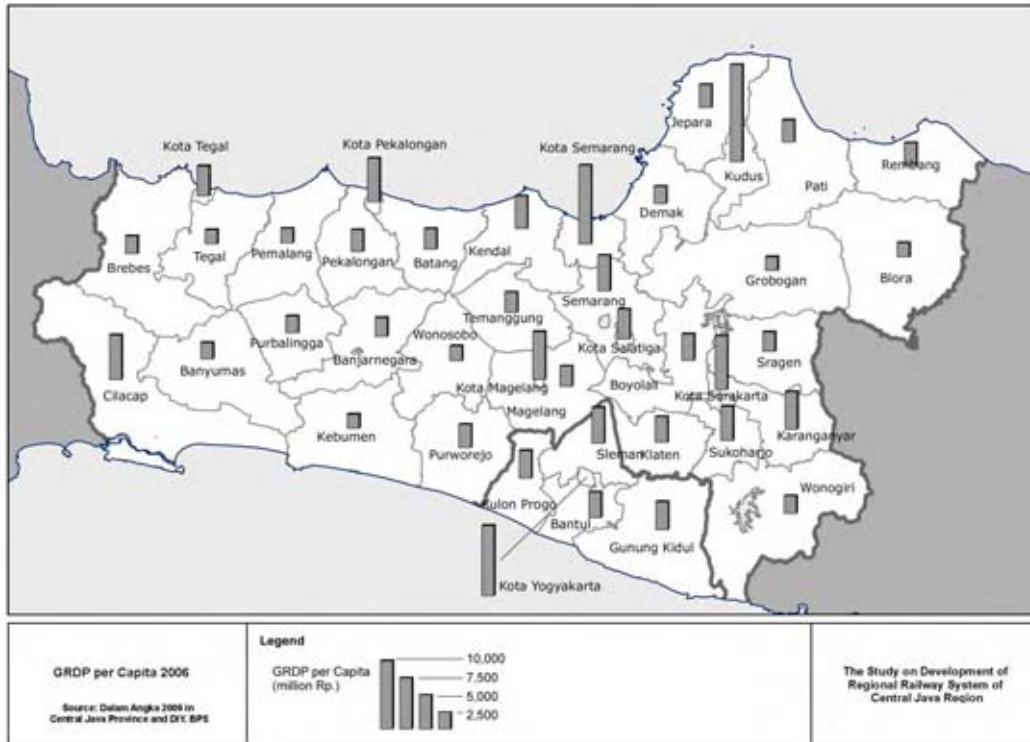


Figure 2.1.8 Gross Regional Domestic per Capita in the Study Area 2006

2.2 Current Situation of Major Metropolitan Areas

2.2.1 General Condition

According to the regional spatial plan (Rencana Tata Ruang Wilayah) in Central Java Province and Yogyakarta Special Province, Semarang, Solo (Surakarta), Yogyakarta, Kudus, Cilacap and Purwokerto are designated as priority cities, namely national activity centers (PKN); they are centers of political, social, and economic activities (see Figure 2.2.1)

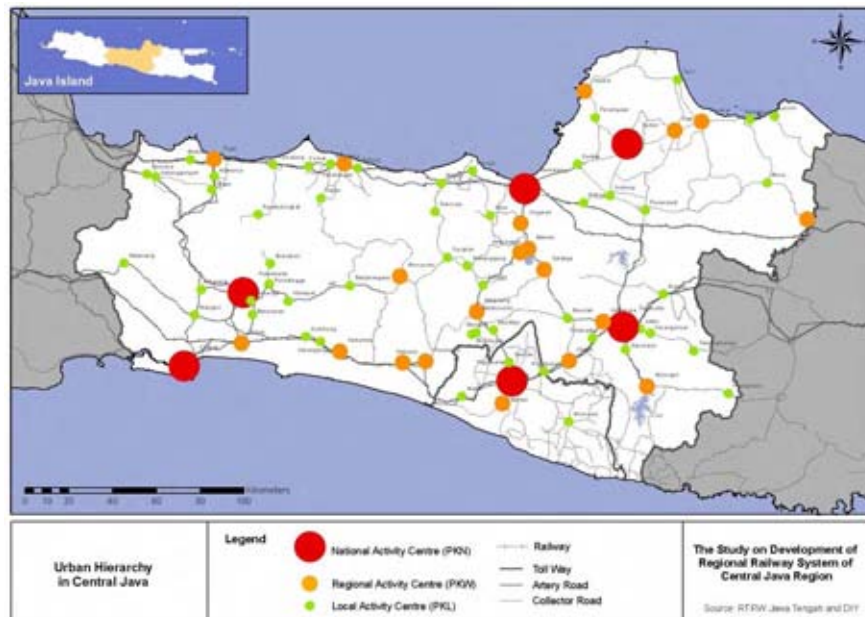


Figure 2.2.1 Urban Hierarchy in the Study Area

Of these, Semarang, Yogyakarta and Solo are the main cities in the Central Java region (including Central Java Province and Yogyakarta Special Province) which lead in regional politics and economics. Semarang and Yogyakarta are capital cities of the provinces. Solo is also the centre of the regional economy and a former capital city. In addition, these three cities play roles of gateway to/from other regions and countries because they have own international airport. Owing to such circumstance, population is accumulating in these cities. The population in 2006 is shown in Table 2.2.1.

Table 2.2.1 Population and Density of Semarang, Solo and Yogyakarta, 2006

Province Kota/ Kabupaten	Area (ha)	Population in 2006		Population Density (person/ha)
		Population	%	
Study Area	3,527,991	35,566,463	100.0 %	10
Kota Semarang	37,367	1,468,292	4.1 %	39
Kota Solo	4,403	512,898	1.4 %	117
Kota Yogyakarta	3,250	443,112	1.3 %	136

Source: Dalam Angka 2006 in Central Java Province and DIY, BPS

Semarang shows relatively low population density compared to Yogyakarta and Solo because of its large area. At a level of kecamatan, Semarang could be recognized as a high density city like other metropolitan cities.

Table 2.2.2 Population and Population Density in Semarang, Solo and Yogyakarta by Kecamatan in 2006

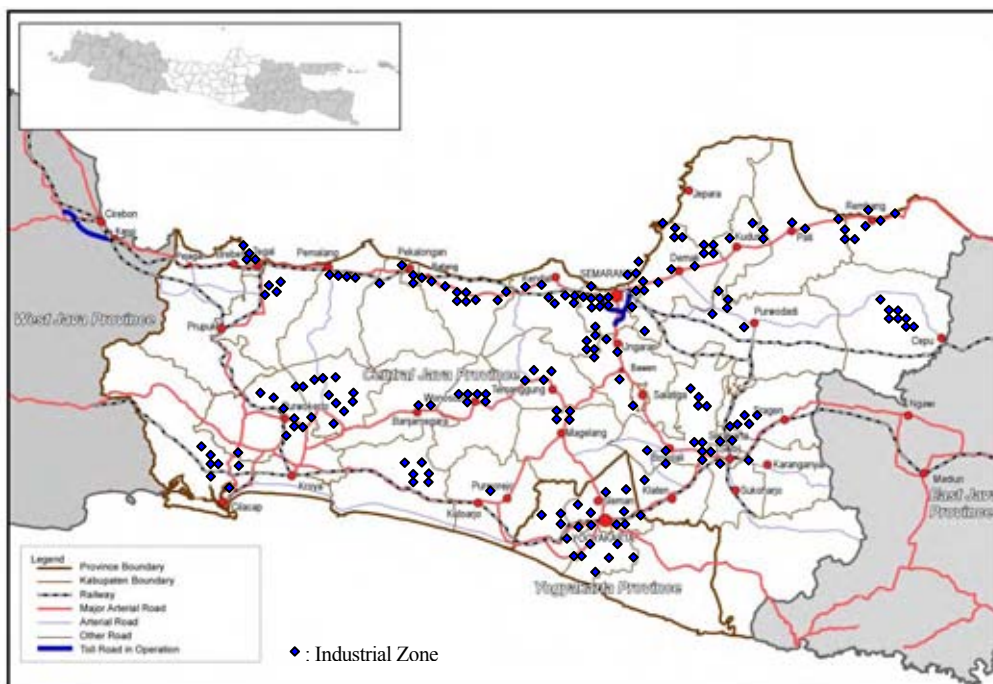
Kota / Kecamatan	Population	Area (ha)	Population Density (persons per ha)
Kota Semarang	1,432,954	37,367	38
Semarang Selatan	85,761	593	145
Ngaliyan	102,228	3,799	27
Semarang Tengah	74,609	614	122
Pedurungan	157,053	2,072	76
Semarang Timur	82,588	770	107
Gayamsari	67,223	618	109
Semarang Utara	124,948	1,097	114
Tugu	25,964	3,178	8
Genuk	74,658	2,739	27
Banyumanik	113,450	2,569	45
Gunungpati	62,647	5,411	12
Mijen	45,248	5,755	8
Tembalang	118,441	4,420	27
Candisari	80,453	654	123
Gajahmungkur	60,980	907	67
Semarang Barat	156,703	2,174	72
Kota Solo*	560,046	4,404	38
Serengan	62,635	319	38
Pasarkliwon	86,708	482	180
Laweyan	109,155	864	126
Jebres	139,292	1,258	110
Banjarsari	162,256	1,481	110
Kota Yogyakarta	443,112	3,205	138
Mantrijeron	36,364	261	139
Kraton	22,093	140	158
Mergangsan	35,049	231	152
Umbulharjo	77,371	812	95
Kotagede	31,162	307	102
Gondokusuman	54,122	399	136
Danurejan	22,065	110	201
Pakualaman	11,831	63	188
Gondomanan	15,498	112	138
Ngampilan	19,611	82	239
Wirobrajan	29,746	176	169
Gedongtengen	19,947	96	208
Jetis	28,995	170	171
Tegalrejo	39,258	291	135

Source: Dalam Angka 2006 in Kota Semarang, Kota Solo, Kota Yogyakarta, Dalam Angka 2005 in Kota Solo

Note: Population of Kota Solo is based upon data in 2005.

2.2.2 Socio-economic Conditions

Semarang is the province capital and centre of economic activities. In particular trade is dominant because of the international port, Tanjung Emas. This port is used for export and import goods for/to the entire Central Java Region, both Central Java Province and Yogyakarta Special Province. Yogyakarta is also a province capital city; it is the center of economic activities such as education, services and trade. Solo is one of core cities for the regional industry such as manufacturing, textiles, wood products, cement, and mining. Figure 2.2.2 depicts the industrial zone in the study area. In particular, many zones exist in the areas surrounding the three cities of Semarang, Yogyakarta and Solo.



Source: Dinas Perdagangan, Central Java Province

Figure 2.2.2 Location of Existing Industrial Zones

Under above situation, GRDP of these three cities is relatively high compared to other kota and kabupaten. GRDP is shown in Table 2.2.3.

Table 2.2.3 GRDP of Semarang, Solo and Yogyakarta in 2006 (constant 2000 price)

Province Kota/ Kabupaten	GRDP in 2006		GRDP per Capita (thousand. Rp.)
	GRDP (mil. Rp.)	%	
Study Area	146,392,553	100.0 %	4,117
Kota Semarang	17,055,212	11.7 %	11,616
Kota Solo	4,067,530	2.8 %	7,930
Kota Yogyakarta	4,547,051	3.1 %	10,323

Source: Dalam Angka 2006 in Central Java Province and DIY, BPS

2.3 Natural Environment

2.3.1 Climate

Climate condition in the Central Java region as well as Java Island belongs to Tropical Monsoon Area, which can be divided into dry season (May to September) and rainy season (October to April). Annual precipitation in coastal area counts for average 1,000 mm, for example, 150 to 1,000 mm in Yogyakarta, and 2,000 mm in Semarang. On the other hand, precipitation in the mountain area reaches more than 7,000 mm per year, with more than 80% of the rainfall in the rainy season. This situation precipitates natural disasters such as flooding and landslides.

2.3.2 Topography, Geological Condition

As shown in Figure 2.3.1, the Central Java region has a wide complex topography, ranging from flat to sloping areas of more than 40%, and altitudes between 0 m and more than 3,000 m. Especially three high mountains, Mt. Merbabu (3,150 m), Mt. Merapi (2,923 m), and Mt. Sumubing (3,375 m), exist in center of the study area. The area between Semarang – Solo – Yogyakarta – Magelang, which is engulfed by mountains, is narrow but relatively flat, so that this area is suitable for agriculture.



Source: South Java Flood Control and BAPEDA ,DIY

Figure 2.3.1 Slope Condition in the Study Area

Geological and hydrological conditions can be identified based on river watershed area. The Central region can be divided into 8 catchment areas as shown in Table 2.3.1 and Figure 2.3.2 lists major rivers in the Central Java region.



Source: CJRR Study Team

Figure 2.3.2 River Catchment Area in the Central Java region

Table 2.3.1 Major River Catchment Areas in the Central Java region

Name of River Basin	Area of River Basin (km ²)	Volume of Catchment (Million m ³ /yr)
Pemali Comal	6,333	14,851
Serayu	3,865	18,182
Bogowonto	3,868	
Progo	2,438	3,289
Jatrunseluna	12,522	14,429
Bengawan Solo	5,503	6,594
Oyo-Opak	2,380	-

Source: CJRR Study Team based on Environmental Status Report in Central Java Province in 2007, nad Report on Ground Design in River Basin.

Railway corridors under the Case Study are located in Jatrunseluna, Bengawan Solo, Oyo-opak and Progo basins.

This area shows wide variety of elevation, and has many big rivers such as Pepe River,

Progo River, Oyo and Opak River. Also it shows wide range of temperature and precipitation. This situation creates rich environmental and hydrological conditions; on the other hand, it is known to be disaster prone to flooding and landslides.

2.3.3 Ecosystem, Flora and Fauna

Java Island is located west of the Wallace line which divides the major bio-geographical regions of Asian and Australasian continents. Hence the type of fauna and flora in Java are closely related to those of the Asian continents. The richness of species and level of endemism in Java Island are less than in Sumatera and Kalimantan (Silvius et al., 1987); however undulate topographic situation, existence of volcanos and rich precipitation produce a wide variety of natural resources. Table 2.3.2 lists example of endemic flora and fauna typically living in the Central Java region.

Table 2.3.2 List of Endemic Fauna and Flora

	Latin Name	Local Name	Common Name / Type	Location/Habitat
Fauna				
1	<i>Spilornis Cheela</i>	Elang ular bido	Crested Serpent Eagle / Eagle	Mount and river area
2	<i>Macaca Fascicularis</i>	Kera ekor panjang	- / Monkey	Forest hill area
3	<i>Dryphis Prasinus</i>	Ular dahan	- / Snake	Forest and village
4	<i>Hylobates Moloch</i> (See Photo 1)	Owa jawa	Javan Gibbon / Monkey	This is a territorial species. High in the treetops of the scattered remains of the island of Java's rainforests
5	<i>Spizaetus Bartelsi</i> (See Photo 2)	Elang jawa	Javan Hawk-Eagle / Eagle	Lowland and montane tropical rainforest. REMARKS Endemic
6	<i>Presbytis Comata</i> (See Photo 3)	Surili	Grizzled leaf monkey / Monkey	High in the treetops of the scattered remains of the island of Java's rainforests
7	<i>Panthera Pardus</i> (See Photo 4)	Macan tutul	Black-spotted Leopard	The leopard is a highly adaptable felid
8	<i>Trachypithecus Auratus</i>	Lutung	Javan langur / Monkey	It is found and endemic to the island of Java. The Javan Lutung inhabits the interior and peripheral areas of rainforests
9	<i>Leptoptilos Javanicus</i> (See Photo 5)	Bangau Tongtong	Lesser Adjutant Stork / Bird	Frequents paddy fields, open burnt or flooded grassy areas, and mud banks and mangroves
10	<i>Muntiacus Muntjak</i> (See Photo 6)	-	Javan Muntjac / Deer	Habitat : Browsers and grazers, barking deer are found in both sal and riverine forests
11	<i>Tragulid Javanicus</i> (See Photo 7)	-	Javan mouse deer / Deer	living on the floor of primary and secondary forests feeding on leaves, shoots, fruits and sometimes fungi
Fauna				
13	<i>Litsea Cubeba</i>	Krangean	-	Critical species
14	<i>Michelia Alba</i>	Kantil Putih	-	Critical species
15	<i>Artocarpus Champeden</i>	Cempedak	-	Critical species
16	<i>Feroniella Lucida</i> (See Photo 9)	Kawista	-	Critical species

Source: CJRR Study Team



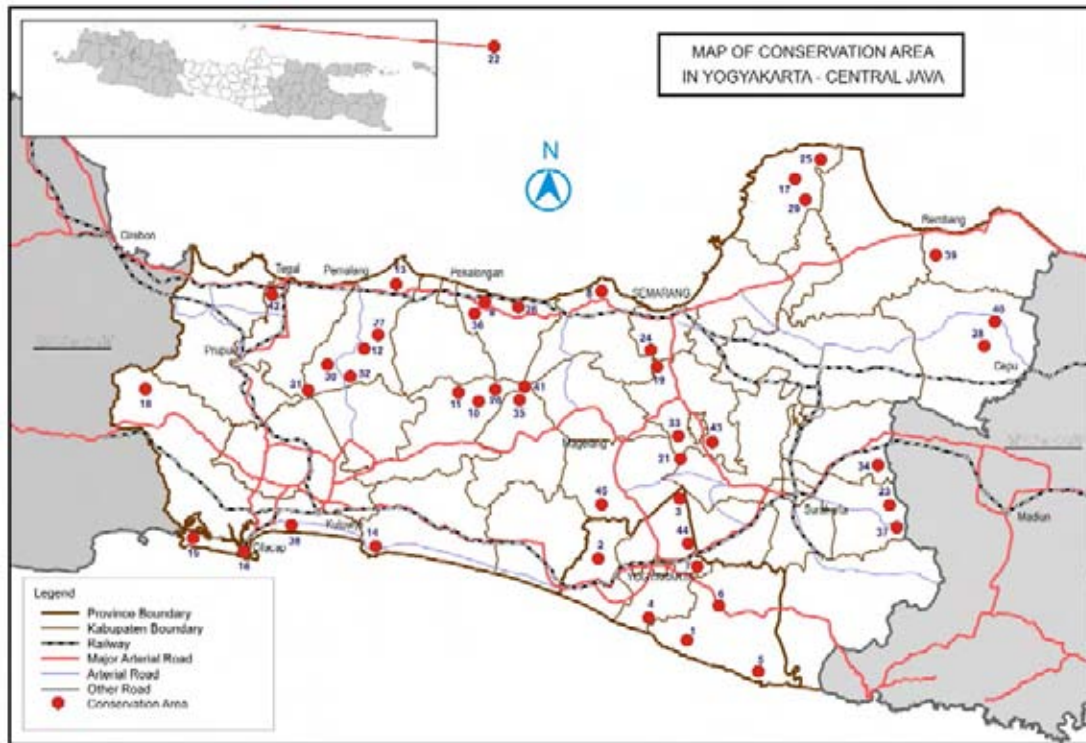
Figure 2.3.3 Pictures of Endemic Flora and Fauna

Governments in the Central Java region have tackled conservation of the areas producing natural resources by developing local regulations. These areas covering mostly mountain, forest, river catchment, and historical areas, etc. are classified as conservation areas. Table 2.3.3 lists conservation areas, and Figure 2.3.4 maps these locations.

Table 2.3.3 List of Conservation Area

Province	Name	Area (ha)	Location (kabupaten)	Type
Yogyakarta	1 Paliyan	434,60	Gunung Kidul	Animal Protected Area
	2 Sermo	181,00	Kulonprogo	Animal Protected Area
	3 Merapi (Plawangan Turgo)	163,64	Sleman	National Park
	4 Imogiri	11,40	Bantul	Forest Protected Area
	5 Teluk Baron	2,40	Gunung Kidul	Forest Protected Area
	6 Gunung Bunder	617,00	Gunung Kidul	Coast Conservation
	7 Gunung Batu Gamping	0,04	Sleman	Forest Protected Area Recreation Park Area
Central Java	8 Pager Wunung Daruprono	33,20	Kendal (North C. Java)	Forest Protected Area
	9 Ulo Lanang Kecubung	69,70	Batang (North C. Java)	Forest Protected Area
	10 Telogo Dringo	26,00	Banjarnegara	Forest Protected Area Lake Conservation Water Conservation
	11 Telogo Sumurup	20,10	Banjarnegara	Forest Protected Area Lake Conservation
	12 Bantar Bolang	24,10	Pemalang (North-West C. Java)	Forest Protected Area
	13 Vak 53 Comal	-	Pemalang (North-West C. Java)	Forest Protected Area
	14 Karang Bolong	0,50	Cilacap (South-West C. Java)	Forest Protected Area
	15 Nusakambangan Barat	928,00	Cilacap (South-West C. Java)	Forest Protected Area
	16 Nusakambangan Timur	277,00	Cilacap (South-West C. Java)	Forest Protected Area
	17 Keling I/II/III	61,70	Jepara (North-East C. Java)	Forest Protected Area
	18 Wijaya Kusuma	1,00	Cilacap (South-West C. Java)	Forest Protected Area
	19 Gebugan (Gunung Ungaran)	1,80	Semarang	Forest Protected Area
	20 Pringombo I/II	58,00	Banjarnegara	Forest Protected Area
	21 Gunung Merbabu	5.725,00	Magelang, Semarang, Boyolali	National Park
	22 Kepulauan Karimun Jawa	111.625,00	Jepara (North-East C. Java)	National Park
	23 Ngargoyoso	231,30	Karanganyar	Forest Park Recreation
	24 Sepakung	10,00	Semarang	Forest Protected Area
	25 Gunung Celering	1.379,00	Jepara (North-East C. Java)	Forest Protected Area
	26 Peson Subah I	10,40	Batang (North C. Java)	Forest Protected Area
	27 Telogo Ranjeng	18,50	Pemalang (North-West C. Java)	Forest Protected Area Lake and water Conservation
	28 Cabak I/II	30,00	Blora	Forest Protected Area
	29 Kembang	1,80	Jepara (North-East C. Java)	Forest Protected Area
	30 Curug Bengkawah	1,50	Pemalang (North-West C. Java)	Forest Protected Area
	31 Guci	2,00	Pemalang (North-West C. Java)	Forest Protected Area
	32 Moga	1,00	Pemalang (North-West C. Java)	Forest Protected Area
	33 Getas	1,00	Semarang	Forest Protected Area
	34 Gunung Tunggangan	103,90	Sragen	Animal Protected Area
	35 Pantodomas	4,10	Wonosobo	Forest Protected Area
	36 Peson Subah II	100,00	Batang (North C. Java)	Forest Protected Area
	37 Grojogan Sewu	64,30	Karanganyar	Nature Recreation Park Area
	38 Gunung Selok	126,20	Cilacap (South-West C. Java)	Nature Recreation Park Area
	39 Sumber Semen	17,10	Rembang (North-East C. Java)	Nature Recreation Park Area
	40 Bekutuk	25,00	Blora	Forest Protected Area
	41 Telogowarno (Pengilon)	39,60	Wonosobo	Nature Recreation Park Area Water conservation area
	42 Sub Vak 18c & 19b	6,60	Tegal (North-West C. Java)	Forest Protected Area
	43 Tuk Songo	6,50	Semarang	Nature Recreation Park Area
	44 Prambanan	39,8	Klaten	Historical Area
	45 Borobudur	44,8	Magelang	Historical Area

Source.: Indonesian Forestry Department



Source: CJRR Study Team based on Data from Indonesian Forestry Department

Figure 2.3.4 Location of Conservation Area

The area along the existing railway corridors has been developed for residential use, market and industrial sectors, agricultural use, e.g. Also the locations are not close to the protected areas and virgin forests. Therefore it is concluded that railway activities have less possible to cause damage to natural environment. While in case of construction of new track, it is necessary to give careful consideration for project location and design to avoid disturbing wild life habitat.

2.3.4 Natural Disaster

The Central Java region has undulate topography, and is located in a volcanic area. In addition, wide variety of climate conditions with heavy rainfall and monsoons creates the characteristic environment, which can generate various types of disasters. Figure 2.3.5 shows disaster prone areas, and indicates the following three critical problems which may affect railway and related developments.

- Flooding in north and south coastal areas;
- Landslides and erosion in mountain area; and
- Volcanic disaster and earthquakes in south area.

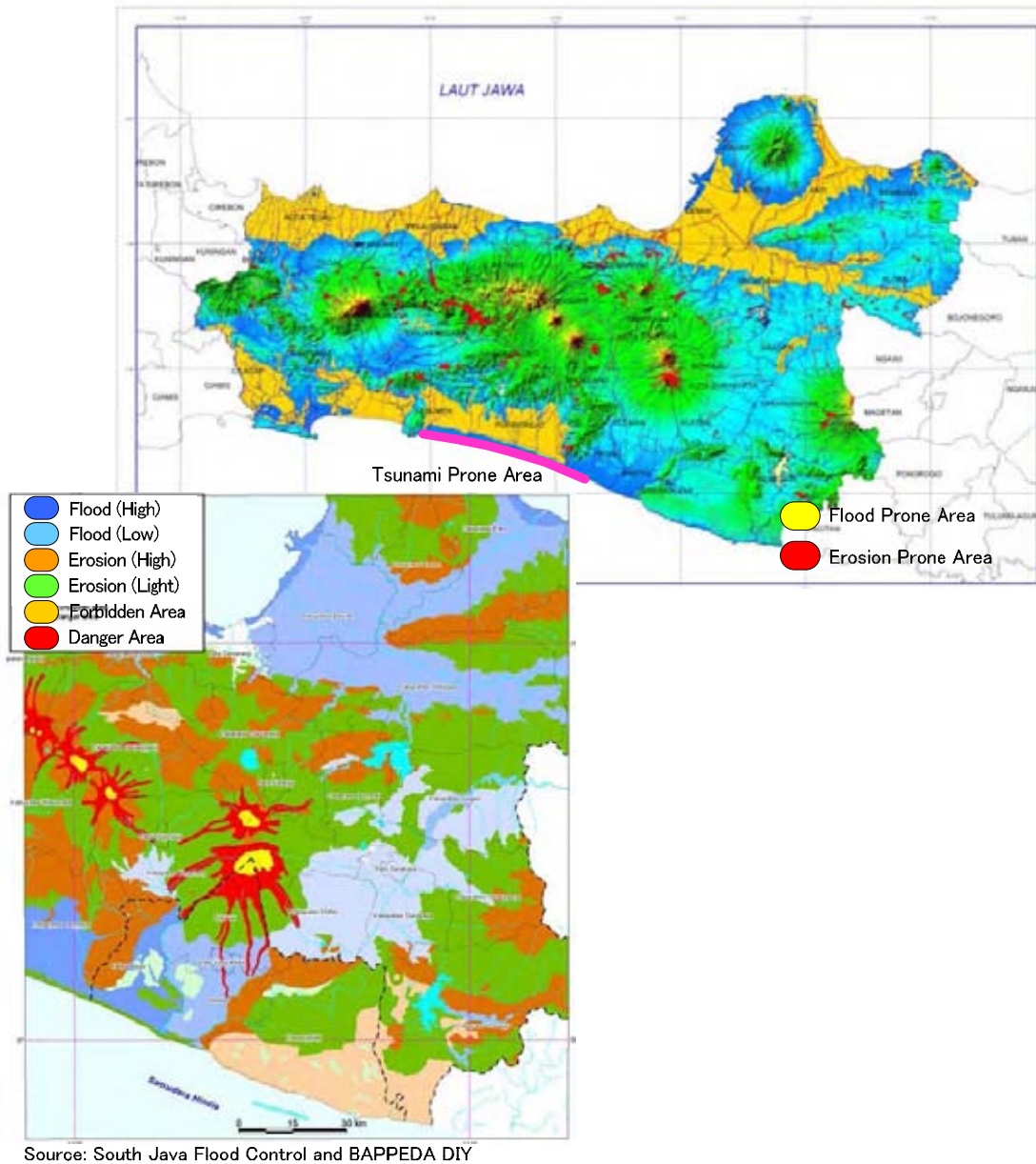


Figure 2.3.5 Natural Disaster Prone Area

Indonesian Government is developing disaster prevention systems, and also overseas authorities/donors are supporting these efforts financially and technically. The table below summarizes examples of recent projects for disaster prevention and rehabilitation.

Table 2.3.4 Examples of Recent Projects for Disaster Prevention and Rehabilitation

Project Title	Donor	Location in Central Java Region	Year	Project Description
Urgent Disaster Reduction Project	Japan	Yogyakarta, Central Java – Mt. Merapi and Progo River Basin	2005 (Date of loan Agreement)	Prevent mudflows of volcanic debris. Install sustainable disaster reduction system contributing local community development.
Integrated Water Resources And Flood Management Project	Japan	Central Java, Semarang	2006 (Date of loan Agreement)	Construct multipurpose dam. Rehabilitate flood drainage channels and weir. Establish comprehensive water resource development and utilization
North Java Flood Control Sector Project	ADB	Pemali River, Tegal City, Kuto River, Bodri River and Pekalongan City in Central Java (also inc. West Java)	2004 (Closing Date)	Flood control and protection. Institutional strengthening of water resource services. Flood warning pilot Project
South Java Flood Control Sector Project	ADB	Citanduy River, Serayu River, Tipar-Ijo River, Telomoyo River, Luk Ulo River, Wawar River, Cokroyasan River, Bogowonto River, Serang River and Progo-Opak River	2006 (Closing Date)	Monitoring river water quality. Flood control and protection. Institutional strengthening of water resource services. Flood warning system
Central Java Groundwater Irrigation Development Project	ADB	Northern coastal area between Bekasi (West Java) and Semarang (Central Java)	2000 (Closing Date)	Monitoring of river characteristics. Land rehabilitation in upper catchment. Coordination of project implementation. Feasibility study for north coast of Java water resources development and flood control (the study for North Java Flood Control Sector Project)
Community Assistance Program	Australia	Kab. Bantul, Kab Klaten	2006 -	Rehabilitate affected areas of recent earthquake.
Mitigation of Geohazards (GEORISK)	Germany	Semarang,, Yogyakarta (Bantul, Sleman and Kota)	2004	Assess geohazards threatening. Identify waste disposal site and appropriate waste management. Improve water supplu. Support national strategy on disaster management.

Source: CJRR Study Team

(1) Flooding

Flooding has brought serious damage to the Central Java region, especially the coastal area and lower lands. Flooding is basically caused by very heavy rain; however, recent human activities are accelerating serious damage such as by inadequate land use, deforestation, mining, and land reclamation. In addition, over pumping of groundwater for water supply has caused land subsidence in Semarang. Especially north area, surrounding Tawang Station and Tanjung Emas Port, has experienced chronic flooding. Figure 2.3.6 shows that the area below sea level has been expanding.

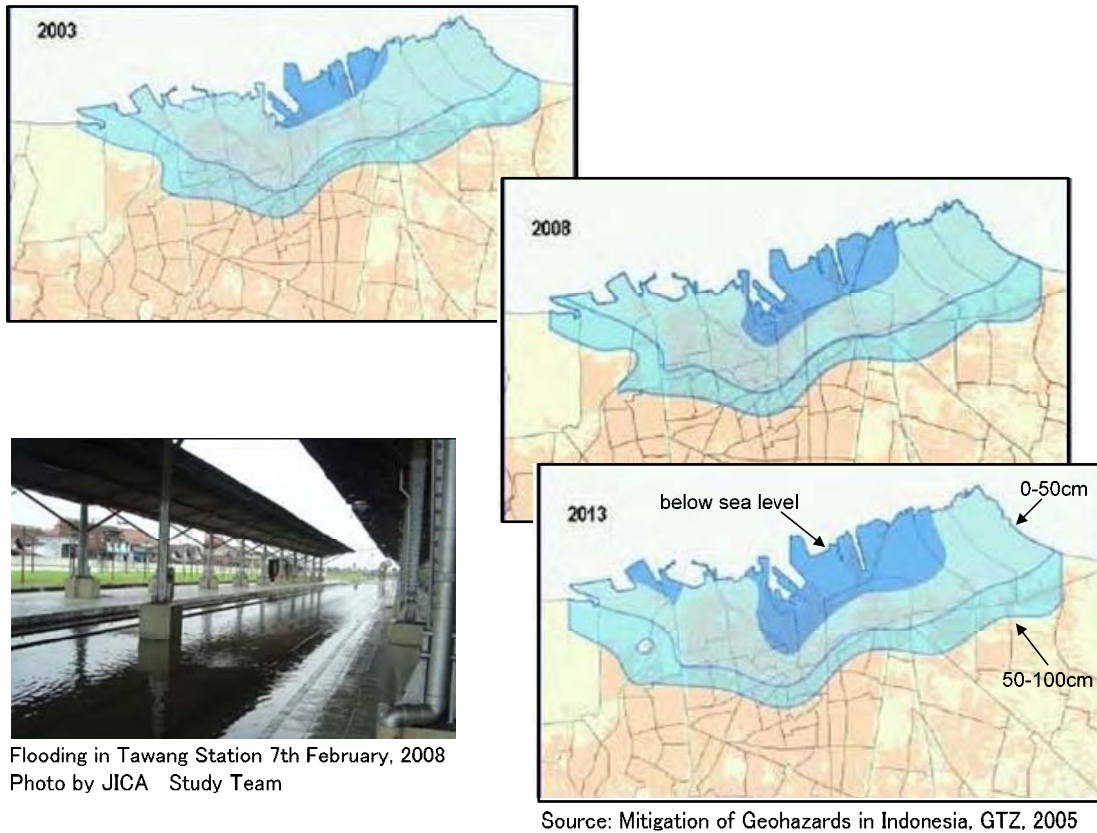
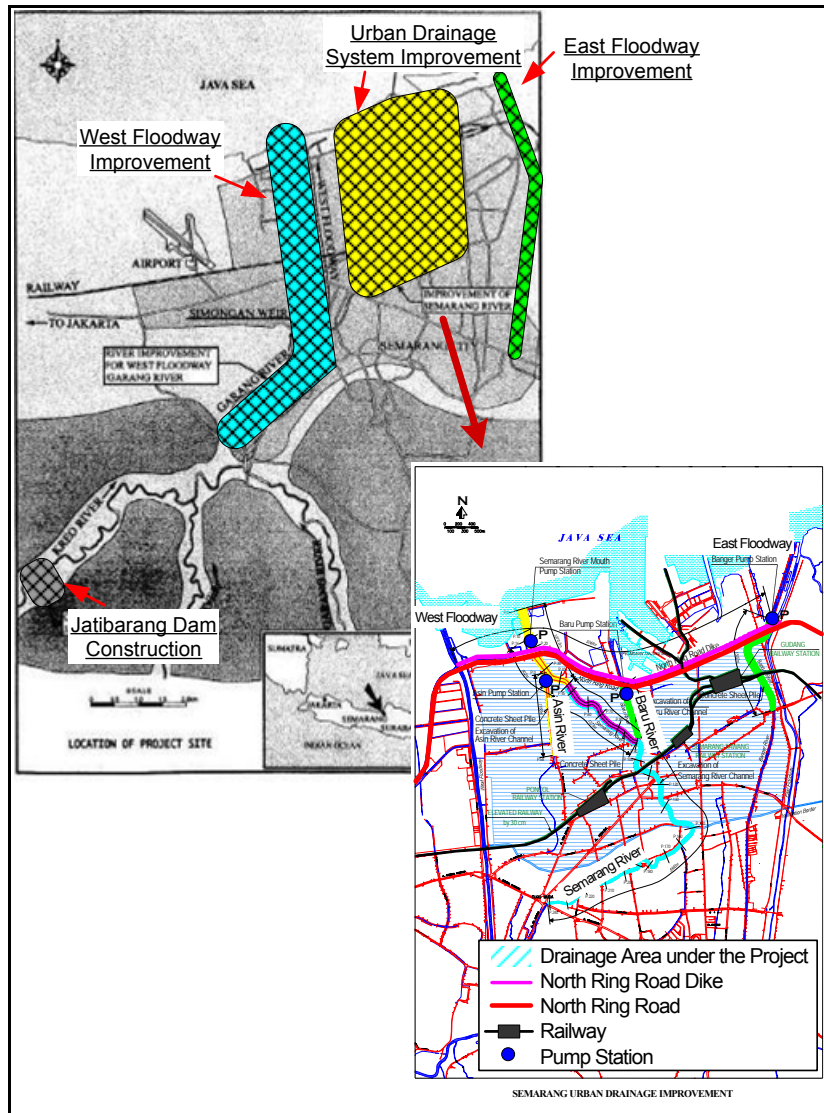


Figure 2.3.6 Forecast of Expanded Land Subsidence

In order to mitigate flood disaster, Indonesian Government has planned flood protection project titled “Integrated Water Resources and flood Management Project for Semarang” financially supported by Japan Government. The project consists of the following three components:

- West Floodway / Garang River Improvement
- Construction of Jatibarang Multipurpose Dam
- Urban Drainage System Improvement

Major functions of drainage system improvement are to protect against tidal waves by dikes and weirs, and to pump out water in the target area. Under Japanese assistance, construction of new pump station at Asin River Mouth, construction / rehabilitation of dike and weir along West Floodway, and drainage in Asin River and Bandarharjo are planned. Also, improvement of East Floodway and construction of road-dike along the north ring highway will be implemented under the Dutch assistance.



Source: CJRR Study Team

Figure 2.3.7 Project locations and descriptions of Flood Protection under Japanese and Dutch Assistance

(2) Landslides

Cause of landslide is related to flooding disaster, that to say, heavy slope and heavy rain trigger flooding in the lower land, and landslide and erosion can be generated in mountain area. Also inadequate land use and deforestation can accelerate such disasters.

Heavy rain has caused serious flooding and landslides in wide areas from December 2007 to January 2008. The most affected area was in Central Java and East Java Provinces, and more than 12,000 houses were destroyed or damaged, and 80 persons were killed. Figure 2.3.8 shows the areas of flooding and landslides. Eastern parts of the Central Java region, which area includes the case

study area, were widely damaged by flooding and landslides.



Source: Information Bulletin January 2008, International Federation of Red Cross and Red Crescent Societies

Figure 2.3.8 Flooding and Landslide Areas Caused by Heavy Rain from December 2007 to January 2008

For the above reasons, it is strongly suggested to carefully design railway development. Slope protection is common for protecting railways from landslides. For instance, greenery (vegetated) slope protection is a recent trend for harmonizing with the environment.



Source: JINEN METHOD, Tekken Co. Ltd.

Figure 2.3.9 Example of Vegetated Slope Protection

(3) Volcanic Disasters and Earthquakes

Since Java Island is located in the volcanic belt, the area has many volcanos. The Central Java region has high risk of earthquakes. Recent huge earthquake, called “Central Java Earthquake”, attacked the Central Java Rgion with a magintitude of 6.3 on the Richer scale on 27th May 2006; the affected area covered south part of Java especially Yogyakarta and surroundings. Most affected areas were in Kabupaten Bantul in DIY and Kabupaten Klaten in Central Java Province. Approximately 6,000 people were killed and more than 85,000 houses were totally destroyed, while another 320,000 suffered damages.

Seismic standard level in the building code in Indonesia is almost half of the Japanese standard. Even the most stringent building code level, adopted in Irianjaya Region, can satisfy only approximate seismic intensity scale of 4 to 6 in MMI (Modified Mercalli Intensity) scale. Seismic intensity scale of the Central Java Earthquake was observed between approximately 5 and 7 in MMI scale. The Indonesian seismic standard is definitely inadequate. It is recommended to adopt more stringent standard than Indonesian building code.

Volcanic activity is related to earthquakes. Before Central Java Earthquake occurred, Mt. Merapi, which is well-known as an active volcano and major tourism spot, had shown signs of eruption. After the earthquake, eruption generated mudflow, and 2 people were killed. Also a huge eruption occurred in 1994, and 60 residents were killed.

These situations strongly require careful consideration for designing of railway development.

2.4 Pollution

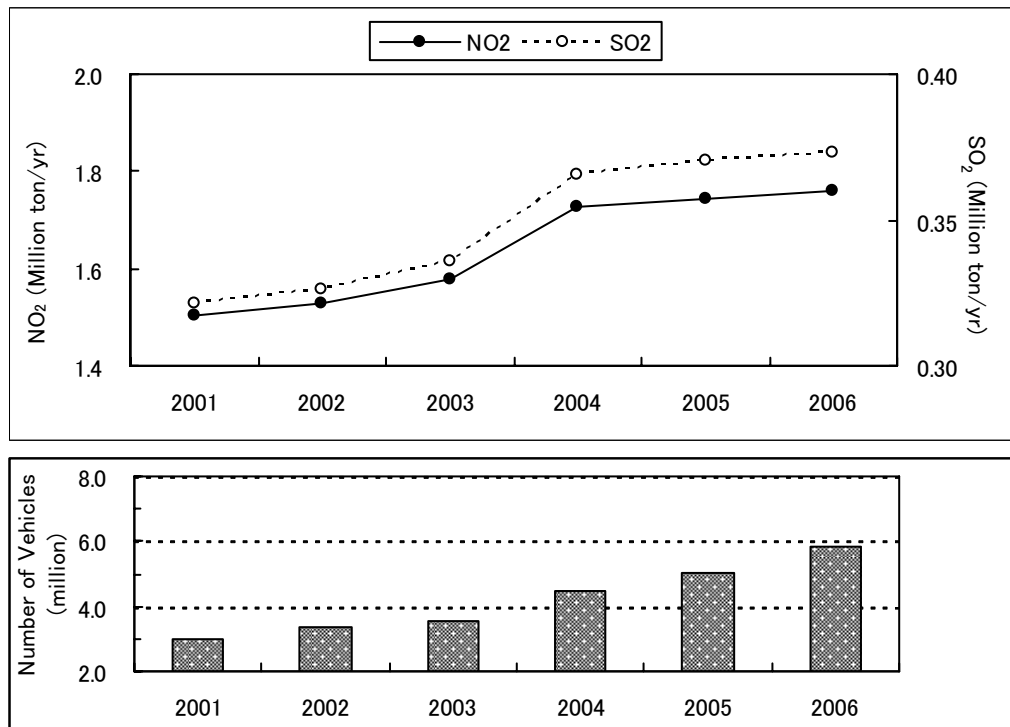
2.4.1 Air Pollution

Air pollution is one of the most critical environmental problems due to recent rapid population growth and urbanization.

Both Central Java Province and Yogyakarta Special Province are tackling reduction of air pollution. Under recent policy on decentralization, the major role on environmental management has been transferred from National Government to Local Governments. Hence provincial governments in each Central Java Province and Yogyakarta Special Government have established their own air quality management system with legal framework and monitoring system. Basically legal systems are structured based on Indonesian national System under Ministry of Environment (KLH). Some standard levels are set more stringent than those in the National Standard.

Major air pollution sources are stationary pollution load from industrial sector, thermal

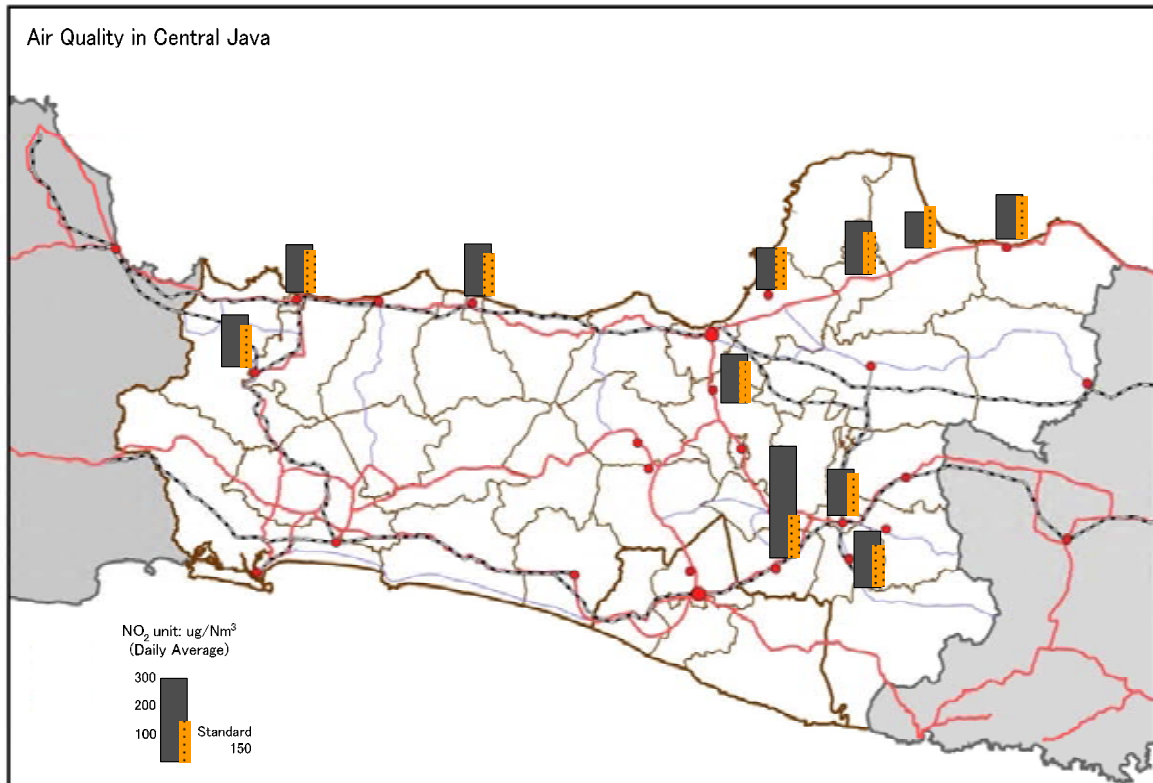
power stations, etc., and mobile pollution load. Especially the increasing population and urban sprawl have led to rapid increase in use of vehicles which has accelerated air pollution. Figure 2.4.1 shows increase of pollution load by mobile source compared with number of registered vehicles in Central Java Province. Number of vehicles increased approximately double (most of them are motor bikes) in five years from 2001 to 2006, while emission of NO₂ and SO₂ from mobile source increased by 20 %.



Source: Environmental Status in Central Java in 2007

Figure 2.4.1 Air Pollution Load in Central Java Province

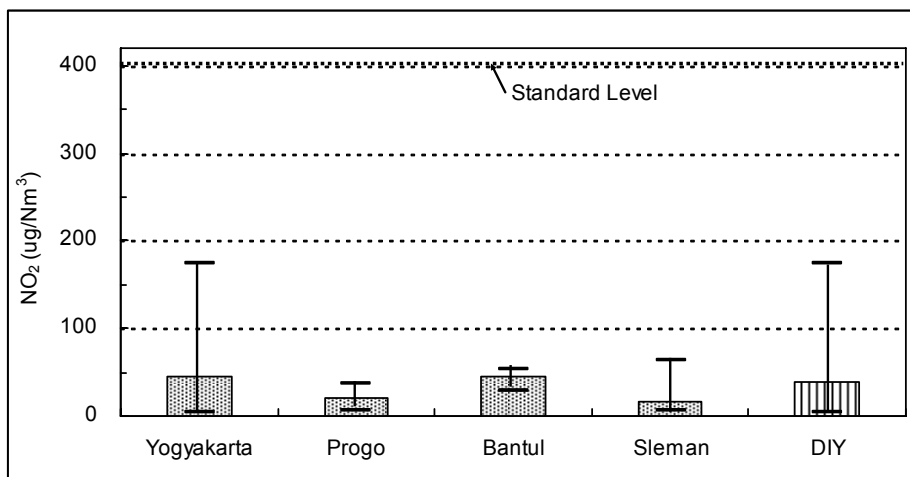
The Figure below shows daily average NO₂ over the Central Java region. The figures indicate that NO₂ concentration mostly exceeds ambient air quality standard level. The NO₂ concentration in Klaten was approximately 400 µg/Nm³, almost 2 times higher than the standard level.



Source: Environmental Status in Central Java in 2007

Figure 2.3.10 Concentration of NO₂ in Central Java Province in 2007

According to the monitoring survey in 2007, results on ambient air quality basically satisfied the standard air quality level, so it could be concluded that Yogyakarta does not still face serious air pollution. However, concentration level of HC and Pb, which are generally generated from mobile sources, shows an increasing. Therefore it is necessary to take adequate air quality control prior to being serious.



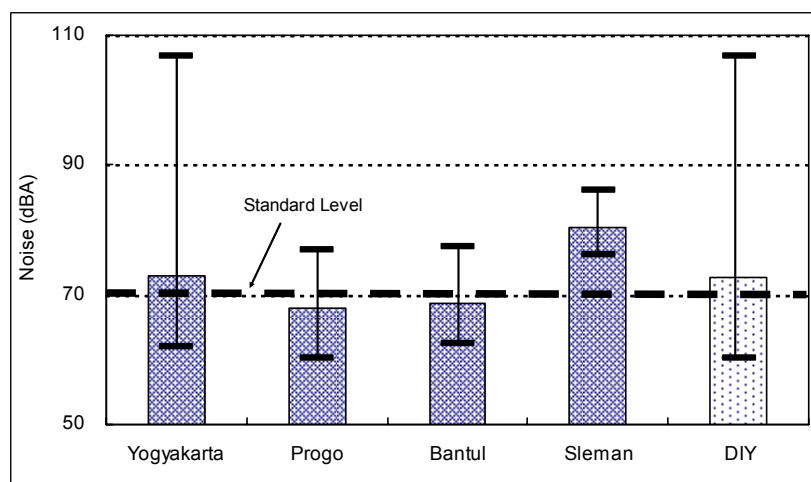
Source: CJRR Study Team based on Environmental Monitoring Report in DIY, 2007

Figure 2.4.2 Concentration of NO₂ in Yogyakarta Special Province in 2007

2.4.2 Noise

Noise disturbance is also one of recent major environmental issues due to rapid urbanization and population growth.

Yogyakarta Special Province performs an annual monitoring survey for identifying noise conditions. Figure 2.4.3 shows results of noise measurement in 2007. Average noise level in Kota Yogyakarta and Kabupaten Sleman exceeded the standard level.



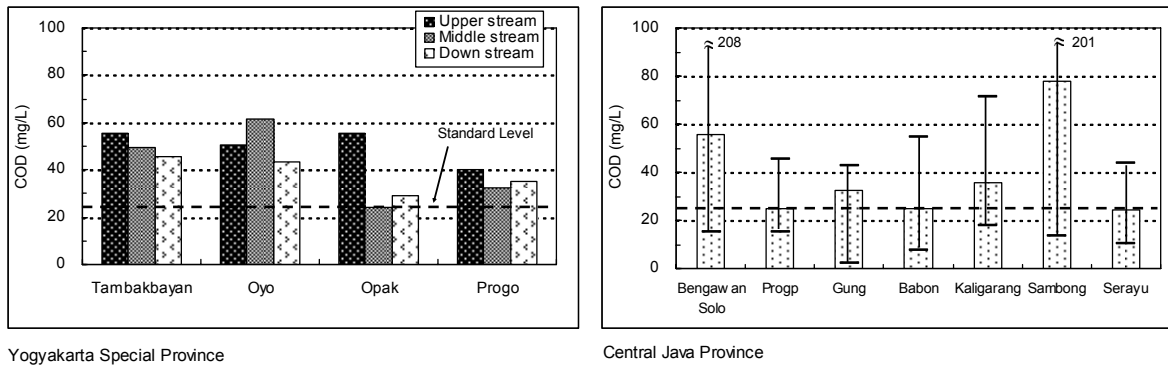
Source: CJRR Study Team based on Environmental Monitoring Report in DIY, 2007

Figure 2.4.3 Noise Level in Yogyakarta Special Province in 2007

2.4.3 Water Quality

Water pollution has been increasing in the Central Java region, also due to recent urbanization and population growth.

Figure 2.4.4 shows concentration of COD (Chemical Oxygen Demand) of river waters in the Central Java region.



Source: CJRR Study Team based on Monitoring Data by BAPEDALDA DIY, and Environmental Status Report in Central Java Province, 2007

Figure 2.4.4 Concentration of COD in River Waters in the Central Java region in 2007

COD generally indicates domestic pollution by organic pollutants. The result shows that most major rivers are facing organic contamination.