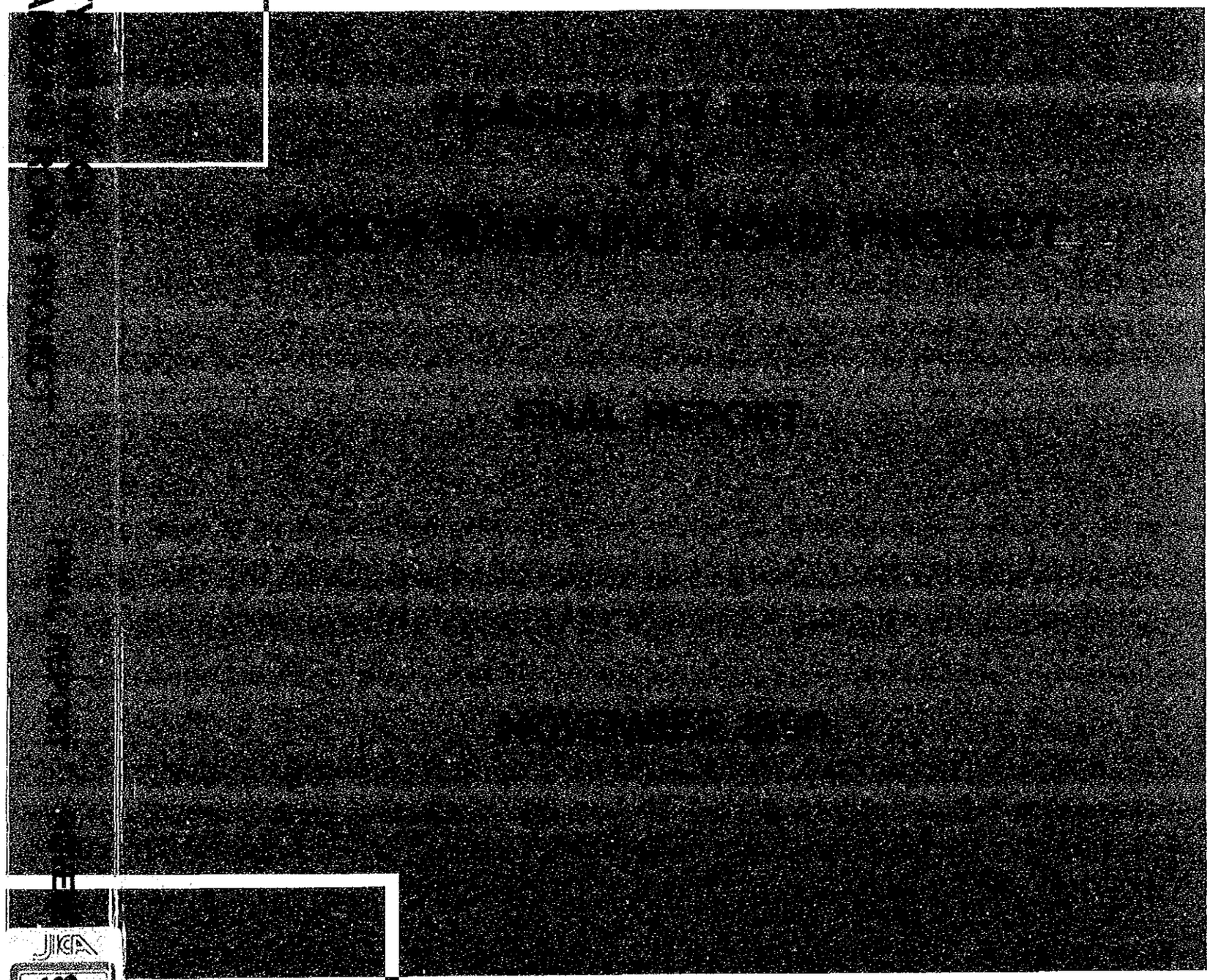
JICA 社会開発調査部報告書

FEASIBILITY STUDY ON BOGOR-BANDUNG TOLL ROAD PROJECT

THE REPUBLIC OF INDONESIA
DIRECTORATE GENERAL OF HIGHWAYS
MINISTRY OF PUBLIC WORKS



JAPAN INTERNATIONAL COOPERATION AGENCY

THE REPUBLIC OF INDONESIA
DIRECTORATE GENERAL OF HIGHWAYS
MINISTRY OF PUBLIC WORKS

FEASIBILITY STUDY ON BOGOR-BANDUNG ROAD PROJECT

FINAL REPORT

NOVEMBER 1990

JAPAN INTERNATIONAL COOPERATION AGENCY

PREFACE

In response to the request from the Government of the Republic of Indonesia, the Japanese Government decided to conduct a feasibility study on the Bogor-Bandung Road Development Project and entrusted the study to the Japan International Cooperation Agency (JICA).

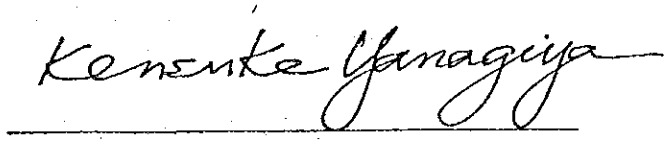
JICA sent to Indonesia a survey team headed by Dr. Akira Ishido, Yachiyo Engineering Co., Ltd., and composed of members from Yachiyo Engineering Co., Ltd., Oriental Consultants and Kokusai Kogyo Co., Ltd., from March 1989 to September 1990.

The team held discussions with the officials concerned of the Government of Indonesia, and conducted field surveys. After the team returned to Japan, further studies were made and the present report was prepared.

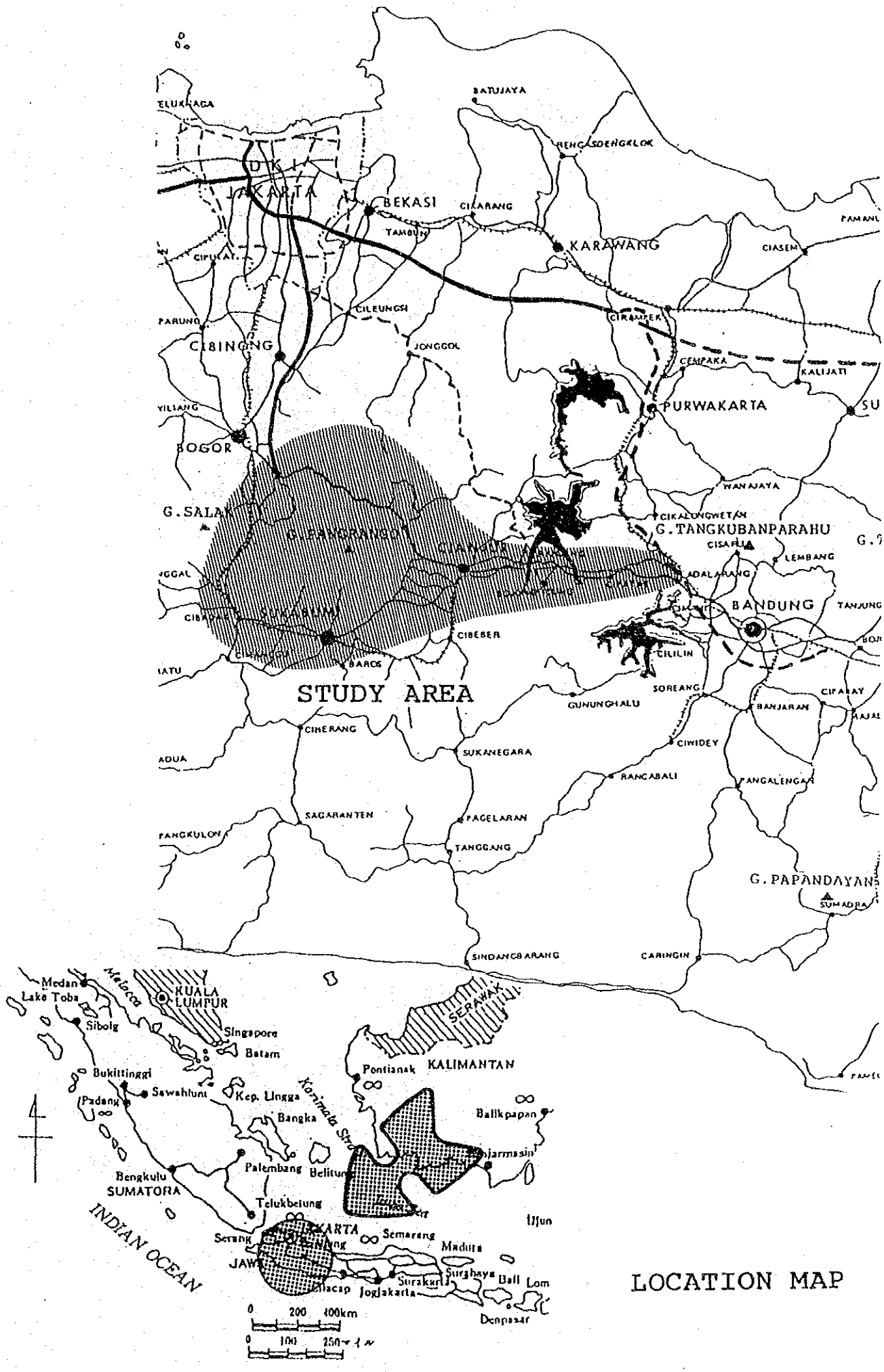
I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of Indonesia for their close cooperation extended to the team.

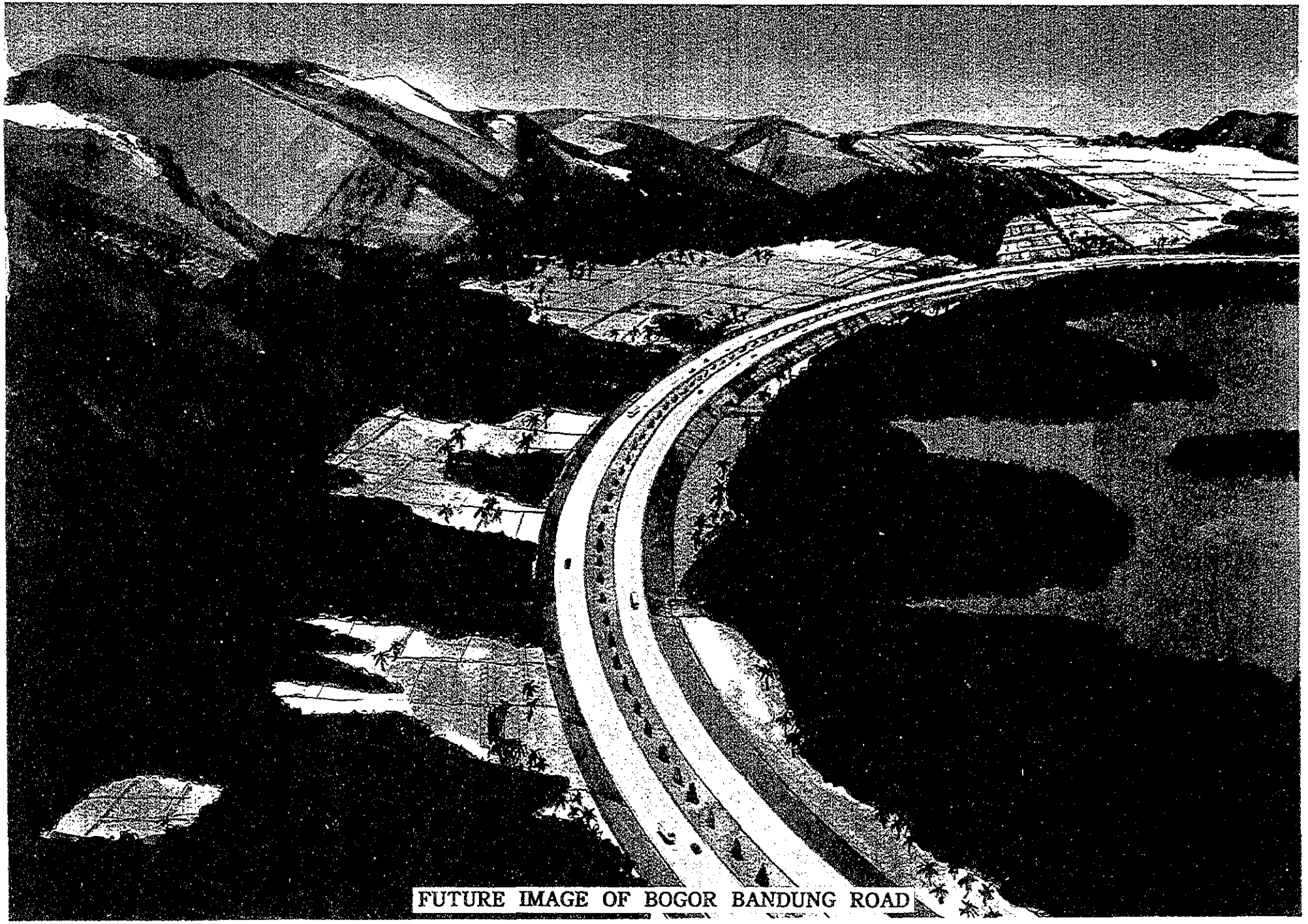
November, 1990



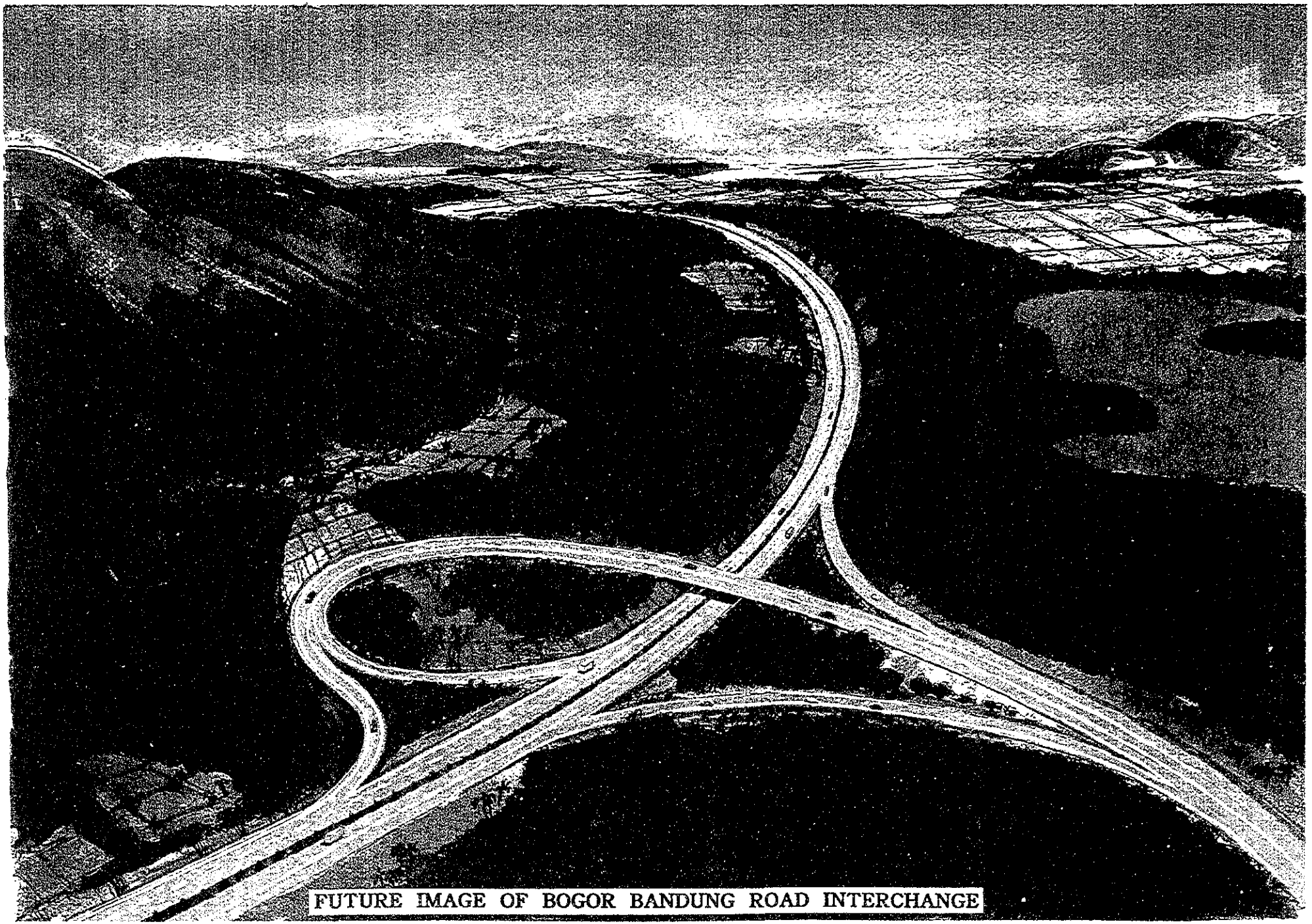
Kensuke Yanagiya
President
Japan International Cooperation Agency



LOCATION MAP



FUTURE IMAGE OF BOGOR BANDUNG ROAD



FUTURE IMAGE OF BOGOR BANDUNG ROAD INTERCHANGE

TABLE OF CONTENTS

PART II ROAD DEVELOPMENT PLAN & EVALUATION

CHAPTER 5 ROAD DEVELOPMENT ALTERNATIVES

PART III PUNCAK PASS ACTION PROGRAM

CHAPTER 12 PUNCAK PASS ACTION PROGRAM

CONCLUSION AND RECOMMENDATION

LIST OF FIGURES

LIST OF TABLES

SUMMARY

SUMMARY

TABLE OF CONTENTS

CONCLUSION AND RECOMMENDATIONS

1. CONCLUSION

(1) New Bogor - Bandung Road Construction

The Study determined that the alternative of constructing a new Bogor - Bandung Road from Ciawi at the end of the Jagorawi tollroad through Cibadak, Sukabumi and Cianjur until Citatah to connect with the new Cikampek - Padalarang tollroad, is feasible with respect to all technical, economic and financial issues studied.

The new Bogor - Bandung Road satisfies the objectives of this Study and solves the problems found on the road network between the two cities of Bogor and Bandung.

The new road will also contribute to a controlled development of the area alongside it. The limited access controlled nature of the new road shall reduce the negative environmental impacts the project may have on the surrounding area.

However, since the construction of the new road is expected to take some years, an action program is recommended for execution at troublesome locations of the Puncak pass road.

(2) High Return for the National Economy

By carefully programing the implementation of the new road construction starting from the earliest possible time until the year of 2010, the economic internal rate of return considering only the direct benefit is estimated at about 27% which is an exceptionally high rate of return for the national economy. A net present value under the discount rate of 15% is estimated at about RP. 133 billion and under the same condition the benefit and cost ratio is estimated at about 1.6.

In addition to the quantifiable benefits, there are expected in many areas and sectors indirect effects such as increase in production capacity, reduction of commodity prices, inducing regional development, increase and improvement of living standards, and creating new demand by road investment. The areas expected to be affected are Cibadak and towards Pelabuhanratu, Sukabumi, Cianjur and other southern regions.

(3) Soft Loan for Tollroad Feasibility

The financial internal rate of return of the final alternative is estimated at a moderate 8.8% on a fixed price basis at 1989. The financial performance of this toll road depends largely on the condition of long term loan and it is imperative to introduce a favorable soft loan particularly for the foreign portion of the cost of the project.

2. RECOMMENDATIONS

(1) Phased Construction of New Bogor - Bandung Road

The new Bogor - Bandung Road is recommended to be constructed as a four lane access controlled road in its final form. However, by taking into account the expected growth of traffic demand and the balance between cost and benefit as major factors, the construction is recommended to be implemented in three phases as follow;

i) Extension of the Jagorawi tollroad until Sukabumi with a two lane access controlled road, completing it by the year 1998.
ii) Extension of the same road until Citatah with a two lane access controlled road, completing it by the year 2005. The whole of the Bogor - Bandung Road is temporarily connected by the end of this phase with a two lane access controlled road.

iii) Widening of the Bogor - Bandung Road to a four lane road at the section between Ciawi and Sukabumi, completing it by the year 2010. Widening of the rest, namely the section between Sukabumi and Citatah, is recommended to be implemented sometime after the year 2010, taking into account the traffic demand build up.

(2) Puncak Pass Action Program

One of the objectives of this Study is to ease the traffic problems indicated at the Puncak Pass road between Ciawi and Cianjur and the new Bogor - Bandung Road is recommended to be the final solution.

The construction of the new road, however, is expected to take many years during which the immediate traffic problems will remain unsolved. The Puncak Pass Action Program is thereabove recommended with minimum investment.

The program recommended consists of the spot improvement at several locations such as Taman Safari intersection and Cibulan Market; the improvement of road cross section such as paved hard shoulder, introduction of climbing lanes and clearly divided passage for pedestrians; and installation of traffic safety devises such as fences, safety mirrors, wider central median strip, etc.

(3) Coordination in Establishing Development Strategy

The construction of a new trunk road is known to have an enormous effect on the society and economy in the area it passes through. This has been already proven in cases of major tollroad constructions in this country.

It is therefore recommended to establish an appropriate development strategy involving and obtaining coordination between the concerned authorities along the new Bogor - Bandung Road, by foreseeing the impact of this new road.

(4) Environmental Study

Careful attention has been paid during the course of the Study to reduce and minimize any negative impact on environment. Nevertheless there shall be some remaining impact and it is recommended to assess the negative effect of the new road construction in order to consider appropriate countermeasures.

Possible problems which will require in-depth evaluation shall include, among others;

i) Separation of local community
ii) Soil erosion at the road site and quarry site
iii) Disturbance of the groundwater flow by excavation
iv) Water contamination by run-off water from road

The environmental study is recommended to proceed prior to the detailed engineering study.

1. Introduction

(1) Study Development

In response to the request of the Government of the Republic of Indonesia, the Japanese Government, through the Japan International Cooperation Agency (JICA), carried out the Bogor-Bandung Road Project Feasibility Study at the Directorate General of Highways, Ministry of Public Works of the Government of Indonesia.

(2) Study Objective

The objectives of the Study were as follows:

(1) to formulate a road development plan in the area between Bogor and Bandung for the target year of 2010, and

(2) to conduct a feasibility study on the formulated plan with emphasis on staged implementation.

(3) Scope of the Study

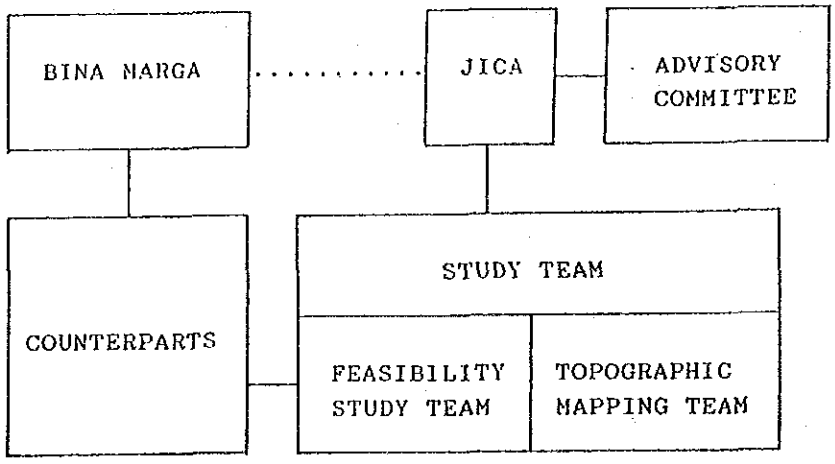
In order to achieve the objectives mentioned above, the Study covered the following items;

(1) Review and study on socio-economic aspects
(2) Traffic surveys and transport inventory surveys
(3) Collection and study of engineering information
(4) Preparation of topographic maps
(5) Selection of a prospective road development program
(6) Study on the road development program
(7) Evaluation and recommendations

(4) Study Organization

To conduct the study, JICA organized both the Study team, headed by Dr. Akira ISHIDO and the Advisory Committee, chaired by Mr. Kaoru ONO, to provide advice for the Study. The government of the Republic of Indonesia formed the counterpart team, headed by Mr. Anas Aly under the Directorate General of Highways, Ministry of public works (BINA MARGA).

ORGANIZATION CHART



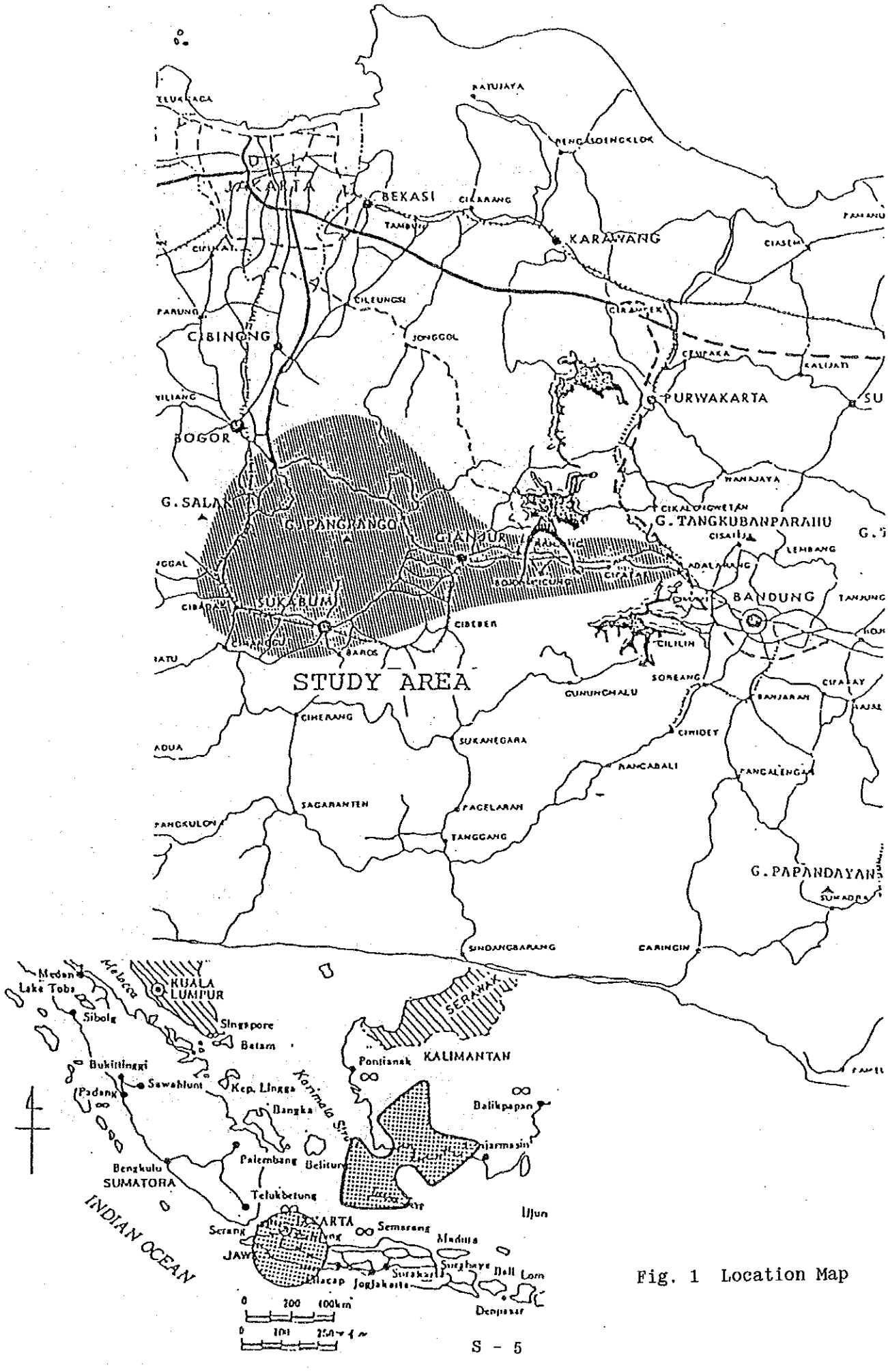


Fig. 1 Location Map

2. Socioeconomic Conditions

(1) Profile

The islands forming the Republic of Indonesia, with a population of 168 million, stretch over an area of 5,000 km in the east-west direction. Over 60% of this population is located in Java Island. The Study Area is situated in the island's West Java Province. The temperature in the northern coast is hot on average, with the inland, especially Bandung located in the central mountainous area, being much cooler. Rainfall is heavy around Bogor, but decreases along the northern coast.

West Java Province occupies a third of the Java island. Jakarta, the capital of the Republic, is situated in the middle of the Province's northern part. The Province consists of 20 Kabupaten and 4 Kotamadya, and the Study Area covers part of these administrative zones, namely Kabupaten Bandung, Bogor, Sukabumi, and Cianjur, and Kotamadya Bandung, Bogor, and Sukabumi.

The Study Area is mountainous, with volcanoes such as G. Salak, G. Pangrange, and G. Gede. Cianjur and Bandung Basins are among the basins that lie between the mountains. Two watersheds exist in the Study Area, one near the boundary of Kabupaten Bogor and Sukabumi, and the other near the Sukabumi and Cianjur boundary. Many rivers cross the area northwards to the Java Sea, such as Cilliwang, Cileungsir, and Citarum rivers, while the Cisadane river flows southwards to the Indian Ocean.

(2) Economic Framework

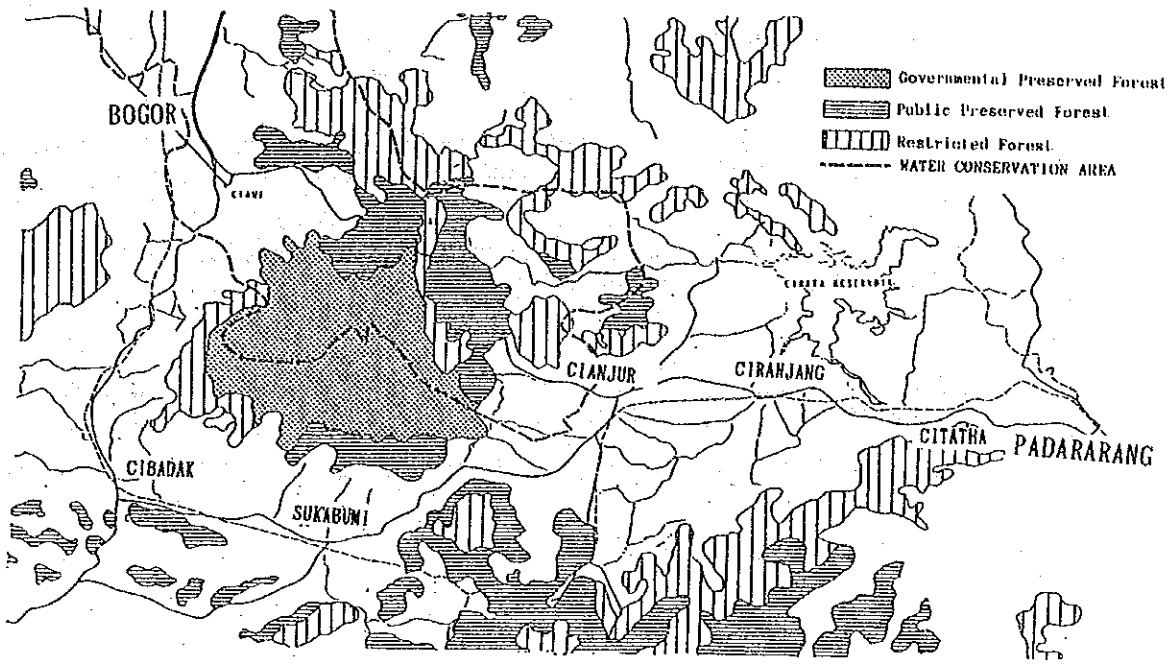
West Java Province, with the capital city of Jakarta, is the leading political, economic and cultural center of the nation. The population of the Province is approximately 31 million (1985) with an annual growth rate of 2.3%. The population densities for Jakarta and West Java Province are 1,400 and 700 persons/km^2 respectively indicating highly dense areas.

Economic activities are significant in the Province and employment rate is high. Almost half of the 10.5 million work force is employed in the primary sector, followed by a third in the tertiary sector (1985 figures).

The development of West Java Province has been following the Regional Development Plan which is based on the Pelita V National Development Plan. Among the Regional Plan's objectives are the encouragement of economic activities, providing employment opportunities in the rural areas, and balancing the use of natural resources and the conservation of the environment. Employment is expected to reach 15.8 million in the year 2000, with 38% and 45% employed in the primary and tertiary sectors respectively. The corresponding figures expected for the year 2010 are 19.2 million, and 34% and 48% respectively. In comparison with the present, the tertiary sector is expected to gain at the expense of the primary sector.

(3) Land Use

The dominant land use activity in West Java Province is agriculture, with a share that exceeded 50% in 1987. Land area used for industrial activity remains very small within the Study Area. Much of the area in and surrounding Jakarta has been rapidly undergoing urbanization and thereby creating a radial influence on the adjacent areas. In the rural regions residential areas exist mainly along the trunk roads. Forest and water preservation areas are defined by Presidential Decrees. The future land use of the Province shall follow the Regional Development Plan.



DISTRIBUTION OF PRESERVED FOREST
AND WATER CONSERVATION AREA

GROSS REGIONAL DOMESTIC PRODUCT

unit: billion Rp

REGION	GRDP IN 1986 *	POPULATION IN 1986	GRDP PER CAPITA	GROWTH RATE(%)
DKI JAKARTA	9,445	8,207	1,151	8.2
WEST JAVA	13,505	30,147	448	8.6
C & E JAVA	21,411	62,104	345	8.4
INDONESIA	82,175	168,348	488	5.2
BANTEN	1,231.1	2,717	453	13.5
BOTABEK	2,681.9	6,388	420	11.4
SUKABUMI	409.0	1,803	227	7.0
BANDUNG RAYA	3,573.9	8,302	430	9.6
PRIANGAN TIMUR	980.0	3,046	322	6.0
CIREBON	3,946.0	4,890	807	5.4
PURWASUKA	1,039.0	2,998	347	8.6

Note : * 1983 Constant Price

TOTAL POPULATION IN TARGET YEAR 2000 and 2010 in West Java

unit: 1000

	1980	2000	2010
WP Banten	2,496	3,469	3,899
WP Botabek	5,434	11,109	14,806
WP Sukabumi	2,770	3,654	4,016
WP Bandung Raya	1,634	2,166	2,441
WP Priangan Timur	7,755	10,850	11,623
WP Cirebon	4,494	6,957	6,547
WP Purwasuka	2,972	3,641	4,000
West Java	27,555	40,835	47,332
DKI Jakarta	6,503	10,934	12,500

3. Transportation Conditions

3.1 Road Network

Of a total length of 2,546.5 km, 74% of the road network has been classified as provincial, and national roads comprise 23%. Length of toll roads are 1.8% of total network length.

In terms of function, the network is roughly divided into collectors (45%) and arteries (36%). Local roads account for 20% of the total.

3.2 Traffic Surveys

In the traffic count survey, traffic volumes with classification into 14 types of vehicles were counted at eight stations during 14 hours or 24 hours. Roadside OD survey was carried out at the same stations where the traffic count survey was executed, and samples of vehicles were stopped and questioned concerning trip attributes as follows;

- Origin and destination of trip
- Type of vehicle
- Trip purpose
- Number of passengers

3.3 Present Vehicle OD Tables

The present vehicle OD tables were calculated by expanding and processing the sample data obtained by the OD survey.

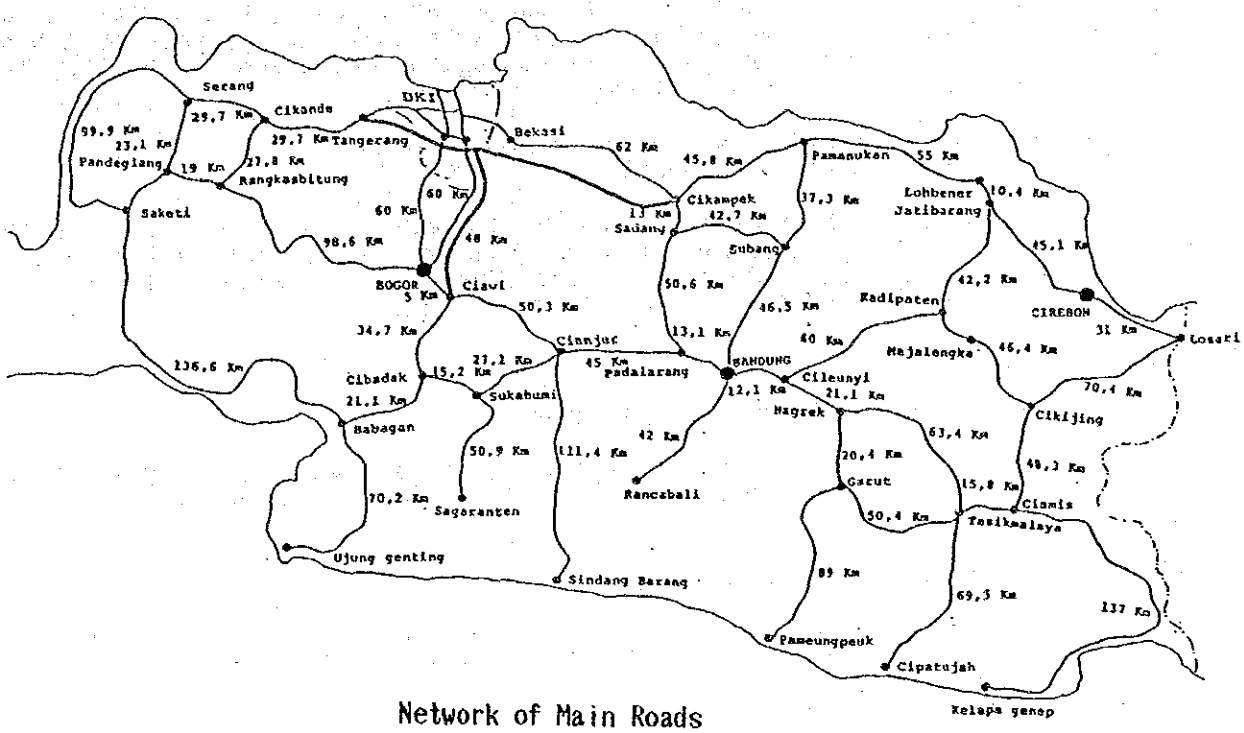
The OD tables were composed by type of vehicle such as angkutan kota, bus, passenger car and trucks. The bus OD table was formed using information from the public transportation registration. The other OD tables were calculated through combining the existing OD tables processed above and the national OD tables converted from the National OD Survey conducted in 1982.

Total production of vehicle trips in the Study Area is about 120 thousand trips. Around 30% of the total production corresponds to trips from/to Jakarta. And, the number of trips generated in and attracted to locations in the survey area such as Bogor, Cibadak, Sukabumi, Cianjur and Bandung, is 43 thousand.

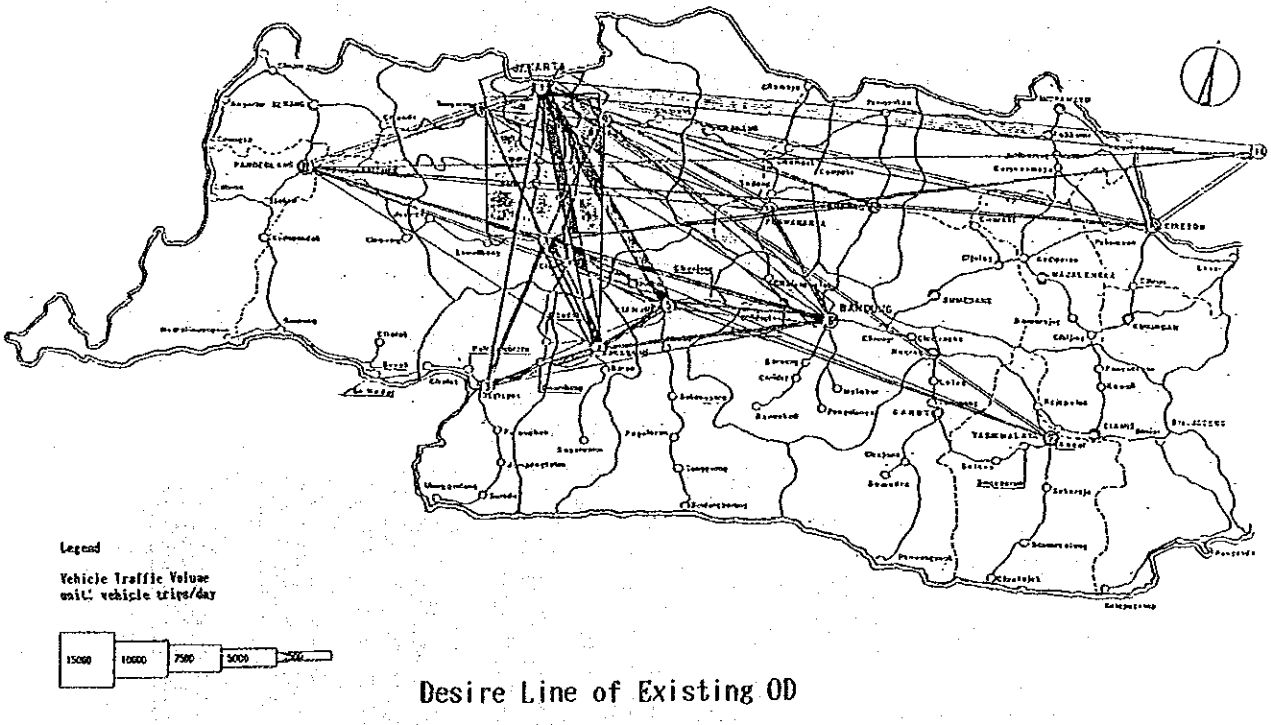
Characteristics of Links in the Study Area

Link City	Survey Station	Traffic Volume Counted	Heavy Truck Ratio	Peak Hour	Peak Ratio	Usage of Link: Main OD Pair	Usage of Link: Traffic Volume (veh/day)
Ciawi-Puncak	1	16,469	5.4%	15-16	7.29%	JKT-BDG	3,200
						JKT-CJR	2,800
Puncak-Cianjur	2	12,246	5.8%	16-17	7.40%	JKT-BDG	3,400
						BGR-CJR	1,400
Ciawi-Cibadak	6	9,847	27.6%	15-16	6.93%	JKT-SKB	2,400
						BGR-SKB	2,000
Cibadak-Sukabumi	4	9,447	16.6%	15-16	6.44%	JKT-SKB	2,200
						BGR-SKB	1,100
Sukabumi-Cianjur	3	4,087	27.5%	11-12	6.97%	SKB-CJR	1,100
						SKB-BDG	1,000
Cianjur-Padajarang	7	9,895	17.0%	16-17	7.01%	JKG-BDG	3,400
						CJR-BDG	2,000

Note: Abbreviation of city name is as follows.
JKT: Jakarta BGR: Bogor SKB: Sukabumi
CJR: Cianjur BDG: Bandung



Network of Main Roads



Desire Line of Existing OD

4. Traffic Demand Forecast

4.1 Methodology

This methodology is briefly divided into two major steps. In the first step, the mechanism of the existing traffic flow is analyzed from the present OD tables and models which estimate future OD tables reflecting the mechanism are built. The first step composes two sub-models as follows;

- Vehicle trip generation/attraction sub-model
- Vehicle trip distribution sub-model

The second step is assigning the future OD tables on shortest routes in the network for which the actual conditions are codified so that traffic volume can be obtained. The network includes toll roads. Therefore the diversion ratio curve is employed to calculate the traffic volume on the toll roads.

4.2 Model Description

(1) Vehicle Trip Generation/Attraction Sub-model

This model is the multiple variation equation, and its variations by zones are population, and number of employees by industry (primary, secondary, tertiary industries).

(2) Vehicle Trip Distribution Sub-model

The vehicle trip distribution is calculated by using the sub-model derived from generation, attraction and distances travelled between zones.

(3) Traffic Assignment Sub-model

In the process of traffic assignment, diversion ratio is used as follows;

Parameters of Vehicle Trip Distribution Model

Vehicle Type	Parameter				Correlation Coefficient
	K	α	β	γ	
Angkutan Kota	258.0329	0.4912	0.3408	-1.5326	0.60
Bus	0.3359	0.6944	0.6840	-0.8292	0.87
Passenger Car	296.2717	0.4309	0.4887	-1.7545	0.94
Light Truck	39.1972	0.4892	0.4735	-1.3298	0.88
Heavy Truck	3.1524	0.6287	0.5465	-1.2169	0.83

Note: Formula of models is as follows;

$$Tij = K * \frac{(Gi^{**}\alpha)*(Aj^{**}\beta)}{Dij^{**}\gamma}$$

Where Tij : Vehicle trips distributed between i zone and j zone
Gi : Generation of i zone
Aj : Attraction of j zone
Dij : Distance traveled between i zone and j zone
K, α, β, γ : Parameters of models

Parameters of Generation/Attraction Sub-Model

Vehicle Type	Generation/ Attraction	Parameter					Multiple Correlation Coefficient	Standard Error (F Value)
		Population	Number of Employment			Constant		
			Primary	Secondary	Tertiary			
Angkutan Kota	Generation	-1.6607			11.0570	1752.04	0.869	1852.5
	Attraction	-1.6607			11.0570	1752.04	0.869	1852.5
Bus	Generation	-0.6207			4.8804	390.21	0.947	585.0
	Attraction	-0.6211			4.8784	392.52	0.947	582.2
Passenger Car	Generation	-1.2354			8.1623	1230.64	0.912	1388.9
	Attraction	-1.2365			8.1776	1228.24	0.911	1403.4
Light Truck	Generation	-0.4619			3.1610	600.31	0.870	566.3
	Attraction	-0.4644			3.1899	594.19	0.873	565.4
Heavy Truck	Generation		-3.8531	6.7822	2.9246	684.88	0.980	665.0
	Attraction		-4.0163	6.7712	2.9671	673.70	0.981	683.9

Formula of Diversion Rate

$$P = \frac{1.0}{1.0 + 2.855E\text{-}5 \times (X/T)^{2.27684}} \qquad \text{(Passenger car)}$$

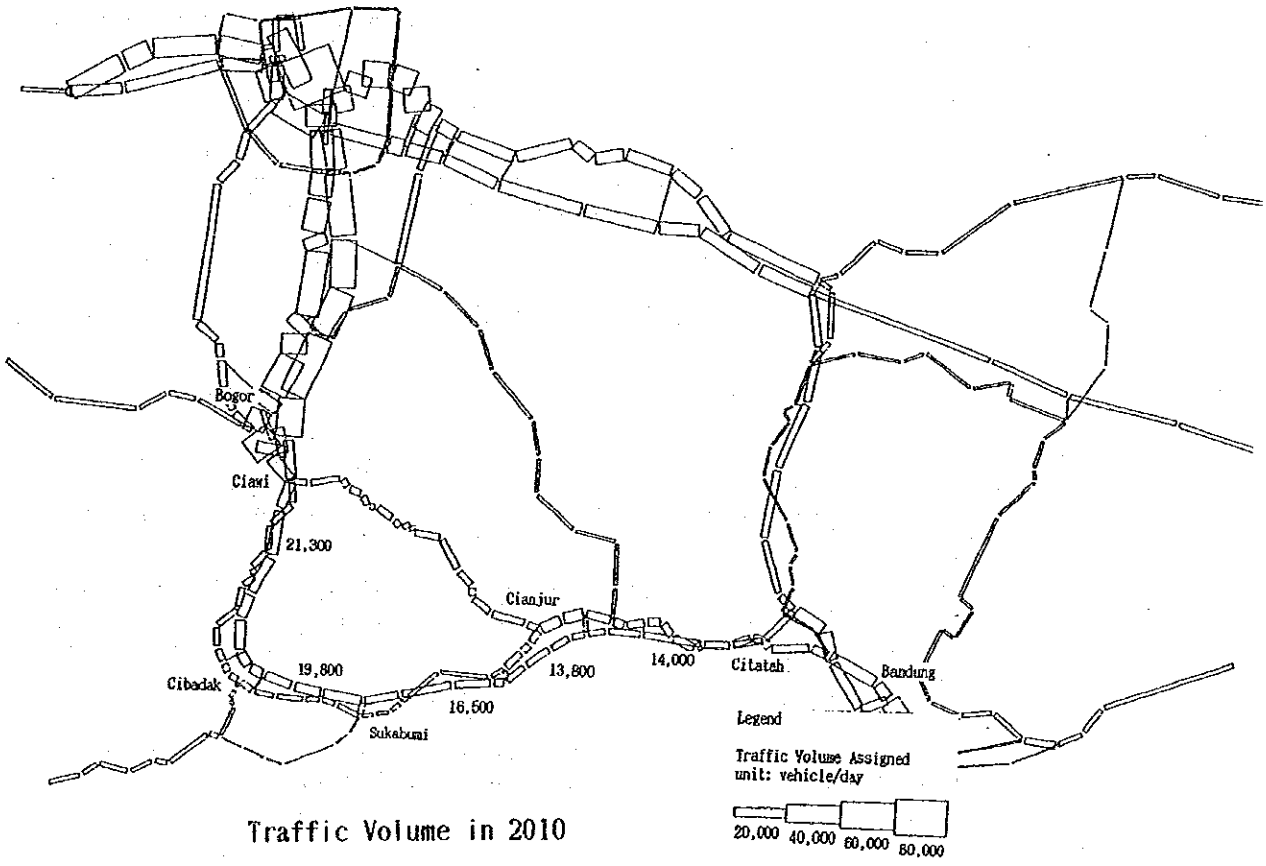
$$P = \frac{1.0}{1.0 + 5.870E\text{-}4 \times (X/T)^{1.74818}} \qquad \text{(Light truck)}$$

$$P = \frac{1.0}{1.0 + 6.078E\text{-}5 \times (X/T)^{2.34860}} \qquad \text{(Heavy truck)}$$

where P : Diversion rate
X : Toll rate (Rp.)
T : Travel time difference (minute)

4.3 Estimation

The future vehicle OD tables were calculated by the previously described models after which traffic volume was assigned to each of the project road alternatives formulated in Chapter 5.



Traffic Volume in 2010

5. Road Development Alternatives

(1) Road Development Alternatives

Based on a comprehensive analysis of pertinent issues related to the Study Area such as traffic characteristics, socio-economic aspects, topographical and geological conditions, four road development alternatives were formulated for evaluation and selection of the optimum road development plan.

(2) Description of Alternatives

Alternative 1 calls for the widening of the existing road from Ciawi, through Puncak resort area, to Cianjur and Cipatat, with a length of 80.4 km, and estimated construction cost of 423,799 million Rp.

Alternative 2 calls for widening the existing road from Ciawi, through Cibadak, Sukabumi, Cianjur and Cipatat, with a length of 113.4 km, and construction cost estimated at 458,275 million Rp.

Alternative 3 proposes the construction of a new road along a route north of the existing Ciawi - Puncak - Cianjur road, with a length of 83.8 km and construction cost estimates of 565,299 million Rp.

Alternative 4 proposes constructing a new road which will link the cities of Ciawi, Cibadak, Sukabumi, Cianjur and Citatah, with a length of 97.5 km, and estimated construction cost of 429,201 million Rp.

(3) Evaluation of Alternatives

The evaluation process of the alternatives was as follows:

(1) Economic Assessment

The construction costs of each alternative were estimated and compared against the benefits that are expected from the execution of that alternative in terms of savings in vehicle operating costs and passenger time costs.

(2) Environmental and Socio-economic Impact Assessment

The environmental impacts each alternative will have on the issues such as forest, flora and fauna preservation, water resources conservation, and air, water, and noise pollution were considered.

Furthermore each alternative was assessed as to its effects on socio-economic aspects such as disruption or severance of social communities, support to existing regional and national development plans, and land use issues.

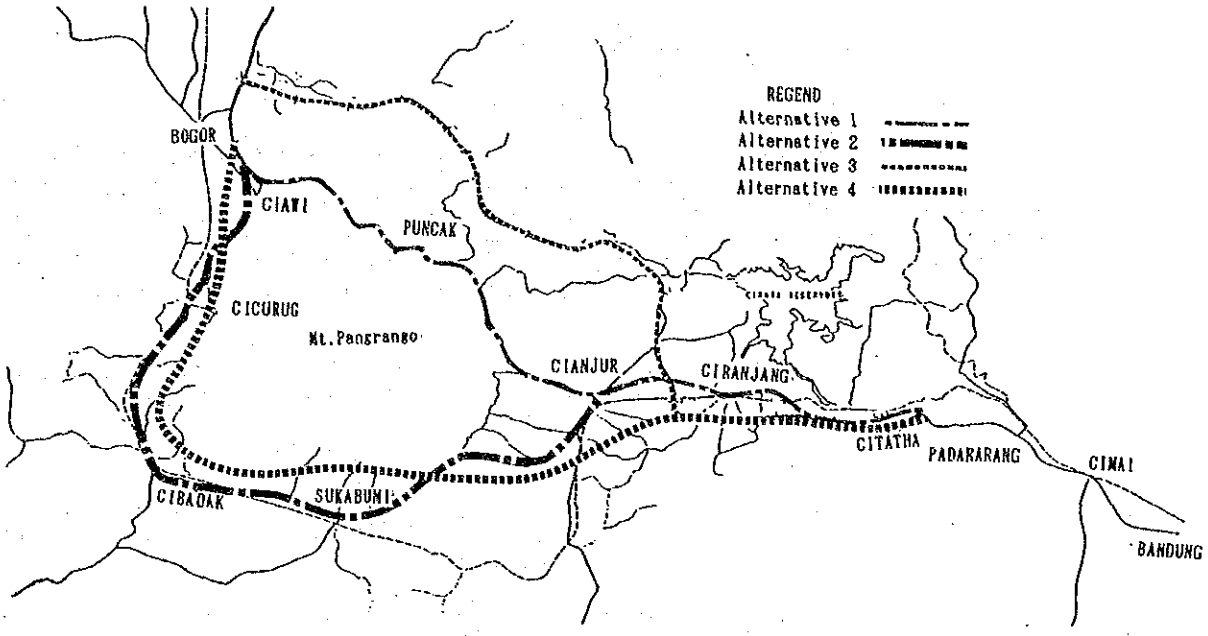
(3) Engineering Assessment

The assessment covered the traffic demand forecasting for each alternative for the years 2000 and 2010. The impacts each alternative would have on the road network, traffic safety and flow, and traffic congestion mitigation issues were analyzed.

The characteristics of the terrain for each alternative were investigated and reflected in the road standards adopted, designs and cost estimations.

(4) Optimum Development Plan

The development plan proposed in Alternative 4 was evaluated as the optimum plan for the road development project between Bogor and Bandung.



Road Development Alternatives

Summary of Evaluations

Item	Alt.1	Alt.2	Alt.3	Alt.4
Road Network (network accessibility)	B	B	C	A
Road Geometry; Horizontal Alignment	C	C	B	A
Vertical Alignment	C	B	C	A
Travel Time (evaluation on whole network)	C	B	C	A
Congestion Ratio (on Study Area)	C	A	C	B
Improvement on Congestion of Puncak Pass	A	C	C	B
Economic Viability; Construction Cost	A	B	C	A
Cost/Benefit Balance	C	B	C	A
In-line with Other Road Development	C	B	C	A
Conflict of Local, Long and Tourim Traffic	C	C	A	A
Impact of Construction to Roadside Society	C	C	A	A
Conflict with Roadside Living Activities	C	C	A	A
Contribute to Area Development	B	B	C	A
Environment Consideration (conservation area)	C	B	C	B

Note: Evaluation scale is in three grades of which "A" is the best.

6. Project Road: Ciawi - Sukabumi Section

(1) Topography and Land Use

The Ciawi-Cibadak portion of this section, traveling north-south, passes through steep mountainous terrain. Land in this area is mainly used for agricultural. A vast rubber plantation is located southeast of Lake Lido. Residences are continuously located on the existing main road village roads. Vertical alignments were considered in relation with balancing cut depths and embankment heights. Maximum cut depths and embankment heights are 30 and 20 meters respectively.

The starting point of the route will connect with the terminal point of Jagorawi Toll Road. The route has been located so as to avoid control points such as residential areas and regional facilities. The route also avoids the rubber plantation by passing through the northeast edge of Lake Lido.

From Ciawi the route travels to Cibadak, in a southward direction, mainly traversing through paddy fields at the foot of Mt. Pangrango. The route gradually climbs from 400 to 800 m while crossing rolling mountainous terrain.

The Cibadak-Sukabumi section of the route has been set to avoid residential areas and governmental facilities, especially the police academy located north of Sukabumi city.

(2) Geometric Design

The geometric design standards of the project road are shown in the Table for the 4-lane, 53.5 km section.

Item	Unit	Design Standard
Design speed	km/h	80
Carriageway width	Meter	3.5
Outer shoulder width	Meter	2.5
Inner shoulder width	Meter	1.0
Median width	Meter	7.0
Pavement cross slope	%	2.0
Pavement type		Cement concrete
Max. superelevation	%	10
Max. radius curve	Meter	210
Stopping sight distance	Meter	115
Row width	Meter	30

(3) Interchanges

- Ciawi Interchange	(Sta. 1+200)	Trumpet type
- Cicurug Interchange	(Sta. 11+800)	Trumpet type
- Cibadak West Interchange	(Sta. 27+200)	Trumpet type
- Cibadak East Interchange	(Sta. 32+400)	Trumpet type 1)
- Sukabumi West Interchange	(Sta. 40+000)	Trumpet type
- Sukabumi Interchange	(Sta. 46+300)	Trumpet type 1)

(Note 1): Construction in future when warranted by traffic demand)

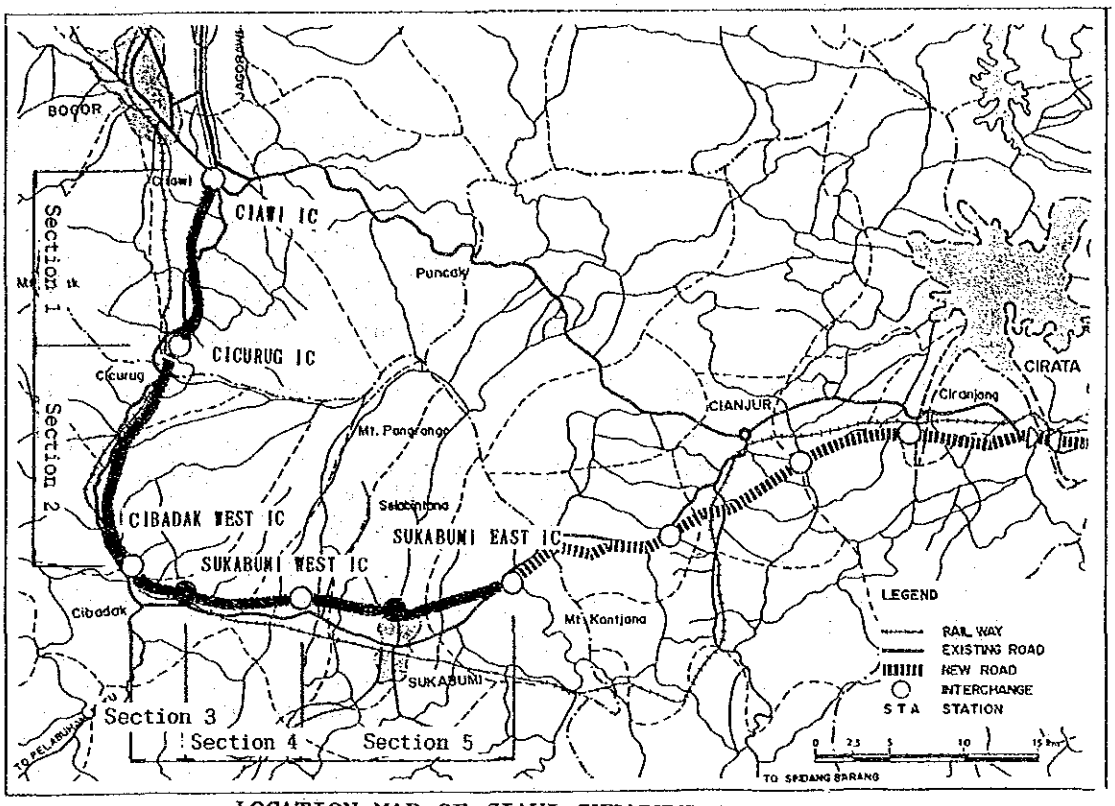
(4) Bridges

The topographical conditions through which the route travels warrant the construction of many long and median span bridges. The total length of main and over bridges are 2488 and 1034 m respectively.

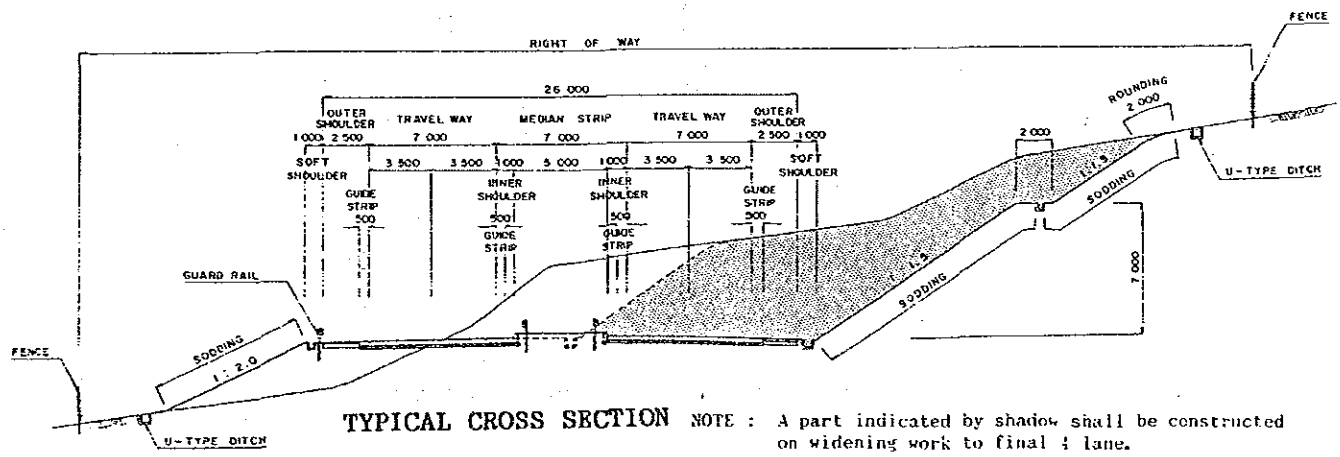
Bridge	Length	Number
Main	L> 100m	10
	100m=> L> 50m	8
	50m=> L> 20m	4
	20m=> L	20
Over	L = 88m	3
	L = 58m	5
	L = 20m	14

(5) Section Cost

This section shall be constructed in two phases; two lanes shall be provided for the total length in the first phase, to be widened to four lanes in the second. The construction costs are estimated as Rp 241,232.9 million and Rp 189,573.6 million in the first and second phase respectively. The total section construction cost is Rp 430,806.5 million.



LOCATION MAP OF CIAWI-SUKABUMI SECTION



TYPICAL CROSS SECTION NOTE : A part indicated by shadow shall be constructed on widening work to final 4 lane.

PROJECT COST OF CIAWI-SUKABUMI SECTION

	Length	Construction Foreign	Construction Local	Total	Foreign	Local	Land Aquisition	Compensation	Total
	(Km)	(US$1000)	(Rp10^6)	(Rp10^6)	(%)	(%)	(Rp10^6)	(Rp10^6)	
4 Lane									
Section 1 (STA 0 + 0 ~ 11 +800)	11.8	24,503.1	24,495.3	67,365.7	36.37%	63.63%	4,095.2	1,175.0	72,635.9
Section 2 (STA 11 +800 ~ 27 +200)	15.4	34,812.1	31,777.8	92,699.0	37.55%	62.45%	1,437.3	210.0	94,346.3
Section 3 (STA 27 +200 ~ 32 +400)	5.2	9,762.8	10,664.2	27,749.1	35.19%	64.82%	2,777.1	615.0	31,141.2
Section 4 (STA 32 +400 ~ 40 + 0)	7.6	11,363.4	12,697.6	32,783.5	34.66%	65.34%	1,173.1	800.0	34,756.6
Section 5 (STA 40 + 0 ~ 63 +600)	13.5	22,042.0	26,871.1	65,444.6	33.68%	66.32%	2,139.9	1,170.0	68,754.5
Sub Total	53.5	102,483.4	106,696.0	286,041.9			11,622.6	3,970.0	301,634.5
Engineering Fee		13,076.2	5,720.8	28,604.2					
Contingency (10%)		11,556.0	12,800.9	33,023.9			←Local	←Local	
Total	53.5	127,115.5	140,810.4	363,262.6					

7. Project Road: Sukabumi - Citatah Section

(1) Topography and Land Use

The Sukabumi-Citatah section of the route travels in an east-west direction mostly over flat land. Land in this area is mainly used for paddy fields. Vertical alignments shall be set at elevations of 1 - 2 meters above the paddy fields surface.

Ground elevations near Sta. 57, passing by Sukabumi East Interchange, are about 850 m above sea level, and represent the highest elevation levels along the entire project route. The average inclination from the highest point to Cianjur West Interchange is about 4% which is the steepest gradient of the route.

The route will travel south of Ciranjang city to avoid the city areas that have developed along the existing main road and the village areas dotting the village roads. The route portion lying between Sta. 100 and Sta. 101 will be located close to the existing main road to avoid the army training fields. The end of the route will connect with the Cikampek-Padalarang Tollway.

(2) Geometric Design

The geometric design standards of the project road are shown in the Table for the 2-lane, 48.2 km section.

Item	Unit	Design Standard
Design speed	km/h	80
Carriageway width	Meter	3.5
Outer shoulder width	Meter	2.5
Median width	Meter	1.0
Pavement cross slope	%	2.0
Pavement type		Cement concrete
Max. superelevation	%	10
Max. radius curve	Meter	210
Stopping sight distance	Meter	115
Row width	Meter	30

(3) Interchanges

- Sukabumi East Interchange (Sta. 53+500) Trumpet type
- Cianjur West Interchange (Sta. 65+400) Trumpet type
- Cianjur East Interchange (Sta. 75+500) Trumpet type 1)
- Ciranjang Interchange Trumpet type
- Rajamandala Interchange (Sta. 91+000) Diamond type

(Note 1): Construction in future when warranted by traffic demand)

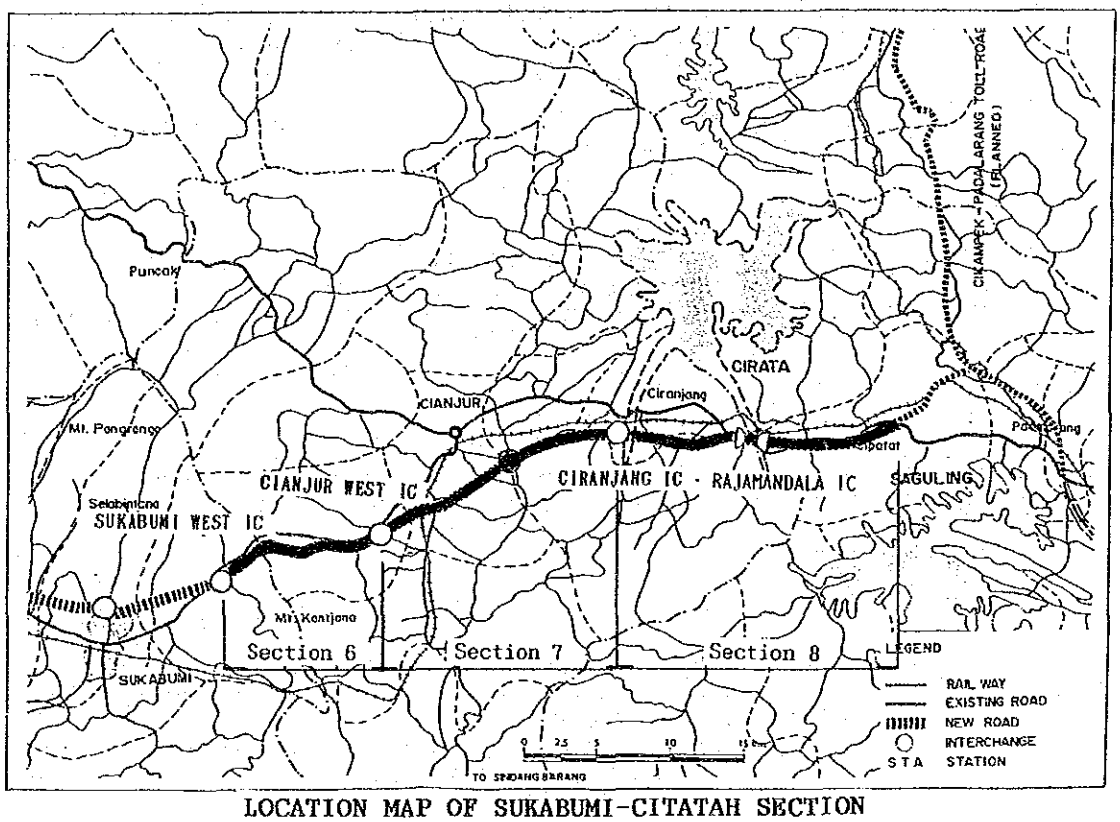
(4) Bridges

The total length of main and over bridges along this section are 700 and 400 m respectively. The number of main and over bridges by length are shown in the following table.

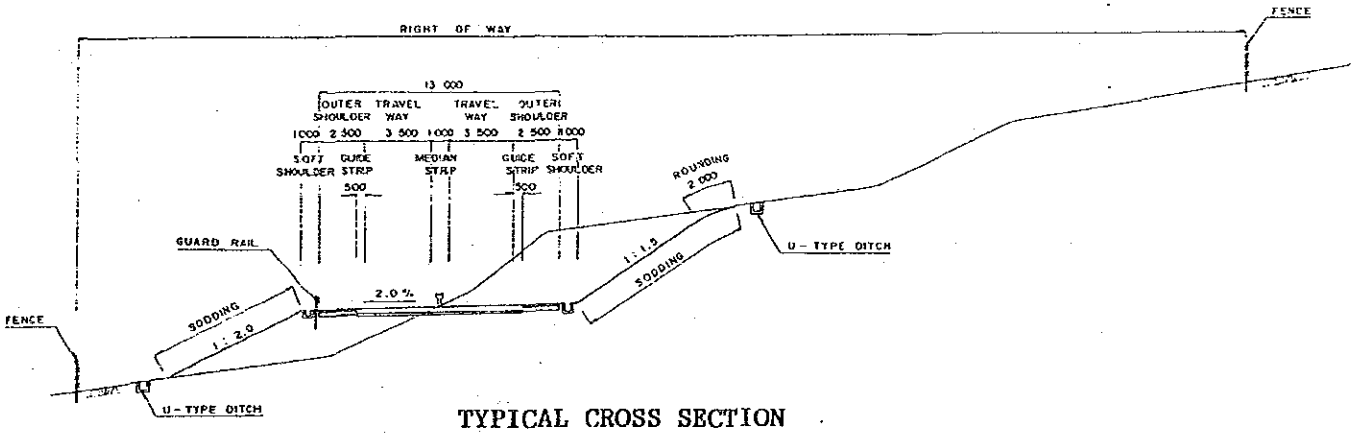
Bridge	Length	Number
Main	L> 100m	1
	100m=> L> 50m	3
	50m=> L> 20m	3
	20m=> L10	10
Over	L = 20m	20

(5) Section Cost

This section shall be constructed in one phase as a two lane road. The estimated construction costs for this section are Rp 136,795.8 million. Therefore the total construction cost of the project road shall be Rp 567,602.3 million.



LOCATION MAP OF SUKABUMI-CITATAH SECTION



TYPICAL CROSS SECTION

PROJECT COST OF SUKABUMI-CITATAH SECTION

	Length	Construction Foreign	Construction Local	Total	Foreign	Local	Land Aquisition	Compen-sation	Total
	(Km)	(US$1000)	(Rp10^6)	(Rp10^6)	(%)	(%)	(Rp10^6)	(Rp10^6)	
2 Lane									
Section 6 (STA 53 +500 ~ 65 +400)	11.9	11,605.3	10,964.9	31,099.1	37.00%	63.00%	1,993.6	445.0	33,537.7
Section 7 (STA 65 +400 ~ 83 +700)	18.3	13,778.4	15,472.1	39,584.3	34.81%	65.19%	4,095.9	720.0	44,310.2
Section 8 (STA 83 +700 ~101 +700)	18.0	11,860.6	9,269.3	30,045.3	39.48%	60.52%	3,918.7	2,476.0	36,439.0
Sub Total	48.2	37,144.2	35,726.3	100,728.8			9,918.2	3,640.0	114,287.0
Engineering Fee		4,604.7	2,014.6	10,072.9					
Contingency (10%)		4,174.9	5,129.9	12,436.0			←Local	←Local	
Total	48.2	45,923.8	56,429.6	136,795.8					

8. Puncak Pass Action Program

(1) Present Conditions

Puncak, located 60 km south of Jakarta, is a beautiful scenic resort that attracts many tourists and holiday makers. The national arterial road connecting Jakarta with Puncak via Ciawi is heavily congested with traffic up to Puncak, particularly on weekends and holidays although heavy vehicles are not allowed to use the road on such days. Daily traffic volumes range between 16,400 to 22,100 vehicles greatly exceeding the two-lane road capacity.

Puncak Pass travels along a steep slope through a mountainous area, with an average grade of 4.2% and a 10% maximum grade.

(2) Upgrading Necessity

The following problems are observed along the existing road:
- Congestion at intersections and mini bus terminals
- Road side friction caused by parked vehicles and mini buses stopping for passengers
- Dangerous and uncomfortable living conditions for people living alone the road
- Negative impact on the tourism activity

The Puncak Pass Action Program offers a remedy to these solutions by making the traffic as smooth as possible through upgrading traffic safety.

(3) Action Program Description

The action program shall be implemented along the existing Puncak Pass from Sta. 70+700 to Sta. 86+000, as follows;
- Standard section of the road shall have hard shoulders, wider median and raised sidewalks. Mini buses shall stop on the shoulders and residents along the road shall safely use the sidewalks.
- At road sections with steep slopes (approximately 7 km) an additional lane will be provided in the climbing direction, a climbing lane, in order to allow faster vehicles to overtake slower vehicles.

(4) Geometric Design

The geometric design standards to be followed by the Puncak Pass Action Program are shown in the table.

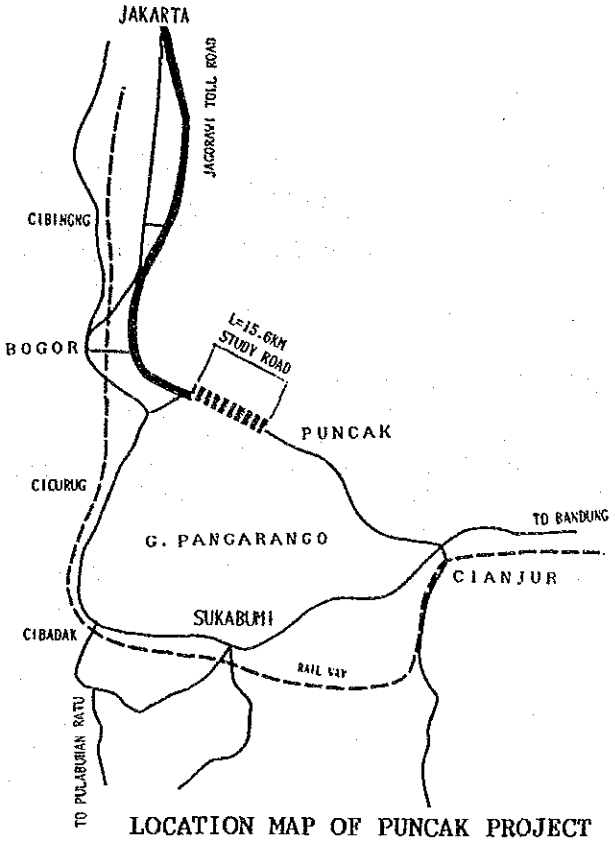
Item	Unit	Design Standard
Design speed	km/h	60
Carriageway width	Meter	3.25
Outer shoulder width	Meter	2.0
Median width	Meter	0.5
Climbing lane width	Meter	3.0
Sidewalk width	Meter	3.0
Row width	Meter	17 - 20
Pavement type		Flexible

(5) Bridges

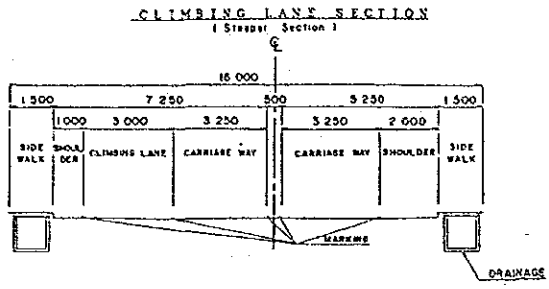
Bridges along standard sections shall not be widened to keep costs down. Only one existing bridge of length 10 m, along a steep section shall be widened from 7.5m to 10 m.

(6) Construction Cost

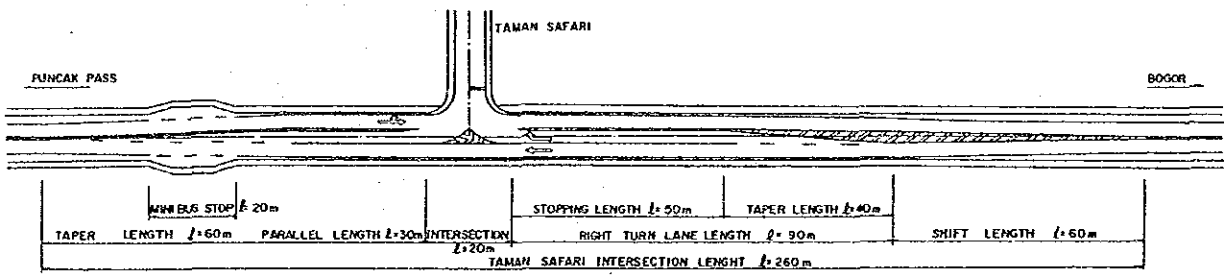
The total estimated construction cost for the Puncak Pass Action Program is Rp. 21,038 million.



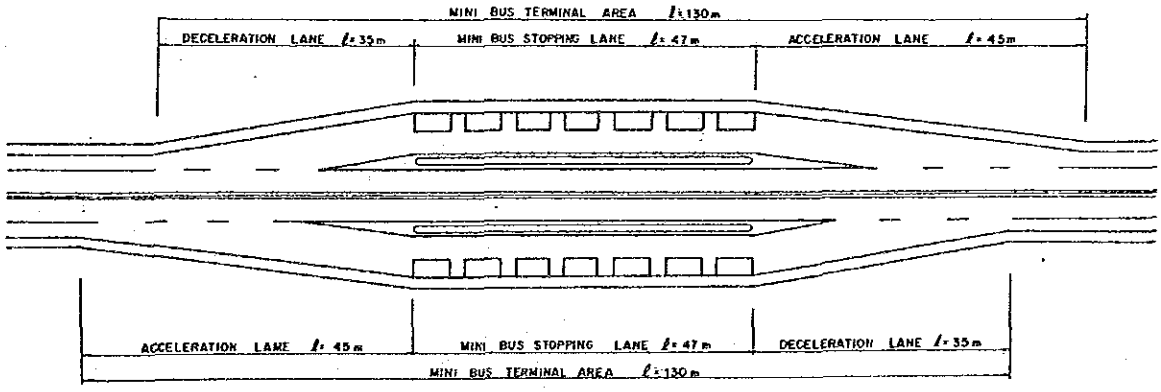
LOCATION MAP OF PUNCAK PROJECT



TYPICAL CROSS SECTION



IMPROVEMENT OF INTERSECTION



MINI BUS TERMINAL

9. Implementation Plan

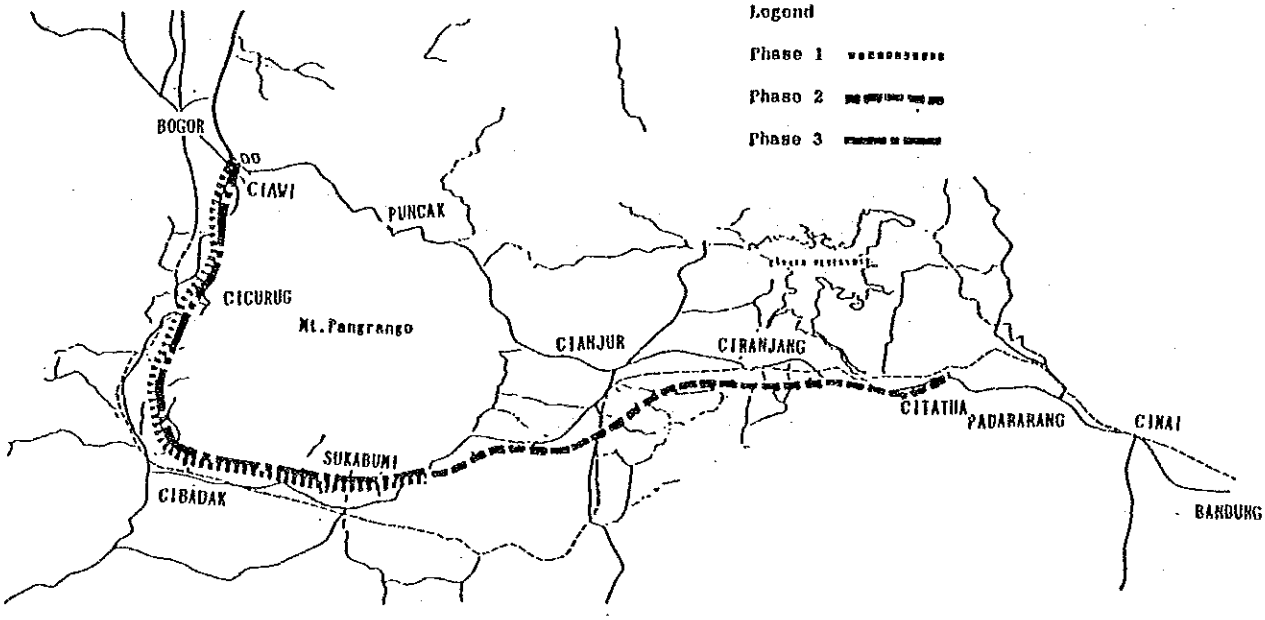
(1) Construction Costs and Period

The construction period is divided into 3 phases. The first phase is during 1993-1997, second 2000-2004, and third 2005-2009. Thus, the target year of the final completion of the project is the year 2009. The full operation will begin in 2010. The total construction cost (total of 3 phases) amounts to Rp 567,602 million in 1989 prices.

(2) Implementation Schedule and Investment Plan

The work sequence was examined in light of future traffic demand and economic analysis. As a result, the staged construction (provisional 2 lane) at the section between 1 and 5 (Bogor - Sukabumi) should be started with a higher priority. The construction at the section between 6 and 8 (Sukabumi - Citatah) shall be implemented at the next phase. At the final phase, the section between 1 and 5 shall be widened to final 4 lanes.

Annual investment during project period beginning with the year 1993 will be distributed as shown in the table.



Total Construction Costs

Unit: Rp Million

First Phase	Foreign	Domestic	Total
DIRECT COST TOTAL	89,965.7	47,212.8	137,178.4
INDIRECT COST (35%)	27,847.2	20,165.2	48,012.5
ENGINEERING (10%)	14,815.3	3,703.8	18,519.1
HOUSES REMOVAL		3,970.0	3,970.0
LAND ACQUISITION		11,622.6	11,622.6
TOTAL	132,628.2	86,674.4	219,302.6
CONTINGENCY (10%)	13,262.8	8,667.4	21,930.3
CONSTRUCTION TOTAL	145,891.0	95,341.8	241,232.9

Second Phase	Foreign	Domestic	Total
DIRECT COST TOTAL	48,150.0	26,464.0	74,614.0
INDIRECT COST (35%)	15,146.6	10,968.3	26,114.9
ENGINEERING (10%)	8,058.3	2,014.6	10,072.9
HOUSES REMOVAL		3,640.0	3,640.0
LAND ACQUISITION		9,918.2	9,918.2
TOTAL	71,354.9	53,005.0	124,360.0
CONTINGENCY (10%)	7,135.5	5,300.5	12,436.0
CONSTRUCTION TOTAL	78,490.4	58,305.5	136,796.0

Third Phase	Foreign	Domestic	Total
DIRECT COST TOTAL	68,170.4	47,883.1	116,053.6
INDIRECT COST (35%)	23,558.9	17,059.9	40,618.7
ENGINEERING (10%)	12,533.8	3,133.4	15,667.2
HOUSES REMOVAL		0.0	0.0
LAND ACQUISITION		0.0	0.0
TOTAL	104,263.1	68,076.4	172,339.5
CONTINGENCY (10%)	10,426.3	6,807.6	17,234.0
CONSTRUCTION TOTAL	114,689.4	74,884.1	189,573.5

	Foreign	Domestic	Total
GRAND TOTAL	339,070.9	228,531.5	567,602.4

Investment Plan for Each Phase

First Phase

Unit: Rp million

Section 1-5	1993	1994	1995	1996	1997
Provisional 2 lane	9,260	24,852	41,424	124,273	41,424

Second Phase

Section 6-8	2000	2001	2002	2003	2004
Provisional 2 lane	5,035	18,595	22,633	67,899	22,633

Third Phase

Section 1-5	2005	2006	2007	2008	2009
Widening to 4 lane	7,834	7,834	34,781	104,344	34,781

10. Road Project Evaluation

10.1 Economic Evaluation

(1) Methodology

The basic purpose of the economic analysis is to screen the alternatives for staged construction (4 alternatives) from the national economic point of view. For this purpose cost-benefit analysis is employed. The economic justification of the project is based on the quantification of the direct benefits to be derived from road users such as (a) vehicle operating cost savings and (b) passengers time savings.

Vehicle operating cost savings were calculated by comparing the with-project case in each staged construction alternative to without-project case in the road network. Time savings for passengers were also estimated in the same manner. After the third phase (2010), the total economic benefits amounts to Rp 84,801 million per year in each alternative. Of the benefits, the passenger time benefits account for 77.6% and the rest for the vehicle operating cost benefits.

Derivation of the economic cost of the project was made through elimination of transfer items such as import tariff levied on financial costs. In conclusion, the total economic construction cost (including costs for land acquisition and compensation) are estimated at Rp 451,257 million for Alternatives A and B, and Rp 510,861 million for Alternatives C and D, respectively.

(2) Results of Economic Evaluation

From the economic point of view, the implementation of the project is justified for the 4 alternatives with an Economic Internal Rate of Return (EIRR) of 24.7% for A, 19.8% for B, 27.0% for C and 22.5% for D, respectively. Besides EIRR, taking into consideration the net present value and B/C ratio, Alternative C is the most recommendable in this analysis.

10.2 Financial Evaluation

(1) Methodology

Financial analysis is focused on Alternative C staged construction plan as a result of the economic appraisal.

As basic assumptions, the implementation body is expected to be Jasa Marga and the toll rates are set up at Rp 60 per km for passenger cars and Rp 90 per km for trucks and buses.

Total construction costs are Rp 241,233 million for the first phase (1993-1997), Rp 136,796 million for the second phase (2000-2004) and Rp 189,574 million for the third (2005-2009).

Combining revenue projections based on the future traffic demand and the toll rates with estimated capital costs and operating costs, annual projected income statements and funds flow statements are developed in order to check the financial performance of the project.

(2) Results of Financial Evaluation

The results of the financial performance are not so optimistic. Financial Rate of Return on Total Investment (FIRROI) is 8.8%. According to the examination of the three cases with varying loan terms, it is deemed necessary to obtain long term loans with favorable conditions.

In addition, the central government or other official bodies may need to obtain loans with favorable terms if a joint venture entity is formed, which may consist of Jasa Marga and private investors.

Four staged-construction alternatives

	Phase 1	Phase 2	Phase 3
Alt.A	Section 1-2 Full 4 lane	Section 3-5 Full 4 lane	Section 6-8 Provisional 2 lane
Alt.B	Section 1-5 Full 4 lane	Section 6-7 Provisional 2 lane	Section 8 Provisional 2 lane
Alt.C	Section 1-5 Provisional 2 lane	Section 6-8 Provisional 2 lane	Section 1-5 Widening to 4 lane
Alt.D	Section 3,5,7 Provisional 2 lane	Section 1,2,4,6,8 Provisional 2 lane	Section 1-5 Widening to 4 lane

Results of EIRR, NPV, B/C ratio Unit: Rp Million for NPV

Alternatives	NPV	B/C ratio	EIRR
ALT. A	100,142	1.48	24.65%
ALT. B	77,414	1.26	19.82%
ALT. C	133,313	1.57	27.02%
ALT. D	65,006	1.34	22.45%

Note: Net present value and B/C ratio are discounted at 15 percent per year.

Results of FIRR

	FIRROI	FIRROE
Case 1	8.83	7.74
Case 2-A	8.83	11.04
Case 2-B	8.83	10.13

Notes: FIRROI means Financial Internal Rate of Return on Total Investment
FIRROE means Financial Internal Rate of Return on Equity
Case 1 : 10% of interest rate for long term loan
Case 2-A : 5% of interest rate for long term loan
Case 2-B : the same as Case 2-A for long term loan and issue of bond

Results of Financial Indicators

	Case 1	Case 2-A	Case 2-B
(a) DSCR 1)	0.94	2.49	0.31
(b) First year after reaching BEP ratio not to exceed 80 % 2)	2017	2001	2027
(c) First year of surplus in Income Statements	2003	2000	2003
(d) First year of surplus in Funds Flow Statements	2019	2001	2032
(e) Total required amount of Short Term Loan (Rp. million)	722,872	12,200	4,278,505

Notes: 1) Debt Service Coverage Ratio
2) Break-Even Point Ratio

PART I

EXISTIONG CONDITIONS AND DEVELOPMENT FRAMES

CHAPTER 1 INTRODUCTION

1.1 Background

Indonesia has a population of 168 million which is the fifth largest in the world, spread among islands in an area stretching 5,000 km in the east-west direction. This large population, of which more than 60% is located in Java island, is causing many problems for this otherwise peaceful and prosperous country.

The West Java Province is located at the western part of Java island and occupies about a third of the island. Jakarta, the national capital, is situated in the middle of the northern part of this province. The population densities for Jakarta and West Java province are 1,400 and 700 persons/km^2 respectively indicating highly dense populated areas. Nationwide the population density is about 36 persons/km^2.

In accordance with the large population located in West Java Province, availability of suitable land for agriculture, industrial potential, and strategic importance of the province, its development is expected to continue to be a high national priority, with emphasis on economic development.

The project road, subject of this Study, connects two of the largest cities in West Java Province, Bogor and Bandung. The traffic demand in this section is very high and exceeds the capacity of available roads. The demand is concentrated in the movement of people and goods between the two cities and adjacent areas, and attraction of tourists to the Puncak area. The project road will contribute to meeting this demand which is expected to increase many folds in the future, and also to the development of the Sukabumi area, where the development at present falls behind the other areas of the region.

1.2 Study Objectives

The objectives of the Study called for carrying out the following works:

(1) Formulate a road development plan in the area between Bogor and Bandung for the target year of 2010.

(2) Conduct a feasibility study on the formulated plan with emphasis on staged implementation.

1.3 Study Area

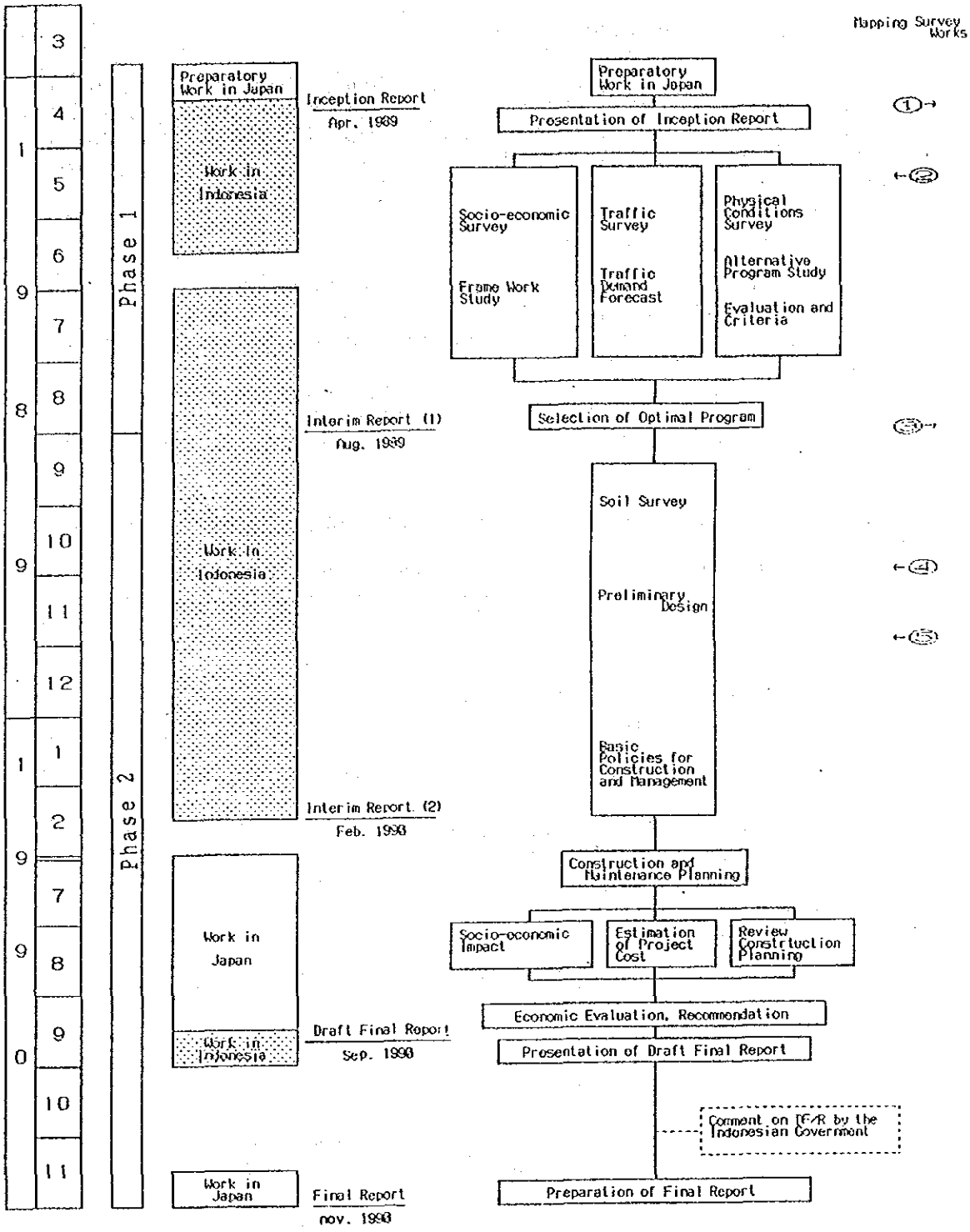
The Study covered the area between Bogor and Bandung and its environs and took into consideration the arterial road networks extending as far as Jakarta, Cikampek, and Sukabumi.

1.4 Scope of the Study

In order to achieve the objectives of the Study, the following items were undertaken.

(1) Review and study of the socio-economic aspects
(2) Traffic surveys and transport inventory surveys
(3) Collection of study related engineering information
(4) Preparation of topographic maps
(5) Selection of prospective road development program
(6) Study of road development program
(7) Evaluation and recommendations

The Study commenced in April 1989 for a duration of 16 months, and was concluded in November 1990.



① Designation of area for collection of existing map.

② Delivery of collected existing map.

③ Designation of aerial photographic area.

④ Partial delivery of completed topography.

⑤ Final delivery of completed topography.

Fig.-1.5.1 General Flow Chart of the Study

1.5 Study Team and Organization

The Study is carried out by the Study Team composed of the consultant team from JICA and their Indonesian counterparts. The Study Team comprises two groups. One is the Feasibility Study Team and the other is the Topographic Mapping Team. Members of these groups are as follows:

Feasibility Study Team

- Dr. Akira ISHIDO	:	Team Leader
- Mr. Akihiko HIROTANI	:	Deputy Leader/Road Planning
- Mr. Hirohisa OHNO	:	Transport and Regional Planning
- Mr. Masayuki ISHIYA	:	Traffic Demand Forecast
- Mr. Shigeru OKUTSU	:	Traffic Survey Planning
- Mr. Tomohisa OHNISHI	:	Traffic Survey
- Mr. Toshihiro HOTTA	:	Road Design and Soil Survey
- Mr. Masatoshi BABA	:	Road Design
- Mr. Nobuhiro KUBOYA	:	Structure Planning/Design
- Mr. Kazuro YANAGIDA	:	Construction Planning and Cost Estimation
- Mr. Hiroshi MITO	:	Landslide Study and Geology
- Mr. Manabu FUJIKAWA	:	Economic and Financial Analysis

Topographic Mapping Team

- Mr. Koichi MIKI	:	Team Leader
- Mr. Kozo TOYODA	:	Supervisor of Ground Control Survey
- Mr. Mitsuo SAITOH	:	- do -
- Mr. Hirohisa OKUHARA	:	Supervisor of Cartography

An Advisory Committee was also organized by JICA. The members of the JICA Advisory Committee are as follows:

- Mr. Kaoru ONO : Chairman
  Ministry of Construction

- Mr. Katsumune SUZUKI : Member
  Ministry of Construction

- Mr. Harutoshi YAMADA : Member
  Ministry of Construction

- Mr. Osamu MATSUO : Member
  Ministry of Construction

- Mr. Yojiro MIYAOKA : Member
  Japan Highway Public Corporation

- Mr. Atsuo OGAWA : Member of
  Japan Highway Public Corporation

The organization chart is shown in Fig.-1.5.2.

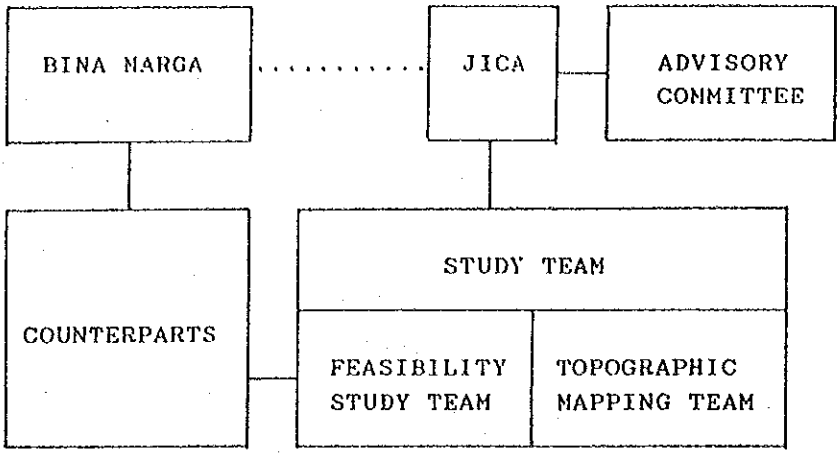


Fig.-1.5.2 Study Organization Chart

The Indonesia Counterpart Team was as follows:

a.	Ir. Moh. Anas Aly Subdit. Perencanaan Teknis Jalan (Subdit. of Road Design) Phone: 712992, 715958	Head Chief
b.	Ir. Saktiyanu Paromo Sidhi Subdit. Perencanaan Teknis Jalan (Subdit. of Road Design) Phone: 712992, 715958	Coordinator
c.	Ir. Baban Sambas --- do ---	Geologist/Soil Engineer
d.	Ir. Eddy Sunyoto --- do ---	Highway Engineer
e.	Ir. Satrio Utomo --- do ---	Highway Engineer
f.	Mr. Imam Prabowo, S.E. --- do ---	Economist
g.	Ir. Dikra Coswara Subdit. Perencanaan Umum (Subdit. of Planning & Program) Phone: 773288	Traffic Engineer
h.	Drs. Edi Prasetyo --- do ---	Traffic Engineer
i.	Mr. Panudjianto, B.E. Subdit. Perencanaan Teknis Jalan (Subdit. of Road Design) Phone: 712992, 715958	Surveyor
j.	Ir. Ibnu Mardjono PT. Jasa Marga	Engineer for Toll Road

CHAPTER 2 EXISTING PHYSICAL AND SOCIO-ECONOMIC CONDITIONS

2.1 General

West Java Province, where the Study Area is situated, occupies the western part of Java island and is located at Longitude 6 to 8 degrees South and Latitude 105 to 109 degrees West. It has a population of approximately 31 million as of 1985.

The Province consists of 20 Kabupaten and 4 Kotamadya. The Study Area covers a part of those administrative zones, namely Bandung, Bogor, Sukabumi and Cianjur Kabupaten and Bandung, Bogor and Sukabumi Kotamadya. Apart from administrative zoning the Province is divided into 7 economic development regions. The Study Area spans over the development regions of Botabek, Sukabumi and Bandung.

Economic activities are significant in and surrounding Jakarta area in all of West Java Province. Employment rate is high in the province. Almost half the work force is employed in the primary sector followed by tertiary with one third.

As to the per capita Gross Regional Domestic Product, Sukabumi development region registered the lowest of all the regions in West Java, as of 1986. Growth rate of Sukabumi was also lower than the average of all the provinces.

As of 1987, 387,846 vehicles were registered in West Java Province. The number has been growing annually by 8.0 percent in the last 7 years.

Land use in West Java is mostly rice paddy fields (26.9%), followed by orchards (19%). Much area is urbanized near Jakarta and this generates a radial influence on the adjacent areas.

In this chapter, details of existing physical and socio-economic conditions are presented.

2.2 Physical Conditions

2.2.1 Climate

Fig.-2.2.1 shows the climate data, temperature and precipitation. The average temperature in Indonesia is 27 degrees in the coastal areas and 25 degrees inland. The data pertaining to the Study Area shows the northern coast to be hot on average, with the inland, especially Bandung, situated in the highlands at the center of West Java Province, being much cooler.

Rainfall is heavier around Bogor located west of Mt. Pangrango and north of Mt. Salak, but decreases along the northern coast. The period of December to February is wet while the remainder of the year, described as the dry season, has lesser rainfall.

2.2.2 Topography

In general the northern part of West Java is composed of low land of some 40 km width while the rest of the area is hilly to mountainous terrain, with a zone of depression at Sukabumi - Cianjur - Bandung - Tasikmalaya. Elevations of mountains in the region, some of which are volcanoes, reach 3000 m (Fig.-2.2.2).

The Study Area is located in the central part of West Java. Volcanoes may be found in this area such as G. Salak, G. Pangrange, and G. Gede. Basins are lcoated between the mountains, such as Cianjur basin and Bandung basin which were formed as a consequence of geological structures created in Java.

Watersheds are formed by the mountainous areas located in central West Java. Two watersheds exist in the Study Area, one is near the boundary of Kabupaten Bogor and Sukabumi, and the other is near the Sukabumi and Cianjur boundary. Many rivers are flowing in the Study Area, northward towards the Java sea, such as Cilliwang, Cileungsir, and Citarum rivers, and Cisadane river flows southward to the Indian Ocean.

2.2.3 Geology

1) General

In geological terms West Java may be divided into four zones; southern mountainous zone; Bandung zone; Bogor zone; and the low land zone along the Java sea. The Study Area is located in the Bandung zone (Fig.-2.2.3).

Bandung zone is a longitudinal belt of intermontane depressions. The belt has a width generally of 20 to 40 km. It extends from the Pelabuhan Raty Bay in the east, via the Cimandri Valley (through Sukabumi, 600 m), the upland plains of Cianjur (460 m), Bandung (715 m), and Garut (710 m), to the Citanduy Valley (with Tasikmalaya, 350 m) in the west, and ending in the Segara Anakan at the south coast of Central Java. The zone takes its name from the main town lying within it.

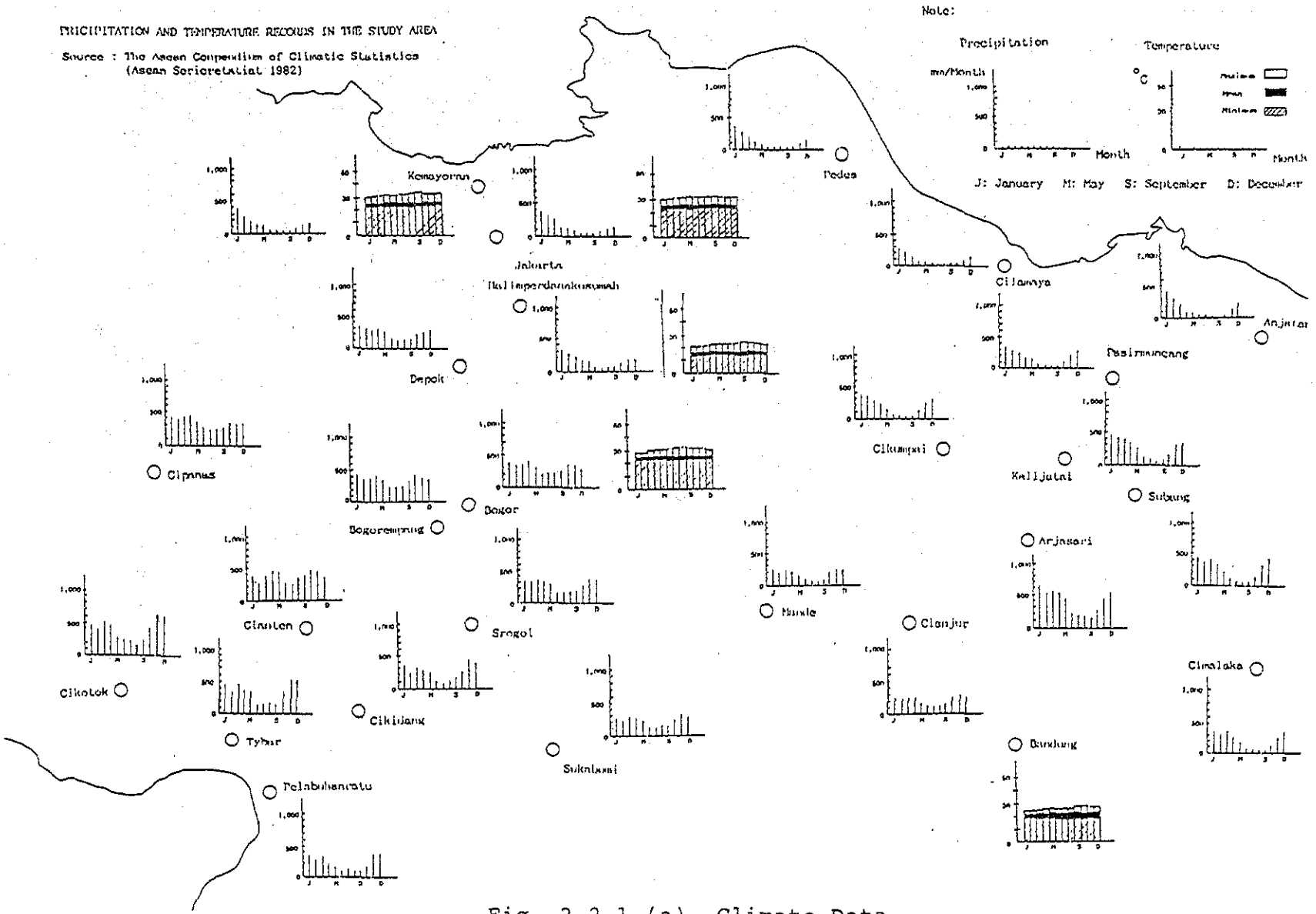
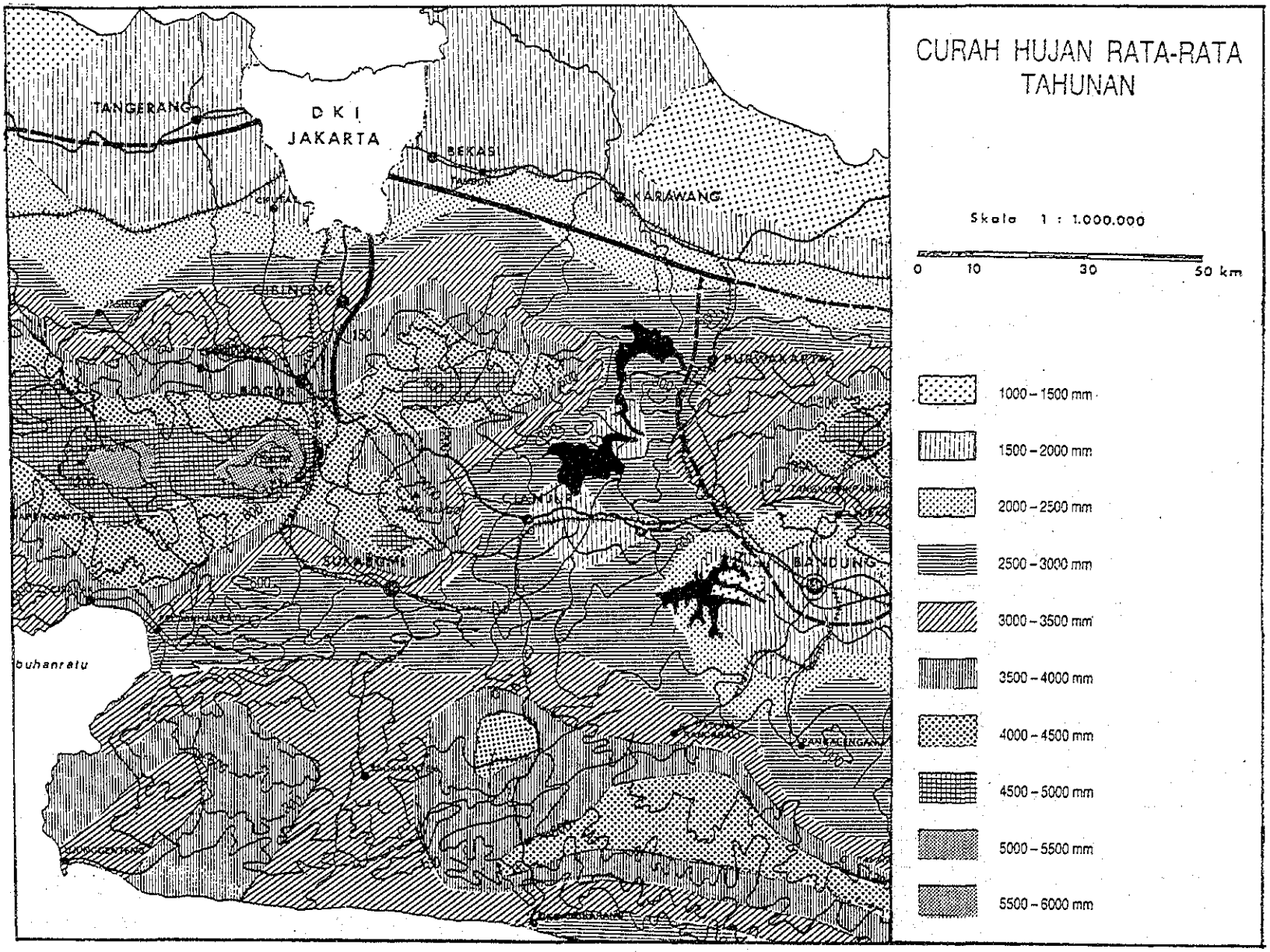
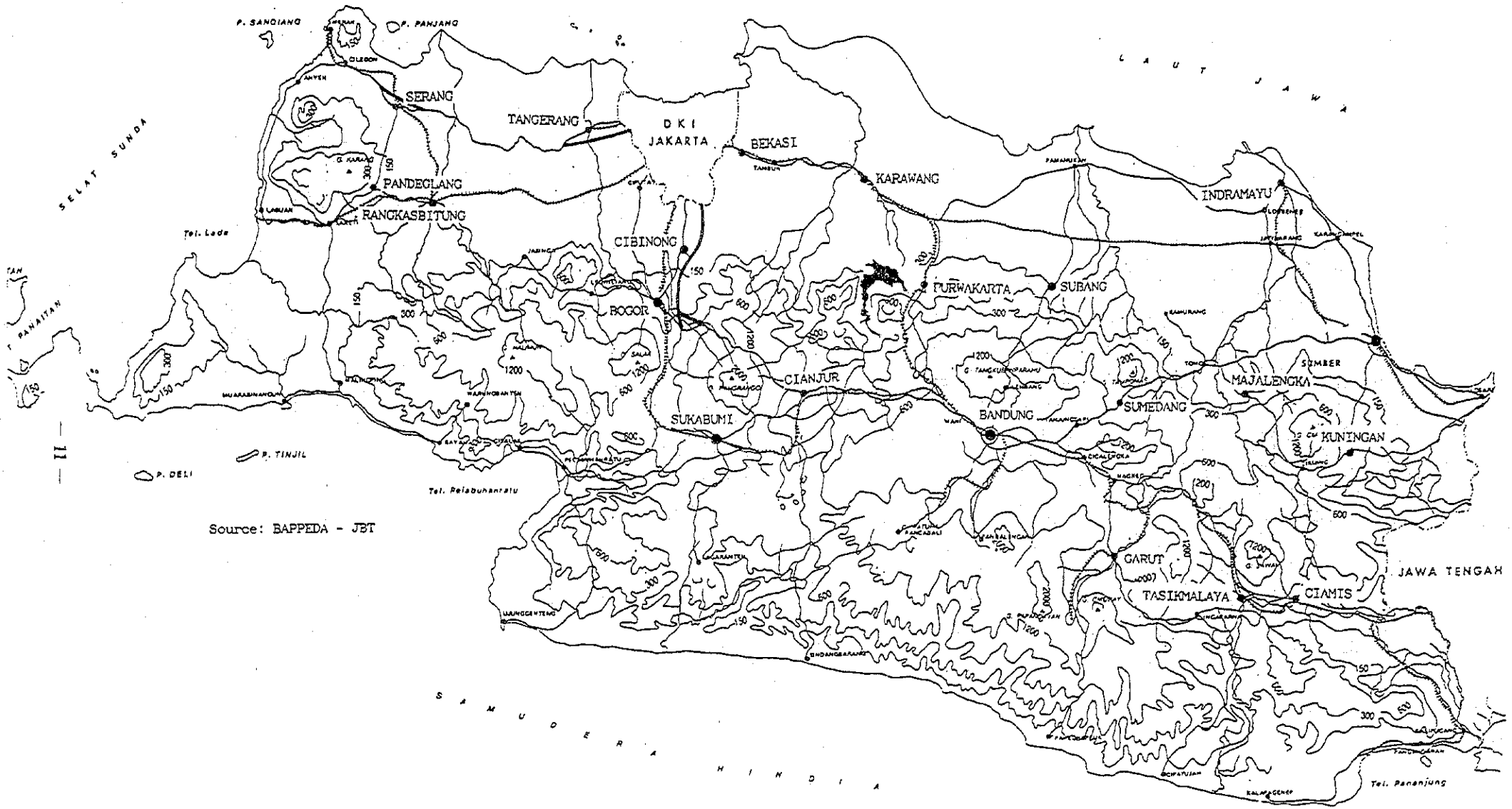


Fig. 2.2.1 (a) Climate Data



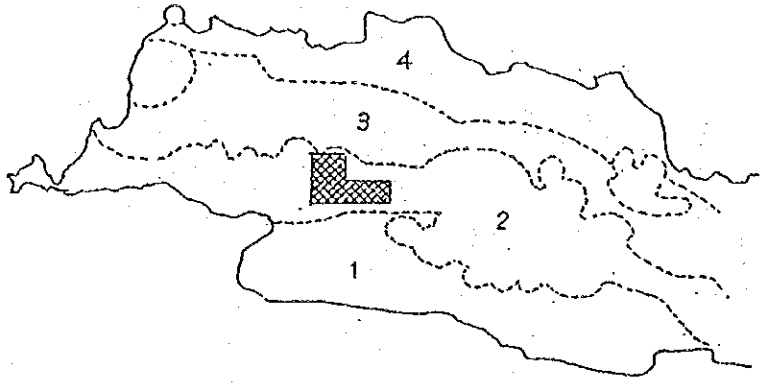
Sumber : BADAN METEOROLOGI DAN GEOFISIKA
TH 1931 – 1960

Fig.-2.2.1 (b) Climate Data



Source: BAPPEDA - JBT

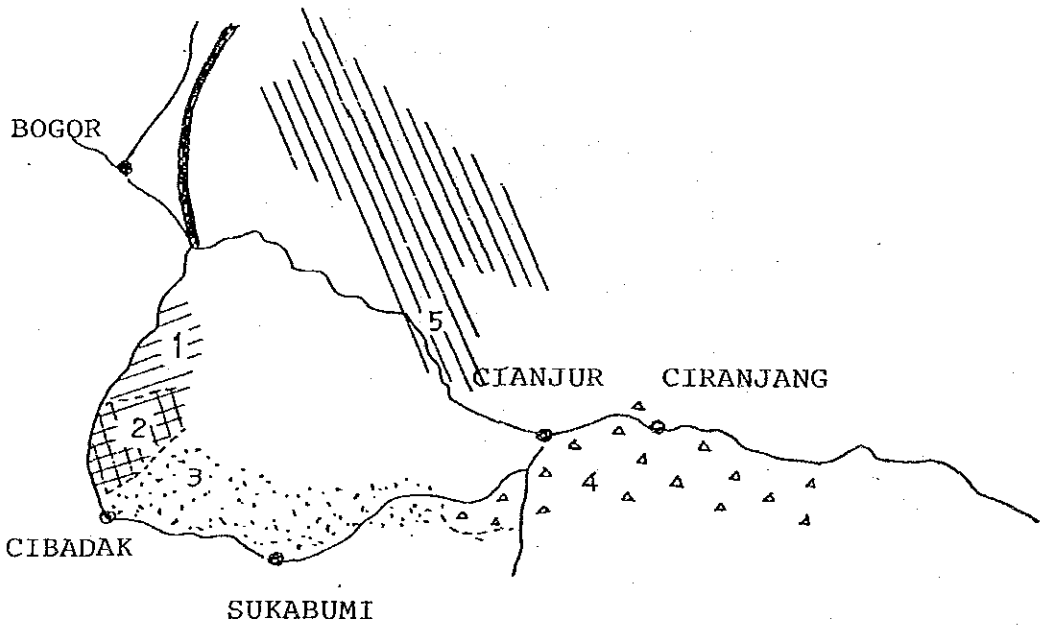
Fig.-2.2.2 Elevations



1. Southern Mountains
2. Bandung Area
3. Bogor Zone
4. Lower Land

Study Area

Fig.-2.2.3 Zoning by Geological Features



1. Complex Meander of Narrow Valleys
2. Alternating Deep and Wide Valleys and Ridges
3. Development of Narrow Parallel Valleys
4. Conical Hills
5. Mountain Area

Fig.-2.2.5 Distribution of Geological Features

This zone is structurally the top part of the geanticline of Java, which has broken down after or during its arching up at the end of the Tertiary period, as well as the north flank of the Java geanticline attaining a width of 40 km.

The border between the Bogor zone is capped by a series of quaternary volcanoes such as; Kendeng, 1,347 m; Gagak, 1,511 m; Sala, 2,211 m; Pangrano - Gede, respectively 3,019 m and 2,953 m; Sunda complex, north of Bandung, with Burangrang, 2,064 m, Tangkuban Perhau, 2,076 m, and Bukittunggal, 2,209 m; Calancang, 1,667 m; and Cakrabuwana, 1,721 m.

The Bandung zone is partially filled by young volcanic and alluvial deposits, but these unused plains are occasionally interrupted by hills and ridges of tertiary rocks.

As previously mentioned, quarternary volcanoes such as G. Salak, G. Pangrano and G. Gede are located in the Study Area. Volcanic eruptions occur in the older and younger deposits and produce lahar, lava, breccia, and tuff. Tertiary strata may be found in the southern part of Cianjur, eastern end of the Study Area, and north of the Puncak pass. Tertiary strata are composed of sandstone, shale, marl, clay, etc. signifying complicated geological structures.

Table-2.2.1 shows the stratigraphy between Cianjur and Padalarang.

2) Geological Formation along the Study Area

According to the geological map produced by the Geological Survey of Indonesia, Ministry of Mines (Fig.-2.2.4), geological formations along the Study Road can be summarized as follows;

(a) Ciawi - Puncak Pass

The Study Road climbs the northern slope of G. Gede along Ciliwung River, crossing it from time to time.

North of the River;
- Breccia and lava from G. Kencana and Gl. Limo. (Qvk)
- Blocks of andesitic tuff and andesitic breccia with abundant pyroxene phenocrysts and basaltic lava.

South of the River;
- Volcanic rocks of G. Pangrango. (Gvpo)
- Older deposits, lahar and lava, andisitic basalt with oligoclase - andesine, labradorite, olivine, pyroxene, and hornblende.
- Young deposits, lahar, andesitic in composition are meanwhile developed much farther south in the south-west direction.

Off-course to South at Puncak Pass;
- Basalt flow from G. Gegerbentang, exposed at south of Puncak Pass. (Gvba)

Table-2.2.1 Stratigraphy of the Cianjur - Padalarang Section of the Bandung Zone

Age	Stratigraphy	Composition
Holocene & Younger Pleistocene	Young quaternary volcanics (Gede, Burangrang)	Fluviatile volcanic deposits and tuffs
Lower Pleistocene	Older quaternary volcanics (Tambakan Beds)	Fluviatile volcanic & black clays in the Citarum (Batujajar)
Lower to Middle Miocene	Upper Citarum Beds	Coarse, andesitic-dacitic conglomerates and sandstones with limestone lenses
		Dacitic pumicebreccia
	Lower Citarum	Hard andesitic (and daitic) sandstones & clay shales (Upper & Lower Citarum Beds together are 3,400 m thick)
Lower Miocene and Oligo-Miocene	Globigerina-marl Horizon	Soft marls
	Masigit and Tagogapu Limestones	Dense reef limestones, some hundreds of meters thick. At the base rich in quartz grains, or conglometric beds.
Oligocene	"Oligocene"	Marly clay shales and sub-ordinate quartz-sandstones

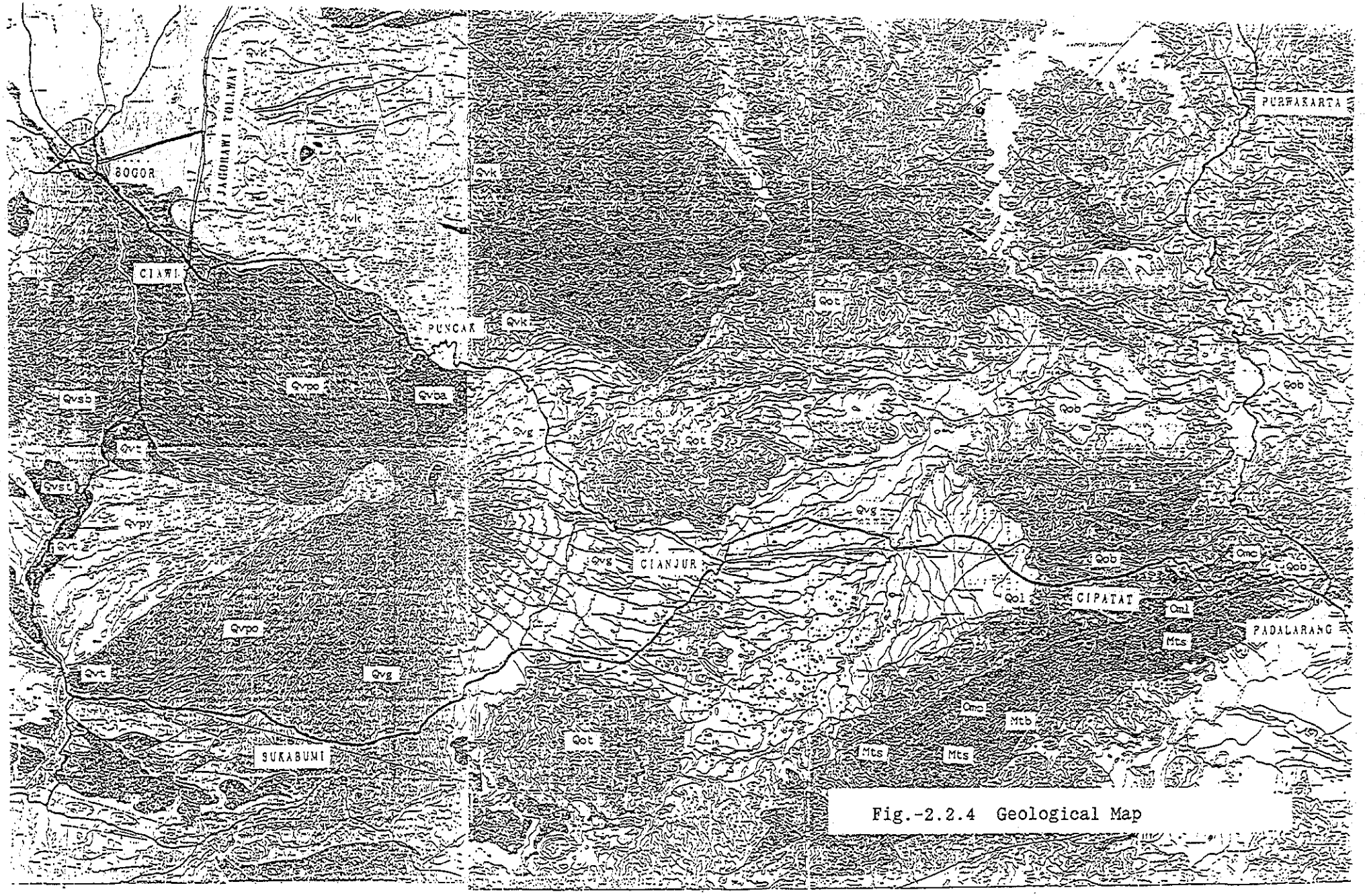


Fig.-2.2.4 Geological Map

(b) Puncak Pass - Cianjur

The Study Road runs down the eastern slope of G. Gede, crossing several rivers which later join Cikundut River and then Citarum River.
Major Formation;
- Breccia and volcanic rocks of G. Gede. (Qvg) (0 - 100 m+)
- Tuffaceous breccia and lahar; andesites with oligoclase-andesine, pyroxene and abundant hornblende, tachytic texture, mostly highly weathered.
- Younger lava flow can be observed remaining at the summit.

North of the Study Road near Cianjur;
- Oldest volcanic products, believed to be the result of activities of the G. Gede - Pangrano Complex. (Qot) (0 - 550 m)
- Breccia and lava; Pyroxene andesites breccia intercalated with andesitic lava. Commonly propylitized forms large isolated hilly and are surrounded by Qvg near Cianjur.

(c) Cianjuc - Citarum River Crossing

The Study Road runs on a plain at the lower east side slope of G. Gede.
Major Formation;
- Breccia and volcanic rocks of G. Gede. (Qvg) (0 - 100 m+) (See previous comments)

(d) Citarum River Crossing - Padalarang

The Study Road climbs a small hill at Cipatat to reach the Bandung plain.
Major Formation;
- Older volcanic products. (Qob) (0 - 150 m)
- Breccia, lahar, lava; volcanic breccia, flow breccia, lahar deposits, and lava showing sheet and columnar jointing. The composition is between andesites and basalt.

At the Citarum Crossing;
- Lake deposit in Qob, described above. (Qol) (0 - 50 m)
- Sedimentations well-bedded tuffaceous clay, sandstone, conglomerate, and breccia around Rajhamandala bridge. Shows cannel filling and cross bedding.

East of Cipatat;
- Citarum formation. (Mts) (1,200 m)
  Sandstone - siltstone member; well bedded sandstone interclated with siltsone, claystone, greywacke, and breccia. Shows typical features of turbidites. Sedimentary structure such as graded bedding, convolute lamination, current ripple lamination, worm tracks, etc. are abundantly displayed.
- Citarum formation. (Mtb) (800 m+)
  Breccia and sandstone member; polymict breccia with basaltic, andesitic, and limestone components.
  Conglomerate, sandstone, and siltstone. Horblende abundant.

- Radjamandala formation. (Omc) (1,150 m)
  Clay, marl, and quartz sandstone member: dary gray to black clay, marly clay, globigreina marl, quartz sandstone and quartz-pebby conglomerate. Contains mica sandstone and quartz-pebbly conglomerate. Contains mica flakes, coal stringers and resin.
- Radjamandala formation. (Oml) (0 - 650 m)
  Limestone member; light colored, massive to indistincly bedded limestone with abundant large foraminifera.

(e) Ciawi - Cibadak - Sukabumi - Cianjur

The highway circles around the southern periophery at the foot of G. Gede - Pangrango complex, at an elevation of approximately 1,000 m west till 400 m just before Cianjur to the east.
Major formations along the highway;
- Volcanic Rocks of G. Pangrango (Qvpo)
  (see previous comments)
- Volcanic Rocks of G. Pangrango (Qvpy)
  Younger deposits, lahar, andesitic in composition.
- Older Volcanic Rocks (Qvt)
  Pumiceous tuff
- Younger Volcanic Rocks (Qvsb)
  Lahar, tuffaceous breccia and lapilli, basaltic andesites in composition, mostly strongly weathered.
- Younger Volcanic Rocks (Qvst)
  Sandy pumiceous tuff. In the vicinity of Cicurug, pumiceous tuff, locally called trass, is quarried for building material.
- Volcanic Rock of G. Gede (Qvg)
  (See previous comments)

3) Summary of Geological and Topographical Features

The results of the aerial photographs interpretation and geological observations are summarized in this section.

The Study Area is composed of volcanic complex. However tertiary strata partially exist near Cibadak, the eastern part of the southern route of the Study Area and north of Puncak route. Volcanic complex generally comes from G. Pangrange and G. Gede. The complex consists of lahar, lava, breccia and tuff which can be classified into older and younger deposits. Older deposits are abundant in the Study Area.

Another feature is the presence of many conical hills consisting of basalt blocks near Cianjur basin. Existing geological maps prepared by geological field survey do not clearly show the strata distribution.

In general the topography of the Study Area is simple, covered by mountains and highland, although erosion in the valleys is very complicated. Through aerial photography interpretation the features of the eroded valleys can be classified into three groups.

Conclusively, the geological and topographical characteristics may be divided into the following five groups (Fig.-2.2.5);

(a) Areas of complex narrow meandering valleys
(Southern parts of Kabupaten Bogor)
(b) Areas of alternating deep and wide valleys and ridges
(Northern parts of Kabupaten Sukabumi)
(c) Areas of development of parallel narrow valleys
(Northern parts from Cibadak to Sukabumi)
(d) Areas of conical hills
(Southern parts of Cianjur to eastern end of the Study Area)
(e) Mountain areas
(Puncak pass and north of Puncak route)

Considerations derived from the engineering standpoint are described in Chapter 5.

2.3 Socio-Economic Conditions

2.3.1 Administrative Structure and Development Regions

The Republic of Indonesia (hereinafter referred to as ROI) consists of the main islands of Java, Sumatra, Kalimantan, Sulawesi, and Irian Jaya and has a total of over 13,000 islands.

Administratively, the ROI has 5 levels of hierarchy (Fig.-2.3.1). At the national level, the country is divided into 3 special districts (DI. Aceh, DKI Jakarta and DI Yogyakarta) and 24 provinces, each of which posesses the same first level of autonomy (tingkat 1). DI Aceh, DI Yogyakarta and each province are divided into Kabupaten (regencies) and Kotamadya (municipalities), each of which possesses the same second level of autonomy (Tingkat 2). DKI Jakarta is also divided into 5 Wilayahs, each of which posesses the second level of autonomy.

Java Island consists of 2 special districts (Jakarta and Yogyakarta) and 3 provinces (West Java, Central Java and East Java). West Java Province is divided into 20 Kabupaten (Regencies) and 4 Kotamadya (Municipalities), as shown in Fig.-2.3.2.

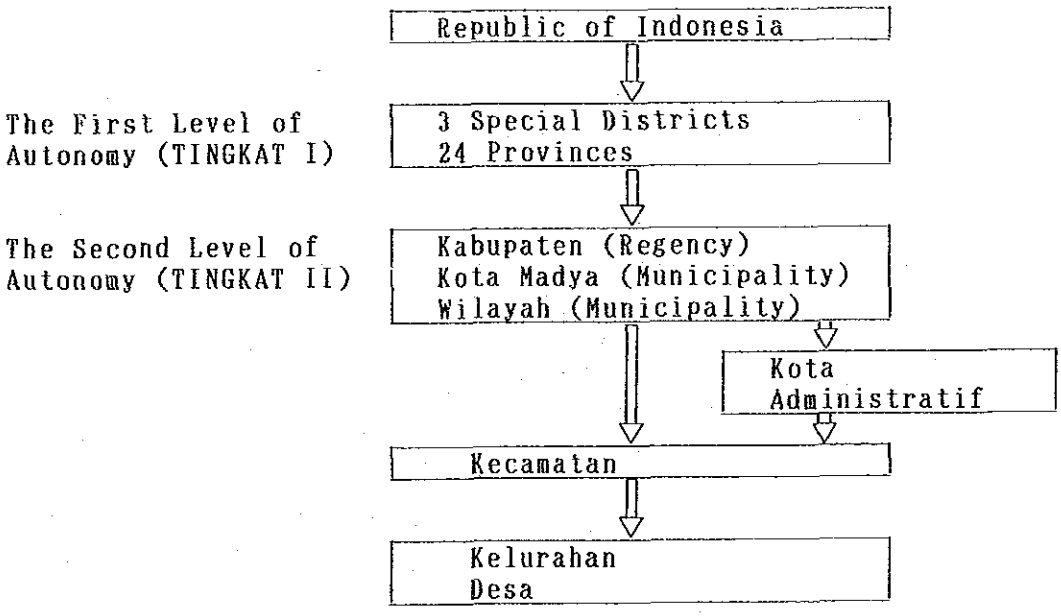
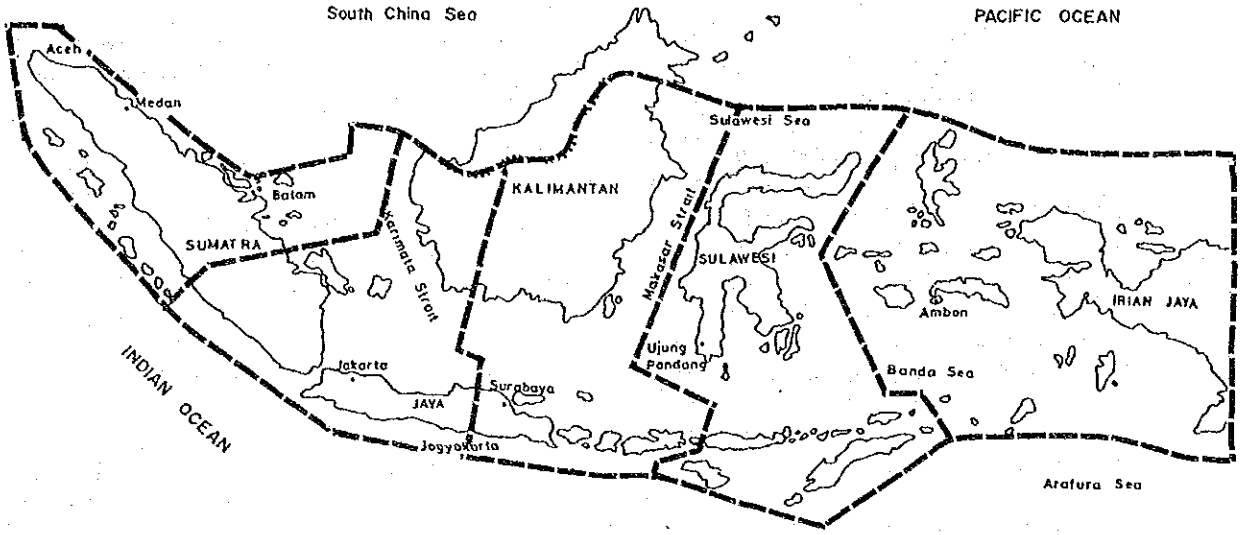


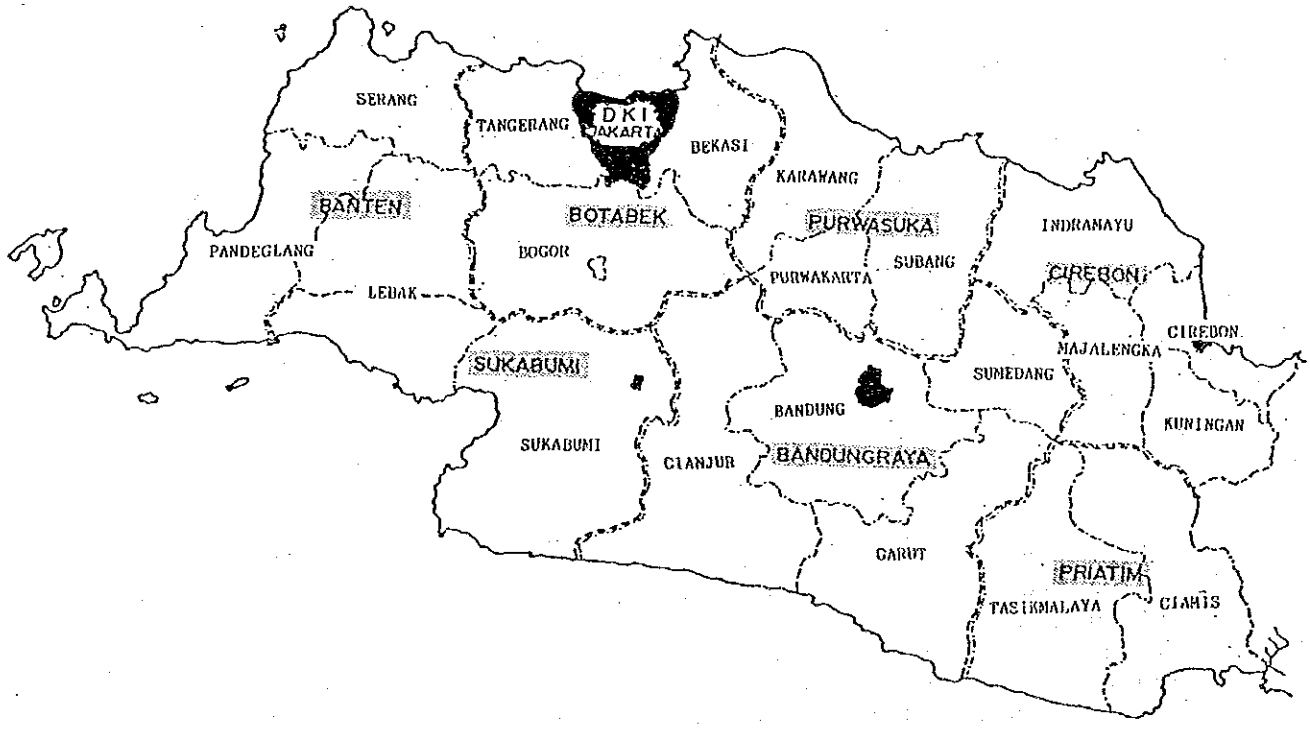
Fig.-2.3.1 Administrative Structure in Indonesia

According to the National Development Plan (Pelita V), the ROI is divided into 5 Major Regional Development Units (SWP Utama) at the national level (Fig.-2.3.2), so as to realize an overall balanced development plan for each region. These major regional development units are broken down into the 27 provincial level development units (SWP-Provinces) based on administrative boundary. The 27 provincial SWP are further broken down into a total of 112 regional development units (SWP-Kabupaten) based on their functional hierarchies and service area of existing cities.

SWP UTAMA IN INDONESIA



DEVELOPMENT REGION & KABUPATEN IN WEST JAVA



FEASIBILITY STUDY ON BOGOR - BANDUNG ROAD PROJECT	Fig.-2.3.2 Administrative Boundary

The study area lies in West Java Province which consists of 7 SWP (Kabupaten level) as shown in Fig.-2.3.2 and is located within 3 development regions, namely Botabek, Sukabumi and Bandung Raya.

2.3.2 Population

The population of the ROI is approximately 164 million persons according to the 1985 Intercensus. (Table-2.3.1)

The population of the ROI grew annually at a rate of 2.3% in the 1970's and at 2.1% from 1980 to 1985. Although the annual growth rate decreased slightly in the 1980's, it still remains at a high level (Table-2.3.2).

The population of Java Island is about 100 million persons (1985 Intercensus) which corresponds to around 61% of the total population in Indonesia, however, its land area occupies only around 7% of the total land area of Indonesia.

DKI Jakarta has progressed rapidly at an average rate of 4%, and is becoming one of the major population centers in Asia.

West Java has approximately 31 million persons (1985 Intercensus) and the population grew annually at a rate of 2.7% during the 1970's and 2.3% from 1980 to 1985. The proportion of West Java population to the total population in Indonesia constantly ranged between 18% to 19% through the 1971-1985 period.

Table-2.3.1 Total Population

Unit: 1,000 persons, (%)

ISLAND	1971 CENSUS		1980 CENSUS		1985 INTERCENSUS	
JAVA	76,029	(64.2)	91,217	(62.1)	99,853	(60.9)
DKI JAKARTA	4,546	(3.8)	6,481	(4.4)	7,886	(4.8)
WEST JAVA	21,621	(18.3)	27,450	(18.7)	30,830	(18.8)
CENTRAL & EAST JAVA	49,862	(42.1)	57,286	(39.0)	61,137	(37.3)
OTHER ISLANDS	42,339	(35.8)	55,559	(37.9)	64,194	(39.1)
INDONESIA	118,368	(100.0)	146,776	(100.0)	164,047	(100.0)

Source: HASIL SENSUS PENDUDUK 1971, 1980
HASIL SURVEI PENDUDUK ANTAR SENSUS 1985

Table-2.3.2 Annual Population Growth Rate

Unit: (%)

	1971-1980	1980-1985
DKI JAKARTA	4.02	4.00
West Java	2.66	2.28
Central & East Java	1.55	1.31
Indonesia	2.32	2.13

Source: LTA-47

The average annual growth rate of most kabupaten and kotamadya in West Java exceeded 2.0% during the 1970's, as shown in Table-2.3.3. In particular Kabupaten Bekasi, Kabupaten Bogor and Kabupaten Tangerang, which are becoming a part of Metropolitan Jakarta, and Kabupaten Bandung recorded an average annual growth rate of over 3.0%.

All Development Regions, except Priatim, experienced accelerated growth in 1971-1980 compared with the 1961-1971 period. Between 1971 and 1980, the annual population growth in the Development Region Botabek (4.13%) was the highest among all the Development Regions in West Java and far exceeded them. Low population growth rates occurred in Kab. Ciamis (1.23%), Kab. Sumedang (1.41%) and Kod. Sukabumi (1.49%).

Table-2.3.3 Annual Population Growth Rate between 1961 and 1985 in West Java

	Ground Rate (%)			Population
	1961-1971	1971-1980	1980-1985	(1985)
WP Banten	2.26	2.57	2.26	
- Kab. Serang	1.83	2.88	2.52	1,256
- Kab. Pendeglang	2.69	2.17	1.89	763
- Kab. Lebak	2.50	2.51	2.20	761
WP Botabek	2.33	4.13	3.53	
- Kab. Tangerang	2.32	4.08	3.49	1,815
- Kab. Bogor	2.50	4.57	3.83	3,009
- Kab. Bekasi	1.86	3.61	3.16	1,336
- Kodya Bogor	2.92	2.65	2.35	277
WP Purwasuka	1.95	2.18	1.88	
- Kab. Karawang	1.89	2.35	2.00	1,365
- Kab. Purwakarta	2.50	2.35	2.12	509
- Kab. Subang	1.79	1.91	1.62	1,154
WP Sukabumi	2.34	2.47	2.18	
- Kab. Sukabumi	2.36	2.54	2.24	1,696
- Kodya Sukabumi	2.02	1.49	1.29	117
WP Bandung Raya	2.31	2.57	2.23	
- Kab. Bandung	2.37	3.34	2.90	3,079
- Kab. Cianjur	2.33	2.35	2.02	1,534
- Kab. Garut	2.74	2.38	2.05	1,642
- Kab. Sumedang	1.53	1.41	1.15	766
- Kodya Bandung	2.20	2.21	1.88	1,604
WP Cirebon	1.71	2.41	2.11	
- Kab. Cirebon	1.46	2.76	2.43	1,501
- Kab. Indramayu	1.32	2.56	2.27	1,384
- Kab. Kuningan	2.92	1.99	1.77	858
- Kab. Majalengka	1.60	2.03	1.75	979
- Kodya Cirebon	1.66	2.53	1.99	247
WP Priatim	2.32	1.72	1.42	
- Kab. Tasikmalaya	2.68	2.17	1.85	1,746
- Kab. Ciamis	1.94	1.23	0.90	1,430

Source: LTA-47

The census taken in 1980 was the first census in which criteria was established to classify a settlement into urban area and rural area. The criteria for urban area classification is as follows.

a. A population density of more than 5,000 inhabitants per square km.
b. Not more than 25% of the households engaged in agricultural sector as basic income source.
c. At least eight of the following 14 urban facilities should be available: motorized public transportation, movie

theater, primary school, junior high school or senior high school, health clinic, maternity clinic, public health center, post office, bank, indoor market, shopping place, boarding house or hotel, and rental house with party equipment.

Tables-2.3.4 and 2.3.5 show the urban and rural populations, and their composition rates respectively for the Study related areas. The urban and rural populations are further broken down by development region, Kabupaten and Kotamadya as shown in Table-2.3.6. The proportion of urban population in West Java is almost the same as that of Central and East Java, and in 1985 occupied about one forth of the total population, however, the progress of urbanization in West Java is a little faster than the rest of Java Island.

According to the 1980 Census figures for the development regions related to the Study, Bandung Raya with an urban population proportion of 33.2% is far superior than that of West Java (20.8%), while proportions in Botabek (23.9%) and Sukabumi (19.2%) are nearly the same as the West Java average proportion.

Fig.-2.3.3 shows the distribution of population density in 1987.

Table-2.3.4 Urban and Rural Population

Unit: x1,000 persons

	1971 Census		1980 Census		1985 Census	
	Urban	Rural	Urban	Rural	Urban	Rural
DKI Jakarta	4,546	0	6,072	409	7,149	737
West Java	2,683	18,938	5,716	21,734	8,278	22,553
C & E Java	6,446	43,416	11,084	46,203	14,890	46,247
INDONESIA	20,465	97,902	32,846	113,931	43,030	121,017

Souce: HASIL SENSUS PENDUDUK 1971, 1980
HASIL SURVEI PENDUDUK ANTAR SENSUS 1985

Table-2.3.5 Composition Rate of Urban and Rural Population

Unit: %

	1971 Census		1980 Census		1985 Census	
	Urban	Rural	Urban	Rural	Urban	Rural
DKI Jakarta	100.0	0.0	93.7	6.3	90.7	9.3
West Java	12.4	87.6	20.8	79.2	26.8	73.2
C & E Java	12.9	87.1	19.3	80.7	24.4	75.6
INDONESIA	17.3	82.7	22.4	77.6	26.2	73.8

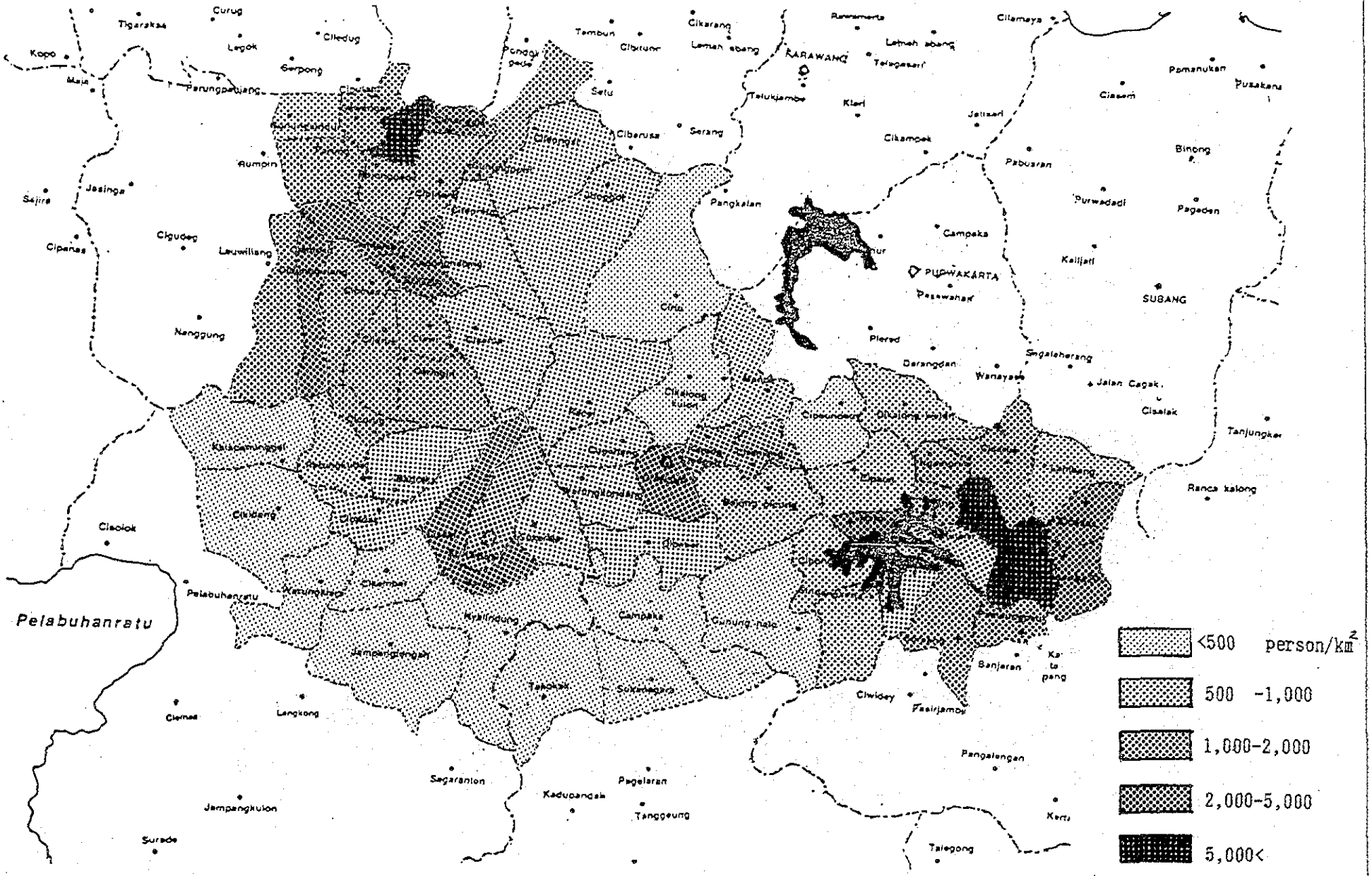
Souce: HASIL SENSUS PENDUDUK 1971, 1980
HASIL SURVEI PENDUDUK ANTAR SENSUS 1985

Table-2.3.6 Total Population and Urban/Rural Population in West Java in 1980

Unit: 1,000 persons, (%)

	Urban	Rural	Total
BANTEN	194.8 (7.8)	2,292.0 (92.2)	2,486.8 (100.0)
KAB.SERANG	121.6 (11.0)	987.5 (89.0)	1,109.1 (100.0)
KAB.PANDEGLANG	47.3 (6.8)	647.5 (93.2)	694.8 (100.0)
KAB.LEBAK	25.9 (3.8)	657.0 (96.2)	682.9 (100.0)
BOTABEK	1,294.5 (23.9)	4,118.8 (76.1)	5,413.3 (100.0)
KAB.TANGERANG	232.9 (15.2)	1,296.1 (84.8)	1,529.0 (100.0)
KAB.BOGOR	626.0 (25.1)	1,867.9 (74.9)	2,493.9 (100.0)
KAB.BEKASI	188.7 (16.5)	954.8 (83.5)	1,143.5 (100.0)
KOD.BOGOR	246.9 (100.0)	0.0 (0.0)	246.9 (100.0)
PURWASUKA	358.5 (13.0)	2,401.2 (87.0)	2,759.7 (100.0)
KAB.KARAWANG	171.5 (13.9)	1,065.1 (86.1)	1,236.6 (100.0)
KAB.PURWAKARTA	78.7 (17.2)	379.2 (82.8)	457.9 (100.0)
KAB.SUBANG	108.3 (10.2)	956.9 (89.8)	1,065.2 (100.0)
SUKABUMI	312.8 (19.2)	1,314.8 (80.8)	1,627.6 (100.0)
KAB.SUKABUMI	202.9 (13.4)	1,314.8 (86.6)	1,517.7 (100.0)
KOD.SUKABUMI	109.9 (100.0)	0.0 (0.0)	109.9 (100.0)
BANDUNG RAYA	2,564.6 (33.2))	5,160.2 (66.8)	7,724.8 (100.0)
KAB.BANDUNG	638.4 (23.9)	2,030.8 (76.1)	2,669.2 (100.0)
KAB.CIANJUR	179.2 (12.9)	1,208.4 (87.1)	1,387.6 (100.0)
KAB.GARUT	196.8 (13.3)	1,286.2 (86.7)	1,483.0 (100.0)
KAB.SUMEDANG	88.8 (12.3)	634.8 (87.7)	723.6 (100.0)
KOD.BANDUNG	1,461.4 (100.0)	0.0 (0.0)	1,461.4 (100.0)
CIREBON	666.9 (14.9)	3,810.0 (85.1)	4,476.9 (100.0)
KAB.CIREBON	236.4 (17.8)	1,095.3 (82.2)	1,331.7 (100.0)
KAB.INDRAMAYU	78.1 (6.3)	1,159.4 (93.7)	1,237.5 (100.0)
KAB.KUNINGAN	52.9 (6.7)	733.5 (93.3)	786.4 (100.0)
KAB.MAJELENGKA	104.7 (11.7)	793.0 (88.3)	897.7 (100.0)
KOD.CIREBON	194.8 (87.1)	28.8 (12.9)	223.6 (100.0)
PRIATIM	323.7 (10.9)	2,637.1 (89.1)	2,960.8 (100.0)
KAB.TASIKMALAYA	241.0 (15.1)	1,352.2 (84.9)	1,593.2 (100.0)
KAB.CIAMIS	82.7 (6.0)	1,284.9 (94.0)	1,367.6 (100.0)
WEST JAVA	5,715.8 (20.8)	21,734.1 (79.2)	27,449.9 (100.0)

Source: HASIL SENSUS PENDUDUK 1980



Feasibility Study on Bogor- Bandung Road Project

Fig.-2.3.3 Distribution of Population Density (1987)