

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

**THE FEASIBILITY STUDY
OF
THE LOCAL ROAD DEVELOPMENT
IN THE REPUBLIC OF INDONESIA**

FINAL REPORT

MAIN REPORT

MARCH 1986

JAPAN INTERNATIONAL COOPERATION AGENCY

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国際協力事業団		
受入 月日	'87.5.21	108
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PREFACE

In response to the request of the Government of the Republic of Indonesia, the Government of Japan decided to conduct a feasibility study of the Local Road Development in the Republic of Indonesia, and entrusted the study to the Japan International Cooperation Agency (JICA).

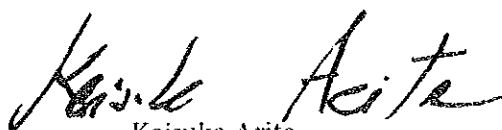
The JICA sent to Indonesia a study team headed by Mr. Nobutaka Sato of Pacific Consultants International from October 1984 to March 1985 for Phase I Study and from June 1985 to December 1985 for Phase II Study.

The team had discussions on the study with the officials of the Government of Indonesia and conducted a feasibility study of the proposed works in 38 Kabupatens of 10 provinces. After the team returned to Japan, further studies were made and the present report has been prepared.

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

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

March 1986



Keisuke Arita
President

JAPAN INTERNATIONAL COOPERATION AGENCY

LETTER OF TRANSMITAL

March 1986

Mr. Keisuke Arita
President
Japan International Cooperation Agency

Dear Sir:

It is my great pleasure to submit herewith the Report of the Feasibility Study of the Local Road Development in the Republic of Indonesia.


This report is the result of studies carried out by the Study Team consisting of experts of Pacific Consultants International and Kyowa Engineering Consultants of Japan. During the service period, the Study Team evaluated the feasibility of improvement of each Kabupaten road in the Project Area, totalling about 2,200 in number of road link and 19,000 km in cummulated length, and prepared an implementation programme for the development of proposed Kabupaten roads in each Kabupaten.

The Study Team has completed the above service with a firm belief that implementation of such Local Road Development Projects will significantly contribute to the promotion of a balanced regional development within relevant developing rural areas in Indonesia.

On behalf of the Study Team, I wish to express herewith our heartfelt thanks to the officials concerned of the Government of the Republic of Indonesia for the generous cooperation, assistance and warm hospitality they extended to us during our stay in Indonesia.

Our thanks are also due to the Japan International Cooperation Agency and the JICA Advisory Committee for their valuable advice and support during the studies and preparation of this report.

Yours faithfully,

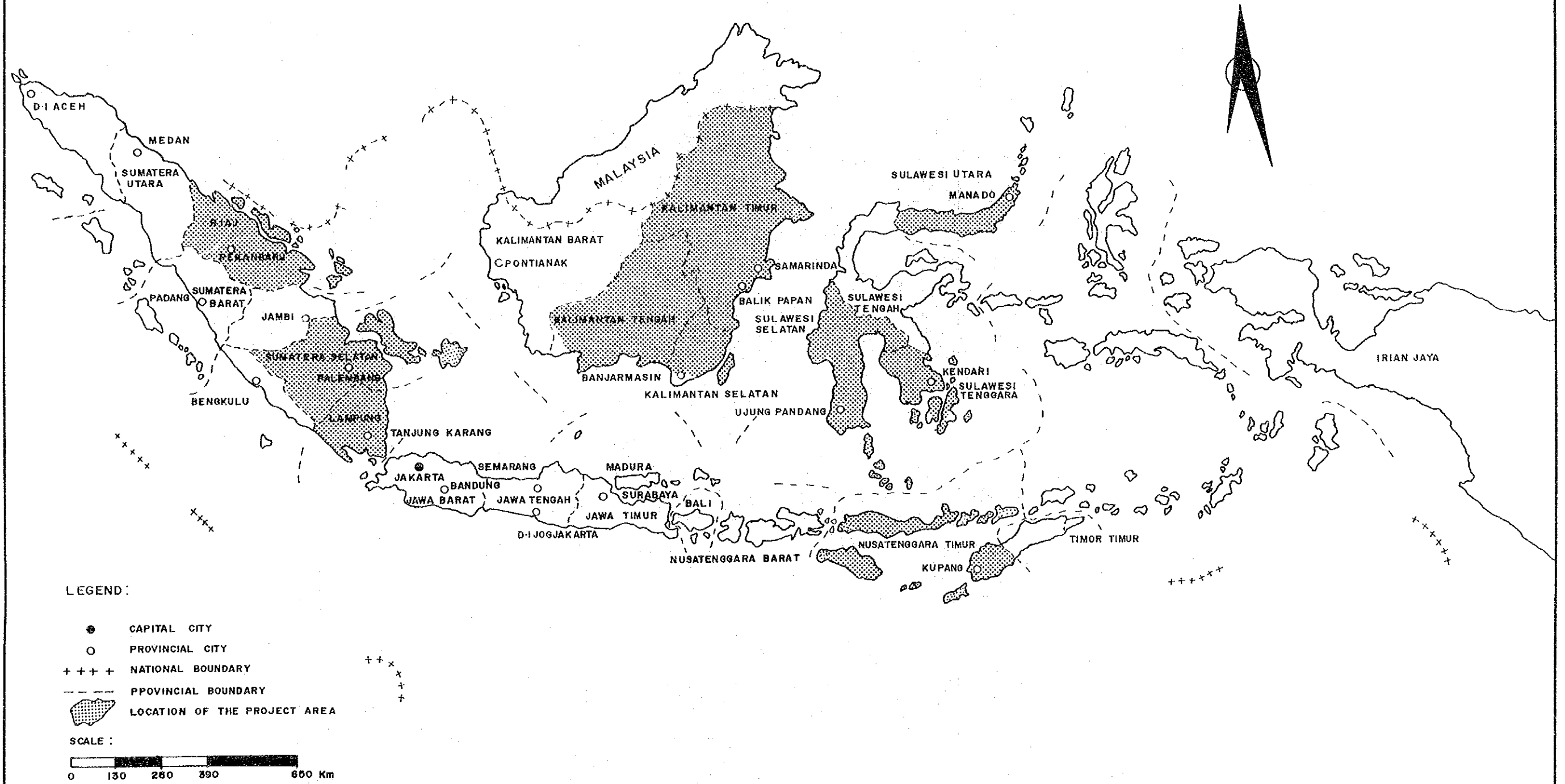


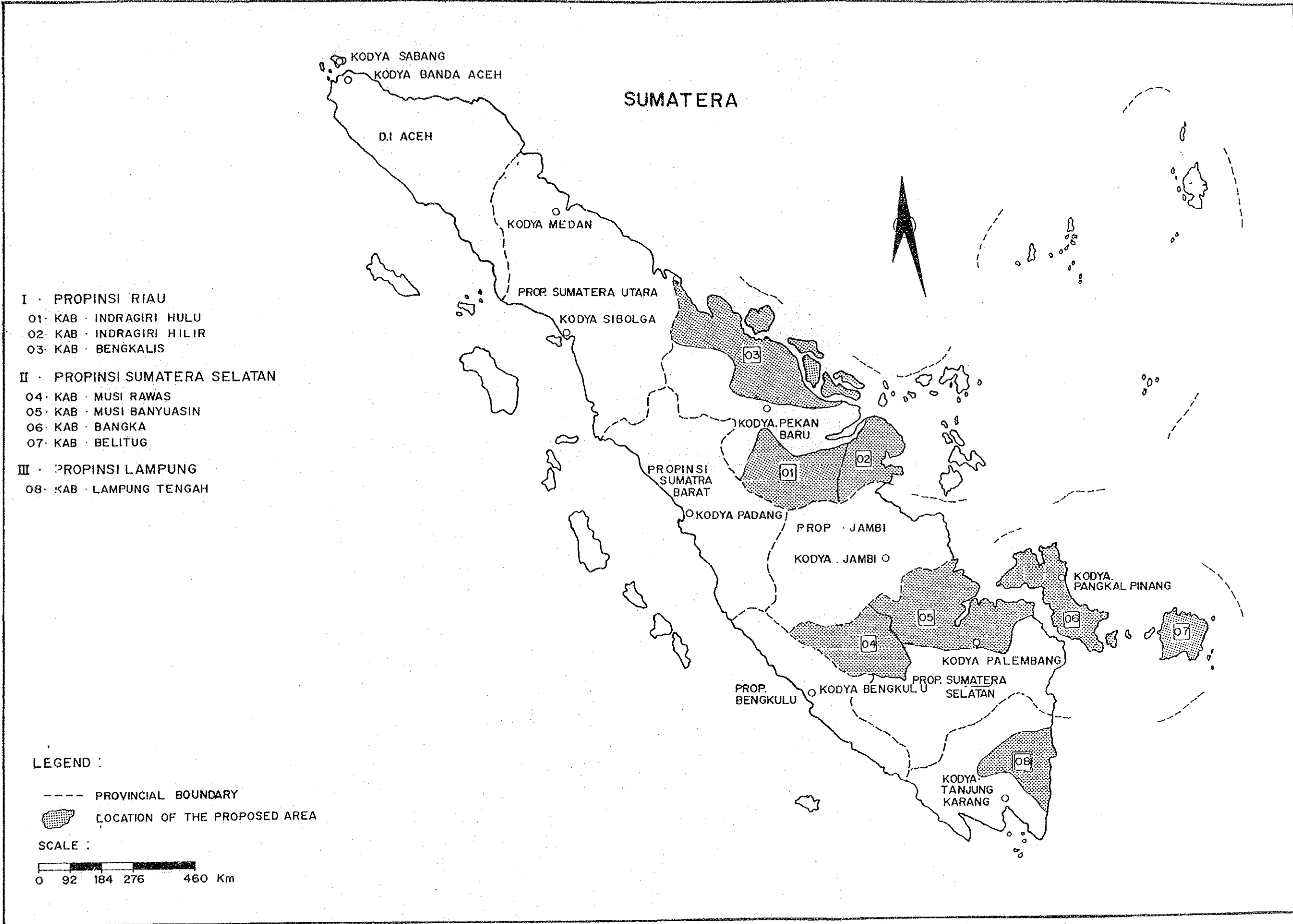
Nobutaka Sato

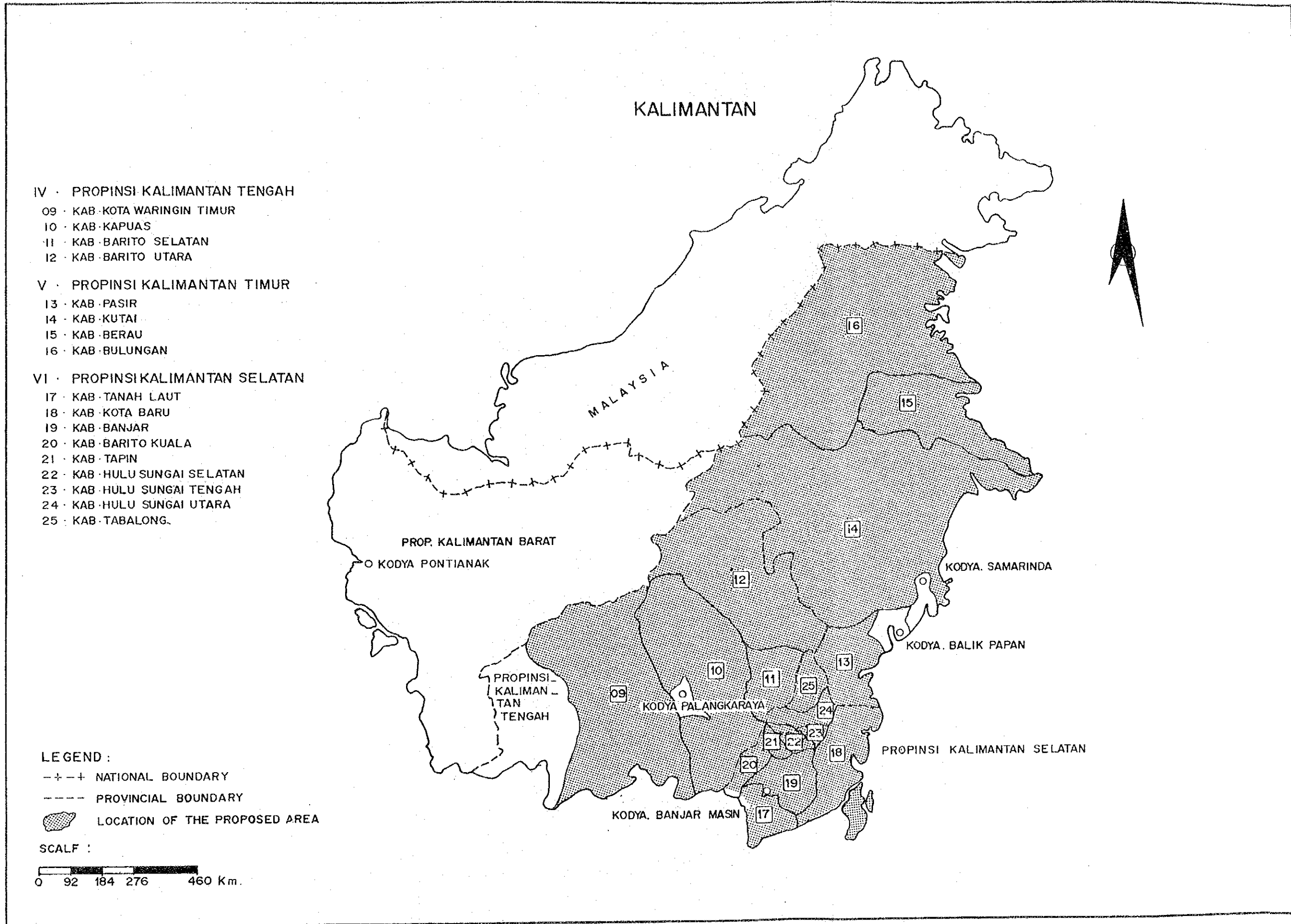
Team Leader

Study Team for the Feasibility Study of
The Local Road Development in
the Republic of Indonesia
(Pacific Consultants International)

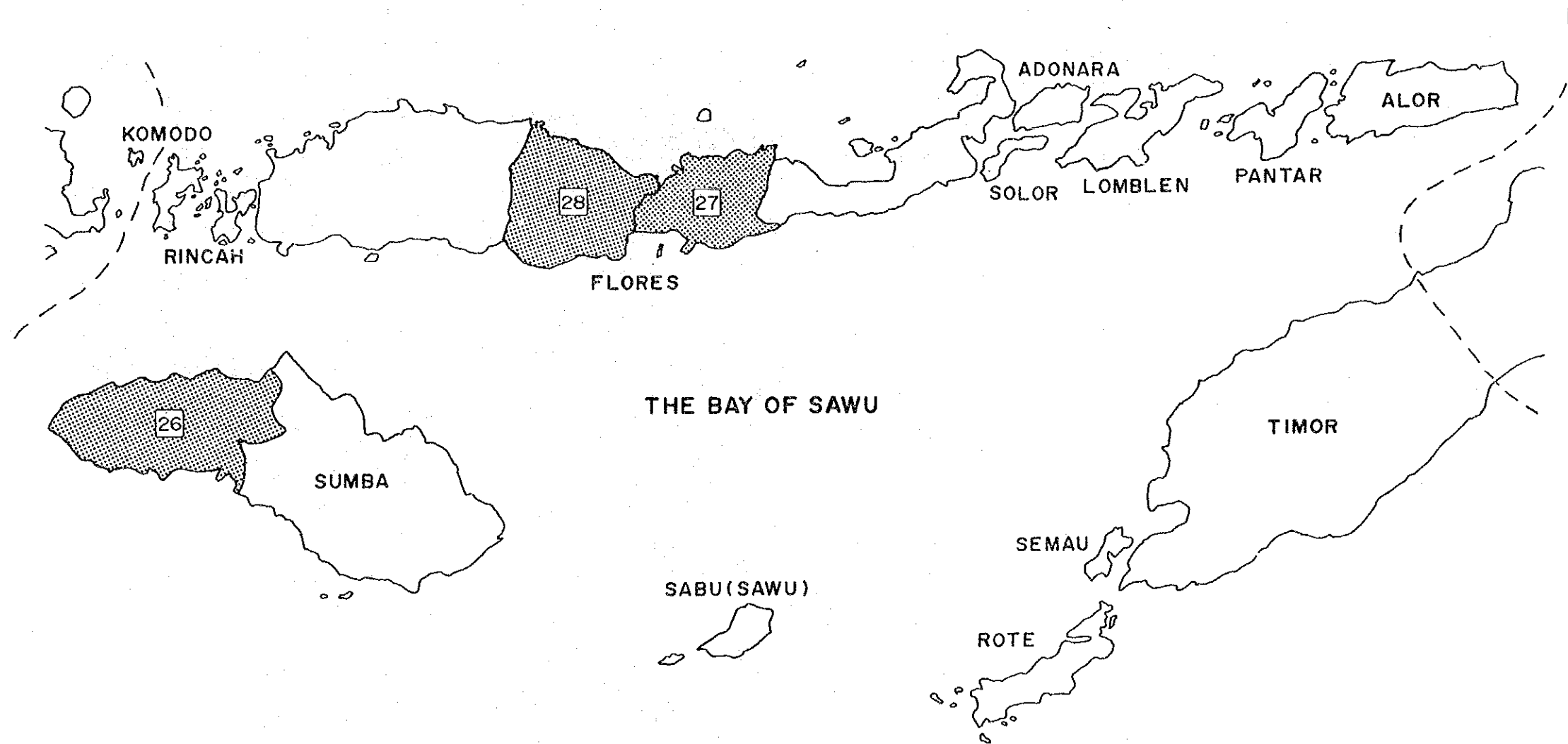
LOCATION MAP OF THE PROJECT AREAS








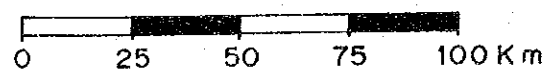
NUSA TENGGARA TIMUR
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LEGEND :

- PROVINCIAL BOUNDARY
-  LOCATION OF THE PROJECT AREA

SCALE :

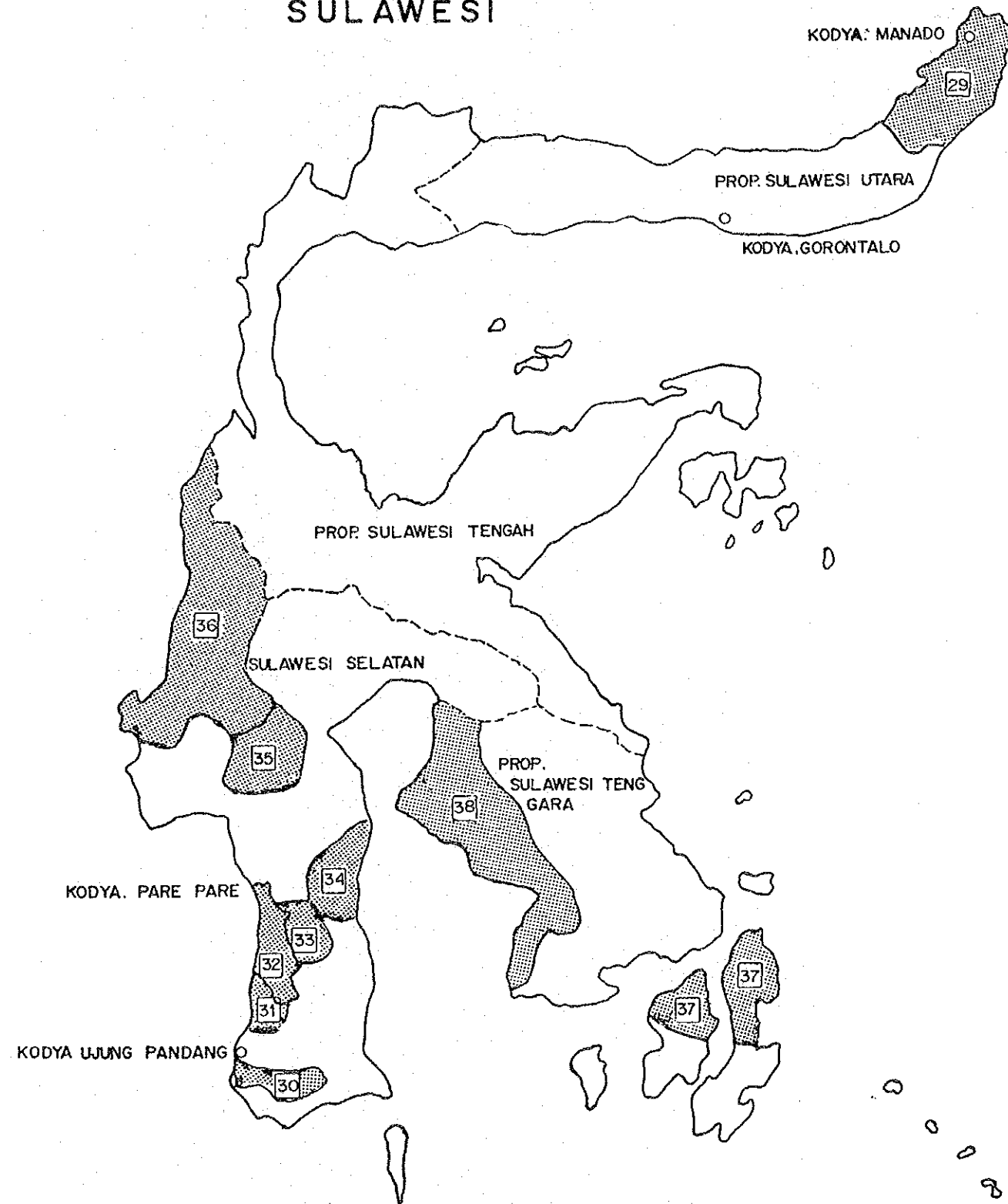


PROVINCE : NUSA TENGGARA TIMUR

- 26 · KAB · SUMBA BARAT
- 27 · KAB · ENDE
- 28 · KAB · NGADA

SULAWESI

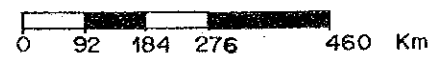
- VIII · PROPINSI SULAWESI UTARA
 - 29 · KAB · MINAHASA
- IX · PROPINSI SULAWESI SELATAN
 - 30 · KAB · GOWA
 - 31 · KAB · PANGKAJENE KEPULAUAN
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LEGEND :

- PROVINCIAL BOUNDARY
- ▨ LOCATION OF THE PROPOSED AREA

SCALE :



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ABBREVIATIONS

ADB	: Asian Development Bank
ADT	: Average Daily Traffic
APBD	: Regional Budget
APBN	: National Budget
AWCAS	: All Weather Compacted Aggregate Subgrade
BANGDA	: Directorate General of Regional Development
BAPPEDA	: Local Development Planning Agency
B/C	: Benefit Cost Ratio
BHN	: Basic Human Needs
DGH or	
BINA MARGA	: Directorate General of Highways
BM 50	: 50% of Bina Marga Live Load
CBR	: California Bearing Ratio
CIF	: Cost, Insurance and Freight
DDN	: Ministry of Home Affairs
DPU	: Ministry of Public Works
DPUK	: Kabupaten Public Works
DPUP	: Provincial Public Works
GDP	: Gross Domestic Product
FOB	: Free on Board
GOI	: Government of Indonesia
GR	: Growth Rate
IBRD	: International Bank of Reconstruction and Development
INPRES	: Presidential Instruction (Central Government Subsidy)
IRR	: Internal Rate of Return
JICA	: Japan International Cooperation Agency
KAB	: Kabupaten
KEC	: Kecamatan
NPV	: Net Present Value
OECF	: Overseas Economic Cooperation Fund
PELITA	: Five - Year Plan

continued

PMU : Project Management Unit
RBO : Regional Betterment Office
TK I : First Level (Provincial Level)
TK II : Second Level (Kabupaten Level)
VOC : Vehicle Operation Cost
Vpd : Vehicle per Day

SUMMARY AND RECOMMENDATIONS

SUMMARY AND RECOMMENDATIONS

1 INTRODUCTION

- (1) In accordance with the request of the Government of Indonesia to the Government of Japan, a feasibility study of local road development for 38 Kabupatens has been hereby carried out as one of the important policies in the Fourth Five-Year Plan, 1984-1988 following the Third Five-Year Plan of Indonesia. The study was executed by JICA, the official agency responsible for implementation of the study appointed by the Government of Japan. (1.1)
- (2) The study objectives include the establishment and the application of a simplified economic feasibility evaluation methodology, the establishment of a simplified implementation programme methodology and its application to 38 Kabupatens in 10 provinces and technology transfer to Indonesian Government personnel in the course of the study. With regard to these objectives the study is divided into Phase I and II studies. Phase I Study is a pilot study for seven model Kabupatens and Phase II Study is carried out for the remaining 31 Kabupatens by the methodology established in the Phase I Study. (1.2)

2 BACKGROUND OF THE STUDY AREA

- (3) The total area of the 38 Kabupatens covered by the study amounts to almost 63 million ha, accounting for about 33 percent of the total area of Indonesia. The involved population amounts to over 12 million, approximately 7.4 percent of the national total. (2.2.1)
- (4) Compared with the vast expanse of the study Kabupaten areas, the area utilized for socio-economic activities is limited to between 5 and 30 percent. The remaining areas are entirely covered by forests, swamps or mountainous terrain difficult for development.

In particular the Provinces of Kalimantan Tengah, Kalimantan Timur and Sulawesi Tenggara have only small cultivated areas, about 4 to 7 percent. (2.2.2)
- (5) Agriculture is the predominant economic activity throughout the Study area employing 60 to 80 percent of all Kabupaten population. The main crop is paddy, especially wetland paddy which is foremost in terms of both cultivated area and yield. (2.2.3)

- (6) The distribution of vehicle registration generally reflects the socio-economic development and road improvement progress in a region. Therefore, vehicle registration in the local area is expected to rapidly increase as the road service level is improved. (2.2.5)
- (7) The Kabupaten roads inventory collected for the study covers almost 19,000 kilometers divided into almost 2,200 links, excluding the roads where no data was collected. (2.3.1)
- (8) Only about 12 percent of the total road network is sealed by asphalt which is a low level compared with the proportion in all Indonesia. This sealed proportion varies from zero percent in Kalimantan Tengah to 57.5 percent in Sulawesi Utara. Moreover the sealed asphalt is mostly limited to bituminous wearing course penetration which has a short life. (2.3.1)
- (9) From the field survey of road surface conditions some 64 percent of the total road network is subjectively classed as good or fair. However that percentage includes the portions not only for asphalt type but also for gravel, split stone, earth and other types. Accordingly, considering the actual Kabupaten road conditions objectively from the sealed proportion the Kabupaten roads should be generally evaluated still in poor condition. (2.3.1)
- (10) Most of the Kabupaten roads lie in relatively gentle terrain. More than 80 percent are in flat or hilly areas, and the remaining 20 percent are in mountainous or swampy areas. However, the proportion of mountainous or swampy roads will be increased with the development of such backward regions. Particularly in the swampy provinces of Riau and Kalimantan Tengah or the mountainous province of Sulawesi Tenggara such tendency can be seen although the road construction is comparatively difficult and expensive. (2.3.1)
- (11) The bridge inventory survey of the Kabupaten roads amounted to almost 5,300 bridges with about 49,000 meters of cumulated length. The number of deficient bridges totaled about 1,200 with 24,000 meters of cumulated length. The majority of bridges are timber accounting for about 74 percent. Concrete bridges account for 14 percent and the others including steel and stone bridges account

for 12 percent. The distribution of bridge types reflects the availability of materials in the regions. (2.3.2)

3 FUTURE TRAFFIC VOLUME

(12) For the estimation of future traffic growth rate the method of qualitative analysis by socio-economic data is adopted instead of the quantitative analysis method by projecting the past growth rate. This is because the relevant data of traffic volumes from the Kabupatens is not reliable. The growth rate for the study is estimated to be 5.47 percent as the average of the 38 Kabupatens.

4 SIMPLIFIED METHODOLOGY

(13) Since the study of so many road links is to be completed within a limited period it can not be carried out by the usual methods. Therefore, all the processes of feasibility evaluation and implementation programming are systematized simply according to the proposed methodology and their calculations carried out by micro-computers. (4.1.1) (4.1.2)

(14) While the feasibility evaluation is as a rule practiced by selecting road links from the highest net present value (NPV), in the stage of implementation programming the road links to be improved are finally selected by the following policies:

- a. Road links economically evaluated with more than 10 percent of internal rate of return (IRR) are given preference.
- b. Road links located at a strategic point to form a regional road network or required particularly for the regional development can be selected from the engineering point of view.
- c. Road links proposed from the point of basic human needs as a minimum regional requirement should be given priority.

The special reasons of items b. and c., permit additional road links to be recommended if concluded to be necessary. (4.1.2)

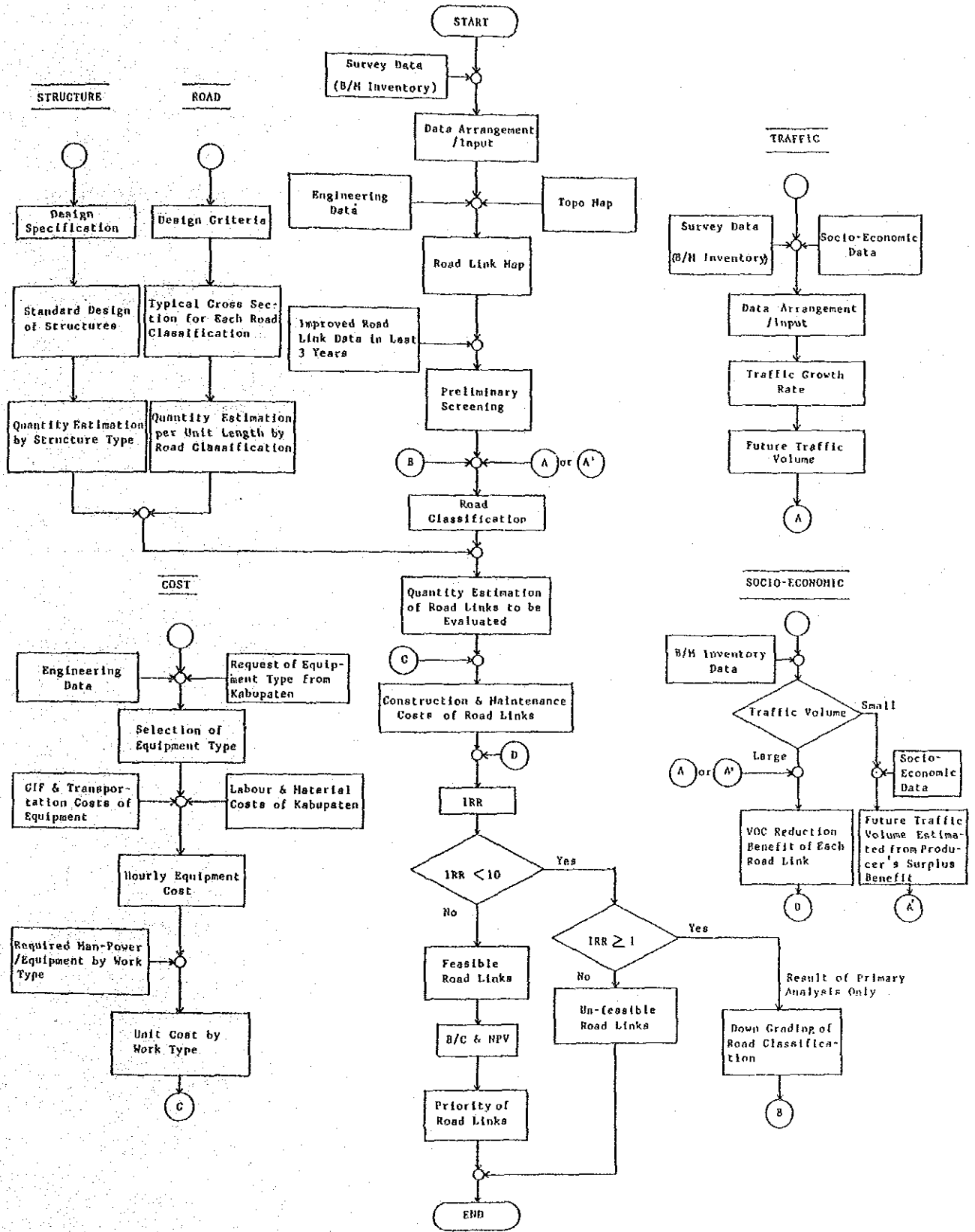
(4.3.4)

(15) The implementation programme is scheduled as a five years programme to start in 1988 and to be completed in 1993. The programme includes the following:

- a. Road improvement five years programme for each Kabupaten
 - b. Road maintenance five years programme for each Kabupaten
 - c. Construction and maintenance equipment proposal for each Kabupaten
 - d. Workshop, laboratory and survey equipment proposal for each Kabupaten
 - e. Training and consulting service schedule. (4.1.2)
- (16) The simplified methodology for economic feasibility evaluation and implementation programme is established as shown in Figs. 4-1 and 4-2 respectively. (4.2.1) (4.2.2)
- (17) Prior to commencement of the economic feasibility evaluation, Kabupaten road links are sifted by preliminary screening. The road links which come under the following conditions are excluded.
- a. Roads apparently insignificant for regional road network framing
 - b. Roads already in good condition owing to current betterment work
 - c. Roads included in city streets or private/project roads
 - d. Roads with no inventory data. (4.3.1)
- (18) The benefit of the Project is estimated by vehicle operation cost (VOC) reduction benefit only, and time saving and traffic accident decrease benefit components are ignored by reason of the undeveloped socio-economic condition of the Project Area. (4.3.2)
- (19) As traffic volume on the Kabupaten roads is generally small, VOC reduction benefit is estimated by the following procedures according to the average daily traffic (ADT) volume:
- a. For road links with not less than 60 ADTs, VOC reduction benefit is directly estimated from the future traffic volume.
 - b. For road links with zero or less than 60 ADTs, VOC reduction benefit is indirectly estimated by adopting the method of producer's surplus model. This is based on the the possible industrial activity in the region brought about by execution of the Project. That is, the future traffic volume is estimated through the process of converting from the physical distribution volume which is obtained by producer's surplus model.

Fig. 4-1

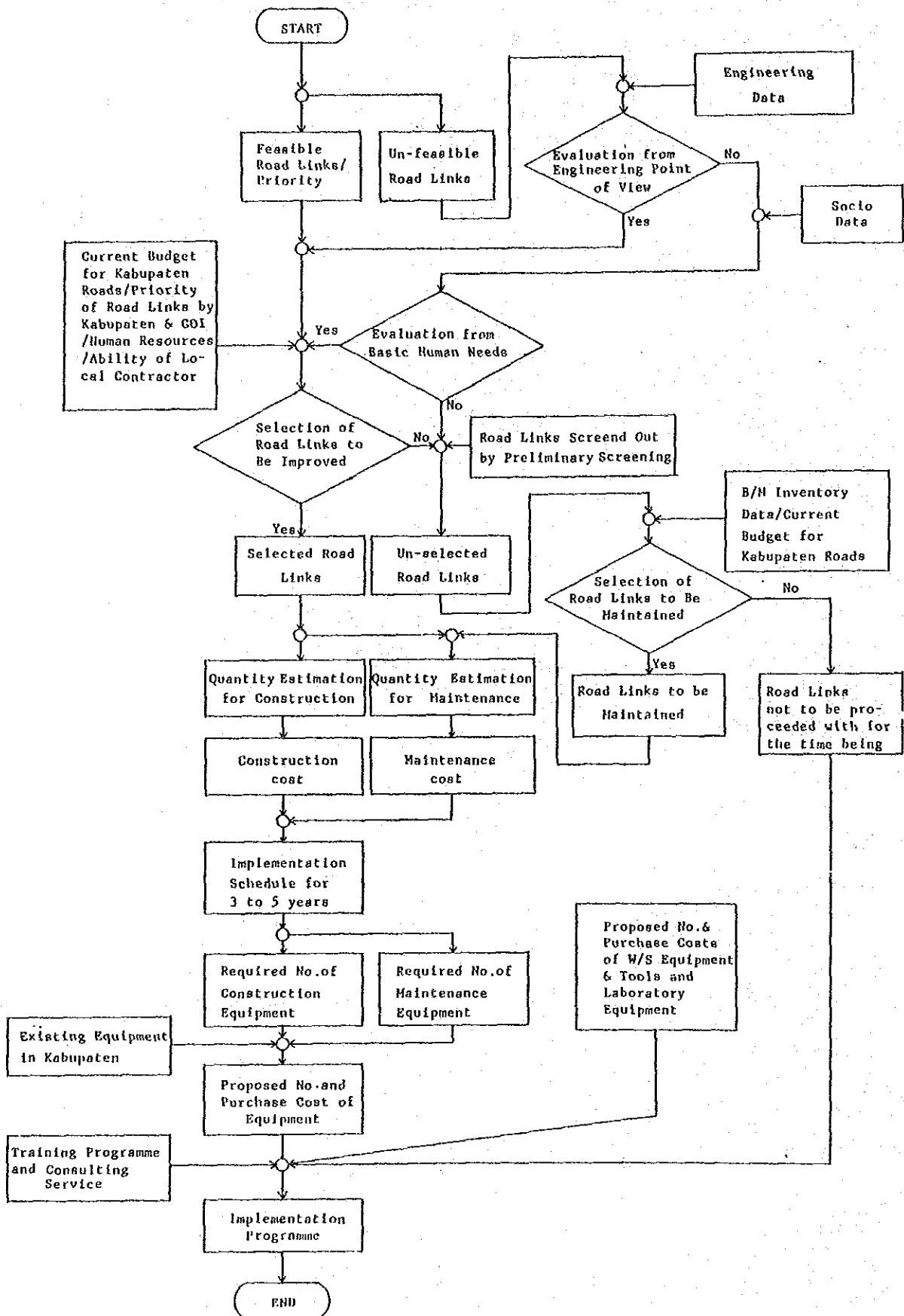
FLOW CHART OF SIMPLIFIED FEASIBILITY EVALUATION



Source : Fig. 4-2-1

Fig. 4-2

FLOW CHART OF SIMPLIFIED IMPLEMENTATION PROGRAMME



- c. For Kabupatens Bangka and Belitung in Sumatra Selatan Province, producer's surplus model is applied with modified conditions to some factors because of data restriction. (4.3.2)
- (20) Economic feasibility evaluation is performed on the ten (10) years' cash flow analysis in the period of 1988 to 1998 by estimating internal rate of return (IRR), cost-benefit ratio (B/C), and net present value (NPV) of cost-benefit analysis. In the cash flow, cost side includes construction and maintenance costs and benefit side includes annual benefit and residual value. Residual value means the remaining properties on the Project road after 10 years. (4.3.3)
- (21) Cash flow analysis is carried out twice by primary and secondary analyses. The primary analysis is carried out for the road improvement level required from the estimated traffic volume at the target year of 1998. The secondary analysis is conducted for the road links unselected by the primary analysis within the IRR range of from 1 percent up to less than 10 percent, providing the road improvement level is degraded by one rank. Therefore, the feasible road links can be obtained from the total of the results of which IRR value achieves more than 10 percent in the above analyses, and they are given priority in the order of their NPV. (4.3.3)
- (22) The five years implementation programme is constructed for each Kabupaten according to the following conditions:
- a. Annual allocation of the project cost is arranged to not vary greatly from the current actual Kabupaten road budget. When the project cost greatly exceeds the expected budget, the proposed road links may be reselected by reducing from the low priority links. When the project cost does not come up to the budget, the five years programme period may be shortened to four or three years.
 - b. The allocation of the project cost takes account of equipment delivery in the starting year, expected training progress of construction skill and consumption of equipment.
 - c. The priority of road links for the project implementation is decided in principle from the highest NPV, the relation of the link to trunk roads and also because of strong request by the central government or Kabupatens. (4.3.4)

- (23) Road maintenance is carried out throughout the project period for road links selected under the following conditions:
- a. Roads already improved after 1981/1982
 - b. All roads scheduled in the Project
 - c. Other roads in reasonable condition which are open to traffic throughout the year.

However, the annual maintenance cost is limited as a rule to within 10 to 30 percent of the road improvement budget. (4.3.5)

5 ENGINEERING

- (24) The technical standard for improvement of Kabupaten roads i.e. PETUNJUK TEKNIS INPRES PENUNJANGAN JALAN KABUPATEN, TAHUN 1984-1985 currently established by Bina Marga is recommended in general for the geometric design criteria in the Project. However, through discussion with Bina Marga pavement width and pavement type are modified from the above standard to minimize the Kabupaten road improvement cost. The criteria adopted for the Project are as shown in Table 5-1. (5.1.1) (5.1.2)
- (25) The LOADING SPECIFICATIONS FOR HIGHWAY BRIDGES BY DIRECTORATE GENERAL BINA MARGA is used in principle as the basic specification of loading. From discussion with Bina Marga the following loads have been decided for the standard bridge design
- a. 50% of Bina Marga live load for concrete and timber bridges on the road of III A classification
 - b. 10-ton truck load for timber bridges on the roads of III B-1, III B-2 and III C classification (5.1.3)
- (26) For the pavement design a formula suitable for small traffic volume is recommended considering the comparatively small effect of the traffic load on Kabupaten roads. The CBR value of road bed varies from about 4 to 10. (5.2.1) (5.2.3) (5.2.4)
- (27) In some Kabupatens where aggregate material is difficult to obtain and the price is extremely high, the cement stabilization method is recommended for the both base and sub-base courses. (5.2.2)

DESIGN CRITERIA FOR KABUPATEN ROADS

Table 5-1

ROAD CLASSIFICATION		CLASS III A				CLASS III B-1				CLASS III B-2				CLASS III C			
SURFACE TYPE		ASPHALT SEAL (DOUBLE)				ASPHALT SEAL (SINGLE)				GRAVEL				GRAVEL			
TRAFFIC VOLUME : ADT (Forecast 10 th year average per day)		3000 - 500				500 - 200				200 - 50				50			
T E R R A I N		FLAT TO ROLLING	HILLY	MOUNT-AINOUS	FLAT TO ROLLING	HILLY	MOUNT-AINOUS	FLAT TO ROLLING	HILLY	MOUNT-AINOUS	FLAT TO ROLLING	HILLY	MOUNT-AINOUS	FLAT TO ROLLING	HILLY	MOUNT-AINOUS	
TRAFFIC LANES		1+	1+	1+	1+	1+	1+	1+	1+	1+	1+	1+	1+	1	1	1	
DESIGN SPEED (Km/hr)	DESIRABLE	70	60	40	70	40	30	60	40	30	60	40	30	50	30	30	AS PRACTICABLE
	MINIMUM	30	30	30	30	30	AS PRACTICABLE	30	30	AS PRACTICABLE	30	30	AS PRACTICABLE	30	AS PRACTICABLE	AS PRACTICABLE	AS PRACTICABLE
GRADIENT (LIMITING) (%)	DESIRABLE	4	5	8	4	6	8	4	7	8	4	7	8	5	8	12	12
	MAXIMUM	7	7	10	7	8	10	7	9	10	7	9	12	7	12	16	16
PAVEMENT WIDTH (M)	DESIRABLE	6.0	6.0	6.0	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	3.5	3.5	3.5	3.5
	MINIMUM	4.5	4.5	4.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.0	3.0	3.0	3.0
SHOULDER WIDTH (M)	DESIRABLE	2.0	1.5	1.5	1.5	1.5	1.0	1.5	1.0	1.0	1.5	1.0	1.0	1.0	1.0	1.0	0.75
	MINIMUM	1.5	1.0	0.75	1.0	1.0	0.75	1.0	0.75	0.75	1.0	0.75	0.5	0.75	0.5	0.5	0.5
ROAD BED WIDTH (M)	DESIRABLE	10.0	9.0	9.0	8.0	7.5	6.5	7.5	6.5	6.5	7.5	6.5	6.5	5.5	5.5	5.0	5.0
	MINIMUM	6.0	6.0	6.0	5.5	5.5	5.0	5.5	5.0	5.0	5.5	5.0	4.5	4.5	4.0	4.0	4.0
RIGHT OF WAY (M)	DESIRABLE	16	16		12	12		12	12		12	12		12	12		
	MINIMUM	12	12		10	10		10	10		10	10		8	8		
ROAD CAMBER (%)	PAVEMENT	3	3		3	3		3	3		3	3		4	4		
	SHOULDER	4	4		4	4		4	4		4	4		5	5		

Source : Table 5-1-1

(28) There are so many bridges to be improved on the Kabupaten roads of the Project Area that it is impossible to prepare an individual design for each bridge. Therefore the following two types of standard bridges are recommended and agreed to by Bina Marga.

- a. Timber beam bridge with timber pile bents
- b. Reinforced concrete T-girder bridge with rubble masonry in mortar substructure.

The applicable standard bridge type is recommended for each region as follow:

- Kalimantan :
Timber bridge regardless of traffic volume
- Sulawesi, Sumatera and Nusa Tenggara :
RC bridge for class III A road and timber bridge for road class III B-1, III B-2 and III C. (5.3.1) (5.3.2)

(29) The following two culvert types are recommended as standard structures for transverse drainage.

- a. Reinforced concrete pipe culvert 80 cm diameter
- b. Rubble in mortar box culvert with RC slab 80 cm x 80 cm

The following two types of retaining walls are adopted.

- a. Rubble in mortar retaining wall
- b. Timber retaining wall. (5.3.3)

(30) Taking into consideration the advantages of both equipment and labour intensive methods, construction methods for major works of the Project are basically decided as follows:

<u>Method</u>	<u>Work Type</u>
Equipment Intensive	Earthwork, Base Course and Subbase Course
Labour Intensive	Surface Dressing, Drainage, Bridge and Other Structures

(5.4.1)

(31) The selection and combination of equipment required for major works of construction and maintenance are recommended as shown in Tables 5-2 and 5-3. (5.4.2) (5.4.3)

Table 5-2

EQUIPMENT OF ONE WORK GANG FOR MAJOR
TYPES OF WORK

TYPE OF WORK	MAIN EQUIPMENT	
1. Site Clearing in Light Bush	1- Bulldozer 90 HP 2- Dump Truck 3.0 Ton	1- Wheel Loader 1.2 m ³
2. Excavation & Embankment		
i) Normal Fill	1- Bulldozer 90 HP 1- Vibratory Roller 4.0 Ton (D&T)	1- Water Tank Truck 4,000 Ltr
ii) Fill by Borrow Material	1- Bulldozer 90 HP 3- Dump Truck 3.0 Ton	1- Wheel Loader 1.2 m ³
iii) Fill in Swamp	1- Swamp Bulldozer 90 HP 1- Water Tank Truck 4,000 Ltr	1- Vibratory Roller 4.0 Ton (D&T)
iv) Excavation to Spoil	1- Bulldozer 90 HP 1- Wheel Loader 1.2 m ³	4- Dump Truck 3.0 Ton
3. Subgrade Preparation	1- Motor Grader 75 HP 1- Vibratory Roller 4.0 Ton (D&T)	1- Water Tank Truck 4,000 Ltr
4. Subbase Course	1- Motor Grader 75 HP 1- Vibratory Roller 4.0 Ton (D&T)	1- Water Tank Truck 4,000 Ltr
5. Base Course	1- Motor Grader 75 HP 1- Vibratory Roller 4.0 Ton 1- Portable Crusher/Screens 30-40 Ton/H	1- Water Tank Truck 4,000 Ltr
6. Cement Stabilizing	1- Motor Grader 70 HP 1- Bulldozer 90 HP 1- Wheel Loader 1.2 m ³ 1- Flat Bed Truck 3.0 Ton	1- Vibratory Roller 4.0 Ton (D&T) 1- Road Stabilizer 1- Water Tank Truck 4,000 Ltr
7. Surface Course	1- Asphalt Sprayer 850 Ltr 1- Tire Roller 8-15 Ton 1- Portable Crusher/Screens 30-40 Ton/H	1- Flat Bed Truck 3.0 Ton
8. Concrete	1- Concrete Mixer 0.5 m ³ 1- Water Pump 200 Ltr/Min 1- Concrete Vibrator 3.3 HP	1- Flat Bed Truck 3.0 Ton 1- Hand-Guided Vibratory Roller 1000 Kg

Source : Table 5-4-3

Table 5-3

EQUIPMENT OF ONE WORK GANG FOR MAINTENANCE

TYPE OF WORK	MAIN EQUIPMENT
Road	1- Motor Grader 1- Tire Roller 8-15 Ton 1- Hand-Guided Vibratory Roller 1000 Kg 1- Flat Bed Truck 3.0 Ton 1- Dump Truck 3.0 Ton
Bridge and Other Structure	1- Flat Bed Truck With Crane 3.0 Ton

Source : Table 5-4-4

- (32) A workshop is recommended to be provided for each Kabupaten. The main tasks of the Kabupaten workshop are as follows:
- a. Administration for and storage of equipment
 - b. Routine maintenance and light repair of equipment
 - c. Storage and supply of spare parts
 - d. Operation of equipment including crushing plant.
- Major repairs other than the above items should be treated at the provincial workshop of Bina Marga. (5.5.1)
- (33) A laboratory is recommended to be provided for each Kabupaten. For each laboratory, provision of laboratory test equipment for the following tests is recommended:
- a. Physical characteristic, compaction and strength tests for the road bed and pavement materials.
 - b. Slump and strength tests for the bridge concrete. (5.5.3)
- (34) Road works of the Project consist of the preparatory survey and several classes of work as follows.
- a. Earthwork which includes preparatory survey, site clearing, common excavation, embankment, fill in swampy area and subgrade preparation.
 - b. Sub-base and base courses and cement stabilized base course
 - c. Other work which includes surface course, shoulder and drainage. (5.6.1)
- (35) For the construction of bridges and other structures, standard methods are recommended from the aspect of familiar and available construction materials in Indonesia such as reinforced concrete, rubble in mortar or timber.
- Standardization in design and construction methods, if it is compatible with local construction ability, seems to be a profitable and practicable measure rather than the supply of new techniques and equipment. (5.6.2)
- (36) Road maintenance is generally undertaken under direct management by the Kabupaten government as part of the routine duties except for large scale repair works. Therefore, it is recommended that the maintenance section is organized independently from other sections. (5.6.3)

(37) With the aim of satisfactorily executing routine maintenance it is suggested that each Kabupaten forms a full-time maintenance team. This should be divided into the road and bridge maintenance teams because each team has different objectives. (5.6.3)

(38) The items considered in the quantity estimation for the road improvement work are as follows:

- Earth and Pavement Works

- a. Site Clearing in Light Bush
- b. Subgrade Preparation
- c. Normal Fill
- d. Fill in Swamp
- e. Normal Excavation to Spoil
- f. Subbase Course
- g. Base Course
- h. Shoulder
- i. Asphalt Patching
- j. Earth Drain
- k. Drain in Swamp

- Bridge and Other Structures

- a. Superstructure by Road Surface Area
 - b. Substructure by Number of Abutments and Piers
 - c. Culvert by Longitudinal Length
 - d. Retaining Wall by Volume for Rubble in Mortar and Area of Wall for Timber
- (5.7.1) (5.7.2) (5.7.3)

6 CONSTRUCTION AND MAINTENANCE COST ESTIMATION

(39) The data for the unit prices of materials and labour were collected from each Kabupaten through Bina Marga. The collected data were compared with those of Jakarta using BAHAN BANGUNAN DKI-JAKARTA MAY & JUNE 1985 compiled by PUSAT INFORMASI TEKNIK PEMBANGUNAN, and then finalized. The exchange rate used is US\$ 1.00 equals Rp. 1,110. (6.1.1) (6.1.2)

(40) The price of stone varies greatly between the Kabuaptens. There is a tendency for the price to be considerably higher in Kabupatens not producing stone than in the other Kabupatens. However, sand is produced in most of the Kabupatens so that the price is relatively constant. (6.2.2)

(41) The hourly equipment cost is estimated as the total of ownership, operation and indirect costs taking into account an adjustment for the delivery cost and the working days of each type of equipment. (6.2.3)

7 RESULTS OF FEASIBILITY EVALUATION

(42) Feasibility evaluation is carried by the process of preliminary screening, then primary and secondary analyses in sequence from which the feasible road links are selected as shown in Table 7-1.

Table 7-1 RESULTS OF ECONOMIC FEASIBILITY EVALUATION

PROVINCE	NO. OF KABS.	STUDIED		FEASIBLE		OTHERS	
		NO.	LENGTH (km)	NO.	LENGTH (km)	NO.	LENGTH (km)
RIAU	3	131	1882	19	420	112	1462
SUMATRA SELATAN	4	268	2905	47	721	221	2184
LAMPUNG	1	137	1231	53	460	84	771
KALIMANTAN TENGAH	4	56	1076	3	125	53	951
KALIMANTAN TIMUR	4	190	1340	31	371	159	969
KALIMANTAN SELATAN	9	639	3030	140	913	499	2116
NUSA TENGGARA TIMUR	3	151	1882	29	523	122	1359
SULAWESI UTARA	1	153	1470	22	369	131	1101
SULAWESI SELATAN	7	395	2730	111	403	284	1827
SULAWESI TENGGARA	2	126	1268	16	302	110	966
TOTAL	38	2246	18814	471	5107	1775	13706

Source : Table 7-2-3

8 IMPLEMENTATION PROGRAMME

(43) The total Project Cost consists of the cost of construction and maintenance, supplementation as described in paragraph (46), workshop, laboratory and survey equipment and consulting service.

The total Project Cost for the 38 Kabuaptens of the study is summarized as follows:

	<u>Foreign Currency</u>	<u>Local Currency</u>	<u>Total(Rp x 10⁶)</u>
Construction & Maintenance	39,696	84,621	124,317
Supplementation	16,518	-	16,518
Workshop/Laboratory/Survey Equipment	1,736	-	1,736
Consulting Service	7,296	4,814	12,110
Total	65,246	89,435	154,681

The total Project Cost can be divided into following costs:

	<u>Foreign Currency</u>	<u>Local Currency</u>	<u>Total(Rp x 10⁶)</u>
Civil Work	21,952	84,044	105,996
Construction & Maintenance Equipment	31,945	-	31,945
Spare Parts	2,317	577	2,894
Workshop/Laboratory/Survey Equipment	1,736	-	1,736
Consulting Service	7,296	4,814	12,110
Total	65,246	89,435	154,681

The cost for civil work is composed of the cost of labour and materials, operation cost excluding spare parts, indirect cost and transportation cost of equipment, and ownership cost for existing equipment.

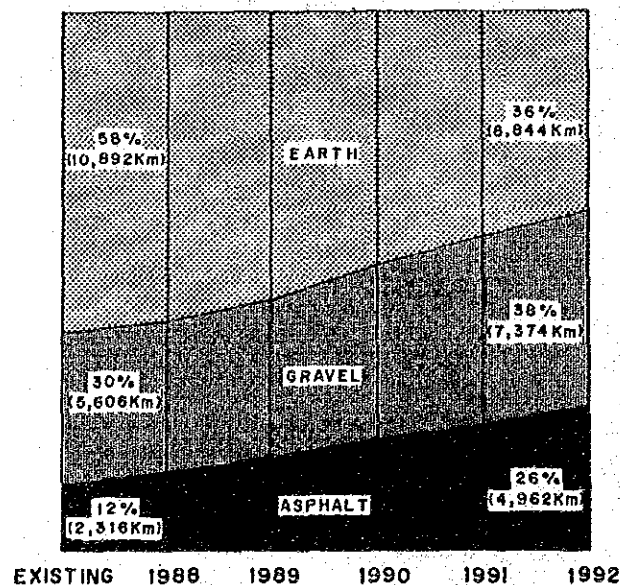
(44) The road links finally proposed to be improved for the 38 Kabuap-
tens are summarized as follows :

<u>Reason for Selection</u>	<u>No. of Road Links</u>	<u>Total Length (km)</u>
Feasible		
- Primary	362	3,988
- Secondary	50	598
Engineering Point of View	155	1,732
Basic Human Needs	39	659
Total	606	6,977

Among the proposed road links 5 links with a 366 km total length are recommended to be newly constructed from the engineering point of view or basic human needs.

Eventually the Project is expected to produce final results from the investment as shown in Fig. 8-1.

Fig. 8-1 ROAD SURFACE TYPE BY YEAR



Source : Fig. 8-1-1

(45) The road links finally proposed to be maintained amount to 1,111 road links with a 8,683 km total length which is approximately 45 percent of the 19,180 km total length of road links studied including new construction. (8.1.2)

(46) The numbers of construction and maintenance equipment proposed to be purchased are recommended as shown in Table 8-1. These are the numbers remaining after reducing by the numbers of existing equipment considered to be available for the Project from the total numbers estimated from the annual requirements.

Supplementation cost is the difference between the purchase cost for newly supplied equipment and the depreciated value. This comes about because full depreciation of the supplied equipment would not be completed within the Project Period of 5 years. (8.1.4)

(47) For execution of the Project it is strongly recommended that structural organization of DPUK is established as shown in Fig. 8-2 with regard to the construction system. It is recommended that the DPUK is obliged to lend some equipment with skilled operators to the local contractors in the Kabupaten for the execution of a part of the road improvement works taking into consideration the policy of the Fourth Five-Year Plan (REPELITA).

However, the following work items are recommended to be executed by force account.

- Routine maintenance work for the Kabupaten roads
- Laboratory tests
- Production of crushed stone
- Technical service for the equipment

(8.2.1) (8.2.2)

(48) The training courses to be conducted before and during implementation of the Project are as follow:

- i) Advanced/basic training course conducted by the Team of Education and Training Project of Bina Marga
- ii) Field training course conducted by the consultants

The advanced/basic training course for the human resources who should be core staff of DPUK should be completed before the commencement of the Project. The field training course aims to foster professional competence in technical expertise and related

Table 8-1 PROPOSED NUMBERS OF CONSTRUCTION AND MAINTENANCE
EQUIPMENT

EQUIPMENT	CLASS	TOTAL		
		RN	EN	PN
Bulldozer	90 HP	18	0	18
Bulldozer/Ripper	90 HP	33	3	30
Swamp Bulldozer	90 HP	12	0	12
Motor Grader	75 HP	83	9	74
Road Stabilizer	W=1850 mm	8	0	8
Hand-guided Vib. Roller	1000 Kg	51	20	31
Tire Roller	8-15 Ton	60	9	51
Vibratory Roller (D&T)	4.0 Ton	59	20	39
Hydraulic Excavator; Wheel	0.3 m ³	22	1	21
Wheel Loader	1.2 m ³	78	4	74
Water Tank Truck	4000 Ltr.	40	0	40
Dump Truck	3.0 Ton	563	98	465
Dump Loader Truck	12.0 Ton	6	0	6
Flat Bed Truck With Crane	3.0 Ton	49	0	49
Flat Bed Truck	3.0 Ton	79	0	79
Portable Crusher/Screening	30-40 Ton/Hr	31	7	24
Concrete Mixer	0.5 m ³	12	0	12
Water Pump	200 Ltr/Min	9	0	9
Concrete Vibrator	3.3 HP	9	0	9
Asphalt Sprayer	850 Ltr	37	11	26
Service Car	3.0 Ton	38	0	38
4 Wheel Drive Vehicle	70 HP	39	0	39
Motorcycle	100 cc	123	6	117

Notes :

RN = Required number estimated by the Study

EN = Existing number to be considered for the Project

PN = Proposed number to be purchased for the Project

Source: Table 8-1-5

policy management (Kebijaksanaan Manajimen) as required for the DPUK staff and to consolidate the foundations for development of self reliability. Without proper consulting services effective implementation of the Kabupaten road development for the 38 Kabupatens can not be ensured. (8.3.1) (8.3.2) (8.3.3)

(49) The field training should be conducted through the following three courses:

- a) Intensive field training (I.F.T) over a period of six months;
- b) Circulating inspection training (C.I.T) over a period of one year; and
- c) Technical support service (T.S.S) over a period of three years.

The recommended structural organization to execute the above consulting service is shown in Fig. 8-3. (8.3.3).

Chapter 1 INTRODUCTION

Chapter 1 INTRODUCTION

1.1 Background of the Study

The Government of Indonesia (hereinafter referred to as the Government) is desirous to expeditiously implement local road (Kabupaten road) improvement in consideration of a balanced development of the rural areas in Indonesia. With this objective a local road development programme was introduced in the Third Five-Year Plan, 1979-1983 (PELITA III), as one of the important policies of the Government.

Several international lending agencies have assisted the Government in financing the programme, viz., the Overseas Economic Cooperation Fund of Japan (hereinafter called OECF) with respect to 21 Kabupatens, the International Bank of Reconstruction and Development (hereinafter called IBRD) with respect to 25 Kabupatens and the Asian Development Bank (hereinafter called ADB) with respect to 14 Kabupatens.

In the Fourth Five-Year Plan, 1984-1988 (REPLITA IV), the Government expects that the said three international lending agencies will continue to assist the Government in financing the programme, in this case 38 Kabupatens by OECF, 43 Kabupatens by IBRD and 30 Kabupatens by ADB.

Under such circumstances the Government requested the Government of Japan to conduct a feasibility study of local road development in the Republic of Indonesia (hereinafter called the Study). In response the Government of Japan decided to conduct the study in accordance with the laws and regulations of Japan.

To conduct the study the Government of Japan appointed the Japan International Cooperation Agency (hereinafter referred to as JICA), the official executive agency responsible for implementation of technical cooperation programmes of the Government of Japan. JICA has accordingly organized for this purpose a Study Team consisting of experts of Pacific Consultants International and Kyowa Engineering Consultants (hereinafter called the Study Team) and an Advisory Committee.

In the study, the local roads mentioned above are identified as Kabupaten roads.

1.2 Objective of the Study

The objective is to carry out a feasibility study of the local road development of 38 Kabupatens in 10 Provinces in the Republic of Indonesia including the following items:

- To carry out feasibility studies by using a simplified economic feasibility evaluation methodology;
- To establish a simplified implementation programme methodology and to prepare an implementation programme ; and
- To perform technology transfer to Indonesian Government personnel in the course of the study.

Since the project locations are dispersed over vast regions and are widely spread over areas including Sumatra, Kalimantan, Sulawesi and Nusa Tenggara, it is clear that usual feasibility study levels can not be adopted. Thus, the study is divided into two phases i.e. the Phase I study and the Phase II study.

The objective of the Phase I study is to establish a simplified feasibility evaluation methodology and a simplified implementation programme methodology through a pilot study of seven (7) model Kabupatens.

The objective of the Phase II Study is to carry out the feasibility study for the remaining 31 Kabupatens using the methodology established in the Phase I Study.

The Kabupatens to be studied are shown in Table 1-2-1. In this table the seven (7) model Kabupatens studied in the Phase I Study are indicated with an asterisk.

1.3 Progress of the Study

The Study Team was dispatched to Indonesia by JICA on October 8, 1984 to proceed with the feasibility study with a schedule for the Phase I Study and submitted the Inception Report to the Government of Indonesia. The JICA Advisory Committee was also dispatched to Indonesia at the same time.

The Study Team carried out the site reconnaissance on the seven model Kabupatens in November and December 1984 and collected both engineering and socio-economic data required. Traffic surveys were carried out

Table 1-2-1

KABUPATEN TO BE STUDIED

NAME OF PROVINCE		NAME OF KABUPATEN
1. RIAU	* i	Indragiri Hulu
	ii	Indragiri Hilir
	iii	Bengkalis
2. SUMATERA SELATAN /SOUTH SUMATERA	* i	Musi Rawas
	ii	Musi Banyuasin
	iii	Bangka
	iv	Belitung
3. LAMPUNG	* i	Lampung Tengah
4. KALIMANTAN TENGAH /CENTRAL KALIMANTAN	* i	Kotawaringin Timur
	ii	Kapuas
	iii	Barito Selatan
	iv	Barito Utara
5. KALIMANTAN TIMUR /EAST KALIMANTAN	i	Pasir
	* ii	Kutai
	iii	Berau
	iv	Bulungan
6. KALIMANTAN SELATAN /SOUTH KALIMANTAN	i	Tanah Laut
	ii	Kota Baru
	* iii	Banjar
	iv	Barito Kuala
	v	Tapin
	vi	Hulu Sungai Selatan
	vii	Hulu Sungai Tengah
	viii	Hulu Sungai Utara
	ix	Tabalong
7. NUSA TENGGARA TIMUR /EAST NUSA TENGGARA	i	Sumba Barat
	ii	Ende
	iii	Ngada
8. SULAWESI UTARA /NORTH SULAWESI	i	Minahasa
9. SULAWESI SELATAN /SOUTH SULAWESI	i	Gowa
	ii	Pangkajene Kepulauan
	* iii	Barru
	iv	Soppeng
	v	Wajo
	vi	Tana Toraja
	vii	Mamuju
10. SULAWESI TENGGARA /SOUTHEAST SULAWESI	i	Muna
	* ii	Kolaka

in the model Kabupatens, except Kabupaten Kapuas, jointly by Bina Marga and the Study Team.

The Study Team established the simplified feasibility evaluation methodology and the simplified implementation programme methodology through a pilot Study of the seven model Kabupatens. The methodologies recommended by the Study Team were approved by JICA and Bina Marga.

The Interim Report which summarized the results of the Phase I Study was submitted in March 1985.

The Phase II Study proceeded in Indonesia for about seven (7) months from June 3, 1985. The engineering and socio-economic data required were collected up to the middle of October mainly through Bina Marga as was the road and bridge inventory data based upon the recommendation made by the Study Team. Some data was collected by the Study Team during site reconnaissance carried out in the provinces of Nusa Tenggara Timur, Sumatra Selatan, Sulawesi Utara and Kalimantan Selatan. The feasibility study for the 31 Kabupatens was carried out and the feasibility study for the seven model Kabupatens reviewed.

The Draft Final Report prepared in Indonesia had been submitted at the end of the Study carried out in Indonesia.

The Final Report together with 38 Kabupaten reports is hereby submitted to the Government of Indonesia after finalizing the comments on the Draft Final Report from the Indonesian Government.

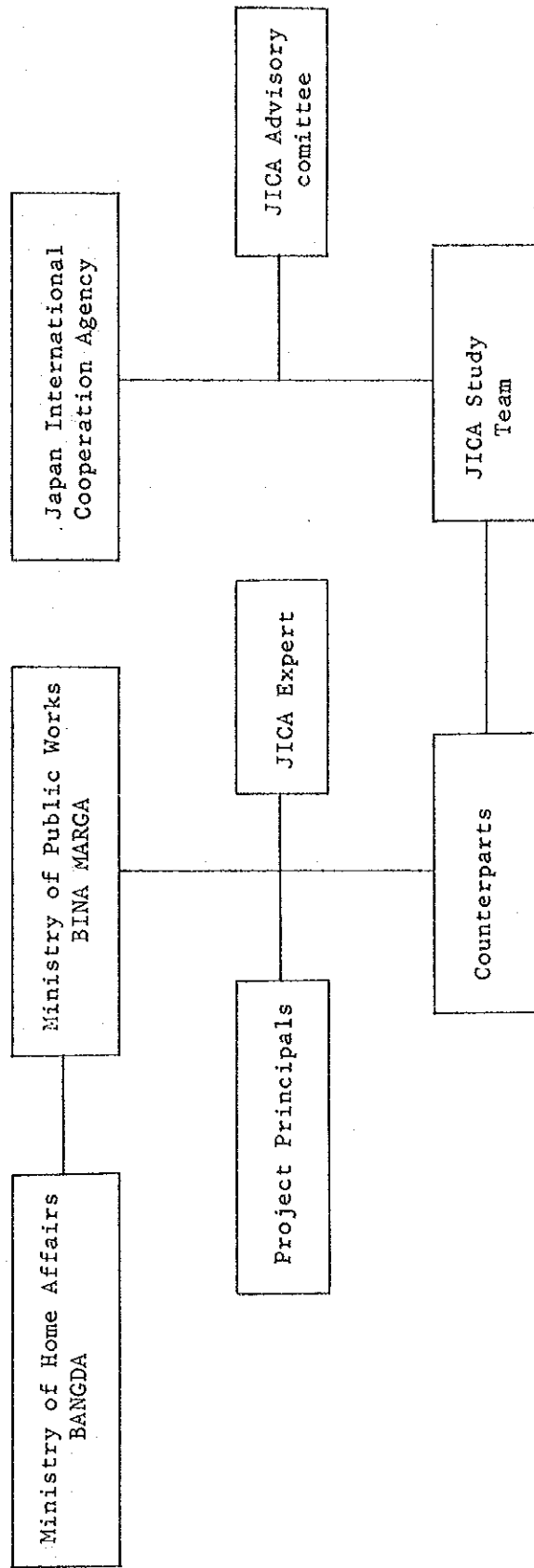
1.4 Organization for the Study

The Study has been carried out by the Study Team under the supervision of the JICA Advisory Committee consisting of Japanese Government Officials organized by JICA. In carrying out the Study and in particular the site reconnaissance and data collection, the Study Team has maintained close collaboration with the counterparts from Bina Marga, and cooperated with Bangda and the Local Governments of the provinces and Kabupatens concerned.

The organization for the Study is shown in Fig.1-4-1.

Fig. 1-4-1

ORGANIZATION FOR THE STUDY



The personnel who are concerned with the Study are as follows:

(1) Phase I Study

1) Ministry of Public Works, BINA MARGA

Ir. Harun Al Rasyid	Director of Road Planning
Ir. Djuned Djohary	Secretary to Director of Road Planning
Ir. Sony Soemarsono	Chief of Sub Directorate of Local Road
Ir. Imanuddin Lutfan	Project Manager
Ir. Adinus Saleh	Highway Engineer/Coordinate Engineer
Ir. Soedarmadji Koesno	Regional Planner
Ir. Mochamad Irian	Bridge/Structure Engineer
Ir. Sigit Widhyharto	Traffic Engineer
Ir. Permadi Hadi	Highway Engineer
Ir. Sumaryanto	Highway Engineer
Drs. Rozali Achmad MSc	Economist
Mr. Ribut Susanto BE	Assistant Highway Engineer
Mr. Indra Mardi BE	Assistant Highway Engineer

2) Ministry of Home Affairs, BANGDA

Mr. Pargio BA	Chief of Sub Directorate of Regional Development
Mr. Simatupang	Chief of Section, Sub Directorate of Regional Development

3) BIRO PEMBANGUNAN DAERAH TK.I

4) KANTOR BUPATI KDH. TK.II

5) JICA Expert

Mr. Yoshimitsu Hiyama/
Mr. Makoto Maruyama

6) JICA Advisory Committee

Dr. Hirohiko Tada	Chairman
Mr. Takashi Sakai	Member
Mr. Hiroo Sato	Member

7) JICA Study Team

Mr. Nobutaka Sato	Team Leader
Mr. Takashi Ohtani	Member (Highway Planning)
Mr. Motoyoshi Yamada	Member (Traffic Planning & Economic Analysis)
Mr. Ryosuke Fujiwara	Member (Agricultural Economic Analysis)
Mr. Yasuharu Yamada	Member (Regional Planning)
Mr. Toshiro Suzuki	Member (Structural Planning)
Mr. Hideki Magori	Member (System Analysis)
Mr. Hiromi Setoh	Member (Coordination)

(2) Phase II Study

1) Ministry of Public Works, BINA MARGA

Ir. Harun Al Rasid/ Ir. Rachmadi Bambang Sumadyo	Director of Road Planning
Ir. Djuned Djohari/ Ir. Djoko Asmoro	Secretary to Director of Road Planning
Ir. Sony Soemarsono	Chief of Sub Directorate of Local Road
Ir. Imanuddin Lutfan	Project Manager
Ir. Adinus Saleh	Highway Engineer/Coordinate Engineer
Ir. Soedarmadji Koesno	Regional Planner
Ir. Mochmad Irian	Bridge/Structure Engineer
Ir. Rachmani Budiayu	Regional Planner
Ir. Sigit Widhyharto	Traffic Engineer
Drs. Rozali Achmad MSc	Economist
Ir. Sutono T	Highway Engineer
Ir. Permadi Hadi	Highway Engineer
Ir. Winarno	Highway Engineer
Mr. Ribut Susanto BE	Assistant Highway Engineer
Mr. Indra Mardi BE	Assistant Highway Engineer
Mr. Budiman	Assistant System Analyst (Computer)

- | | |
|-------------------------------------|--|
| 2) Ministry of Home Affairs, BANGDA | |
| Mr. Pargio BA | Chief of Sub Directorate
of Regional Development |
| Mr. Simatupang | Chief of Section, Sub Directorate
of Regional Development |
| 3) BIRO PEMBANGUNAN DAERAH TK.I | |
| 4) KANTOR BUPATI KDH, TK.II | |
| 5) JICA Expert | |
| Mr. Makoto Maruyama | |
| 6) JICA Advisory Committee | |
| Dr. Hirohiko Tada | Chairman |
| Mr. Takashi Sakai | Member |
| Mr. Hiroo Sato | Member |
| 7) JICA Study Team | |
| Mr. Nobutaka Sato | Team Leader |
| Mr. Takashi Ohtani | Member
(Highway Planning) |
| Mr. Motoyoshi Yamada | Member
(Traffic Planning &
Economic Analysis) |
| Mr. Hideki Magori | Member
(System Analysis) |
| Mr. Takashi Chujo | Member
(Construction & Maintenance
Planning) |
| Mr. Hiromi Setoh | Member
(Coordination) |

Chapter 2 BACKGROUND OF THE STUDY AREA

Chapter 2 BACKGROUND OF THE STUDY AREA

2.1 Topographic and Meteorological Conditions

2.1.1 Location and Topographic Condition

(1) Riau Province

Riau Province is located in the middle of the eastern part of Sumatera Island and faces Malaysia and Singapore across the Malacca Strait. The equator crosses the center of the province.

A mountainous area lies along the border in the western to south-western part of the province, and the remaining area which extends from the foot of the mountain range towards the east is flat. Four main rivers from the north, namely the Rokan, the Siak, the Kampar and the Indragiri together with their branches spread throughout the whole area of the province. The northern to eastern part of the province is mainly swampy.

The total province area is 94,562 Km² which is approximately 20% of the total area of Sumatera. The province consists of five Kabupatens. Three Kabupatens namely Indragiri Hulu, Indragiri Hilir and Bengkalis are included in the Study while the remaining two Kabupatens i.e. Kabupaten Kampar located in the central province and Kabupaten Kepulauan Riau consisting of islands spread over the Natuna sea, are not included.

(2) Sumatera Selatan Province

Sumatera Selatan Province is located in the south-eastern part of Sumatera Island. It is bordered on the north by Jambi Province, on the west by Bengkulu Province and on the south by Lampung Province located in the southernmost part of Sumatera Island. Two islands, Bangka and Belitung, belong to the province. Palembang, the capital of the province is located in the central part.

The Bukit Barisan Mountains, of altitude more than 3,000 m above sea level, run from the north to the south in Sumatera

Island and form the border with Bengkulu Province on the west. The remaining areas are mostly flat and swampy being river basins of the Musi River and many other smaller rivers. In particular the eastern coastal area where the mouth of the Musi River is located is almost entirely undeveloped swamp.

The islands of Bangka and Belitung located on the border of the Jawa sea with the Natuna sea both have different geographical conditions from Sumatera Island. Bangka Island is formed of mild undulating hilly and flat areas. Belitung Island, which is located further from Sumatera Island, is mostly formed of flat to mild rolling areas with many small rivers and ponds, and is surrounded by a coral reef.

The area of Sumatera Selatan Province is 103,688 Km² which is approximately 22% of Sumatera making it the largest province in Sumatera. It consists of eight Kabupatens. Four Kabupatens are to be studied, namely Musi Rawas and Musi Banyuasin located in the northern part of the province, and Bangka and Belitung mentioned above.

(3) Lampung Province

Lampung Province is the southernmost province in Sumatera Island and is close to Jawa Island facing the Sunda Strait. Both islands are connected by ferry service approximately 20 Km in distance between Bakahuni and Merak.

In the western to southern parts of the province there is a mountainous area which is the southern end of the Bukit Barisan Mountains which cross Sumatera Island from north to south. Some of these mountains are more than 2000 m above sea level. In the central to eastern part of the province there is a flat region. The eastern coastal area is mostly swampy.

The area of Lampung Province is 33,307 Km² which is approximately 7% of the area of Sumatera. Lampung Province consists

of three Kabupatens. The Kabupaten to be studied is Kabupaten Lampung Tengah which faces the Jawa Sea on the south east.

(4) Kalimantan Tengah Province

Kalimantan Tengah Province is located in the central to southern parts of Kalimantan Island. The equator crosses the province in the north.

The province, which faces the Jawa Sea in the south, has a boundary with three neighbouring provinces, namely Kalimantan Barat Province on the north to west, Kalimantan Timur Province on the north to east and Kalimantan Selatan Province on the east. In the northern part of the province there is a mountainous area with mountains of 1000 to 2000 m above sea level forming a boundary with both the provinces of Kalimantan Barat and Kalimantan Timur. From the foot of the mountain range towards the south there is a vast flat area covered by tropical forest.

The main rivers, of approximately 400 to 600 Km length, namely the Barito, the Kapuas, the Kahayan, the Mendawai, the Sampit, and the Pembuang originate in the northern mountainous area and flow down in parallel to the south of the province. All the coastal area facing the Jawa Sea and the south eastern area of Palangkaraya, the capital of the province, form a vast flat swampy area.

Kalimantan Tengah Province consists of nine Kabupatens and Kotamadya Palangkaraya. However at present the nine Kabupatens are governed by five governors because of the scale of population. Thus, the Kabupatens of Kotawaringin Timur, Kapuas, Barito Selatan and Barito Utara govern administratively the Kabupatens of Katingin, Gunung Mas, Barito Timur and Murung Raya respectively.

The area of the province is 152,600 Km² which is approximately 28% of the area of the Indonesian territory of Kalimantan

Island. The Kabupatens to be studied are the four administrative Kabupatens mentioned above.

(5) Kalimantan Timur Province

Kalimantan Timur Province is located in the northeastern part of the Indonesian territory of Kalimantan Island. The province, facing the Sulawesi Sea and the Makassar Strait to the east, is bordered on the north by the states of Sabah and Serawak of Malaysia, on the west by the provinces of Kalimantan Barat and Kalimantan Tengah, and on the south by Kalimantan Selatan Province. The equator crosses the province at approximately 45 Km north of Samarinda, the capital of the province located south of the mid region of the province.

Approximately two thirds of the province is mountainous. In the boundary area with Malaysia and Kalimantan Tengah Province there are mountains of 1500 to 2000 m above sea level. A branch of the mountain range crosses the centre of the province from west to east towards the Mangkalihat Cape jutting out into the Makassar Strait. Another branch runs from north to south alongside the boundary with Kalimantan Tengah Province. The height of these mountain ranges is approximately 500 to 1000 m above sea level.

Flat areas are located in the southern area of the northern border with Malaysia, in the coastal areas facing the Sulawesi Sea and the Makassar Strait, and in the Mahakam river basin located west of Samarinda. In these flat areas, there are many large and small rivers which rise from the mountain range in the west and flow into the Sulawesi Sea or the Makassar Strait. Vast flat swampy areas are formed in the mouths of the main rivers namely, the Sembakung, the Sesayap, the Kayan, the Berau, the Mahakam and the Kandilo. The middle sections of the Mahakam River form a vast swampy area inland.

The area of the province is 202,440 Km² which is approximately 38% of the Indonesian territory of Kalimantan Island. It is the largest province in the island and consists of the two Kotamadyas (municipalities) of Samarinda and Balikpapan and four Kabupatens namely, Pasir, Kutai, Berau and Bulungan in the south, all of which are to be studied.

(6) Kalimantan Selatan Province

Kalimantan Selatan Province is located in the southeastern part of Kalimantan Island. It faces the Makassar Strait on the east and the Jawa Sea on the south, and is bordered on the north and west by the provinces of Kalimantan Timur and Kalimantan Tengah respectively. Two islands located at the south east of the province, namely Laut Island separated from the main island by the Laut Strait and Sebuku Island located to the east of Laut Island, belong to the province.

The Meratus Mountains start from the boundary with Malaysia and run towards the south, crossing the central area of the province from north to south dividing it into eastern and western areas. The highest mountain is Mount Besar of 1,892 m above sea level located in the center of the province. The other mountains are approximately 1000 to 1600 m high.

The Riamkanan Reservoir which dams the Riamkanan River near the southmost part of the mountain range is used as an energy source and for flood control of the southern area on the west side of the mountain range.

East and south of the mountain range are rolling areas which continue to the coast. West of the mountain range is a vast flat swampy area which is formed by the Barito River and its branches namely, the Negara, the Martapura, the Riamkanan and the Riamkiwa rivers, and continues to the province of Kalimantan Tengah on the west. Banjarmasin the provincial capital is located in the south eastern part of the province.

The area of the province is 37,660 Km² which is approximately 7% of the Indonesian territory of Kalimantan Island. The province is the smallest in the island and consists of a Kotamadya and nine Kabupatens namely Tanah Laut, Kota Baru, Banjar, Barito Kuala, Tapin, Hulu Sungai Selatan, Hulu Sungai Tengah, Hulu Sungai Utara and Tabalong which are all to be studied.

(7) Nusa Tenggara Timur Province

Nusa Tenggara Timur Province is in the chain of islands which continues from Jawa Island eastwards. It is located east of Nusa Tenggara Barat Province which consists of Lombok and Sumbawa Islands, and which is itself located east of Bali Province.

The province consists of islands, namely Komodo, Rancah, Flores, Solor, Adonara, Lomblen, Pantar and Alor Islands in the north, Sumba Island in the southwest, Sabu Island in the south, and Rote and Semau Islands and the western half of Timor Island in the southeast. The eastern half of Timor Island belongs to Timor Timur Province. The Sawu Sea surrounding the islands is located between the Flores Sea and the Indian Ocean. Most of the islands in the province are volcanic.

In Sumba Island, mountains of 800 to 1000 m height run from east to west in the center of the island. The south eastern part of the island is the highest area and falls towards the southern coast. The northern area of the island is mountainous with gentler slopes than the southern area and with many small rivers. Narrow flat areas lie along the northern coast. In the center of the western area there is the high land of a crater basin.

Flores Island is mostly formed by mountains of 1000 to 1500 m high which fall towards the coast. Flat area is very limited. In the central part of the island there are highland areas of crater basins.

The area of the province is 47,876 Km² which is approximately 54% of Nusa Tenggara's area of 88,488 Km². The province consists of twelve Kabupatens. Three Kabupatens are studied, namely Sumba Barat, Ende and Ngada.

(8) Sulawesi Utara Province

Sulawesi Utara Province consists of a peninsula which extends from west to east of the northern part of Sulawesi Island and islands which lie from north to south in the Maluku Sea. The province faces the Sulawesi Sea on the north, the Maluku Sea on the east and the Tomini Bay on the south, and is bordered on the west by Sulawesi Tengah Province.

The Paleleh Mountains which are more than 2000 m high run from west to east a little to the north of the center of the peninsula. East of the central part of the peninsula, the Perautannan, the Bone, the Buludawa and other mountains which are approximately 1000 to 2000 m high form watersheds. Most of the peninsula is mountainous and flat areas are limited to the narrow coastal regions.

The islands lie from the north to south in the Maluku Sea and consist of the Talaut Islands where Karakelong Island is the main island, the Sangir Islands where Sangir Island is the main island, and other small islands. The northern part of the islands is bordered by the Philippine Island of Mindanao.

The area of the province is 19,023 Km² which is approximately 10% of Sulawesi Island. The province consists of Kotamadya Manado, Kotamadya Gorontalo and four Kabupatens. The Kabupaten to be studied is Kabupaten Minahasa.

(9) Sulawesi Selatan Province

There are two peninsulas extending from the centre of Sulawesi Island towards the south with Bone Bay between them. Sulawesi Selatan Province is mainly located in the western peninsula. The province is bordered on the north by Sulawesi Tengah Province. The north eastern area of the province which extends to the eastern peninsula is bordered by Sulawesi Tenggara Province. The western and southern areas of the Province face the Makassar Strait and the Flores Sea respectively. The eastern part of the province faces Bone Bay and extends to the innermost part of the bay. The province has many small islands in the Flores sea and Sulaya Island to the south.

Most of the northern half of the province is mountainous where there are the Takolekayu Mountains and the Quarles Mountains of approximately 3000 m height. Remaining areas such as the northern coastal area facing the Makassar Strait and the coastal area facing the innermost part of Bone Bay are flat and swampy with many small rivers.

Mount Lompobatang, 2871 m high is in the southernmost part of the peninsula. Two mountain ranges separate from this mountain towards the north becoming less high. The northern area, central area, and eastern and western coastal areas of the southern half of the peninsula are flat. North of the mountains there are Lake Tempe and Lake Sidenreng with low swampy areas surrounding them.

The area of the province is 72,781 Km² which is approximately 38% of Sulawesi making it the largest province in Sulawesi. It consists of 21 Kabupatens together with Kotamadya Ujung Pandang and Kotamadya Parepare. Seven Kabupatens are to be studied namely Gowa, Pangjene Kepulauan, Barru, Soppeng, Wajo, Tana Toraja and Mamuju.

(10) Sulawesi Tenggara Province

Sulawesi Tenggara Province consists of the eastern peninsula which extends from the centre of Sulawesi towards the south and the islands close to the peninsula namely Wowoni, Buton, Muna and Kabaena, together with small islands in the Flores Sea. The province is bordered on the north by Sulawesi Tengah and Sulawesi Selatan Provinces and faces the Banda Sea, the Flores Sea and Bone Bay to the east, south and west respectively.

A little to the west of the northern part of the province the Tangkeleboke Mountains run from the northern boundary towards the south. The Matarombea Mountains and the Abuki and Meluhu Mountains branching from the Tangkeleboke Mountains run in parallel towards the southeast while the Mengkoka Mountains run along the western coast line. Thus, the northern and western parts of the province are mostly mountainous while a few flat areas are found along the Lasolo River. In the central and southern regions flat areas are formed by the basins of the Sampara River and its branches, and the Labandia River. The remaining areas are mostly hilly or mountainous.

Muna Island is almost flat except for a hilly area along the east coast. The northern to western coastal parts of the island are swampy.

In the center of Buton Island the mountains run from north to south. Flat areas are limited to the narrow coastal regions and the remaining areas are mostly undulating hills or mountains.

The area of the province is 27,686 Km² which is approximately 15% of Sulawesi. The province consists of four Kabupatens. Two Kabupatens are to be studied, namely Muna and Kolaka.

2.1.2 Meteorological Conditions

A year in Indonesia consists of a rainy season and a dry season. The dry season is from June through August or from August through October, depending on the location. In Kalimantan and Sumatera, however, rainfall is so heavy throughout the year that any difference between dry and rainy seasons is practically indistinguishable.

The number of rainy days and the amount of yearly rainfall in the 38 Kabupatens to be studied are shown in Table 2-1-1.

From the table it can be noted as follows:

- In most of the Kabupatens in the Project Area the amount of yearly rainfall is more than 2000 mm
- There are some Kabupatens in both Sumatera and Kalimantan Islands where the amount of yearly rainfall is more than 3500 mm.
- In the case of Kabupaten Ngada of Nusa Tenggara Timur Province the average number of rainy days in a year is 69.

The annual number of working days in each Kabupaten concerned is indicated in the right-hand column of Table 2-1-1.

The working days are estimated using the following formula.

$$\text{Working Days} = 365 - \text{Holidays} - \text{Rainy Days} + \left(\text{Rainy Days} \times \frac{\text{Holiday}}{365} \right) + (0.10 \times \text{Rainy Days})$$

Where :

- Holidays consist of 52 Sundays and 13 national holidays; and
- 10% of rainy days are assumed to be workable days.

The working days adopted for Kabupatens Indragiri Hilir, Pasir, Kota Bharu and Gowa are assumed from the data of Kabupatens Indragiri Hulu, Kutai, Tanah Laut and Pangkajene Kepulauan respectively, because there is little or no meteorological data available.

Table 2-1-1

METEOROLOGICAL CONDITIONS OF THE PROJECT AREA

PROVINCE	KABUPATEN	STATION	1980		1981		1982		1983		1984		MEAN ESTIMATED WORKING DAYS	ADOPTED WORKING DAYS	
			RAINY DAYS	RAINFALL (mm)	RAINY DAYS	RAINFALL (mm)	RAINY DAYS	RAINFALL (mm)	RAINY DAYS	RAINFALL (mm)	RAINY DAYS	RAINFALL (mm)			
RIAU		Air Molek	158	2,419	168	1,980	132	2,017	-	-	-	-	153	219	220
	Indragiri Hulu	-	-	-	-	-	-	-	-	-	-	-	-	-	220
	Indragiri Hilir	No. 153	87	-	67	1,847	-	-	77	2,048	102	3,207	83	280	250
SUMATERA SELATAN															
	Musi Rawas	-	157	3,899	164	3,434	122	2,649	141	2,672	-	-	146	211	210
	Musi Banyuasin	-	189	3,549	189	2,518	156	2,592	146	2,540	120	1,928	160	214	210
	Bangka	-	120	2,277	115	2,373	95	2,049	134	2,224	139	2,654	120	248	240
LAMPUNG															
	Belitung	Buluh Tumbang	-	-	-	-	183	2,506	226	2,692	231	3,738	213	168	170
KALIMANTAN TENGAH															
	Lampung Tengah	No. 288 D	112	2,172	137	2,573	89	2,214	80	2,907	94	3,654	102	264	250
	Kotawaringin	Sampit	79	1,025	136	2,827	100	1,904	122	2,466	222	3,136	132	234	230
	Kapuas	Kuala Kurun	-	-	131	3,291	131	2,644	141	3,910	-	-	134	236	240
	Barito Selatan	Dinas Pertanian	-	-	95	3,355	116	3,573	91	2,710	106	2,716	102	264	250
	Barito Utara	297.TDA.50 m	127	2,572	-	-	130	2,253	144	2,646	-	-	134	236	240
KALIMANTAN TIMUR															
	Pasir	Melak	-	-	-	-	-	2,136	-	-	-	-	-	-	240
	Kutai	Berau	-	-	-	-	-	1,619	145	1,771	174	1,953	133	237	240
	Berau	Tarakan	57	1,140	61	1,599	48	959	130	1,588	176	1,975	94	271	250
KALIMANTAN SELATAN															
	Tanah Laut	Pelaihari	140	2,850	102	3,751	101	2,476	140	3,520	178	3,616	132	234	230
	Kota Baru	-	-	-	-	-	-	-	-	-	-	-	-	-	230
	Banjir	Syamsudin Noor	-	-	-	-	153	2,543	-	-	-	-	153	219	220
	Berito Kuala	Marabahan	73	2,142	68	1,531	83	2,274	71	2,709	80	1,852	74	288	250
	Tapin	Tatakaran Rantau	196	2,318	105	2,289	148	2,255	155	2,029	224	2,421	166	208	210
	Hulu Sungai Selatan	N.I	-	-	172	2,033	130	1,715	-	-	100	3,107	134	236	240
	Hulu Sungai Tengah	Parabei	180	3,291	187	2,354	157	1,818	177	2,101	213	2,315	183	194	200
	Hulu Sungai Utara	Amuntai	148	1,714	183	2,056	164	1,724	179	1,751	180	2,023	171	204	200
	Tabalong	Tanjung	100	1,936	110	1,826	66	2,177	89	1,888	103	1,916	94	271	250
NUSA TENGGARA TIMUR															
	Sumba Barat	Waikabubek	76	1,671	129	2,231	69	1,287	77	1,595	134	2,656	97	268	250
	Ende	Ende	104	3,228	103	3,298	69	1,277	132	2,258	141	2,338	110	257	250
	Ngada	Ngada	55	701	87	1,259	55	886	75	1,512	75	1,561	69	292	250
SULAWESI UTARA															
	Minahasa	Kayuwatu Manado	204	2,676	244	2,843	176	2,222	231	2,171	-	-	213	168	170
SULAWESI SELATAN															
	Gowa	Baring	-	-	-	-	-	-	-	-	-	-	-	-	-
	Pangkajene Kepulauan	Barru	143	2,976	166	2,748	113	1,740	139	3,708	183	2,664	149	223	220
	Barru	Barru	121	2,958	147	2,906	-	-	-	-	-	-	134	236	240
	Soppeng	Matan Soppeng	102	1,550	128	2,045	79	1,064	155	1,326	140	1,709	121	240	240
	Wajo	No. 10	109	1,230	132	2,232	92	1,647	141	2,131	158	2,125	126	243	240
	Tana Toraja	Makale	132	1,347	174	2,182	128	978	151	1,208	178	1,573	153	219	220
	Mamuju	Mamuju	91	2,774	140	3,146	51	1,409	78	1,987	61	1,692	84	279	250
SULAWESI TENGGARA															
	Muna	Raha	94	1,028	119	1,579	75	1,273	90	1,400	113	2,092	98	267	250
	Kolaka	Kolaka	115	1,711	149	1,959	120	1,370	-	-	-	-	128	241	240

2.2 Socio-Economic Conditions

2.2.1 Population

The Project Area is spread over 38 Kabupatens in 10 provinces in the islands outside Jawa. The 10 provinces consist of three in Sumatera Island, three in Kalimantan Island, one in Nusa Tenggara and three in Sulawesi Island.

As shown in Table 2-2-1 the population in the Project Area in 1983 was 19.1% of the total population of Indonesia, however the Project Area is 41.2% of Indonesia. The population density in the Project Area is very low. The density of 1.64 persons per ha in Lampung Province, which is the highest in the Project Area, is twice the national value, however it is only 1/4.5 of the density in Jawa Island. The population density of Kalimantan Tengah Province is 0.07 persons per ha, the lowest in the Project Area. It is 1/12 of the national value and only 1/106 of the density in Jawa Island.

However the population growth rates from 1980 to 1983 in the Project Area are almost the same as or higher than the national rate except for the provinces of Nusa Tenggara Timur and Sulawesi Selatan. This growth is dependent on the transmigration plan to the islands outside Jawa which has been promoted since the Third Five-Year Plan (1979-1984). This trend will continue. From the future population estimated by the national development plan the ratio of the population of the Project Area to the national population is expected to increase from 19.1% in 1983 to 20.2% in 1990 as shown in Table 2-2-2.

The population, density and growth rate of the project Kabupatens are shown in Table 2-2-3.

2.2.2 Land Use

Land use of the provinces is shown in Table 2-2-4 the source of which is the STATISTICAL YEARBOOK of INDONESIA 1983 published by the Central Statistic Bureau. Characteristics of each province are as follows:

Table 2-2-1 POPULATION AND DENSITY BY PROVINCE

PROVINCE	POPULATION (X 1000)		AAGR (%)	AREA (1000 ha)		DENSITY	
	1980	1983		(%)	1983	(%)	1980
Riau	2,176.7	2,373.6	(1.5)	2.93	(4.9)	0.23	0.25
Sumatera Selatan	4,647.1	5,099.7	(3.2)	3.15	(5.4)	0.45	0.49
Lampung	4,642.0	5,464.7	(3.5)	5.59	(1.7)	1.39	1.64
Kalimantan Tengah	957.9	1,054.6	(0.7)	3.26	(8.0)	0.06	0.07
Kalimantan Timur	1,222.5	1,438.7	(0.9)	5.58	(10.5)	0.06	0.07
Kalimantan Selatan	2,072.3	2,198.4	(1.4)	1.99	(2.0)	0.55	0.58
Nusa Tenggara Timur	2,747.4	2,896.7	(1.8)	1.78	(2.5)	0.57	0.61
Sulawesi Utara	2,123.3	2,262.4	(1.7)	2.14	(1.0)	1.12	1.19
Sulawesi Selatan	6,084.8	6,376.1	(4.0)	1.57	(3.8)	0.84	0.88
Sulawesi Tenggara	945.9	1,031.2	(0.7)	2.92	(1.4)	0.34	0.37
Jawa Island	91,609.5	96,892.9	(61.3)	1.89	(6.9)	6.93	7.33
Indonesia	148,040.0	158,082.7	(100)	2.21	(100)	0.77	0.82

Notes : 1. AAGR : Average Annual Growth Rate

2. Unit of Density : Persons/ha

3. Source : Statistical Yearbook of Indonesia 1983 published by the Central Statistics Bureau.

Table 2-2-2 POPULATION PROJECTION BY PROVINCE

PROVINCE	1983 (X 1000)	1990 (X 1000)	AAGR (%)
Riau	2,373.6	2,882.6	2.81
Sumatera Selatan	5,099.7	6,285.3	3.03
Lampung	5,464.7	7,934.7	5.47
Kalimantan Tengah	1,054.6	1,309.5	3.14
Kalimantan Timur	1,438.7	2,089.5	5.48
Kalimantan Selatan	2,198.4	2,503.4	1.87
Nusa Tenggara Timur	2,896.7	3,252.2	1.67
Sulawesi Utara	2,262.4	2,602.9	2.02
Sulawesi Selatan	6,376.1	7,055.2	1.46
Sulawesi Tenggara	1,031.2	1,252.1	2.81
Indonesia	158,082.7	183,456.7	2.15

Notes : AAGR : Average Annual Growth Rate

Source: Statistical Yearbook of Indonesia 1983 published
by the Central Statistic Bureau.

Table 2-2-3

POPULATION

PROVINCE	KABUPATEN	NO. OF KECAMATAN	POPULATION	AAGR (%)	AREA (1000 ha)	DENSITY	SURVEY YEAR
RIAU	Indragiri Hulu	9	259,032	5.5	1,585.4	0.16	1982
	Indragiri Hilir	11	424,583	2.0	1,232.6	0.34	1984
	Bengkalis	14	639,607	5.5	3,089.8	0.21	1983
SUMATERA SELATAN	Musi Rawas	9	397,143	3.1	1,520.0	0.26	1982
	Musi Banyuasin	8	860,597	4.5	2,619.1	0.33	1984
	Bangka	13	436,687	2.7	1,159.2	0.38	1984
	Belitung	4	173,379	1.8	462.3	0.38	1984
LAMPUNG	Lampung Tengah	23	1,745,433	0.8	840.9	2.08	1984
KALIMANTAN TENGAH	Kotawaringin Timur	24	293,800	3.3	5,070.0	0.06	1984
	Kapuas	23	364,172	6.0	3,480.0	0.10	1982
	Barito Selatan	12	125,014	1.0	1,290.0	0.10	1983
	Barito Utara	11	126,398	1.6	3,200.0	0.04	1984
KALIMANTAN TIMUR	Pasir	9	94,620	4.5	2,004.0	0.05	1984
	Kutai	30	440,129	6.3	9,102.7	0.05	1982
	Berau	7	48,900	4.3	3,270.0	0.01	1984
	Bulungan	13	198,570	5.0	6,400.0	0.03	1984
KALIMANTAN SELATAN	Tanah Laut	7	148,708	3.5	347.7	0.43	1984
	Kota Baru	19	253,400	5.6	1,426.4	0.18	1984
	Banjari	10	355,078	3.0	504.0	0.70	1982
	Barito Kuala	12	198,282	4.0	299.7	0.66	1984
	Tapin	8	115,752	3.0	270.1	0.42	1983
	Hulu Sungai Selatan	10	187,161	3.5	189.3	0.99	1984
	Hulu Sungai Tengah	8	205,266	0.5	147.2	1.39	1983
	Hulu Sungai Utara	12	248,860	1.5	359.2	0.69	1984
Tabalong	7	130,218	2.0	394.6	0.33	1984	
NUSA TENGGARA TIMUR	Sumba Barat	8	261,721	3.0	458.7	0.57	1984
	Ende	7	214,627	2.0	204.7	1.05	1984
	Ngada	9	183,532	2.0	303.8	0.60	1984
SULAWESI UTARA	Minahasa	27	704,024	2.0	432.2	1.63	1983
SULAWESI SELATAN	Gowa	8	368,552	0.6	188.3	1.90	1983
	Pangkajene Kepulauan	9	224,630	0.6	111.2	2.02	1984
	Barru	5	137,392	0.5	117.5	1.17	1982
	Soppeng	5	239,335	0.5	135.9	1.76	1984
	Wajo	10	379,948	0.5	250.6	1.52	1984
	Tana Toraja	9	340,015	0.6	195.0	1.73	1984
	Hamuju	6	124,315	6.0	1,105.8	0.11	1984
SULAWESI TENGGARA	Muna	7	187,653	5.7	488.7	0.38	1984
	Kolaka	6	159,790	2.3	885.5	0.18	1982

Table 2-2-4

LAND USE BY PROVINCE

YEAR : 1980

(Ha)

PROVINCE	TOTAL AREA	AGRICULTURAL HARVEST AREA							RESIDENTIAL USABLE OPEN SPACE	RIVER & LAKE	FORESTRY AREA	OTHERS
		WET PADDY FIELD	UPLAND PAD-DY FIELD	OTHER CULTI-VATED AREA	PLANTATION AREA	SUB TOTAL	RESIDENTIAL AREA	USABLE OPEN SPACE				
RIAU	7,578,604 (100)	130,202 (1.7)	54,998 (0.7)	200,055 (2.6)	825,486 (10.9)	1,210,741 (15.9)	208,123 (3.6)	5,178 (0.07)	448 (0.006)	4,338,879 (57.2)	1,743,295 (23.2)	
SUMATERA SELATAN	10,925,111 (100)	308,108 (2.8)	141,455 (1.3)	222,858 (2.0)	795,526 (7.3)	1,467,947 (13.4)	174,979 (1.6)	146,741 (1.3)	8,660 (0.08)	3,068,567 (28.1)	6,058,217 (55.5)	
LAMPUNG	3,162,359 (100)	146,610 (4.6)	210,100 (6.6)	293,795 (9.3)	219,135 (6.9)	869,640 (27.4)	177,442 (5.6)	139,957 (4.4)	6,909 (0.2)	918,745 (29.0)	1,049,866 (33.4)	
KALIMANTAN TENGAH	15,341,436 (100)	94,414 (0.6)	112,005 (0.7)	126,551 (0.8)	549,454 (3.6)	882,424 (5.7)	299,082 (1.9)	147,769 (1.0)	8,016 (0.05)	10,664,994 (69.5)	3,339,151 (21.8)	
KALIMANTAN TIMUR	15,171,530 (100)	196,851 (1.3)	92,540 (0.6)	33,965 (0.2)	647,681 (4.3)	971,037 (6.4)	160,745 (1.0)	67,675 (0.4)	16,150 (0.1)	12,210,027 (80.5)	1,745,896 (11.6)	
KALIMANTAN SELATAN	2,286,902 (100)	373,064 (13.7)	58,926 (2.6)	133,865 (5.8)	133,784 (5.8)	699,639 (27.9)	93,462 (4.1)	53,502 (2.3)	5,976 (0.3)	731,590 (32.0)	762,730 (33.4)	
NUSA TENGGARA TIMUR	4,423,112 (100)	70,042 (1.6)	265,498 (6.0)	241,368 (5.4)	151,662 (3.4)	728,570 (16.4)	84,208 (1.9)	784,922 (17.7)	18,243 (0.4)	910,633 (20.6)	1,896,540 (43.0)	
SULAWESI UTARA	2,298,073 (100)	42,885 (1.8)	100,607 (4.4)	109,465 (4.8)	285,650 (12.4)	538,607 (23.4)	54,781 (2.4)	88,352 (3.8)	3,134 (0.1)	1,201,416 (52.3)	411,783 (18.0)	
SULAWESI SELATAN	7,285,335 (100)	545,065 (7.5)	345,932 (4.7)	578,549 (7.9)	296,317 (4.1)	1,765,863 (24.2)	136,720 (1.8)	359,921 (4.9)	73,113 (1.0)	2,728,343 (37.4)	2,221,371 (30.7)	
SULAWESI TENGGARA	4,521,744 (100)	16,186 (0.3)	56,356 (1.2)	72,823 (1.6)	33,610 (0.7)	178,975 (3.8)	28,466 (0.6)	125,065 (2.7)	599 (0.01)	2,650,467 (58.6)	1,538,172 (34.2)	
INDONESIA	129,691,765 (100)	7,058,950 (5.4)	2,481,331 (1.9)	6,410,801 (4.9)	6,866,792 (5.3)	22,817,874 (17.5)	4,543,416 (3.5)	2,861,008 (2.2)	451,166 (0.3)	66,405,392 (51.4)	32,612,909 (25.1)	

NOTES : 1. The value in () denotes the proportion.

2. Source : Statistical year book of Indonesia 1983 published by The Central Statistic Bureau.

(1) Riau Province

Both the agricultural harvest area and forestry area of Riau Province are the third largest within the ten provinces concerned with the Project. The unusable area such as rivers, lakes, etc. is relatively small. In the agricultural harvest area the paddy field area is small being eighth within the ten provinces, while the plantation area is very large and is the largest within the ten provinces.

Approximately 70% of the paddy field area is wet paddy. While the upland paddy field area amounts to approximately 55,000 ha. The ratio of wet paddy to upland paddy is the largest within the ten provinces.

The future possibility of changing approximately 200,000 ha of the cultivated area, excluding paddy field, and the remaining usable coastal area to wet paddy field is high if an irrigation plan is promoted. Accordingly local road development will be important for the future development of the area.

(2) Sumatera Selatan Province

The approximate 796,000 ha of agricultural harvest area of Sumatera Selatan Province is the second largest within the ten provinces concerned with the Project and the approximate six million ha of unusable swampy area which spreads into the coastal area is the largest within the ten provinces. Both the paddy field and plantation area are the second largest within the ten provinces. The ratio of wet paddy to upland paddy is 69:31. Thus the proportion of wet paddy field to upland paddy field is the second largest after Riau Province. The approximate three million ha of forestry area is the fourth largest following Riau Province and shows the importance of the forestry resources for the province. Future development strategies will be to make useable by flood control of the Musi River basin, presently unusable areas, together with development of transportation systems.

(3) Lampung Province

Land use in Lampung Province is notable for the high proportion of agricultural harvest areas, the low proportion of forestry area and the highest proportion of residential area within the ten provinces concerned with the Project. Both forestry and unusable areas are the eighth largest within the ten provinces and the proportion of these areas are the lowest within the ten provinces. Thus the province is the most developed with respect to land use within the ten provinces.

The proportion of agricultural harvest area of approximately 27.4% is the second highest following the 27.9% for Kalimantan Selatan Province. The proportion of paddy field of approximately 11.2% is the highest following the 12.2% for Sulawesi Selatan Province.

The ratio of wet paddy field to upland paddy field is approximately 41:59. Highly developed land use for agriculture by the development of irrigation will be expected in the future.

(4) Kalimantan Tengah Province

The total area of forestry and presently unusable areas of Kalimantan Tengah Province is 91.8% of the total area of the province while the proportion of usable open space available for the residents is less than 10%. These figures show that the province is the lowest developed area in Indonesia. The forestry area of approximately 15 million ha is the largest within the ten provinces concerned with the Project. The proportion of the agricultural harvest area of approximately 880,000 ha is only 5.7%. The plantation area of approximately 550,000 ha and paddy field area of 210,000 ha are 62.3% and 23.4% of the agricultural harvest area respectively. The ratio of wet paddy field to upland paddy field is 46:54. These figures show the lack of development in the agricultural structure.

Settlement of residents through the land use together with development of the transportation structure and development

of forestry resources will be desirable in the future.

(5) Kalimantan Timur

The vast area of approximately 15 million ha of Kalimantan Timur Province is the second largest of the ten provinces concerned with the Project following Kalimantan Tengah Province. However 92.1% of the total area is forestry or unusable area and the proportion of usable area for the residents is only 7.9%.

The agricultural harvest area consists of approximately 197,000 ha of paddy field, wet 93,000 ha of upland paddy field, 34,000 ha of other cultivated area and 648,000 ha of plantation area which is the third largest within the ten provinces. The ratio of wet paddy field to upland paddy field is 68:32 which shows a higher agricultural productivity and higher development compared with Kalimantan Tengah Province. The proportion of the residential area is relatively large because of the two Kotamadyas of Samarinda and Balikpapan.

The objectives for the future development of the province are almost the same as for Kalimantan Tengah Province. Since there are suitable area for transmigration in the inland development of the transmigration programme is desirable.

(6) Kalimantan Selatan Province

Kalimantan Selatan Province is a developing area and has the most developed land use in Kalimantan Island. The proportion of agricultural harvest area is 27.9% of the total area and is the highest within the ten provinces concerned with the Project.

Accordingly the proportion of forestry area and unusable area is relatively low at 65.4%. The agricultural harvest area consists of wet paddy field, upland paddy field, other cultivated area and plantation area the areas of which are approximately 373,000 ha, 59,000 ha, 134,000 ha and 134,000 ha respectively.

A high proportion of the wet paddy field shows high productivity. The wet paddy field area is the second largest within the ten provinces following Sulawesi Selatan Province. For the future it is desirable to change the agricultural structure from rice production to multiple produce by flood control of the Barito River basin and development of drainage and irrigation systems.

(7) Nusa Tenggara Timur

The land use in Nusa Tenggara Timur Province is based upon the fact that the province consists of volcanic islands.

Most of the province is mountainous and there is no flat land along the coast except in a few areas.

Therefore, 43.4% of the total area is unusable. The flat usable areas are mostly in the crater basins surrounded by the mountains. The ratio of approximately 70,000 ha of wet paddy field to approximately 265,500 ha of upland paddy field is 21:79.

The proportion of upland paddy field is the highest and the unusable area of approximately 785,000 ha the largest within the ten provinces concerned with the Project.

Effective use of the limited coastal flat areas and the crater basins for multiple production is desirable for future development.

(8) Sulawesi Utara Province

Land use in Sulawesi Utara Province depends upon the geographical conditions of the province the which consists of a peninsula extending from west to east.

The mountains run a little to the north of the center of the peninsula and fall towards the coast resulting in only a small amount of flat areas. 70.3% of the province area is forestry

or unusable. The proportion of the plantation area and upland paddy field area is large. The agricultural harvest area which is quite large at 23.4% of the total province area, consists of wet paddy field, upland paddy field, other cultivated area and plantation area the areas of which are approximately 43,000 ha, 100,000 ha, 110,000 ha and 286,000 ha respectively. The total proportion of upland paddy area, other cultivated area and plantation area which do not need to be flat is 92.0%.

Because of the limited geographic conditions, it is desirable that the efficiency of the cash crop circulation is high. This can be achieved by development of the transportation systems.

(9) Sulawesi Selatan Province

The agricultural harvest area of approximately 1,766,000 ha of Sulawesi Selatan Province is the largest within the ten provinces concerned with the Project. Its area is 23.4% of the province area. The area of rivers and lakes is approximately 73,000 ha which is the largest within the ten provinces. These topographic conditions promote wet paddy field cultivation, the area of which is approximately 545,000 ha which is the largest area within the ten provinces. Furthermore the upland paddy field area of approximately 346,000 ha is also the largest.

Thus the province is the most highly developed agricultural province for rice production in the islands outside Jawa.

It is desirable that the circulation of production becomes more efficient and this depends upon the future development of transportation systems.

(10) Sulawesi Tenggara Province

The proportion of forestry area and unusable area of Sulawesi Tenggara Province is 92.9% which is the highest within the ten provinces concerned with the Project. The proportion of agricultural harvest area is 3.8% and is the lowest within the ten provinces because of its mountainous topographical conditions. The agricultural harvest area of approximately 179,000 ha consists of wet paddy field, upland paddy field, other cultivated area and plantation area the areas of which are approximately 16,000 ha, 56,000 ha, 73,000 ha and 34,000 ha respectively. Thus the wet paddy field area is very small.

It is desirable that the land is used more efficiently and this depends upon the future development of irrigation and transportation systems.

2.2.3 Agriculture

The main industrial activity in the Project Area is the agriculture sector for both socio and economic structures, as can be realised from the land use previously described. Thus the majority of the population in the Project Area is supported by agricultural activity. This is demonstrated by the fact that the proportion of the agricultural population to the total population is within the range of 60% to 80% as shown in Table 2-2-5.

The main production of the agricultural sector in the Project Area is food crops, especially paddy. However in the provinces of Riau, Sumatera Selatan and Sulawesi Utara, the production of plantation crops historically forms an important activity in the agricultural sector of the region.

Derived from Table 2-2-6 through Table 2-2-8 the food crop production, of which paddy is major, and plantation crop production in the provinces are outlined as follows:

(1) Riau Province

The current cultivated area and food crop production in Riau Province are approximately 178,000 ha and 447,000 ton respectively with the proportions of paddy production being approximately 76% and 72% respectively. Thus, paddy is the most predominant agricultural crop of the province.

The yield rate of paddy production is 2.37 ton per ha which is lower than the national value of 3.62 ton per ha. However the current average annual growth of yield rate is 6.1% which is higher than the national rate of 5.5%. Furthermore the growth rate of paddy field area of 3.2% is higher than both the national rate of 0.4% and the average rate of the provinces studied of 1.4%. Since the transmigration programme is being promoted in the province further development can be expected.

One of the agricultural characteristics of the province is plantation crops of which the main production is palm oil and rubber. The total area and production of plantation crops in the Kabupatens studied in the province are approximately

356,000 ha and 132,000 ton respectively. Attention will be given to these as export crops, along with the development of roads and Dumai Harbour.

(2) Sumatera Selatan Province

The current cultivated area and production of food crops in Sumatera Selatan Province are approximately 475,000 ha and 1,400,000 ton respectively the proportions of paddy production being approximately 88% and 81% respectively. Thus paddy is the most predominant agricultural crop of the province.

The paddy production is the fourth largest within the islands outside Jawa following the provinces of Sumatera Utara, Sumatera Barat and Sulawesi Selatan and is also the second largest within the ten provinces of the study. Current average annual growth rates of both paddy field and paddy production are higher than the national rates. However the yield rate of paddy is 2.72 ton per ha which is lower than the national rate of 3.62 ton per ha and its current growth rate remains comparatively low. Therefore development of an irrigation programme together with river improvements is desirable.

One of the agricultural characteristics of the province is plantation crops of which the main production is rubber. The area and production of plantation crops are approximately 470,000 ha and 107,000 ton respectively. Rubber is the traditional export product. Therefore some counteraction is expected considering the international balance of supply and demand.

(3) Lampung Province

The current cultivated area and production of food crops in Lampung Province are approximately 513,000 ha and 2,000,000 ton respectively with the proportion of paddy production being approximately 63% and 50% respectively. Thus, paddy is the major agricultural crop of the province.

One of the agricultural characteristics of the province is cassava production of about 600,000 ton which is approximately 30% of the food crop production. The paddy production is the fifth largest within the islands outside Jawa following Sumatera Selatan Province and is also the third largest within the ten provinces of the study. Current annual average growth rates of both paddy field and paddy production are higher than the national rates. The yield rate of paddy of 3.08 ton per ha is lower than the national rate of 3.62 ton per ha, however its growth rate of 6.9% is higher than the national rate of 5.5%. A rise in production of paddy in the future is desirable.

The proportions of both area and production of plantation crops to all crops in the Kabupatens concerned with the study are only 5.5% and 5.8% respectively. This is a low ratio, however development of preferred crops such as coffee and cacao is expected.

(4) Kalimantan Tengah Province

The current cultivated area and production of food crops in Kalimantan Tengah Province are approximately 27,000 ha and 310,000 ton respectively with the proportion of paddy production being approximately 81% and 71% respectively. Thus paddy is the most predominant agricultural crop of the province. However, both the paddy field area and paddy production are 14th and 17th respectively within the 20 provinces of the islands outside Jawa.

The province is an undeveloped area with regards to the agricultural sector. Because of the geographic conditions the proportion of upland paddy production is high. Since there has been a high proportion of slash-and-burn agricultural production the area has been subject to deforestation and currently the paddy field growth rate has declined a little to 1.7%. However current paddy production is tending upwards a little, as the growth rate of 2.1% shows, and this increase in yield gives the average annual growth rate of 3.9%.

Agricultural development in the province is expected to become more intensive due to the increase of settlers under the transmigration programme together with new construction and improvement of trunk transportation systems. An increase of plantation crops will not be expected in the present or near future because of conditions of both geography and transportation.

(5) Kalimantan Timur Province

The current cultivated area and production of food crops in Kalimantan Timur Province are approximately 67,000 ha and 166,000 ton respectively with the proportion of paddy production approximately 68% and 54% respectively. Thus paddy is the major agricultural crop of the province. However its production scale is the smallest within the ten provinces of the study. Both the area and production of paddy in the province are 18th within the 20 provinces in the islands outside Jawa. The economic structure of the province is low and undeveloped even though the province is an agricultural province.

From the national point of view, the province is rich in both petroleum and forest resources. It is expected that development in the current situation will be effected as the economic impact due to development of these resources does not reflect in the regional economic activity.

The current proportion of plantation crops is rather small, however development is expected in suitable areas with production in parallel with the promotion of the transmigration programme.

(6) Kalimantan Selatan Province

The current cultivated area and production of food crops in Kalimantan Selatan Province are approximately 320,000 ha and 814,000 ton respectively with the proportion of paddy production approximately 92% and 89% respectively. Thus paddy is the most predominant agricultural crop of the province.

The area and production of paddy are 6th and 9th respectively within the 20 provinces in the islands outside Jawa and 4th within the ten provinces of the study. The average annual growth rates of paddy field and paddy production are 3.7% and 12.2% and are higher than the national rates of 0.4% and 5.9% respectively. It is noted that the production is increasing even though the yield rate is stagnant.

In future the agricultural development in the province is expected to become more intensive due to the effective utilization of the rich water resources of the Barito River basin. Current plantation crop production is small scale. All the Kabupatens concerned with the study have plans for increasing plantation production, and care will be needed in selecting suitable crops.

(7) Nusa Tenggara Timur Province

The current cultivated area and production of food crops in Nusa Tenggara Timur Province are approximately 460,000 ha and 1,480,000 ton respectively with the proportion of paddy approximately 31% and 20% respectively. Of the food crops produced in the province, production of maize and cassava are approximately 250,000 ton and 780,000 ton respectively which are approximately 17% and 53% respectively of the total food crop production excluding paddy. The largest food crop production is cassava, paddy and maize in that order.

Since development of flat areas along the rivers in the province islands has been promoted recently, development of paddy production is expected in the future. It is noted that the average annual growth rates of paddy field, paddy production and yield are 3.7%, 12.2% and 8.2% which are all higher than the national rates. There is no notable plantation crop in the province.

(8) Sulawesi Utara Province

The current cultivated area and production of food crops in Sulawesi Utara Province are approximately 214,000 ha and 680,000 ton respectively with the proportion of paddy approximately 32% and 38%.

Production of maize and cassava is approximately 200,000 ton and 130,000 ton respectively which proportions of total food crops production are approximately 30% and 18% respectively. Paddy is the major product, however its proportion is relatively low. However current average annual growth rates of paddy field, paddy production and yield are comparatively high as shown in the rates of 1.3%, 9.0% and 7.6% respectively which are all higher than the national rates. Especially the increase of yield is so large that technical progress of the cultivation method of paddy production can be observed.

One of the agricultural characteristics in the province is plantation crop production of which the productivity per area is high. Clove as a major item and many other kinds of plantation crops which are important commodity crops in the province are produced by small holders.

(9) Sulawesi Selatan Province

The current cultivated area and production of food crops in Sulawesi Selatan Province are approximately 950,000 ha and 3,000,000 ton respectively with the proportion of paddy approximately 60% and 73% respectively.

Thus paddy is the most predominant agricultural crop of the province. Paddy production is the largest within the provinces in the islands outside Jawa. The current tendency is that the paddy field is declining a little, however average annual growth rates of paddy production and yield of paddy are 7.2% and 8.5% respectively which are higher than the national rates. It is noted that the paddy fields are superior and irrigation systems are developed. Thus the position as the highest paddy production province in the islands outside Jawa is consolidated.

Due to the good geographical conditions 96% of the paddy field is wet paddy field. This is the cause of the high productivity. There are no notable plantation crops in the province.

(10) Sulawesi Tenggara Province

The current cultivated area and production of food crops in Sulawesi Tenggara Province are approximately 150,000 ha and 550,000 ha respectively with the proportion of paddy production only approximately 27% and 17% respectively.

Production of maize and cassava is approximately 74,000 ton and 350,000 ton respectively which proportions of total food crop production are approximately 14% and 64% respectively. The largest food crops produced are cassava, paddy and maize in that order. This shows the same pattern as Nusa Tenggara Timur Province. The development of paddy production is expected due to the on-going transmigration programme in the province. The progress of development can be observed from the fact that the average annual growth rates of paddy field, paddy production and yield are 4.3%, 15.4% and 8.2% respectively which are considerably higher than the national rates.

The current plantation crop production is comparatively small, however the productivity per area is relatively high. Future development of plantation crop production is expected.

Table 2-2-5

FARMING POPULATION

PROVINCE	KABUPATEN	T O T A L POPULATION	FARMING POPULATION	(person)	
				PROPORTION OF FARMING POPULATION (%)	SURVEY YEAR
RIAU					
	Indragiri Hulu	259,032	222,768	86.0	1982
	Indragiri Hilir	424,583	314,400	74.0	1984
	Bengkalis	639,607	552,510	86.4	1983
SUMATERA SELATAN					
	Musi Rawas	397,143	346,070	87.1	1982
	Musi Banyuasin	860,597	466,307	54.2	1984
	Bangka	436,687	224,100	51.2	1984
	Belitung	173,379	-	-	-
LANPUNG					
	Lampung Tengah	1,745,433	1,476,000	84.6	1984
KALIMANTAN TENGAH					
	Kotawaringin Timur	293,800	181,700	61.8	1984
	Kapuas	364,172	-	-	1982
	Barito Selatan	125,014	102,150	81.7	1983
	Barito Utara	126,398	66,120	52.3	1984
KALIMANTAN TIMUR					
	Pasir	94,620	82,915	87.6	1984
	Kutai	440,129	358,160	81.4	1982
	Berau	48,900	37,200	76.1	1984
	Bulungan	198,570	149,400	75.2	1984
KALIMANTAN SELATAN					
	Tanah Laut	148,708	122,400	82.3	1984
	Kota Baru	253,400	161,400	63.7	1984
	Banjar	355,078	312,492	88.0	1982
	Barito Kuala	198,282	155,768	78.6	1984
	Tapin	115,752	71,200	61.5	1983
	Hulu Sungai Selatan	187,161	114,200	61.0	1984
	Hulu Sungai Tengah	202,370	125,252	61.9	1984
	Hulu Sungai Utara	248,860	191,600	77.0	1984
	Tabalong	130,218	106,080	81.3	1984
NUSA TENGGARA TIMUR					
	Sumba Barat	261,721	187,151	71.5	1984
	Ende	214,627	178,100	83.0	1984
	Ngada	183,532	154,500	84.2	1984
SULAWESI UTARA					
	Minahasa	704,024	452,268	64.2	1984
SULAWESI SELATAN					
	Gowa	368,552	225,760	61.3	1983
	Pangkajene Kepulauan	224,630	145,522	64.8	1984
	Barru	137,392	88,935	64.8	1982
	Soppeng	239,335	165,990	69.4	1984
	Wajo	379,948	242,500	63.8	1984
	Tana Toraja	340,015	259,620	76.4	1984
	Mamuju	124,315	101,350	81.5	1984
SULAWESI TENGGARA					
	Muna	187,653	119,269	63.6	1984
	Kolaka	159,790	139,727	87.4	1982

Table 2-2-6

CULTIVATED AREA OF FOOD CROPS

Year : 1983

PROVINCE	P A D D Y			SUB TOTAL	AGGR	OTHER FOOD CROPS	TOTAL
	WET LAND	UPLAND					
RIAU	85,476	49,317		134,793	3.2	43,278	178,071
SUMATERA SELATAN	301,584	117,809		419,393	6.1	54,633	474,026
LAMPUNG	190,611	134,109		324,720	6.0	188,262	512,982
KALIMANTAN TENGAH	75,274	40,936		116,210	1.7	26,955	143,165
KALIMANTAN TIMUR	27,033	18,418		45,451	17.4	21,812	67,263
KALIMANTAN SELATAN	264,187	29,520		293,707	0.04	27,229	320,936
NUSA TENGGARA TIMUR	74,715	71,275		145,990	3.7	315,567	461,557
SULAWESI UTARA	55,442	13,140		68,582	1.3	145,032	213,614
SULAWESI SELATAN	547,734	25,022		572,756	1.2	376,844	949,600
SULAWESI TENGGARA	15,414	25,123		40,537	4.3	108,308	148,845
TOTAL	1,637,470 (75.9)	524,669 (24.3)		2,162,139 (100)	1.4	1,307,920	3,470,059
INDONESIA	7,940,691 (87.2)	1,161,583 (12.8)		9,102,274 (100)	0.4	5,641,902	14,744,176

Notes : 1. Source : Statistical Yearbook of Indonesia 1984 published by The Central Statistic Bureau

2. AACR : Average Annual Growth Rate of paddy between 1980 and 1983

3. The value in () denotes the proportion in %.

Table 2-2-7

PRODUCTION AND YIELD OF FOOD CROPS

PROVINCE	P A D D Y		UPLAND	SUB TOTAL	AACR	O T H E R F O O D C R O P S		T O T A L
	WET LAND	(Ton)				(Ton)	(Ton)	
RIAU	249,504 (2.92)	70,474 (1.43)	319,978 (2.37)	9.4 (6.1)	127,449 (2.94)	447,427		
SUMATERA SELATAN	941,545 (3.12)	197,919 (1.68)	1,139,464 (2.72)	9.3 (3.0)	265,703 (4.86)	1,405,167		
LAMPUNG	783,609 (4.11)	214,790 (1.60)	998,399 (3.08)	13.3 (6.9)	1,006,757 (5.35)	2,005,156		
KALIMANTAN TENGAH	164,925 (2.19)	54,936 (1.34)	219,861 (1.89)	2.1 (3.9)	90,036 (3.34)	309,897		
KALIMANTAN TIMUR	61,987 (2.29)	28,161 (1.53)	90,148 (1.98)	15.4 (5.1)	75,462 (3.46)	165,610		
KALIMANTAN SELATAN	681,586 (2.58)	42,151 (1.43)	723,737 (2.46)	0.3 (0)	89,791 (3.30)	813,528		
NUSA TENGGARA TIMUR	220,110 (2.95)	82,180 (1.15)	302,290 (2.07)	12.2 (8.2)	1,178,915 (3.74)	1,481,205		
SULAWESI UTARA	238,567 (4.30)	20,604 (1.57)	259,171 (3.78)	9.0 (7.6)	422,354 (2.91)	681,525		
SULAWESI SELATAN	2,172,634 (3.97)	44,392 (1.77)	2,217,026 (3.87)	7.2 (8.5)	800,222 (2.12)	3,017,248		
SULAWESI TENGGARA	48,476 (3.15)	42,396 (1.69)	90,872 (2.24)	15.4 (8.2)	456,954 (4.22)	547,826		
TOTAL	5,562,943	798,003	6,360,946	-	4,543,643	10,904,589		
INDONESIA	33,209,880 (4.18)	2,026,839 (1.75)	35,236,719 (3.87)	5.9 (5.5)	20,412,224 (3.62)	55,648,943		

NOTES : 1. Source : Statistical Yearbook of Indonesia 1984 published by the Central Statistic Bureau.

2. AACR : Average Annual growth rate of paddy between 1980 and 1983.

3. The Value in () denotes the yield in ton per ha.

Table 2-2-8

AREA AND PRODUCTION OF PLANTATION

CROPS IN THE PROJECT AREA

Year : 1983

PROVINCE	NO. OF KABS	AREA (ha)	PRODUCTION (Ton)
RIAU	3	356,061	132,851
SUMATERA SELATAN	4	473,384	106,911
LAMPUNG	1	77,892	33,283
KALIMANTAN TENGAH	4	58,305	24,651
KALIMANTAN TIMUR	4	19,789	8,881
KALIMANTAN SELATAN	9	109,066	41,030
NUSA TENGGARA TIMUR	3	135,086	16,643
SULAWESI UTARA	1	124,982	116,243
SULAWESI SELATAN	7	43,943	34,821
SULAWESI TENGGARA	2	22,244	57,038
TOTAL	38	1,420,752	572,352
INDONESIA		8,091,400	7,280,500