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No. 52

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
DIRECTORATE GENERAL OF HIGHWAYS
MINISTRY OF PUBLIC WORKS
THE REPUBLIC OF INDONESIA

ROAD NETWORK STUDY IN CENTRAL AND SOUTHEAST SULAWESI IN THE REPUBLIC OF INDONESIA

FINAL REPORT

VOLUME I : SUMMARY

DECEMBER 1998

PACIFIC CONSULTANTS INTERNATIONAL
YACHIYO ENGINEERING CO.,LTD.

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FINAL REPORT
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NOTE

The following exchange rate is applied.

US$ 1.00 = Rp 10,600 (as of July 1998)

The exchange rate between the US $ and Indonesian Rp is based upon the exchange rate used officially for the government budget, July 1998.

PREFACE

In response to a request from the Government of the Republic of Indonesia, the Government of Japan decided to conduct a Road Network Study in Central and Southeast Sulawesi in the Republic of Indonesia and entrusted to study to the Japan International Cooperation Agency (JICA).

JICA selected and dispatched a study team headed by Mr. Haruo Sakashita of Pacific Consultants International (PCI) and consisting of PCI and Yachiyo Engineering Co., Ltd. to the Republic of Indonesia, between March 1997 and December 1998. In addition, JICA set up an advisory committee headed by Mr. Masaru Sasaki, Director of First Construction Bureau of Japan Highway Public Corporation between March 1997 and December 1998 which examined the study from specialist and technical points of view.

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

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

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

December 1998

Kimio Fujita
President
Japan International Cooperation Agency

December 1998

Mr. Kimio Fujita
President
Japan International Cooperation Agency
Tokyo, Japan

Letter of Transmittal

Dear Sir:

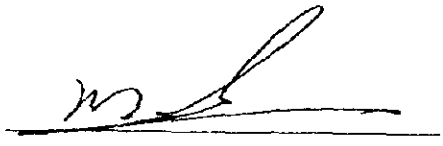
We are pleased to submit herewith the Final Report of Road Network Study in Central and Southeast Sulawesi in the Republic of Indonesia. The report contains the advice and suggestions of the authorities concerned of the Government of Japan and your agency as well as the formulation of the above mentioned project.

This report presents a Master Plan, Pre-Feasibility Study and Feasibility Study of road network in Central and Southeast Sulawesi in the Republic of Indonesia.

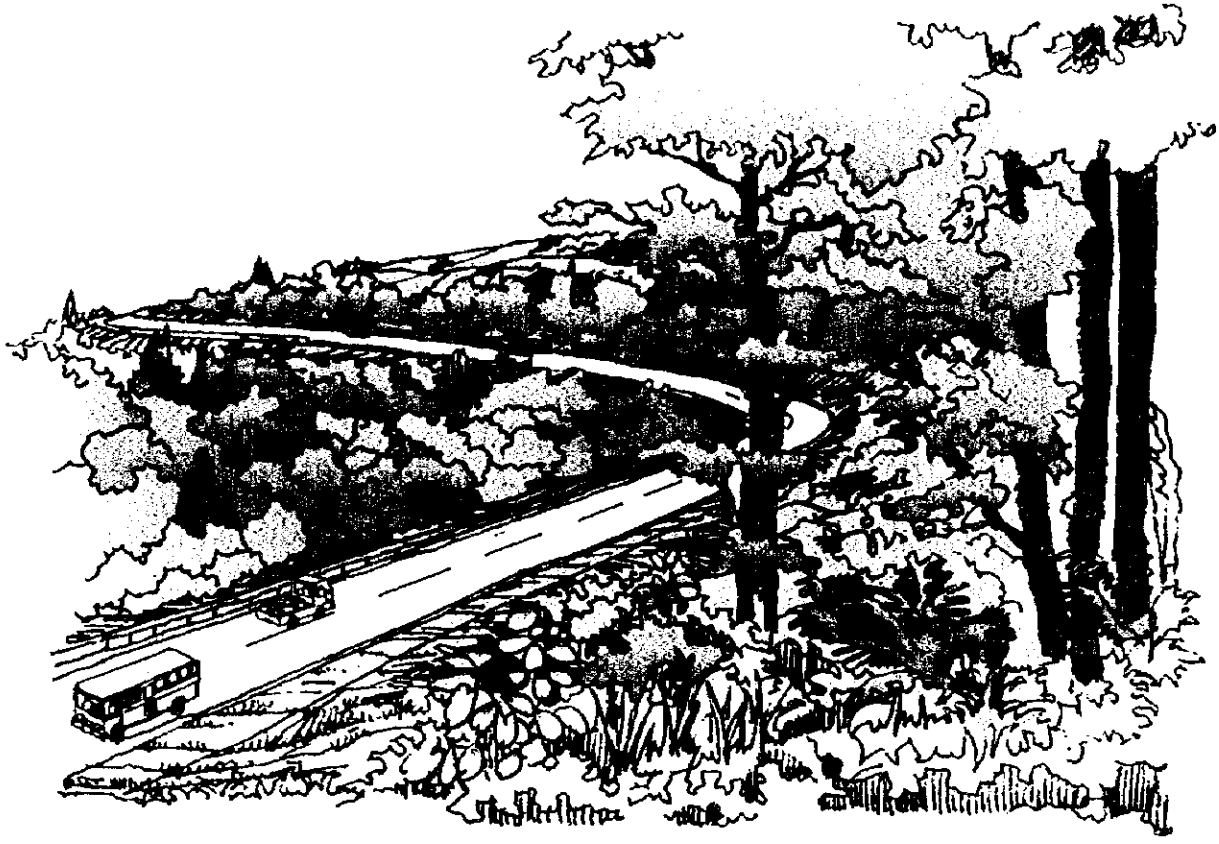
In view of necessity of the road network master plan, we recommend that the Republic of Indonesia will implement these projects following the master plan.

We would like to express our sincere gratitude to your agency and the Ministry of Foreign Affairs. We also wish to express our deep gratitude to the officials concerned of Directorate General of Highways, Ministry of Public Works of the Republic of Indonesia, the Japanese Embassy in the Republic of Indonesia for close cooperation and assistance extended to us during our investigation and study.

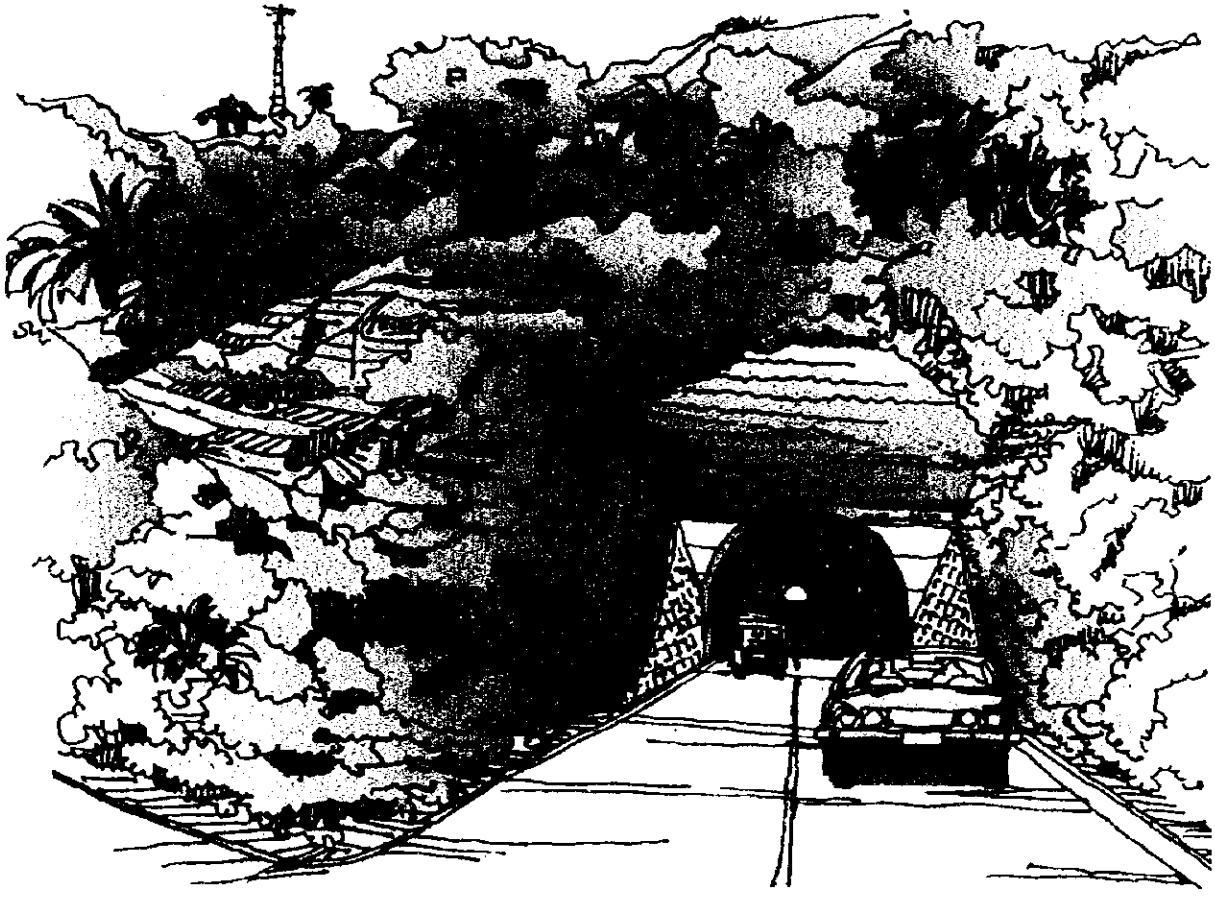
Very truly yours,



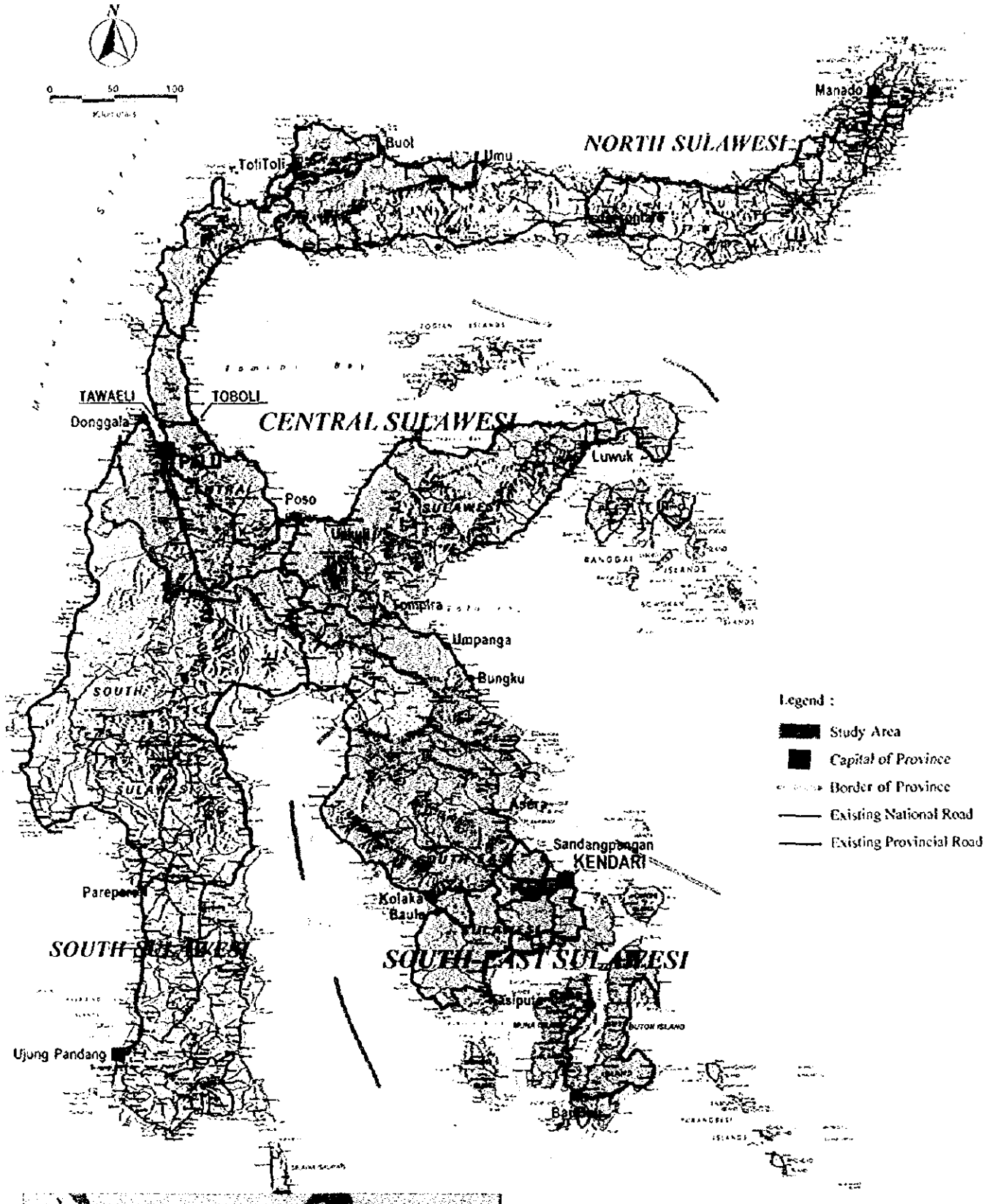
Haruo Sakashita
Team Leader
The Road Network Study in Central and Southeast Sulawesi
In the Republic of Indonesia



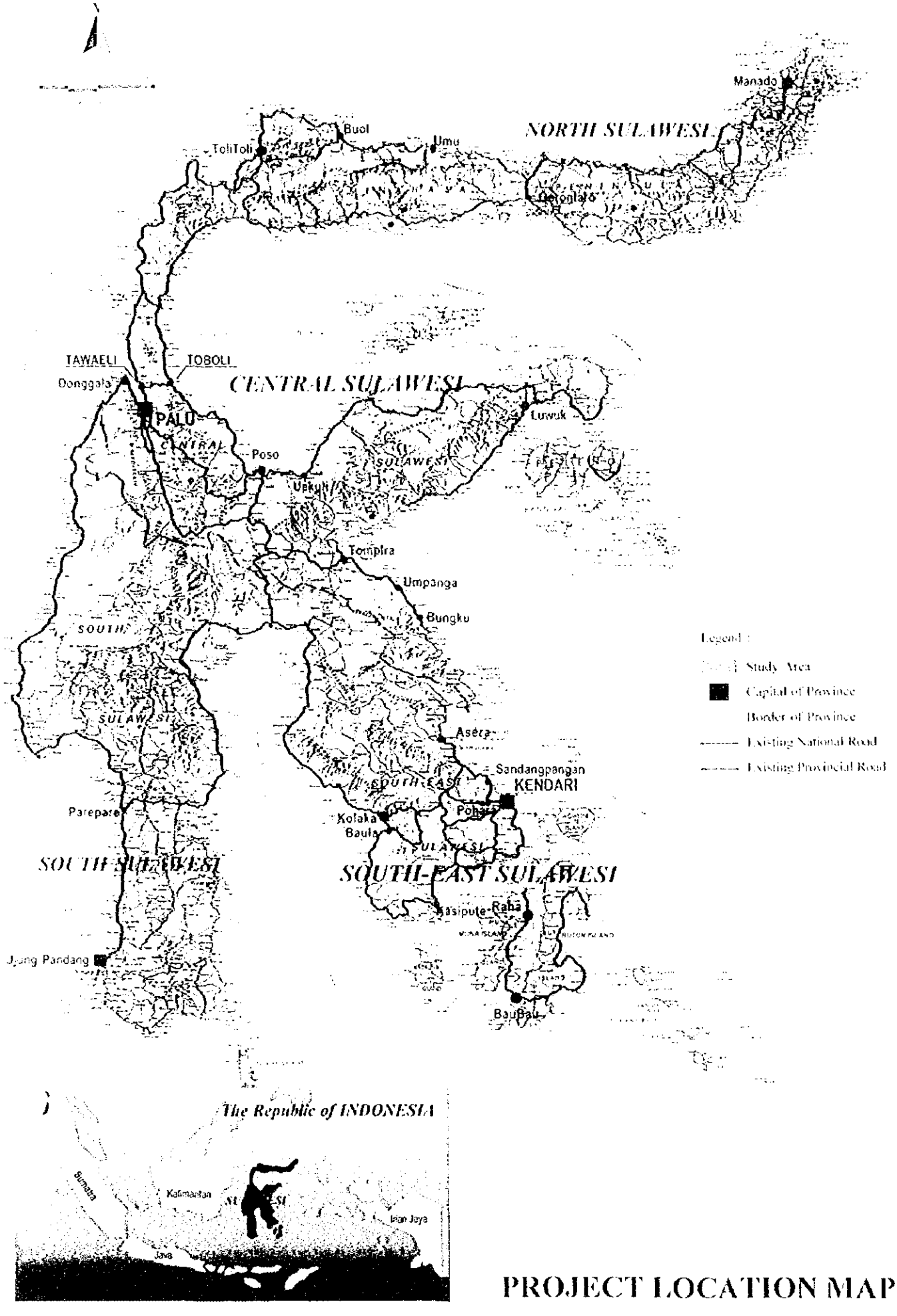
BYPASS FOR TAWAELI-TOBOLI ROAD



TUNNEL FOR TAWAELI-TOBOLI ROAD



PROJECT LOCATION MAP



PROJECT LOCATION MAP

LIST OF FINAL REPORT

Volume I : Summary

Volume II : Master Plan and Pre-Feasibility Study

Volume III: Feasibility Study for Tawaeli-Toboli Road

Volume IV: Feasibility Study for Trans-Sulawesi East Road

Volume V : Drawings for Tawaeli - Toboli Road

Volume VI: Drawings for Trans-Sulawesi East Road

ABBREVIATION AND GLOSSARY

AADT	Annual Average Daily Traffic
AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
ADB	Asian Development Bank
ADT	Average Daily Traffic
AMDAL	Environmental Impact Assessment
ANDAL	Environmental Impact Statement
APBD	Anggaran Pendapatan dan Belanja Daerah, (Provincial or district Budget)
APBN	Anggaran Pendapatan dan Belanja Negara (National Budget)
APPKD	Anggaran Penerimaan dan Pengeluaran Kas desa (Village Budget)
ASTM	American Society for Testing and Materials
B/C	Benefit Cost ratio
BPR	Bureau of Public Road, USA
BPS	Biro Pusat Statistik (Central Bureau of Statistics, Indonesia)
Bappeda	Badan Perencanaan Pembangunan Daerah (Regional Development Planning Agency)
Bappenas	Badan Perencanaan Pembangunan Nasional (National Development Planning Agency, Indonesia)
Bina Marga	Directorate General of Highways
Binkot	Directorate of Urban Roads
Bintec	Directorate of Technical Support
Bipran	Directorate of Planning
CBR	California Bearing Ratio
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
DPUK	Road Department of Regency or Prefecture
DPUP	Road Department of Province
Desa	Administrative village
Dinas PU	Department of Public Works, Office of Provincial Government
EIA	Environmental Impact Analysis
EIRR and FIRR	Economic and financial internal rate of return
F/S	Feasibility Study
F/C	Foreign currency
FG	Finished grade
G/A	Generation/attraction
GDP	Gross Domestic Product
GNP	Gross National Product
GRDP	Gross Regional Domestic Product
IEE	Initial Environmental Examination
JICA	Japan International Co-operation Agency
KA-ANDAL	Terms of Reference of Environmental Impact Assessment
KEL	Knife-Edge Load
Kabupaten	Regency or prefecture administrative unit below the province
Kanwil	Kantor Wilayah (Regional Office, Ministry of Public Works)

Kecamatan	Sub-regency, administrative unit below the regency (Kabupaten)
Kotamadya	Municipality
L/C	Local Currency
LIPI	National Institute of Sciences
NPV	Net Present Value
OD	Origin and Destination
PC	Prestressed Concrete
PCC	Portland Cement Concrete
PCU	Passenger Car Unit
PJP II	Pembangunan Jangka Panjang II (Second Long-Term Development, 1994-2018)
Pre-F/S	Pre-feasibility Study
PU	Pekerjaan Umum (Public Works)
RC	Reinforced Concrete
RKL	Environmental Management Plan
ROW	Right-Of-Way
RPL	Environmental Monitoring Plan
Rp.	Rupiah
Sta.	Station
Sulawesi Tengah	Central Sulawesi
Sulawesi Tenggara	Southeast Sulawesi
UDL	Uniformly Distributed Load
UKL	Environmental Management
UPL	Environmental Monitoring
VOC	Vehicle Operating Cost

Dia. or ϕ	Diameter
Hr	Hour
Km	Kilometer
Km/h or KPH	Kilometer per hour
cm, cm^2, cm^3	Centimeter, square centimeter, cubic centimeter
veh./h	Vehicle per hour

OUTLINE OF THE STUDY

The Republic of Indonesia, Road Network Study in Central and Southeast Sulawesi

- Study period: March, 1997 – December, 1998
- Counterpart Agency: Directorate General of Highways, Ministry of Public Works

1. Background

Sustainable economic growth of the Republic of Indonesia has been attained through the effects of the First 25-Year Long Term Plan, which was inaugurated in 1969. In particular, the market-oriented economy policy initiated in the mid-1980's has facilitated economic activities in the private sector and has been successful in socio-economic development.

The island of Java, among certain others, has enjoyed rapid economic development, but eastern Indonesia, including Sulawesi, has benefited comparatively little from this development due to the insufficiency of the socio-economic infrastructure.
The Sixth 5-Year Development Plan (1994-1998), in reflection of the previous 5-year plans, aims to eradicate poverty, rectify regional economic imbalances and facilitate activities of the private sector relating to economic development.

Based on the above background, a study for a new road network master plan has been launched to boost the economy of the provinces of Central and Southeast Sulawesi. These provinces were selected from the eastern portion of Indonesia due to their high potential in the agriculture, mining & quarrying sectors.

Indonesia has been affected by the Asian economic recession which started in August 1997. The Indonesian economic growth rate has slowed considerably since then, which is considered in this Study.

2. Objective

The objective of the Study is to propose a master plan (target year: 2018) for the road network system in Central and Southeast Sulawesi, conduct a pre-feasibility study for 1,200 km of road (target year: 2008) and a feasibility study for 350 km of road (target year: 2003) from among the priority roads of the master plan.

3. Study Area

The study covers Central and Southeast Sulawesi Provinces and an adjacent area of South Sulawesi Province.

4. Project Outline

4.1 Basic Policy

The total length of national and provincial roads in the study area is 4,884 km. The road length per unit area is 0.05 km/km^2, which is about half of the Java Island total. Roads in the study area are typically of low standard, provide an incomplete network,

are highly susceptible to potential disasters, and are not adequately maintained. Improvement of the roads is needed to facilitate regional activities, in consideration of the following goals:

- Improvement of road links between main cities to facilitate the transportation of persons and goods;
- Preemption of disaster and ensuring of uninterrupted transport to and from production facilities;
- Upgrading road infrastructure to keep in line with future transportation demand and to foster increased efficiency of production;
- Formulation of a road network master plan providing alternative links between main cities, together with a realistic implementation schedule; and
- Increase of the national and provincial road length ratio to about 7 % (6,552 km) from 5 %.

4.2 *Content*

The Road Network Master Plan was formulated, and feasibility studies were carried out in terms of the approaches described in following sections.

(1) Master Plan of Road Network

The master plan, shown in Figures 1 and 2, contains 6,552 km of roads throughout Central and Southeast Sulawesi.

As the result of master plan subsequence, priority has been assigned to road link Nos. 4, 5, 8, 9, 15, 16, 22, 31, 32, 33.

(2) Pre-Feasibility Study

A pre-feasibility study of the above-mentioned road links (over 1,200 kilometers) was conducted for the construction target year 2008.

Pavement, bridges, slope protection design as well as tunnel and construction planning were completed based upon the road's geometric standard. Cost estimates were prepared in due consideration of traffic volume and environmental aspects (See Table 4).

(3) Future Traffic Volume and Number of Traffic Lanes

Table 1 Future Traffic Volume of Pre-F/S Links

Link No.		4	5	8	9	15	16	22	31	32	33
Traffic Volume (veh/day)	Year 2003	33	16	1,540	1,364	764	1,141	1,064	262	1,192	1,064
	Year 2018	42	51	5,496	3,850	1,694	1,486	1,321	827	1,431	1,351
Number of Traffic Lane		1	1	2	2	2	2	2	2	2	2

Note: Traffic volume does not include motorcycles.

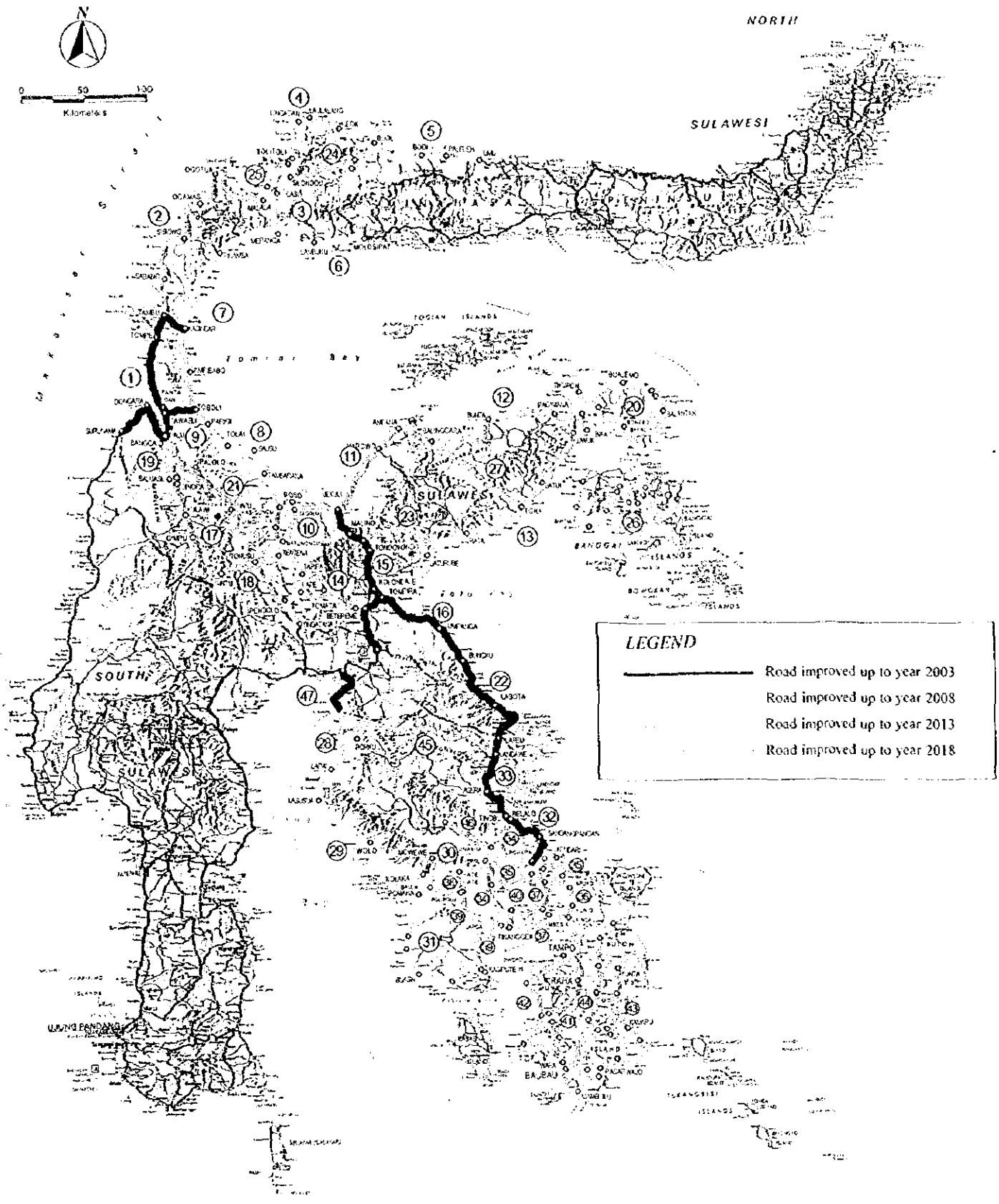


Figure 1 Master Plan of Road Network with Road Link No.

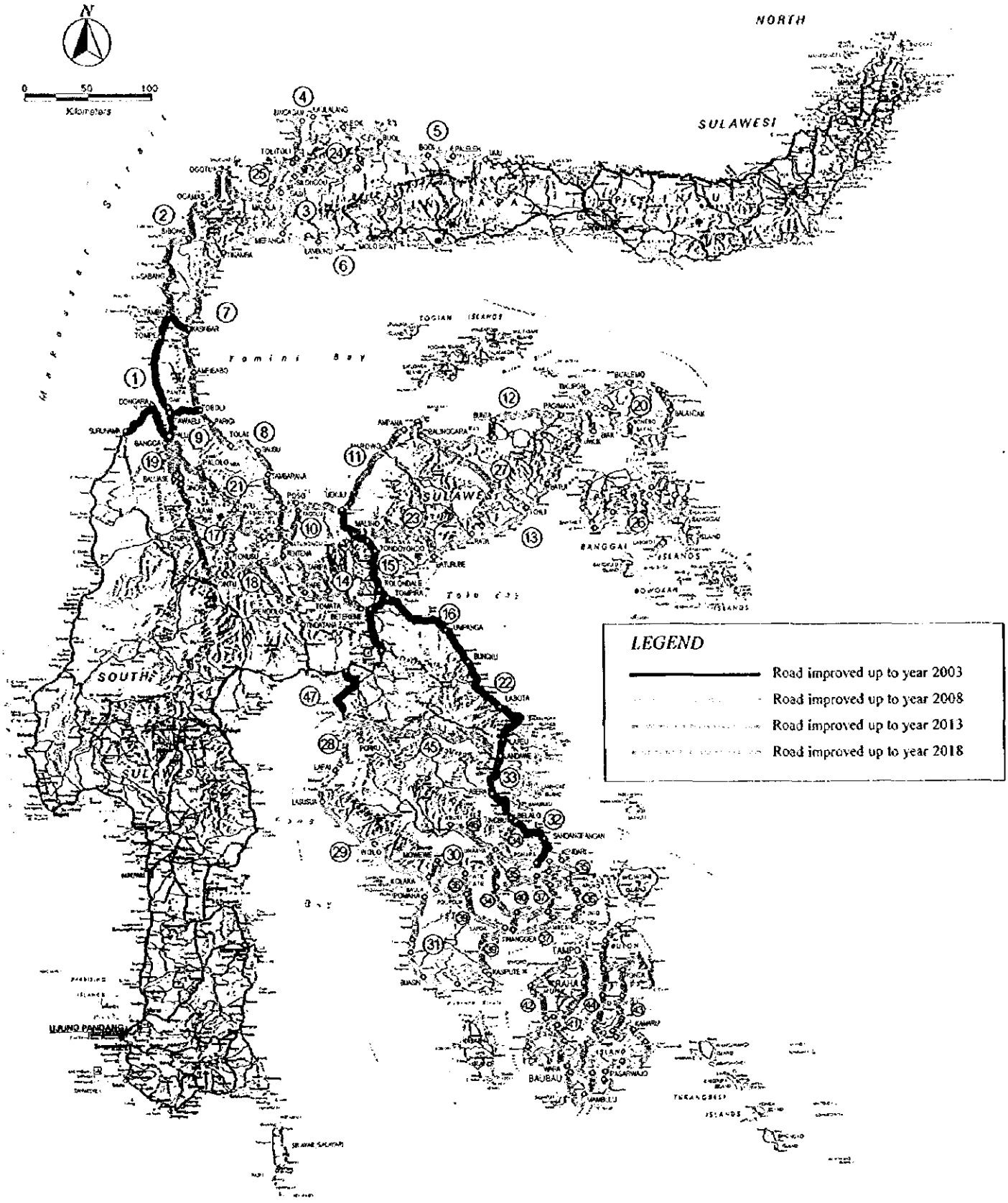


Figure 1 Master Plan of Road Network with Road Link No.

(4) Feasibility Study

- As a result of pre-feasibility study, the Trans-Sulawesi East Road (Link Nos. 15, 16, 22, 33 and 32) and the Tawaeli-Toboli Road (Link No. 9) took priority for the feasibility study.
- Major salient features of the feasibility study links are shown in Table 2.

Table 2 Major Quantities of Feasibility Study Links

Link No.	Link Name	Road Length (km)	Earthwork (m^3)	Pavement (km)	Bridge (m)	Slope Protection Work (m^2)	Tunnel (m)
9	Tawaeli – Toboli	40.1	852,000	40.1	1,030	124,000	620
15	Uekuli – Tompira	114.1	1,282,000	114.1	1,360	194,000	0
16	Umpanga – Bungku	35.8	31,000	35.8	675	0	1,990
22	Bungku – Provincial Border	110.7	1,551,000	110.7	3,000	123,000	0
33	Provincial Border – Asera	55.5	115,000	55.5	1,050	600	0
32	Asera - Sandangpangan	81.5	372,000	81.5	1,464	27,000	0
	Total	437.7	-	-	-	-	-

5. Project Costs

The estimated construction costs for the road links of the master plan, pre-feasibility and feasibility are shown below in foreign and local currencies in exchange rates effective in July 1998 (1US$ = 10,600 Rp/official rate).

Table 3 Construction Costs for Road Network Master Plan (6,500 km)

Unit: Billion Rp.

Years	1999-2003	2004-2008	2009-2013	2014-2018	Total
Construction Cost in S-E Province	552	1,659	898	1,270	4,379
Maintenance Cost in S-E Province	323	236	266	277	1,102
Construction Cost in Central Province	1,567	1,754	2,629	2,272	8,222
Maintenance Cost in Central Province	487	340	394	533	1,755
Total	2,929	3,989	4,187	4,352	15,458

Table 4 Construction Costs for Road Links of Pre-Feasibility Study (1,200 km)

Link No.	Link Name	Length (km)	Foreign (Thousand US$)	Local (Billion Rp.)	Total (Billion Rp.)
4	Toli Toli – Buol	174.2	10,969	106.83	223.10
5	Buol – Umu	141.0	9,715	93.69	196.68
8	Toboli – Poso	146.8	10,528	105.17	216.76
15	Uekuli – Nuha	174.0	18,269	167.34	362.45
16	Tompira – Bungku	103.9	11,703	112.38	236.51
22	Bungku – Provincial Border	115.0	22,220	198.21	433.75
31	Barru – Kasipute	188.0	12,826	123.31	259.26
32	Pohara – Asera	91.7	10,262	98.66	207.44
33	Asera – Provincial Border	76.0	10,582	99.74	211.91
	Total	1,210.6	-	-	2,347.86

Table 5 Construction Costs for Road Links of Feasibility Study (440 km)

Link No.	Schedule and Cost	2000	2001	2002	2003	Total
9	F/C (Thousand US$)	698	3,282	6,049	5,340	15,369
	L/C (Billion Rp.)	4.94	27.01	50.03	51.23	133.21
	Total (Billion Rp.)	12.34	61.80	114.15	107.84	296.13
15	F/C (Thousand US$)	1,383	6,213	10,934	11,526	30,056
	L/C (Billion Rp.)	16.03	56.42	87.11	108.11	267.67
	Total (Billion Rp.)	30.69	122.27	203.01	230.29	586.26
16	F/C (Thousand US$)	145	400	989	1,478	3,012
	L/C (Billion Rp.)	1.43	4.16	9.06	15.00	29.65
	Total (Billion Rp.)	2.97	8.40	19.54	30.67	61.58
22	F/C (Thousand US$)	1,138	4,439	9,300	9,390	24,267
	L/C (Billion Rp.)	10.20	40.95	81.42	92.74	225.31
	Total (Billion Rp.)	22.26	88.01	180.00	192.28	482.55
33	F/C (Thousand US$)	307	883	2,273	3,078	6,541
	L/C (Billion Rp.)	2.92	8.93	19.00	30.08	60.93
	Total (Billion Rp.)	6.17	18.30	43.09	62.71	130.27
32	F/C (Thousand US$)	522	1,696	3,707	4,907	10,832
	L/C (Billion Rp.)	5.64	17.63	33.59	49.68	106.54
	Total (Billion Rp.)	11.18	35.61	72.89	101.69	221.37
9, 15, 16, 22, 33, 32 (Grand Total)	**F/C (Thousand US$)**	**4,193**	**16,913**	**33,252**	**35,719**	**90,077**
	L/C (Billion Rp.)	**41.16**	**155.10**	**280.21**	**346.84**	**823.31**
	Total (Billion Rp.)	**85.61**	**334.39**	**632.68**	**725.48**	**1,778.16**

Notes: Exchange Rate: 1.0 US$ = 10,600 Rp. F/C: Foreign Currency, L/C: Local Currency
Link No. 15 was studied based on topographic map with a scale of 1:50,000, but other links were based on topographic map with a scale of 1:5,000.

6. Project Evaluation

6.1 Economic Analysis

The road links of the master plan as well as those in the feasibility study are feasible. The economic indicators for the road links are shown in Table 6.

Table 6 Result of Economic Analysis

	Link No.		Location	EIRR (%)	NPV (Million Rp.)	B/C	Road Length (km)
Master Plan	All Links		Central and Southeast Sulawesi	24.3	1,670,981	1.61	6,552.2
Feasibility Study	9		Tawaeli – Toboli	19.8	76,555	1.50	40.1
	Trans-Sulawesi East Road	15	Uekuli – Tompira	20.5	152,563	1.51	114.1
		16	Umpanga – Bungku	40.9	84,660	3.89	35.8
		22	Bungku – Provincial Border	19.5	89,869	1.37	110.7
		33	Provincial Border – Asera	33.4	106,586	2.79	55.5
		32	Asera – Sandangpangan	30.4	163,407	2.48	81.5
			Sub-total	23.8	597,085	1.81	397.6

Discount Rate: 15 % p.a.

6.2 Environmental Aspects

Improvement of the Tawaeli-Toboli Road and Trans-Sulawesi East Road will catalyze considerable positive influence on society and persons residing in the vicinity of the road as well as within the province. Therefore, the following points are to be considered:

- Appropriate compensation should be made for land and structures affected by road link Nos. 15, 16, 22, 33 and 32.
- The alignment change and widening of the existing road should be minimized to reduce impact on the Parigi-Binangga Nature Reserve (Road Link No. 9).
- Impact on fauna and flora is to be mitigated by restricting the speed of vehicles, reducing the noise and vibration, prohibiting illegal cultivation and settlements in that area (Links No. 9 and 22).
- More than 560,000 m^3 of excess soil for Tawaeli-Toboli road (1,354,000 m^3 for Trans-Sulawesi East Road including Link No. 15), will be produced by construction of the road due to the imbalance of cut and fill volume. The following points need to be heeded in regards to selection of dumping sites:
  - Excavated soil should not be dumped or left as is in excessively rainy or dry seasons.
  - Dump sites in which exposed or graded surfaces of excavated soil can be minimized should be selected.
- Slope protection works such as sprayed concrete cribwork, shotcrete work, stone masonry and mat gabions for fill and cut slopes should be constructed to prevent soil erosion and landslides (Links No. 9, 15, 22, 33 and 32).

7. Implementation Schedule

The construction schedule for each road link of the road network has been planned in stages, considering priority, budgetary allocation and environmental impacts. (See Figure 2.)

8. Recommendations

(1) The master plan of road network is to be employed together with the implementation schedule to promote the construction of the priority road links in Central and Southeast Sulawesi.

(2) Tawaeli-Toboli road (Link No. 9) is a feasible project and should be completed by the end of year 2003 as follows:

- The road consists of two lanes with a design speed of 30 km/h to 60 km/h;
- The construction cost is 296.12 Billion Rp. (July 1998 prices) with a by-pass of 12.5 km, pavement works, bridges, a tunnel and slope protection works; and
- Excavated surplus soil should be dumped in properly selected sites at an interval of about 10 km.

(3) The Trans-Sulawesi East Road (Links No. 15, 16, 22, 33 and 32) is feasible with a high EIRR and is to be constructed by 2003, to complete the missing part of the road links.

- The road consists of two lanes with a design speed of 40 km/h to 60 km/h;
- The construction cost including ROW is 1482.02 Billion Rp. (July 1998 prices) including pavement work, bridges, slope protection works and disposal of soils; and
- Soil should be disposed of in properly selected and managed sites.

(4) The alignment change and widening of the existing road should be minimized to reduce impact on the Parigi-Binangga Nature Reserve (Road Link No. 9).

(5) Slope protection works such as sprayed concrete cribwork, shotcrete work, stone masonry and mat gabions for fill and cut slopes should be constructed to prevent soil erosion and landslides (Links No. 9, 15, 22, 33 and 32).

(6) Tunnel construction was recommended for Road Links No.9 and 15 for the following reasons:

- Disaster prevention on the road where slope protection structure is not practical.
- Ensuring of adequate road alignment by reducing of sharp turns.

	NAME OF SEGUMENT	LENGTH (Km)	CONSTRUCTION YEAR																		
			1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
	CENTRAL SULAWESI																					
1	SURUNAMA-DONGARA-PALU-KASINBAR	223.0			*	*	*						*	*	*							
2	TAMBU-MALALA	241.8							*	*	*											
3	MALALA-TORITORI,BASI-MEPANGA	124.1						*	*	*												
4	TOLITORI-BUOL	174.2							*	*	*											
5	BUOL-UMU	141.0								*	*	*										
6	MEPANGA-MOLOSIPAT	87.9							*	*	*											
7	TOBOLI-MEPANGA	201.4								*	*	*										
8	TAWALI-POSO	146.8											*	*	*							
9	TAWAELI-TOBOLI	40.1		*	*	*	*															
10	POSO-TINDATANA	151.4								*	*	*										
11	TAGOLU-AMPANA	140.2											*	*	*							
12	AMPANA-LUWUX	227.0											*	*	*							
13	LUWUX-BATURUBE	206.5																*	*	*		
14	TARIPA-BETEREME,-PAPE-TOMATA	115.0													*	*	*					
15	UEKUULI-NUHA	174.0			*	*	*															
16	TOMPIRA-BUNGKU	103.9			*	*	*															
17	PALU-GINPU	95.9																		*	*	*
18	TENTENA-GINTU	186.6																		*	*	*
19	PALU-SIMORA	45.5																*	*	*		
20	BIAK-SALODIK	286.6																*	*	*		
21	PALU-KASIGUNCU, SANGGINORA-BATUNONCU	226.5													*	*	*					
22	BUNGKU-S.F.	115.0			*	*	*															
23	BATURUBE-TONDOYANDA	97.4																		*	*	*
24	BUOL-BASI	121.7											*	*	*							
25	TOLITORI-BASI	70.5								*	*	*										
26	BANGAI ISLAND	199.9																*	*	*		
27	BALINGARA-TOILI	90.0											*	*	*							
	SUB-TOTAL OF CENTRAL PROVINCE	4033.9																				
	SOUTH-EAST PROVINCE																					
28	LASUSUA-BTS.PROP.SUL.	171.0								*	*	*										
29	KOLAKA-LASUSUA	139.0								*	*	*										
30	KUNDARI-KOLAKA	170.4							*	*	*											
31	BARRU-KASIPUTE	188.0						*	*	*												
32	POHARA-ASERA	91.7			*	*	*															
33	ASERA-BTS.PRO.	76.0			*	*	*															
34	BELALO-TINANGGEA	124.0													*	*	*					
35	MOTAHA-TOBIMETA	59.7													*	*	*					
36	NANGA NANGA-AMBESIA	105.8																*	*	*		
37	MANDONGA-TINANGGEA	107.7											*	*	*							
38	LATE LATE-BAULA	57.5											*	*	*							
39	POLIPOLIA-KASIPUTE	127.7																*	*	*		
40	ALANGGA-PUNGGALUKU	31.2													*	*	*					
41	TAMPE-WARA	136.2											*	*	*							
42	MUNA ISLAND K.	193.7																*	*	*		
43	BUTON ISLAND	292.0											*	*	*							
44	BUTON ISLAND K.	242.9																*	*	*		
45	TRANCE PENI.	153.0																				
46	UNAAHA-ABUKI	13.3													*	*	*					
47	MALILI-TOTOLA	37.5			*	*	*															
	SUB-TOTAL of SOUTH-EAST PROVINCE	2518.3																				
	GROUND TOTAL	6552.2																				

Figure 2 Implementation Schedule for Each Road Link

ROAD NETWORK STUDY
IN CENTRAL AND SOUTHEAST SULAWESI
IN THE REPUBLIC OF INDONESIA

Final Report - Volume I: Summary

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PART-I

MASTER PLAN

PART-I MASTER PLAN

1. INTRODUCTION

1.1 Background

Sustainable economic growth of the Republic of Indonesia has been attained through the effect of the First 25-Year Long Term Plan, which was inaugurated in 1969. In particular, the market-oriented economy policy initiated in the mid-1980's has facilitated economic activities in the private sector and has been successful in improving socio-economic development.

The island of Java, among certain others, has enjoyed rapid economic development, but eastern Indonesia, including Sulawesi, has benefited comparatively little from this development due to the insufficiency of the socio-economic infrastructure.
The Sixth 5-Year Development Plan (1994-1998), in reflection of the previous 5-year plans, aims to eradicate poverty, rectify regional economic imbalances and facilitate activities of the private sector relating to economic development.

Based on the above background, a study for a new road network master plan has been launched to boost the economy of the provinces of Central and Southeast Sulawesi. These provinces were selected from the eastern portion of Indonesia due to their high potential in the agriculture, mining & quarrying sectors.

Indonesia has been affected by the Asian economic recession which started in August 1997. The Indonesian economic growth rate has slowed considerably since then, which is considered in this Study.

1.2 Objective of the Study

The objectives of the Study are:

- To prepare a master plan (target year: 2018) for the road network system consisting of primary, arterial, and collector roads including candidate routes in the provinces of Central and Southeast Sulawesi and a part of South Sulawesi Province which is adjacent to the two provinces.
- To select priority road links and to carry out pre-feasibility studies (target year: 2008) and feasibility studies (target year: 2003) on the selected road links.

1.3 Study Area and Related Area

The study covered Central and Southeast Sulawesi Provinces and an adjacent area of South Sulawesi Province, as well as other related areas in North and South Sulawesi.

1.4 Scope of the Study and Work Flow

In order to achieve these objectives, the scope of the Study covered:

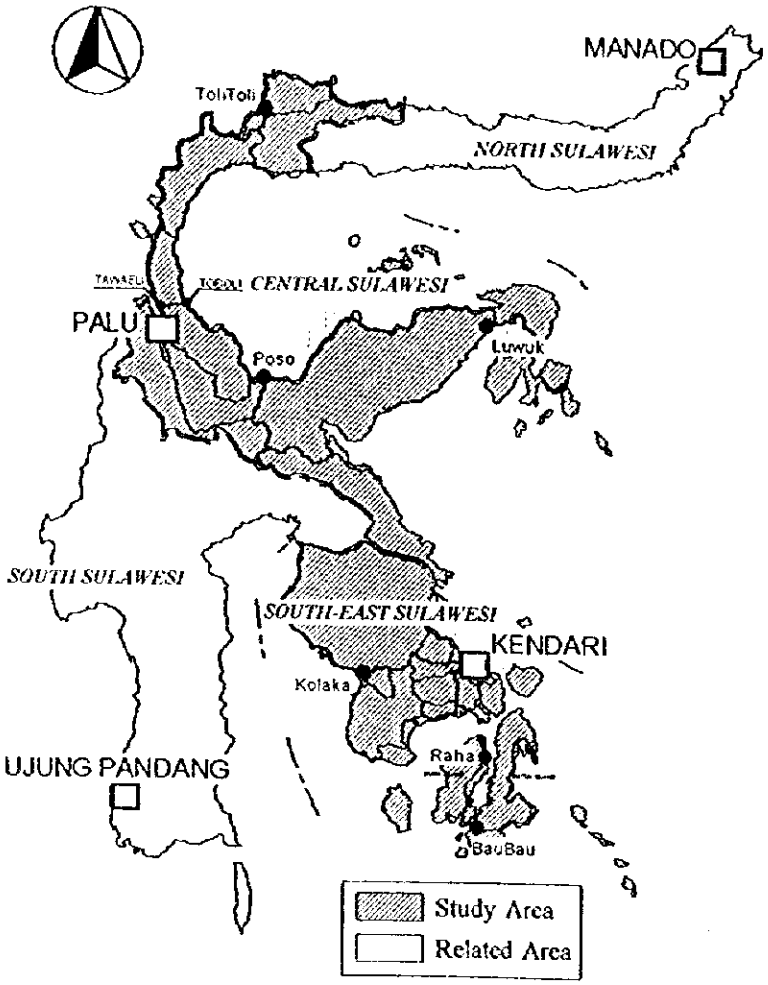
- Phase I
  Master plan of the road network system (Target Year 2018 to be considered)

- Phase II
  Pre-feasibility study (Target Year 2008)

- Phase III
  Feasibility Study (Target Year 2003)

The Study has been carried out based on the scope of work which was agreed upon between the Directorate General of Highways and JICA Preparatory Study Team in October 1996.

A Work Flow Chart for Phases I, II and III was prepared as shown in Figure 1.2.



source: Study Team

Figure 1.1 Study and Related Area

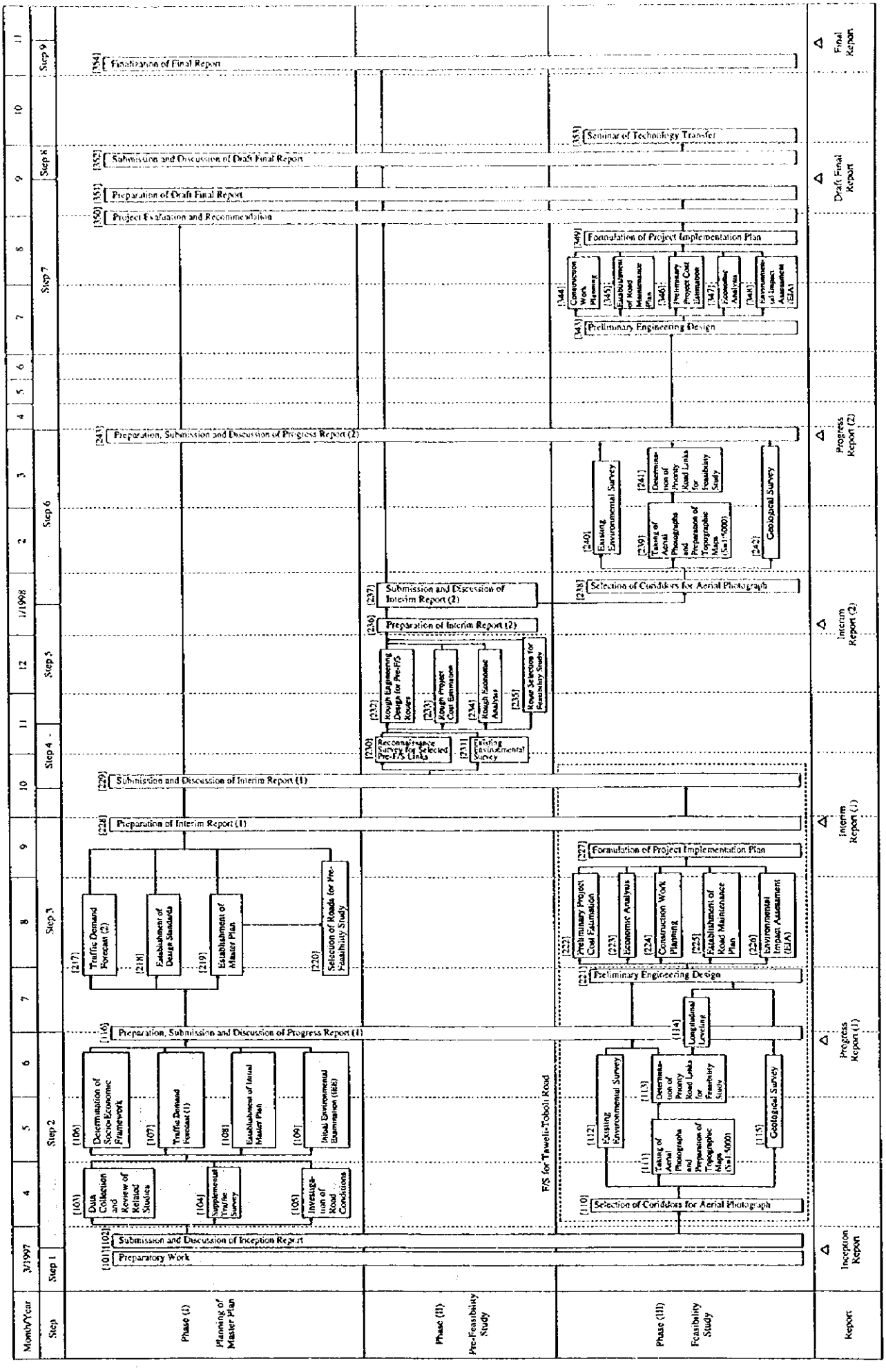


Figure 1.2 Work Flow Chart

2. PRESENT ROAD SITUATION, OBSTACLES AND PROBLEMS

2.1 Transportation System

The principal transportation facilities in Sulawesi are marine ports for sea transport, airports for air transport, and roads for overland transport.

Trunk roads on Sulawesi Island are currently improved and expanded along the slender isthmus areas of this island, but they are not built for long-distance transport. The Trans-Sulawesi Road, which is the sole road running through Sulawesi Island from south to north, has a minimum pavement width of 4.5 m, but includes temporary bridges in certain sections, and is not appropriate as a large, long-distance transport system.

2.2 Road Network System

National and provincial roads of Indonesia are administered and operated by the Bina Marga, and their total length is 66,599 km. The length of national and provincial roads in Sulawesi as a whole is 9,876 km, and their share of the nationwide road length is 14.8 %. In Central Sulawesi and Southeast Sulawesi, the two provinces concerned in the Study, the length is 4,884 km, or 7.3 %.

$$I_1 = \frac{Road\ Length\ (km)}{Area\ (km^2)} \qquad I_2 = \frac{Road\ Length\ (km)}{\sqrt{\frac{Population}{1{,}000} \times Area\ (km^2)}}$$

The index of road length per unit area (I_1) is 0.05 km/km^2, which is higher than the nationwide average value of 0.03 km/km^2, but only half of the index for Java.

The index of road length per square root of population multiplied by area (I_2) is high at 0.26 which is 2.36 times higher than the national average of 0.11.

The inter-regional road network in the study area totals 13,778 km, which includes 1,910 km of national roads, 2,975 km of provincial roads and 8,895 km of kabupaten(regency) roads as shown in Table 2.1. National and provincial road networks include link Nos..t accessible by vehicles. The national and provincial road network in the study area is shown on the project location map at the front page.

Table 2.1 Regional Road Length

Unit: km

	Central Sulawesi	Southeast Sulawesi	Total
National Road	1,606	304	1,910
Provincial Road	1,523	1,452	2,975
Kabupaten Road	5,023	3,870	8,893
Total	8,152	5,626	13,778

Source: Study Team

National and provincial roads are classified into four categories according to the Bina Marga: Arterial roads, Collector roads 1, Collector roads 2, and Collector roads 3.

The functions of roads according to the four classifications are designated as:

Arterial Road: National roads connecting the provincial capital cities, serving primary transportation requiring long distance routes with high average speed.

Collector Road 1: National roads connecting with arterial roads, serving collection and distribution transportation requiring medium-distance route with medium average speed.

Collector Road 2: Provincial roads connecting kabupatens, serving collection and distribution transportation requiring medium-distance route with medium average speed.

Collector Road 3: Provincial roads to be connected to arterial roads or other collector roads, serving collection and distribution transportation requiring relatively short distance trip, at medium average speed.

2.3 Present Road Conditions in Study Area

Of the 6,405 km inter-regional road network, 6,076 km or 95 %, is accessible by four-wheeled vehicles. The remaining 329 km is 2.5 m wide or less. Furthermore, a length of 3,333 km, or 52 %, consists of substandard sections with pavement width of less than 4.5m.

The pavement ratio of existing national and provincial roads is 82.7 % while that of kabupaten roads is 51.1 %. As a whole, the pavement ratio is 77.0 %. On the other hand, 60 % of national and provincial roads have a pavement width of 4.5 m, while that of remaining roads is 3.5 m. Table 2.3 shows road pavement condition of study area.

There are 1,734 bridges (total length of about 27,000 m) in Central Sulawesi, and 739 bridges (total length of about 10,000 m) in Southeast Sulawesi.

The total length of sections lacking bridges translated into necessary bridge length in Central Sulawesi is 1.1 km, and 2.8 km in Southeast Sulawesi. In Southeast Sulawesi it should be noted that the total of sections lacking bridges on national roads is more significant.

Most of the inland roads cross ridges of over 800 m in altitude. These roads are unsatisfactory both in terms of horizontal and vertical alignment, with a width of 3.0m or less in most sections. Besides this, the routes encounter precipitous terrain and most suffer from collapse of slope due to rainfall, cave-ins in the road due to erosion, washout of pavement, and frequent accidents in which vehicles fall of the road. There are places also where roads have become impassable.

Table 2.3 Road Pavement Condition in Study Area

Description	Unpaved			Paved			Total		
	W<4.5	W>4.5	Total	W<4.5	W>4.5	Total	W<4.5	W>4.5	Total
Road Length (km)									
Central									
National/Provincial	249.09	131.57	380.66	838.63	1,759.44	2,598.07	1,087.72	1,891.01	2,978.73
Kabupaten	289.00	116.20	405.20	270.30	0.00	270.30	559.30	116.20	675.50
Total	538.09	247.77	785.86	1,108.93	1,759.44	2,868.37	1,647.02	2,007.21	3,654.23
Southeast									
National/Provincial	192.00	284.62	476.62	261.26	1,252.44	1,513.70	453.26	1,537.06	1,990.32
Kabupaten	105.40	31.30	136.70	235.20	60.20	295.40	340.60	91.50	432.10
Total	297.40	315.92	613.32	496.46	1,312.64	1,809.1	793.86	1,628.56	2,422.42
Total									
National/Provincial	441.09	416.19	857.28	1,099.89	3,011.88	4,111.77	1,540.98	3,428.07	4,969.05
Kabupaten	394.40	147.50	541.90	505.50	60.20	565.70	899.90	207.70	1,107.60
Total	835.49	563.69	1,399.18	1,605.39	3,072.08	4,677.47	2,440.88	3,635.77	6,076.65

Source: Study Team

2.4 Organization and Budget

The Ministry of Public Works (PU) consists of six (6) assistants to the Minister, the Secretary General, the Inspector General, three (3) Director Generals, the Institute of Research and Development, Four (4) centers, 27 regional offices (Kanwil offices for 27 provinces) and state enterprises (18 companies). Road administration remains within the jurisdiction of the Directorate General of Highways (Bina Marga) of PU.

Bina Marga has the following divisions:

- Secretariat to the Director General
- Directorate of Planning
- Directorate of Technical Support
- Directorate of Urban Roads
- Directorate of Implementation for Central Region
- Directorate of Implementation for East Region
- Directorate of Implementation for West Region

Bina Marga administers the maintenance, rehabilitation, betterment, new construction, procurement of materials and equipment, planning, design and management of national and provincial roads, kabupaten roads and toll roads.

Table 2.2 shows the Bina Marga's budget in the Central and Southeast Sulawesi provinces.

2.5 Obstacles and Issues

The total road length of the national and provincial roads in the study area, is 4,884km. The road length per unit area is 0.05 km/km^2 which is not quite half of that in Java Island. The roads in the study area, including important roads for social, economical and production activities; are of low standards, provide insufficient links, lack disaster prevention measures

and are in need of maintenance. Therefore, road improvement is needed to facilitate regional activities.

Table 2.2 Annual Budget of Bina Marga Road Projects

Unit: Billion Rp.

FISCAL YEARS	89/90	90/91	91/92	92/93	93/94	94/95	95/96	96/97	98/99
1. Local Portion									
(1) National and Provincial Roads									
Total Indonesia	338.84	704.93	1,122.78	1,373.75	1,529.78	1,559.82	1,670.02	1,618.13	1,178.17
Total Sulawesi	41.26	79.94	107.61	136.18	169.80	134.26	174.74	179.27	145.75
Central	10.29	16.60	29.13	36.51	46.31	36.52	45.29	51.54	39.97
Southeast	9.05	17.36	18.07	25.66	30.85	28.16	40.91	38.57	41.77
(2) Local Roads									
Total Indonesia	206.89	152.99	677.13	818.36	818.05	967.62	997.65	1,097.38	1,147.06
Total Sulawesi	27.49	54.80	87.89	111.29	137.79	122.93	129.99	152.00	123.83
Central	5.09	9.03	15.87	18.66	20.56	22.97	26.00	30.50	24.23
Southeast	6.20	10.24	16.94	18.99	20.27	19.33	21.00	24.50	20.08
2. Foreign Loan									
(1) National and Provincial Roads									
Total Indonesia	758.87	871.46	921.76	565.41	515.36	628.42	549.90	454.14	1,258.32
Total Sulawesi	70.92	92.95	59.35	45.33	71.16	51.98	50.59	66.50	113.58
Central	13.33	27.32	25.91	26.28	33.74	17.29	17.82	22.87	62.58
Southeast	13.72	10.96	8.52	1.83	7.04	6.59	9.75	10.00	78.69
(2) Local Roads									
Total Indonesia	83.06	43.15	89.55	12.67	104.97	264.05	164.84	145.96	242.11
Total Sulawesi	11.41	12.60	21.31	6.93	-	29.24	31.06	26.50	84.60
Central	1.81	-	-	-	-	6.39	7.88	6.26	10.94
Southeast	1.71	0.82	3.6	1.39	-	3.39	4.16	3.46	11.28
3. Grand Total									
Total Indonesia	1,387.66	2,072.53	2,811.42	2,770.22	2,968.16	3,419.91	3,382.44	3,315.61	3,825.66
Total Sulawesi	151.08	240.29	276.16	229.73	378.75	338.41	386.70	424.27	467.76
Central	30.52	52.95	70.91	81.45	100.61	83.17	96.99	111.17	137.82
Southeast	30.15	39.38	47.13	47.87	58.61	58.47	75.82	76.53	151.82
Central and Southeast	60.67	92.33	118.04	129.32	158.77	141.64	172.81	187.70	289.54

Notes:

1. The Budget consists of the cost of the maintenance, rehabilitation, betterment, new construction, procurement of materials and equipment, planning, design and management of road projects under Bina Marga administration together with the allowance cost (about 10 % of the Budget) of the Bina Marga staff.
2. The Budget does not include the toll roads nor the routine budget such as the salaries of Bina Marga staff.

Source: Directorate of Planning, Bina Marga

3. SOCIO-ECONOMIC FRAMEWORK

3.1 Present Conditions

(1) Population and Employment

The population of Central and Southeast provinces are 1,894,558 and 1,460,616, respectively, in 1995 as shown in Table 3.1.

Between 1990 and 1995, Central Sulawesi recorded the most rapid population growth rate in Indonesia, that being 2.08 %. During this period the population growth rate in the administrative areas of Central Sulawesi ranged from a low of 1.3 % per year in Donggala regency to a high of 45.69 % per year in Palu city.

Table 3.1 Population in Sulawesi Island

Province	Central Sulawesi	Southeast Sulawesi	North Sulawesi	South Sulawesi
1980	1,284,528	941,681	2,114,822	6,074,273
1990	1,709,106	1,349,377	2,371,551	6,980,549
1995	1,894,558	1,460,616	2,541,696	7,647,492

Source: Study Team

Southeast Sulawesi had the most rapid growth in labor force over 15 years old, at 5.73 % per year. This was followed by Central, South, and North Sulawesi at 5.43 %, 5.24 %, and 3.04 % per year, respectively. Employment grew at 4.97 %, 4.19 %, 4.49 %, and 1.42 % per year in Southeast, Central, South, and North Sulawesi, respectively.

(2) Economic Situation

The GRDP of Central Sulawesi excluding oil/gas production increased at an average annual growth rate of 8.7 % from 1988 to 1993, well above the national average (7.7 %) recorded during the same period. Most revenues of the province are derived from agriculture, accounting for about 45 % of the GRDP in 1993. The growth rate of agriculture is still high in comparison to the national average rate.

The GRDP of Southeast Sulawesi excluding oil/gas products increased at an average annual growth rate of 9.1 % between 1988 and 1993. The economy is also dominated by agriculture which accounted for about 44 % of the GRDP in 1993.

3.2 Future Socio-Economic Framework

The Second 25 Year Development Plan starting from the fiscal year 1993/1994 stresses the development of eastern Indonesia, including Sulawesi.

Following the high rate of development in Indonesia and eastern Indonesia regions, the growth rates of Central and Southeast Sulawesi are programmed as follows.

Table 3.2 Planned Provincial Growth Rate (Base Case)

GRDP Growth (% p.a.)

	5 Year Development Plan Period			
	VII 1999-2003	VIII 2004-2008	IX 2009-2013	X 2014-2018
Indonesia	6.60 %	7.10 %	7.80 %	8.70 %
Eastern Indonesia	7.43 %	7.99 %	8.84 %	9.94 %
Central Sulawesi	7.31 %	7.68 %	7.92 %	8.87 %
Southeast Sulawesi	7.71 %	8.06 %	8.44 %	9.50 %

Source: Study Team

For comparative purposes, the resulting growth rates from the above were used to project the GRDP for lower and higher cases. Individual rates were developed for both Central and Southeast Sulawesi.

Table 3.3 Updated Provincial GRDP Growth Rates (Base Case)

GRDP Growth (% p.a.)

	5 Year Development Plan Period									
	VII							VIII	IX	X
	1997	1998	1999	2000	2001	2002	2003	2004-2008	2009-2013	2014-2018
Central Sulawesi	-	-9.40	-2.35	1.67	2.68	5.10	7.31	7.68	7.92	8.87
Southeast Sulawesi	-	-9.06	-1.99	2.05	3.06	5.49	7.71	8.06	8.44	9.50
Indonesia	-	-10.00～ -12.00	-3.00～ -4.00	1.00～ 2.00	2.00～ 4.40	4.40	6.60	7.10	7.80	8.70

Source: Study Team

However, Indonesia has been affected by Asian economic crisis that started in August 1997. The country's economic growth rate has reduced rapidly since then, which requires revisions to the GRDP growth rates. The revision for Indonesian economy has been considered as shown below based on the above mentioned base case:

- The economic growth rate of year 1998 will be negative ten (10) to twelve (12) percent;
- The economic level of year 1997 will be attained at the end of year 2003; and
- The economic growth rate of year 2003 will be six point six (6.6) percent.

In this review the base case of Provincial GRDP growth rates was adopted for the future socio-ecomonic framework.

The base case has been updated as shown Table 3.3 based on the above assumption.

4. TRANSPORT DEMAND FORECAST

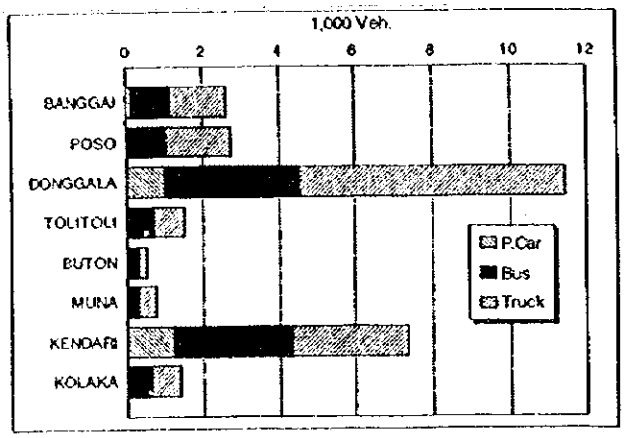
4.1 Overview of Existing Transport Conditions

(1) Vehicle Registration

The vehicles registered in each kabupaten(regency) in 1995 are summarized in Figure 4.1. The total registered vehicles in 1995 in the provinces of Central and Southeast Sulawesi are 28,351, of which almost two-thirds are concentrated in the provincial capitals of Palu and Kendari.

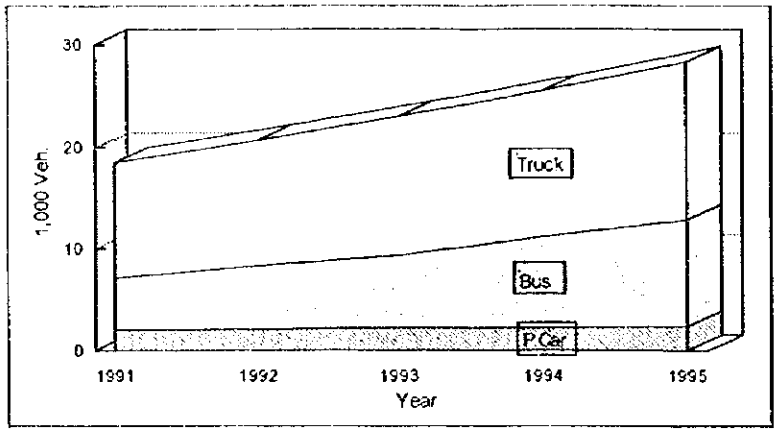
Trucks have the highest share of 55.0 %, followed by buses (36.5 %) and passenger cars (8.5 %) in two provinces. The car ownership is calculated at 9.7 and 6.9 vehicles/1,000 inhabitants in Central and Southeast Sulawesi provinces respectively.

Figure 4.2 shows the trend of the registered vehicles in Central and Southeast Sulawesi provinces. The average annual growth rate between 1992 and 1995 in the study area is calculated at 11.08 %. The average annual growth rate in Southeast Sulawesi is as high as 17.88 % in the same period.



Source: Annual Statistics of Provinces and Kabupatens

Figure 4.1 Registered Vehicles in 1995



Source: Annual Statistics of Provinces and Kabupatens

Figure 4.2 Trend of Registered Vehicles in the Study Area

(2) Sea Transport

A total of five ferry routes are currently registered in the study area. These are;

1) Torobulu (main island in Southeast Sulawesi) - Tampo (Muna island)
2) Kolaka (main island in Southeast Sulawesi) - Bajoe (main island in South Sulawesi)
3) Tolandona (Muna island) - Bau Bau (Buton island)
4) Luwuk (main island in Central Sulawesi) - Sabang and Salakan (Banggai island)
5) Pagimana (main island in Central Sulawesi) - Gorontalo (main island in North Sulawesi)

The ferry route between Kolaka in Southeast Sulawesi and Bajoe in South Sulawesi, shows the highest traffic flow of about 1,000 passengers, 10 vehicles and 300 tons of freight per day in 1996, due to the lack of a comparable land transport route between the two peninsulas.

On the other hand, the ferry route between Pagimana in Central Sulawesi and Gorontalo in North Sulawesi, which connects the two towns located on the main island of Sulawesi, showed in 1995 a low traffic flow of about 100 passengers, 1.4 vehicles, and 23 tons of freight per day.

The above five ferry routes are shown in Figure 4.3.

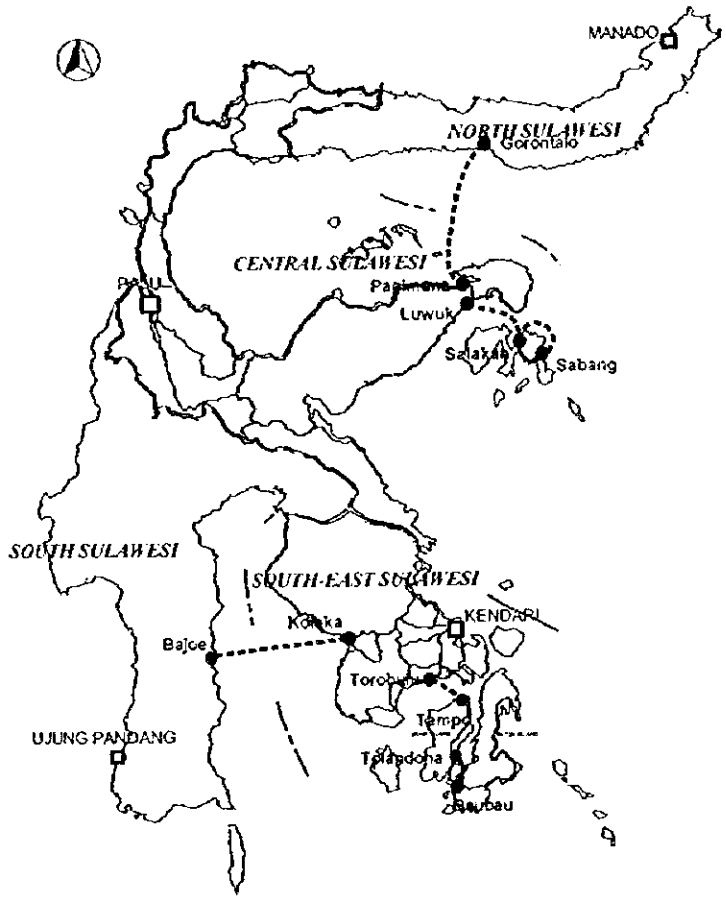


Figure 4.3 Ferry Route in the Study Area

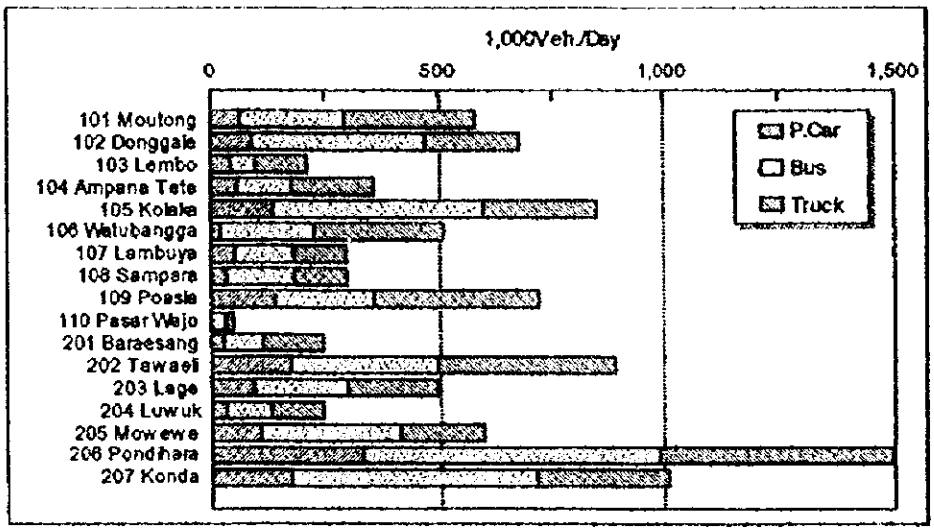
4.2 Traffic Survey

The following traffic surveys were carried out in the study area.

- Traffic Counting at 10 stations (Sta. 101 - 110)
- Road Side OD Survey at 7 stations (Sta. 201 - 207)

Figure 4.4 shows the 24-hours traffic volume at the 17 survey locations indicated in Figure 4.5. The highest volume of about 1,500 vehicles/day is seen at survey station No. 206, at Pondihara in Southeast Sulawesi on National Highway 001. At eight stations out of 17, the 24-hours traffic volume were less than 500, and 500 - 1,000 at six stations. The lowest volume of 51 vehicles/day is seen at the station No. 110 at Pasar Wajo in Buton Island. On the Tawaeli-Toboli road (Sta. 202), the volume was 886 vehicles/day.

The roadside OD interview surveys were carried out at the seven survey stations at the points where road links cross the traffic zones to supplement the OD movements of the kabupaten level OD matrix in 1991. Almost all the vehicles were interviewed. The data collected from the road side OD surveys are expanded to the full size information based on these sample rates by station and by vehicle classification.



Source: Study Team

Figure 4.4 1997 Traffic Counting Results

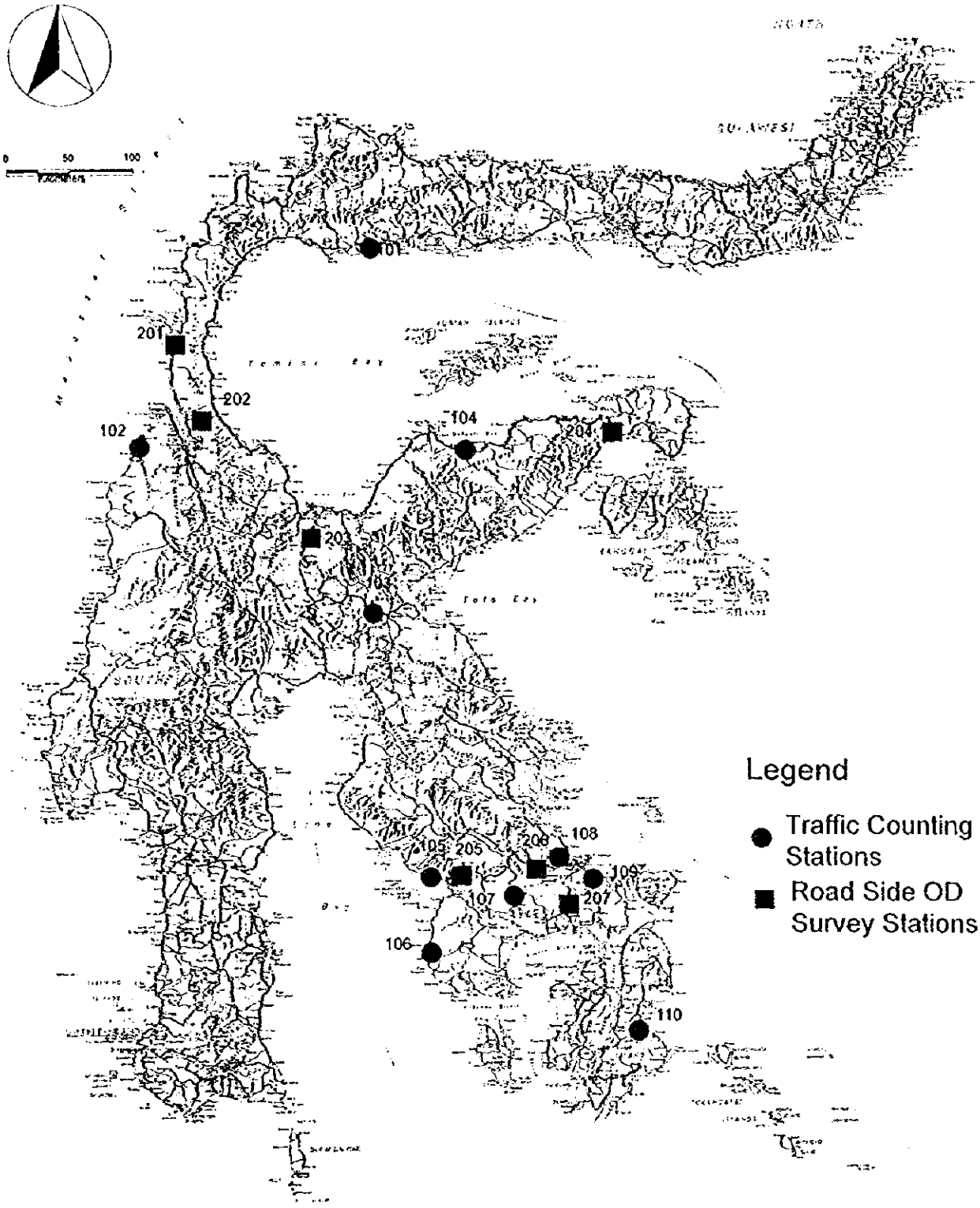


Figure 4.5 Traffic Survey Locations

4.3 Future Demand Forecast

(1) Demand Forecast Process

Figure 4.6 shows the demand forecast process. The process is divided into two parts: Model building and demand estimate. In model-building, vehicle trip generation/attraction (G/A) and trip distribution model by vehicle classification is developed from the present vehicle OD and inter-zone impedance.

Applying the future socio-economic indicators to the trip generation/attraction model, the future vehicle trip generation/attraction is estimated. A applying this G/A and the future inter-zone impedance, based on the future road network configurations to the trip distribution model, the future OD matrix is developed. The future link flow is estimated by assigning the future OD demand to the future road network.

(2) Trip Generation/Attraction Model

The trip generation/attraction model was developed from the present generated/attracted traffic, and the population and per-capita GRDP in terms of 1993 constant price as the socio-economic indicators.

The vehicle trips generation/attraction models were developed using linear regression analysis;

$$G = a1 \times P + a2 \times GDP + a3 \times Dum + a4$$

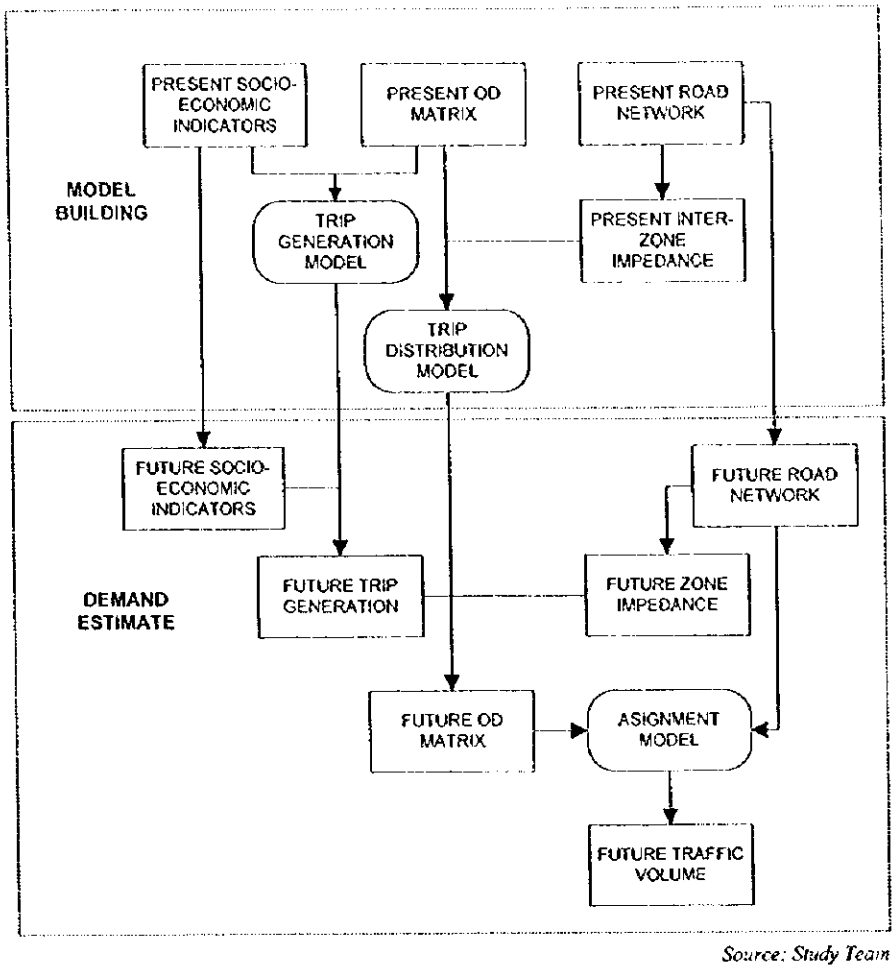
Where, *G:* Generating Trip (veh./day)
P: Population (person)
GDP: Per-Capita GRDP (1,000 Rp./person)
Dum: Dummy Variable

(3) Trip Distribution Model

The following Voorhees type gravity model was applied to the trip distribution model. The parameters were calculated to best fit with the 1997 OD matrix.

$$Tij = K \times Gi \times \frac{Aj \times Dij^{a}}{\Sigma (Aj \times Dij^{a})}$$

Where, *Tij:* Trip between zone i and j
K: Parameter
Gi: Generated trips from zone i
Aj: Attracted trips to zone j
Dij: Impedance between zone i and j (Travel time in min.)
a: Parameter



Source: Study Team

Figure 4.6 Demand Forecast Process

(4) Assignment Model and Future Traffic Volume

As the traffic volume is far less than the capacity and usually no comparable alternative route exists in the study area at present, the present link flow was calculated by All-or Nothing (A/N) assignment, searching the minimum travel time routes based on the link free flow speeds. For the future, the link flows were considered to exceed the present free flow traffic capacity of one-lane roads (2,000 pcu./day), however few alternative routes will exist. Therefore, to avoid the long-distance detour due to the capacity constraints, Multi-Path Assignment was applied. The multi-path assignment method searches plural effective paths for an OD pair and assigns link flow in proportion with each link impedance.

Traffic volumes for years 2003 and 2018 were computed based on the 2003 and 2018 master plan network.

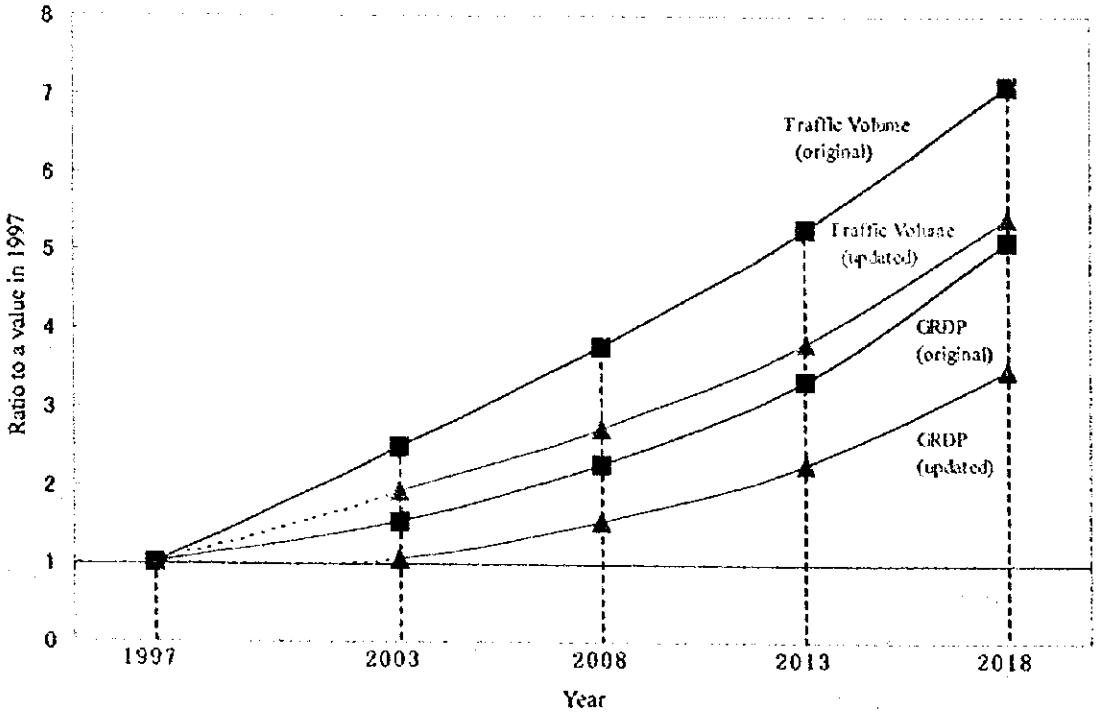
(5) **Review of Future Traffic Volume**

As the Indonesian economic growth has decreased sharply since August 1997, a review of future traffic demand forecast was conducted based on Section 3.2 of Chapter 3.

There is a close relationship between socio-economic growth and traffic volume increase. The relationship was obtained from the GRDP, population and traffic volume for the years 2003 and 2018 as shown in Figure 4.7.

Updated future traffic volumes were computed by applying updated GRDP and populations for the years 2003 and 2018 to the growth and volume relationship mentioned in the previous paragraph. The computed result indicates that the updated traffic volumes of year 2003 and 2018 are 76.5% of the previously forecast volumes for the same years.

Figure 4.8 through 4.9 shows the 2003 and 2018 traffic volumes of four-wheel vehicles. Table 4.1 shows traffic volume for each link in year 1997, 2003 and 2018.



Source: Study Team

Figure 4.7 Relationship between GRDP and Traffic Volume

Table 4.1 Traffic Volume for Each Road Link

unit: Veh /day

Link No.	1997				2003				2018			
	M.C	P.C	Bus	Truck	M.C	P.C	Bus	Truck	M.C	P.C	Bus	Truck
1	303	112	159	231	391	132	214	281	1437	531	801	1053
2	136	15	24	37	210	11	29	44	599	51	83	161
3	112	14	12	28	206	8	18	35	663	35	77	175
4	79	7	16	18	106	5	14	14	37	17	10	15
5	9	7	7	3	8	7	6	3	33	22	19	10
6	53	34	79	151	39	30	60	145	203	126	219	568
7	143	62	141	145	304	63	184	233	1254	345	666	1014
8	692	223	168	305	934	318	454	768	2664	1115	1593	2788
9	716	177	319	390	746	268	438	658	1778	907	1102	1841
10	139	64	82	233	191	90	166	356	1232	595	928	2039
11	89	60	86	140	281	129	253	422	989	496	840	1472
12	62	41	95	130	157	73	168	266	695	326	619	1001
13	22	14	13	28	21	15	11	33	86	57	51	135
14	96	21	42	46	57	17	21	54	60	30	21	52
15	33	10	14	18	261	126	242	396	577	352	480	862
16	34	42	35	58	352	190	349	602	502	285	385	816
17	121	27	10	67	155	40	15	100	455	136	36	291
18	0	0	0	0	0	0	0	0	35	20	0	83
19	0	0	0	0	0	0	0	0	352	96	26	201
20	0	0	0	0	0	0	0	0	23	17	12	21
21	20	15	26	26	17	11	24	21	84	63	73	103
22	0	0	0	0	335	162	333	569	441	224	347	750
23	0	0	0	0	0	0	0	0	32	37	28	105
24	0	0	0	0	0	0	0	0	271	9	23	73
25	0	0	0	0	0	0	0	0	8	9	14	19
26	2	6	6	5	2	6	5	5	8	20	18	21
27	0	0	0	0	0	0	0	0	11	21	19	13
28	0	0	0	0	74	41	111	127	1073	571	904	1698
29	144	111	330	161	184	137	432	259	1274	672	1216	1775
30	582	381	823	559	802	426	1011	715	1359	576	974	1175
31	93	15	148	182	70	10	110	142	313	83	280	461
32	78	26	111	87	400	176	415	601	543	239	417	775
33	0	0	0	0	335	162	333	569	450	230	352	769
34	69	30	87	69	216	78	249	194	338	118	259	262
35	77	16	47	82	88	36	74	90	170	68	105	137
36	19	13	30	29	34	21	37	39	112	49	57	88
37	173	78	244	144	199	75	223	200	361	115	135	353
38	0	0	0	0	0	0	0	0	1267	583	929	1246
39	35	9	5	22	57	11	46	75	606	184	373	565
40	310	140	478	267	278	117	415	296	295	93	179	220
41	19	7	1	6	99	22	14	99	522	141	93	581
42	6	6	5	6	7	7	4	6	23	22	13	21
43	39	10	13	41	15	2	11	16	41	6	15	33
44	19	4	4	12	34	10	7	34	104	18	16	89
45	0	0	0	0	0	0	0	0	15	10	10	35
46	412	215	381	264	526	278	478	324	1129	398	691	565
47	0	0	0	0	74	41	111	127	1086	579	912	1726

Source: Study Team

Note: For the road link locations, see Figure 6.3.

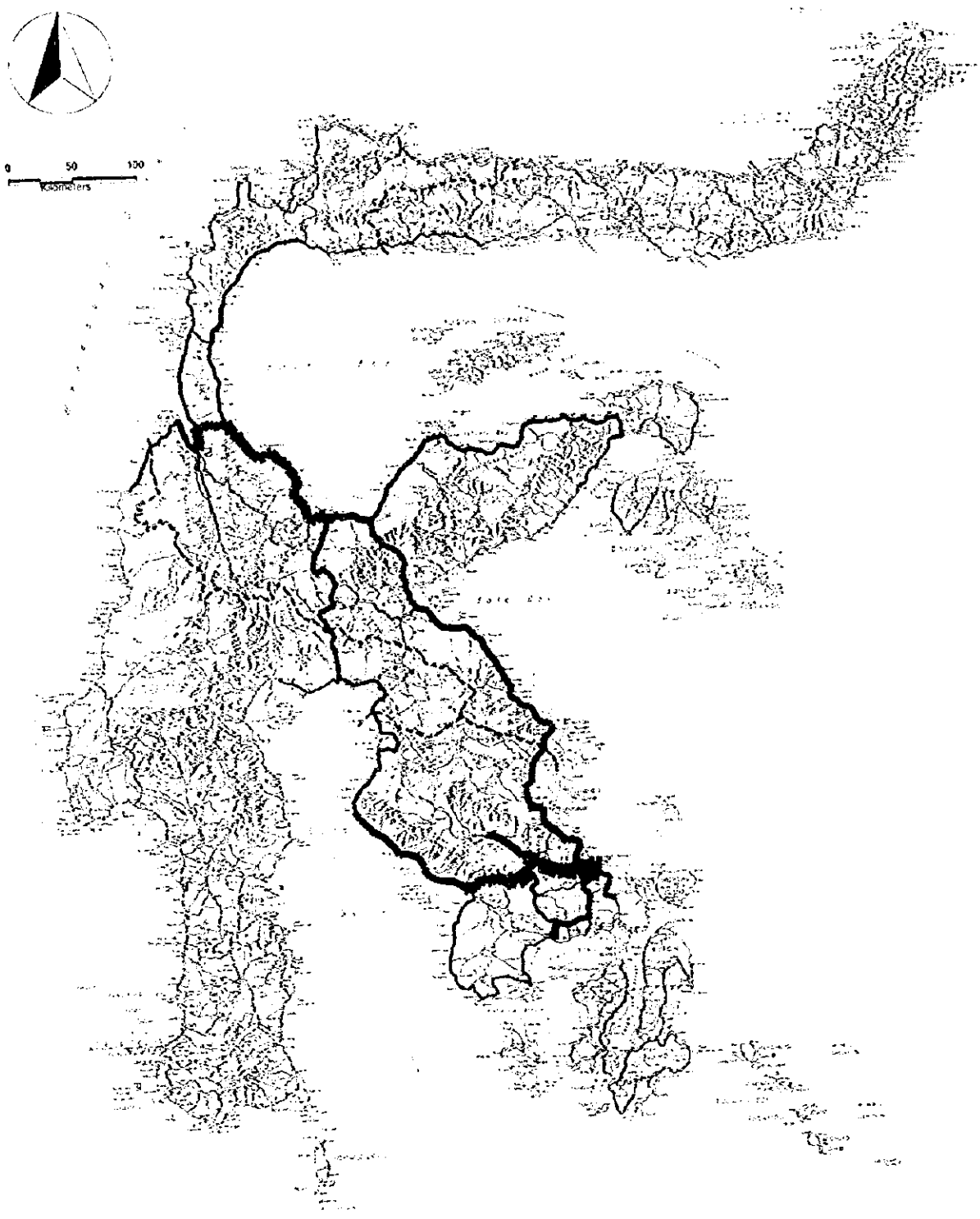


Figure 4.8 2003 Vehicle Flow Assigned to 2003 Master Plan Network

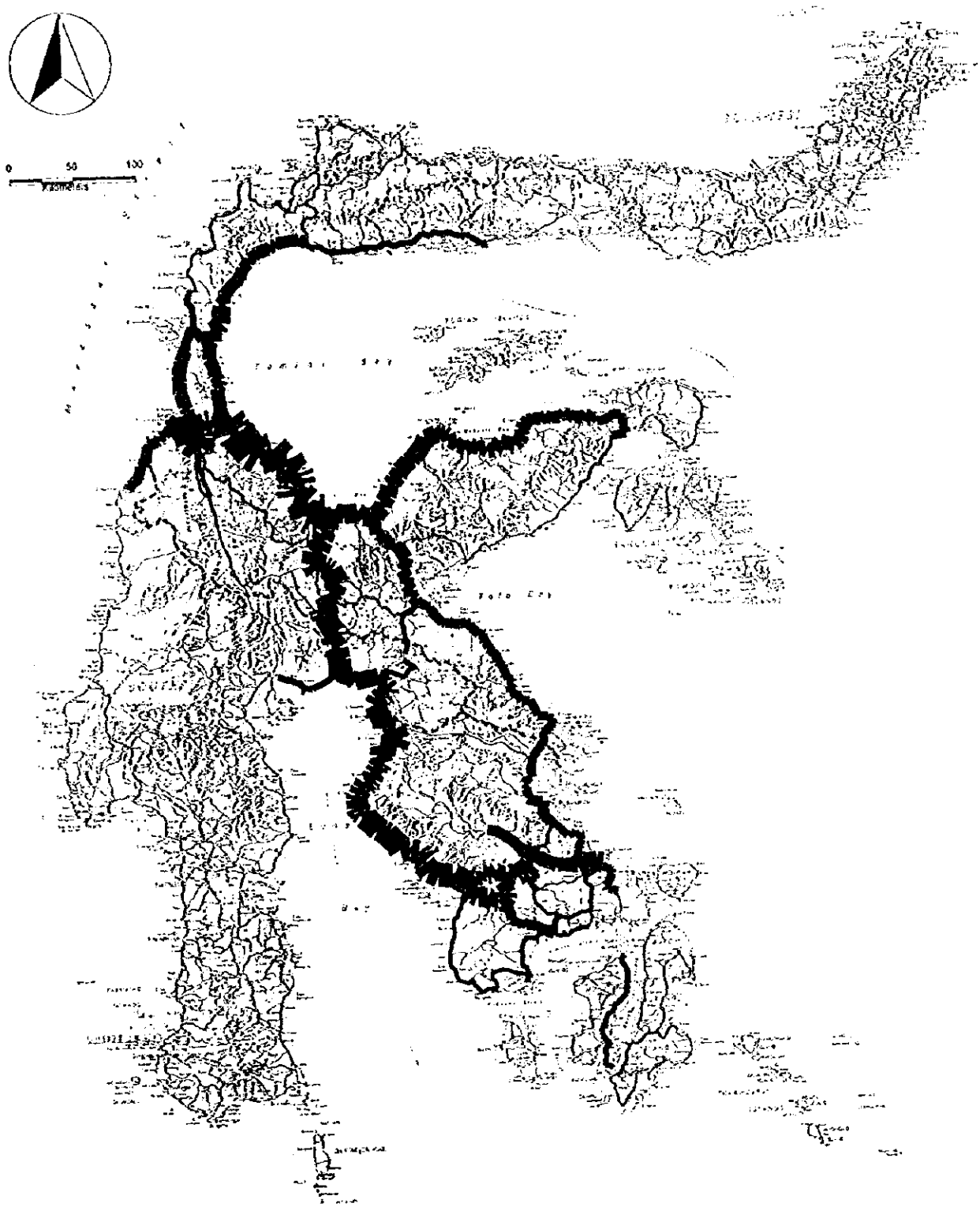


Figure 4.9 2018 Vehicle Flow Assigned to 2018 Master Plan Network

5. ENVIRONMENTAL SURVEY

5.1 Environmental Management in Indonesia

In the Republic of Indonesia, the basic law concerning the environment is Government Act No.4 of 1982, regarding basic provisions for the management of the living environment. The Act adopts 'sustainable development' as a basic policy for environmental management. 'Sustainable development' can be defined as development which provides economic, social, and environmental benefits in the long term and for future generations. Establishment of an environmental impact assessment system has therefore been stressed in the act as one of the actions for the protection of environment.

Act No.4 of 1982 prescribes that every plan/ project which is considered likely to have a significant impact on the environment must be accompanied with an environmental impact assessment (EIA/ AMDAL: analisa meganai dampak linkungan). An environmental impact assessment system has been established accordingly to meet this requirement. Necessary processes of AMDAL are specified in the government regulation No. 51 of 1993, while, the type of businesses and activities for which AMDAL is required are specified in the decree of the state minister of environment No. KEP-39/MENLH/8/1996 according to the scale of the plan/ project.

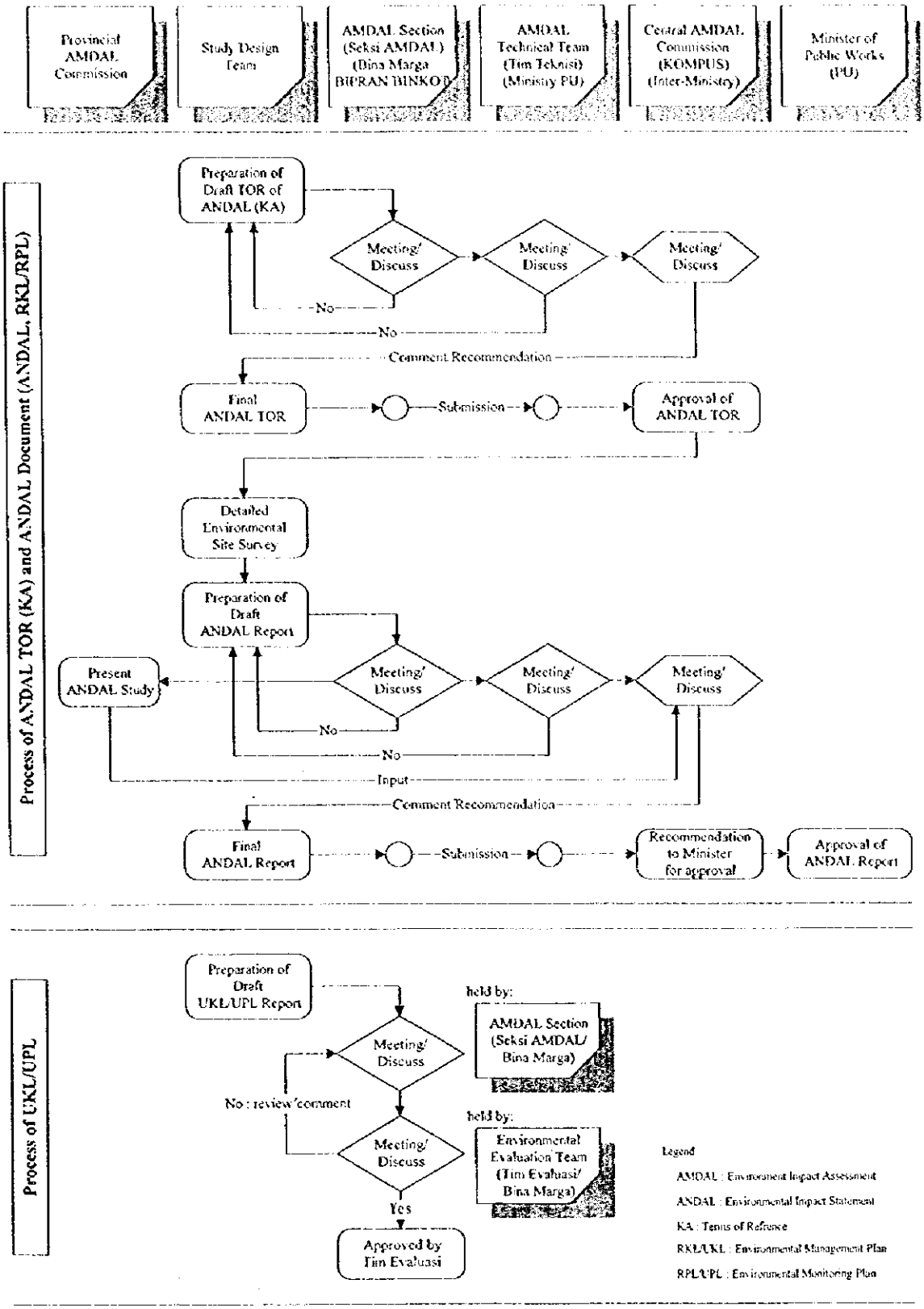
At the national level, the Ministry of State for the Environment (KLH) is responsible for environmental management along with the Ministry of Public Works (PU) for public works projects. The Central Commission, called KOMPUS, which handles the AMDAL process, is organized by the Ministry of Public Works with its chairman appointed by the Minister.

The general procedure of the environmental management in Indonesia is shown in Figure 5.1.

5.2 Present Environmental Conditions

Sulawesi comprises an area of 159,000 km^2 and has a coastline of approximately 6,000 km. The Indonesian archipelago is inhabited by two distinct sets of wildlife. Contrary to Sumatra, Java and Borneo which were connected to the south Asian mainland during the last ice-age, some 10,000 years ago, Sulawesi has never been connected to any great land area. "Wallace's Line" is drawn between Bali and Lombok and between Borneo and Sulawesi. Sulawesi's isolated position has lead to the development of unique fauna. 98% of the Sulawesian mammals are endemic, while 89 of 247 known birds species on Sulawesi are not found anywhere else.

Regulation of use and trade of wildlife is attempted by the signing of CITES (the Conventionon International Trade in Endangered Species of Wild Fauna and Flora) in 1979. The two main executing body of CITES in Indonesia are Directorate General of Forest Protection and Nature Conservation (PHPA) in the Ministry of Forestry and National Institute of Sciences (LIPI).



Source: Study Team

Figure 5.1 Procedure of Environmental Management

(1) Fauna

Many of the mammals in Sulawesi, including tarsiers, monkeys, deer, civets and pigs are of Asian origin. The two species of *cuscus*, one endemic are marsupial phalangers with close cousins in Australia. The island, because of its long isolation, has other curious animals uniquely its own - *babirusa*, an aberrant pig; *anoa*, smallest of all known buffalo; and *heavy-set black apes* which are not apes at all but monkeys closely related to the pig-tailed macaques of Southeast Asia. Although Sulawesi has a somewhat impoverished mammal fauna, it has a rich avifauna made up of both Oriental and Australian families - *hornbills*, *drongos*, *babblers*, *sunbirds* and *maleo* bird. *(Source: Indonesian publish)*

A list of protected fauna in Sulawesi is shown in Table 5.1.

(2) Flora

Sulawesi has few endemic plant species of its own, and is greatly impoverished in floral richness when compared with neighboring Borneo. The flora is clearly Malaysian, however, with few Australian forms except in the pockets of high mountain flora. Many of the forests in Sulawesi are characterized by an abundance of palm, and this family can be used as a good indicator of flora type.

In dry coastal areas, *Corypha* palms predominate on lowland sandy soils. The beautiful fan-palm *Livistona rotundifolia* is a common colonizer of wetter upland forests. Delicate *Pinanga* and *Areca* palms occur throughout the mountain forest, and everywhere rattans, *Calamus*, and *Caryota* palms are abundant. Meanwhile, some excellent timber trees are found in Sulawesi, including riverine stands of beautiful *Eucalyptus deglupta*.

Sulawesi is famed for its many fine orchids such as *Grammatophyllum sp.*, *Phallanopsis amabilis* and *Vanda celebica*. *(Source: National Conservation Plan for Indonesia, 1995)*

(3) Conservation Areas

The conservation area system is legally based on the provisions of Act No.5 of 1990, "Concerning Conservation of Living Resources and Their Ecosystems". This allows for a number of kinds of conservation areas with different objectives and characteristics. The areas concerned include Sanctuary Reserves (Article 14, comprising Strict Nature Reserves and Wildlife Sanctuaries) and Nature Conservation Areas (Article 29, comprising National Parks, Grand Forest Parks and Natural Recreation Parks). The law also allows the constitution of biosphere reserves, protection of endangered and rare species, etc.

Existing and proposed conservation areas of different categories in Central and Southeast Sulawesi are shown in Figure 5.2 and Figure 5.3, respectively.

Table 5.1 Protected Fauna in Sulawesi

No	Local Name	Family	English Name	Scientific Name
Mammals				
1	Binatang Hantu	Tarsiidae	Tarsier	*Tarsius pumilus*
2	Binatang Hantu	Tarsiidae	Tarsier	*Tarsius spectrum*
3	Monyet dihe	Cercopithecidae	Crested Celebes Macaque	*Macaca nigra*
4	Monyet Buntung	Cercopithecidae	Booted macaque	*Macaca bruescans*
5	Monyet dare	Cercopithecidae	Moor macaque	*Macaca maura*
6	Monyet digo	Cercopithecidae	Tonken macaque	*Macaca tonkeana*
7	Kuskus	Phalangeridae	Beer phalanger	*Phalanger ursinus*
8	Kuskus	Phalangeridae	Celebes phalanger	*Phalanger celebesis*
9	Musang Sulawesi	Viverridae	Celebes Palm Civet	*Macrogalidae musschenbrockii*
10	Babi rusa	Suidae	Babyrusa	*Babyrousa bairussa*
11	Rusa	Cervidae	Deer	*Cervus timorensis*
12	Anoa dataran rendah	Bovidae	Lowland Anoa	*Bubalus depressicornis*
13	Anoa pegunungan	Bovidae	Highland Anoa	*Bubalus quarlesi*
14	Monyet Hitam Sulawesi	Ceropithaecidae	Celebes crested macaque	*Cynopithecus niger*
Birds				
1	Gosong	Megapodidae	Incubator Bird	*Megapodius icobarensis*
2	Gosong	Megapodidae	Incubator Bird	*Megapodius tenimberensis*
3	Mandar Sulawesi	Ballidae	Celebes Rails	*Aramidopsis plateni*
4	Serindit Sulawesi	Psittacidae	Celebas Spotted Hanging Parrot	*Loriculus exilis*
5	Nuri Sulawesi	Psittacidae	Muller's Parrot	*Tanygnathus sumatranus*
6	Kasturi Sulawesi	Psittacidae	Orrate Lorikeet	*Trichogloscus ornatus*
7	Raja udang sungai	Alcedinidae	River Kingfisher	*Alcedo atthis*
8	Raja udang kerdil Sulawesi	Alcedinidae	Kingfisher Celebes Pygmy	*Ceyx fallax*
9	Raja Udang Sulawesi Telinga Biru	Alcedinidae	Celebes Blue Eared Kingfisher	*Cittura cynanotis*
10	Raja Udang	Alcedinidae	Kingfisher Molucean	*Halcyon monacha*
11	Raja Udang Kuduk Hitam	Alcedinidae	Black Capped Kingfisher	*Halcyon pileata*
12	Raja Udang	Alcedinidae	Sacred Kingfisher	*Halcyon sancta*
13	Rangkok Buton	Bucerotidae	Hornbill	*Rhyticeros cassidix*
14	Burung Tahun	Bucerotidae	Wrinkled Hornbill	*Rhyticeros leucocephalus*
15	Rangkong Sulawesi	Bucerotidae	Celebas Hornbill	*Penelopides exarhatus*
16	Paok Dada Merah	Pittidae	Red Breated Pitta	*Pitta erythrogaster*
17	Burung Madu Merah Jingga	Nectariniidae	Crimson Sunbird	*Aethopyga siparaja*
18	Burung Madu	Nectariniidae	Brown Thereated Sunbird	*Anthreptes Malacensis*
19	Burung Madu Tenggorokan Ungu	Nectariniidae	Purple Threated Sunbird	*Nectarinia sperata*
20	Burung Madu Kuning	Nectariniidae	Yellow Breasted Sunbird	*Nectarina jugularis*
21	Burung Madu Sulawesi	Meliphagidae	Celebes Honey-Eater	*Myza celebensis*
Reptiles				
1	Tuntong	Emydidae	River terrapin	*Batagur baska*
2	Kura-kura Irian Leher Pendek	-	New Gunea Snapper	*Elseya novaeguicae*
3	Buaya Muara	Crocodylidae	Marsh crocodile	*Crocodylus porosus*
4	Biawak Toglan	Varanidae	Togian Monitor	*Varanus salvator togianus*
5	Biawak Kalimantan	Varanidae	Cantarus Lizard	*Varanus borneansis*
6	Soa Payung	Agamidae	Collar skin flapped Lizard	*Chlamydosaurus kungi*
7	Sanca Hijau	Boidae	Green Python	*Chondropython viridis*
8	Sanca Timor	Boidae	Timor Python	*Python timorensis*

Source: A Glimpse of Nature Conservation, Ministry of Forest, 1992

(4) Coastal and Wetland Environment

Coral reefs occur around most of Sulawesi's shores and all the major reef environments -fringing, barrier and atoll- can be found around their shores. As for fauna and flora: nesting turtles, dugongs, mangroves, coconut crabs and giant clams can be observed in some of the coastal area of the study area.

Conservation of mangrove forests has been given the highest priority by the Indonesian Government. 20% of the total mangrove areas, over 700,000 hectares of mangrove forest all over Indonesia have been designated as conservation forests.

Wetlands are part of Indonesia's diversity, both in terms of ecosystems as well as species, therefore, wetland conservation is of great importance in Indonesia.

(5) Transmigration

Four provinces in Sulawesi, including Central and Southeast Sulawesi, together with Sumatra (8 provinces), Kalimantan (4 provinces) and eastern region/islands (4 provinces) are designated as "transmigrates-receiving provinces". Table 5.2 shows the past history of transmigration over the 1st to 5th Five-year Plans, and the future plan described in 6th Five Year Plan.

Table 5.2 The History and Future Plan of Transmigration

(unit : hectare)

Region/Islands	Developed Agricultural Land (1st to 5th Five year Plan)			6th Five Year Plan (1994-1998)
	Rice Field	Vegetation Field	Total	
Java	--	--	--	--
Bali, others	--	--	--	--
Sumatra	185,000	851,050	1,036,050	233,180
Kalimantan	9,000	400,060	409,060	140,435
Sulawesi	--	191,340	191,340	58,367
Maluku, Irian Jaya	--	97,230	97,230	70,993
Total	194,000	1,539,670	1,733,670	502,975

Source: Indonesia Handbook 1995/1996

(6) Minority Races

A formerly semi-nomadic tribe of people, the *Bajau*, inhabit the Banggai Islands, islands outside of Kendari Bay, Toronipa (17 km east from Kendari) and elsewhere in Southeast Sulawesi. They build wooden houses above the sea along the seashore, fishing and gathering are their main source of sustenance. No reliable data regarding to their total population has been obtained, but, about 1,000 *Bajaus* inhabit Toronipa. Recently, *Bajau* ethnics have been forced to change their way of life in accordance with government policies and international fishing laws.

Certain nomadic races are also found living in mountain areas. Their lifestyle is based on hunting and they tend to move from place to place in a group in order to catch game. The Sukuwana tribe, nomads who live in bands of 60 or so people, live within the Morowari Reserve (Central Sulawesi).

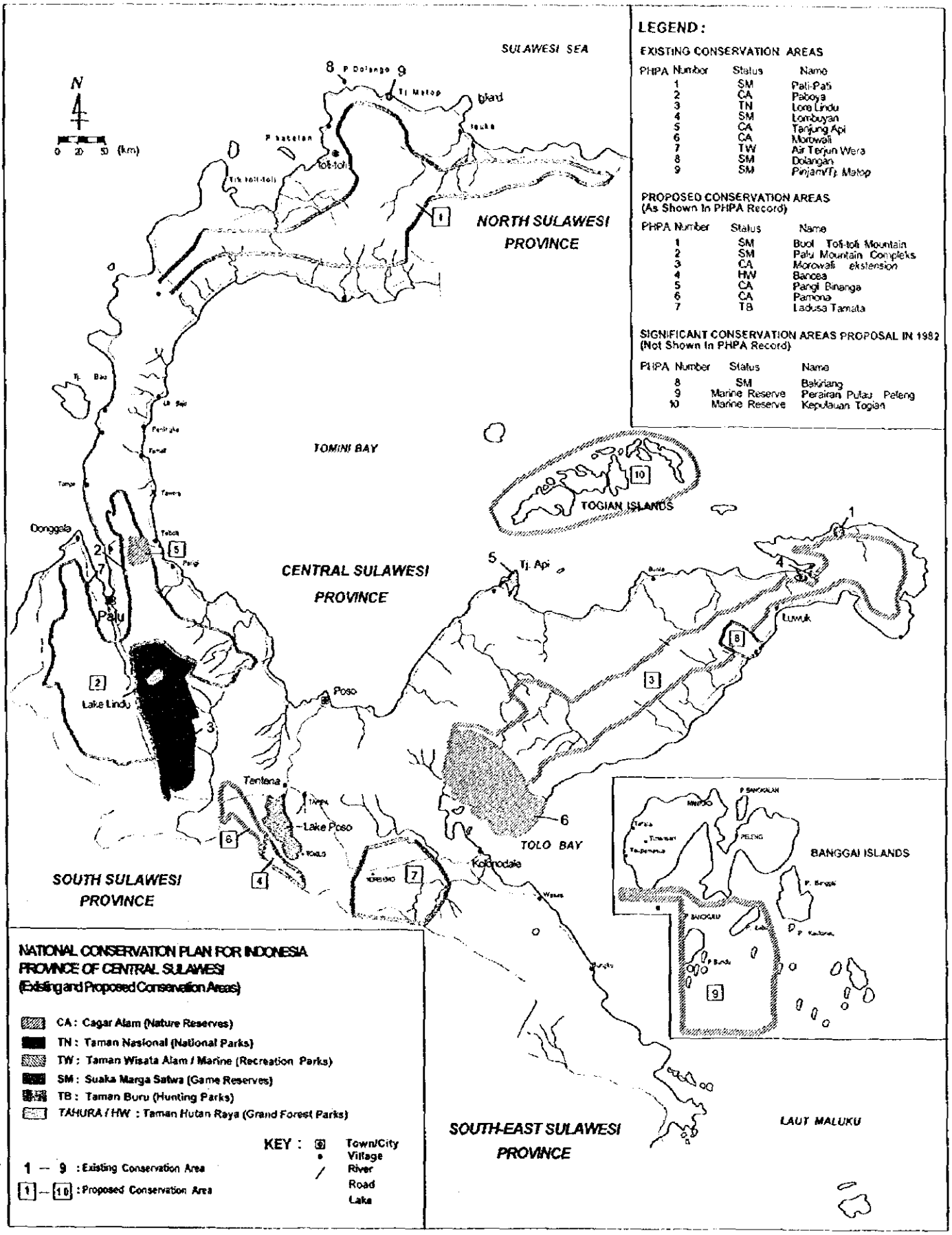


Figure 5.2 Location of Conservation Areas in Central Sulawesi

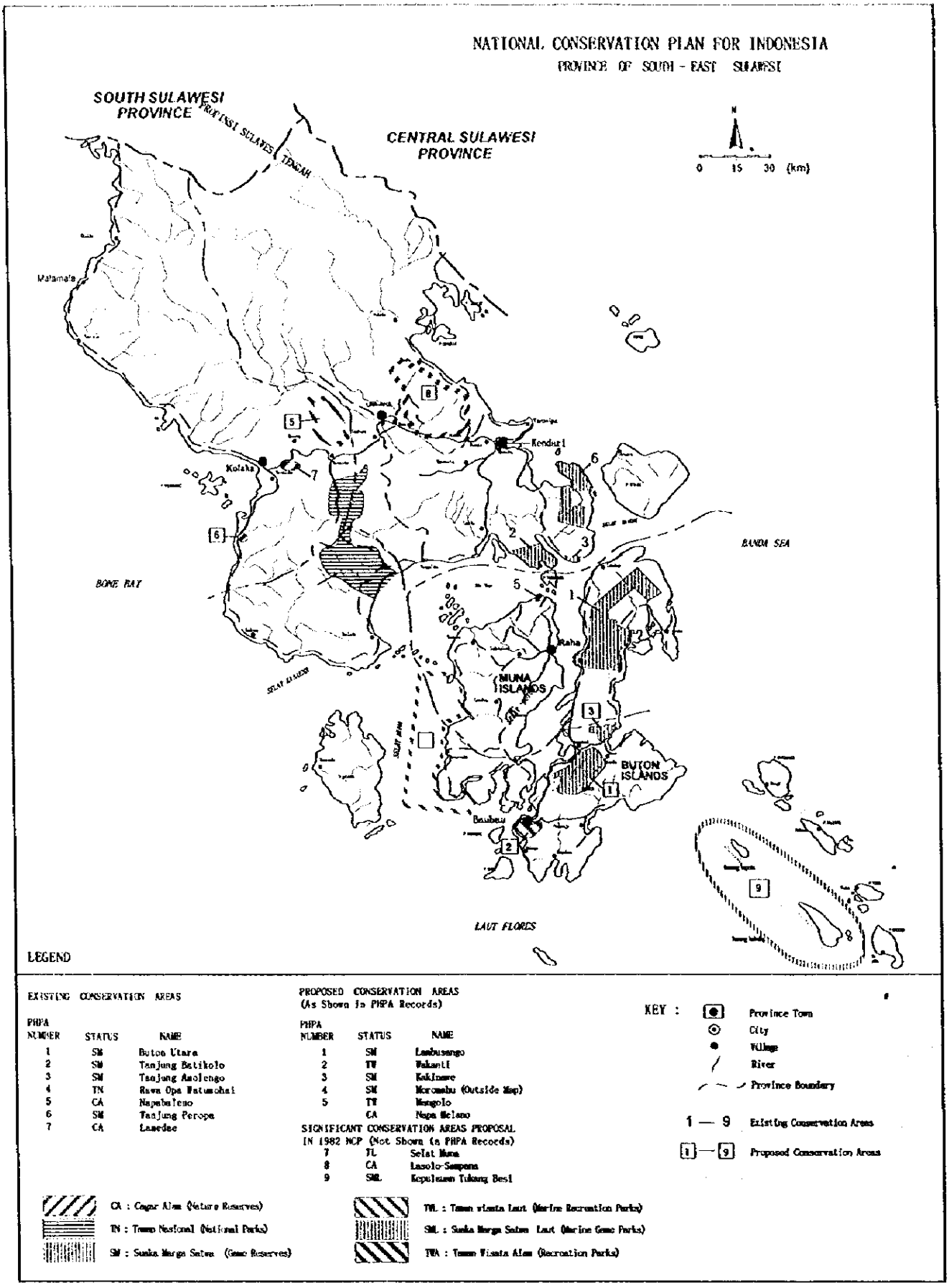


Figure 5.3 Location of Conservation Areas in Southeast Sulawesi

(7) Cultural Properties

Megaliths, imposing phallic figures/statues, which represent a human forms, mainly can be found in the Bada Valley which extends 15 km south of the Lore Lindu National Park, in Central Sulawesi. Further, some megaliths can be observed in Besoa and Napu Valleys, located in the park also. However, nothing definite is known either of the origin or the purpose of the megaliths.

(8) Environmental Pollution

There is almost no data available regarding the environmental pollution which relates to the construction of new roads and improvement of existing roads in the study area as far as air pollution, water pollution, soil contamination, noise and vibration, land subsidence and offensive odor are concerned. However, taking into consideration the contents of the Project and its scale; i.e., lower traffic volume in the study area, no toxic substances produced, no groundwater pumping, etc.; significant environmental pollution may not take place as a result of the Project.

5.3 Initial Environmental Examination (IEE)

In the Initial Environmental Examination (IEE) process, negative environmental aspects/impacts in the master-plan study area were identified based on existing information, data and site reconnaissance survey by using screening and scoping methods which are defined by the "JICA Environmental Guidelines". IEE has the two following objectives;

- To evaluate whether Environmental Impact Analysis (EIA) is necessary or not for the project and, if necessary, to define the contents/items which cause negative environmental impact, and which are used for an environmental site survey.
- To examine, from the environmental viewpoint, the counter-measures for alleviating the effects of the Project which require environmental considerations, however, not using a full-scale environmental impact assessment.

The results of screening and scoping processes, carried out by the JICA Study Team for the master-plan study area, are shown in Tables 5.3 and 5.4, respectively, and main points/items of the project which may cause environmental impact will be taken into account for the next step (environmental site survey, EIA Study, etc.).

Table 5.3 Screening Result for the Master Plan Study Area

No.	Environmental Item	Description	Evaluation	Remarks (Reason)
A. Social Environment				
1.	Resettlement	Resettlement due to land occupancy (Transfer of rights of residence/land ownership)	Yes	Residences exist
2.	Economic Activities	Loss of bases of economic activities, such as land, and change of economic structure	Yes	Some changes predicted by land acquisition, etc.
3.	Traffic and Public Facilities	Impacts on schools, hospitals and present traffic conditions, such as the increase of traffic congestion and accidents	Yes	Infrastructures and public facilities exist
4.	Split of Communities	Community split due to intervention of area traffic	No	No notable impacts predicted
5.	Cultural Property	Damage to or loss of value of churches, temples, shrines, archaeological remains or other cultural assets	No	Little cultural property exists
6.	Water Rights and Common Rights	Obstruction of fishing rights, water rights, common rights	Yes	Forest protection area exist
7.	Public Health Conditions	Deterioration of public health and sanitary conditions due to generation of garbage and the increase of vermin	No	No notable impacts predicted
8.	Waste	Generation of construction wastes, debris and ash	Yes	Surplus soil might be produced
9.	Hazards (Risk)	Increase in danger of landslides, cave-ins, and accidents	Yes	Study area mainly located mountainous area
B. Natural Environment				
10.	Topography and Geology	Changes of valuable topography and geology due to excavation of filling work	Yes	Study area mainly located mountainous area
11.	Soil Erosion	Topsoil erosion by rainfall after reclamation and vegetation removal	Yes	Study area mainly located mountainous area
12.	Groundwater	Changes of distribution of groundwater by large-scale excavation	Yes	Tunnel construction may affect groundwater
13.	Hydrological Situation	Changes of river discharge and riverbed condition due to landfill and drainage inflow	Yes	Bridge construction may affect hydrological conditions
14.	Coastal Zone	Coastal erosion and sedimentation due to landfill or change in marine condition	Yes	Some roads pass through coastal zones
15.	Fauna and Flora	Obstruction of breeding and cause of extinction of species due to changes of habitat conditions	Yes	Endemic fauna and flora exist in the study area
16.	Meteorology	Changes of temperature, precipitation, wind, etc. due to large-scale land reclamation and building construction	No	No meteorological impact predicted
17.	Landscape	Change of topography and vegetation due to reclamation. Deterioration of aesthetic harmony by structures	Yes	Cut slopes will cause impact on landscape
C. Pollution				
18.	Air Pollution	Pollution caused by exhaust gas or toxic gas from vehicles and factories	No	Traffic volume is small
19.	Water Pollution	Pollution caused by inflow of silt, sand and effluence into rivers and groundwater	No	Impact on water quality is negligible
20.	Soil Contamination	Contamination of soil by dust and chemicals, such as herbicides	No	No toxic substances produced
21.	Noise and Vibration	Noise and vibration generated by vehicles	Yes	Construction equipment will cause impact
22.	Land Subsidence	Deformation of land and land subsidence due to lowering of groundwater table	No	No groundwater pumping
23.	Offensive Odor	Generation of exhaust gas and offensive odor by facility construction and operation	No	No factor for offensive odor

Source : "JICA Environmental Guidelines"

Table 5.4 Scoping Result for the Master Plan Study Area

No	Environmental Item	Evalu-ation	Reasons
A. Social Environment			
1.	Resettlement	B	Resettlement will be taken into consideration due to construction of new roads and improvement of existing roads
2.	Economic Activities	C	Some changes of economic activities by land acquisition etc. will be predicted
3.	Traffic/Public Facilities	B	In Pre-F/S and/or F/S stage, impacts on infrastructures (electric cable, water supply, etc.) and public facilities (schools, hospital, etc.) will be considered
4.	Split of Communities	D	Notable impact regarding split communities not predicted
5.	Cultural Property	D	Cultural properties are few in the study area
6.	Water Rights and Common Rights	B	National parks, nature conservation areas, forest protection areas exist in the study area
7.	Public Health Condition	D	No impact on public health conditions
8.	Waste	B	Large amount of surplus soil by cutting work will be produced
9.	Hazards (Risk)	A	Study area is mainly located in mountainous region, therefore a potentially hazardous area, especially landslides.
B. Natural Environment			
1.	Topography and Geology	B	Many slopes will be cut to accommodates construction of new roads and improve existing roads
2.	Soil Erosion	B	Soil erosion may occur during construction stage, due to earth works, cutting of forest, etc., mainly in mountainous area
3.	Groundwater	C	Some impact is anticipated by tunnel construction
4.	Hydrological Situation	B	Some impacts is anticipated by bridge construction
5.	Coastal Zone	B	Some project roads in the study area pass through the coastal zone
6.	Fauna and Flora	B	Protected/Endemic fauna and flora exist in the study area. Nature reserves, national parks, forest reserves, etc., exist in Central and Southeast Sulawesi
7.	Meteorology	D	No meteorological impacts are predicted
8.	Landscape	B	Large cut slopes in mountainous area will cause some impacts on landscape
C. Pollution			
1.	Air Pollution	D	Predicted traffic volume in the study area is small
2.	Water Pollution	D	Impacts on water bodies by construction works etc. is negligible
3.	Soil Contamination	D	Toxic substances will not be handled by the project
4.	Noise and Vibration	B	Noise and vibration may occur by construction equipment during construction stage
5.	Land Subsidence	D	No ground water pumping will be carried out in the project
6.	Offensive Odor	D	There is no factor of offensive odor in the project

Source: "JICA Environmental Guidelines"

Note : Evaluation categories:

A: Serious impact is expected.
B: Some impact is expected.
C: Extent of impact is unknown (Examination is needed. Impact may become clear as study progresses).
D: No impact is expected.

6. MASTER PLAN AND IMPLEMENTATION PLAN

6.1 Road Network Development Policy

The basic development policy of an inter-regional road network based on improving and expanding national, provincial and kabupaten (regency) roads is described below:

- Connections of provincial capital cities to develop gross corridors (arterial roads) for the entire Sulawesi area.
- Connections of provincial capital cities with kabupaten capital cities to develop sub-gross corridor (collector roads) which complement and strengthen regional tie-ups.
- Connections of principal port facilities and places of production in order to guide and promote the regional industry.
- Connections to provide improvement of a quality of life through transportation.
- These connections form a future road network, providing alternative links between provincial cities.

The above basic policy is shown in Figure 6.1 as a road network concept considering the role of the gross corridor, sub-gross corridors, port and airport corridors and emergency services access corridors.

The characteristics of the improvement of each corridor is as follows:

(1) Gross corridor (arterial road) for the entire Sulawesi area

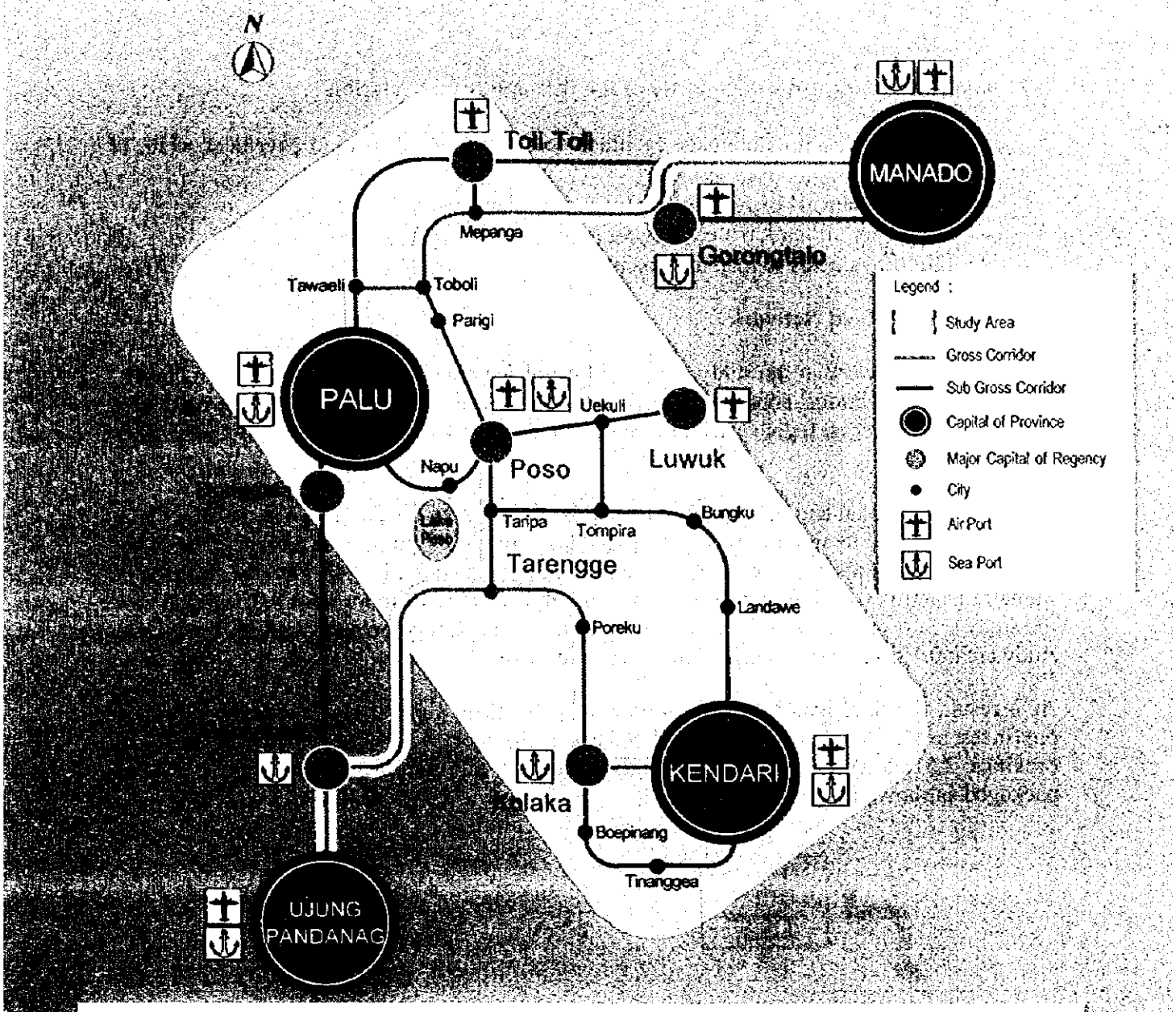
- Improvement of drainage facilities and achievement of road pavement width of 6.0 m
- Improvements to permanent-structure bridges
- Disaster mitigation measures for roads
- Improvements to road alignments
- Creating new links; improving existing links

(2) Sub-gross corridor (collector road) to connect provincial cities and regional junction cities

- Improvement of drainage facilities and achievement of a road pavement width of 4.5 m or more
- Improvements to permanent-structure bridges
- Disaster mitigation measures for roads
- Improvement of road alignment
- Creating new links; improving existing links

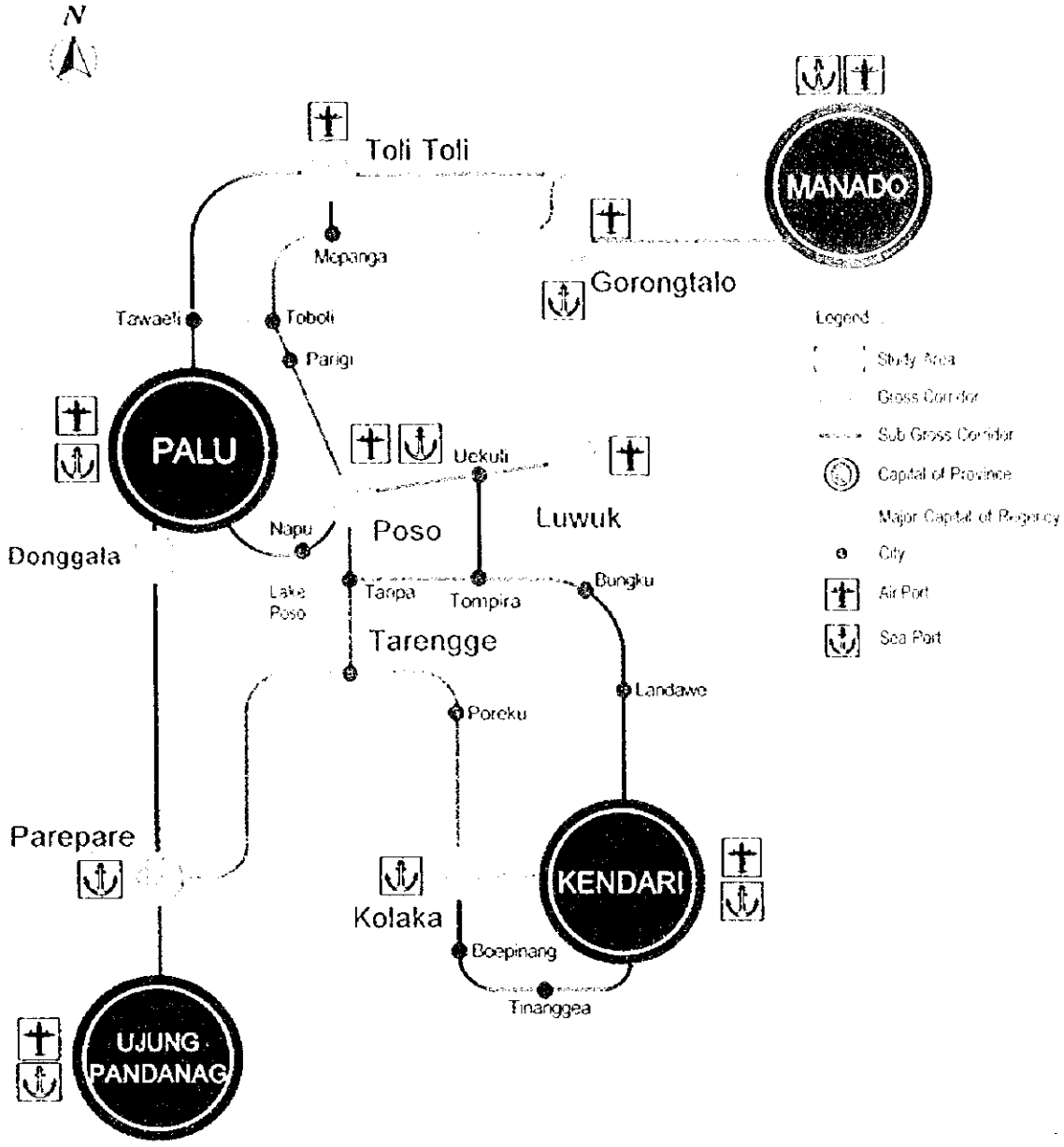
(3) Corridor for promotion of industry

- Improvement of drainage facilities and achievement of road pavement width of 6.0 m
- Improvements to convenience factor (development of shortcut routes)
- Improvements to permanent-structure bridges
- Disaster mitigation measures for roads
- Improvements to road alignment



ROLE OF CORRIDOR	CONNECTION OF CITIES
(1) GROSS CORRIDOR (Arterial Road) CONNECTING PROVINCIAL CAPITALS	- MANADO ~ PALU ~ POSO ~ KOLAKA ~ KENDARI ↳ UJUNG PANDANG
(2) SUB-GROSS CORRIDOR (Collector Road with Higher Standard) CONNECTING REGIONAL DISTRIBUTION CITIES WITH GROSS CORRIOR	- PALU ~ TOLITOLI - PALU ~ DONGGALA ~ PAREPARE - POSO ~ UEKULI ~ LUWUK - TARIPA ~ BUNGKU - KENDARI ~ TINANGGEA ~ BOEPINANG ~ KOLAKA
(3) CORRIDOR (Collector Road) CONNECTING PORTS WITH PRODUCTIVE AREAS	- TOLITOLI ~ MEPANGA - PALU ~ NAPU ~ POSO - POSO ~ UEKULI ~ BUNGKU ~ LANDAWE ~ KENDARI
(4) CORRIDOR (Collector Road) TO PROVIDE IMPROVEMENT OF A QUALITY OF LIFE THROUGH TRANSPORTATION	- ACCESS TO HOSPITAL, EDUCATION, AND CULTURE FACILITIES

Figure 6.1 Concept of Inter Regional Road Network System in Study Area



ROLE OF CORRIDOR	CONNECTION OF CITIES
(1) GROSS CORRIDOR (Arterial Road) CONNECTING PROVINCIAL CAPITALS	- MANADO ~ PALU ~ POSO ~ KOLAKA ~ KENDARI ~ UJUNG PANDANG
(2) SUB-GROSS CORRIDOR (Collector Road with Higher Standard) CONNECTING REGIONAL DISTRIBUTION CITIES WITH GROSS CORRIOR	- PALU ~ TOLITOLI - PALU ~ DONGGALA ~ PAREPARE - POSO ~ UEKULI ~ LUWUK - TARIPA ~ BUNGKU - KENDARI ~ TINANGGEA ~ BOEPINANG ~ KOLAKA
(3) CORRIDOR (Collector Road) CONNECTING PORTS WITH PRODUCTIVE AREAS	- TOLITOLI ~ MEPANGA - PALU ~ NAPU ~ POSO - POSO ~ UEKULI ~ BUNGKU ~ LANDAWE ~ KENDARI
(4) CORRIDOR (Collector Road) TO PROVIDE IMPROVEMENT OF A QUALITY OF LIFE THROUGH TRANSPORTATION	- ACCESS TO HOSPITAL, EDUCATION, AND CULTURE FACILITIES

Figure 6.1 Concept of Inter Regional Road Network System in Study Area

(4) Corridor to improve the quality of life through transportation

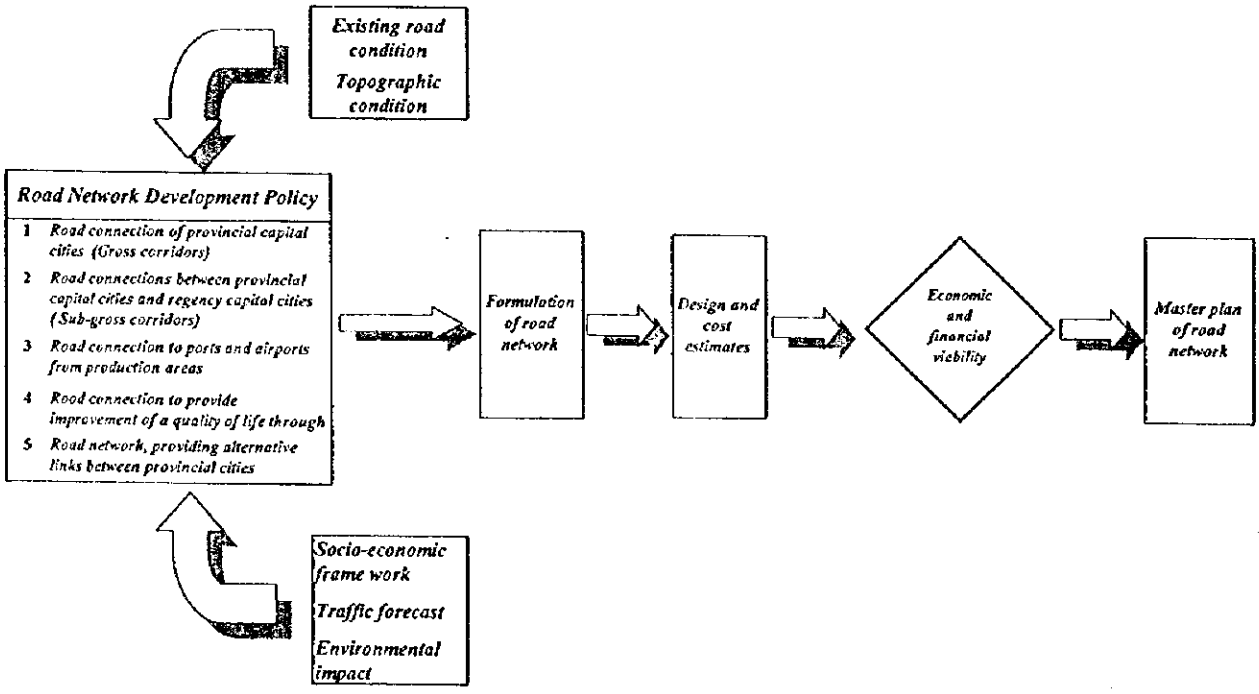
- Improvement of drainage facilities and achievement of road pavement width of 4.5 m
- Improvements to permanent-structure bridges
- Disaster mitigation measures for roads
- Improvements to road alignment

6.2 Future Road Network

A future road network in the study area was formulated considering topographic conditions, present road and bridge conditions, environmental situation, future economic growth and traffic demand forecast together with the above road network development policy (See Figure 6.2).

The index of national and provincial road length per unit area for the future in the study area has been increased to about 0.07km/km^2 (6,552km) from 0.05 km/km^2 at present. That index of 0.05 km/km^2 is appropriate as the same index for Java island is 0.10 km/km^2 and that of Sumatra island is 0.05 km/km^2 at present. The higher index of more than 0.07 km/km^2 for the study area is excessive considering the other index mentioned on page 4 of this report (i.e. study area: 0.19, Java island: 0.10, Sumatra island: 0.16).

As a result, the total length of the future road network in Central and Southeast Sulawesi provinces becomes 6,552 Km (Central Sulawesi province: 4,034 km, Southeast Sulawesi province: 2,518 km). The future road network is shown in Figure 6.3 and road link Nos.. are packaged as shown in Figure 6.4.



Source: Study Team

Figure 6.2 Flow Chart for Formulation and Master Plan of Road Network

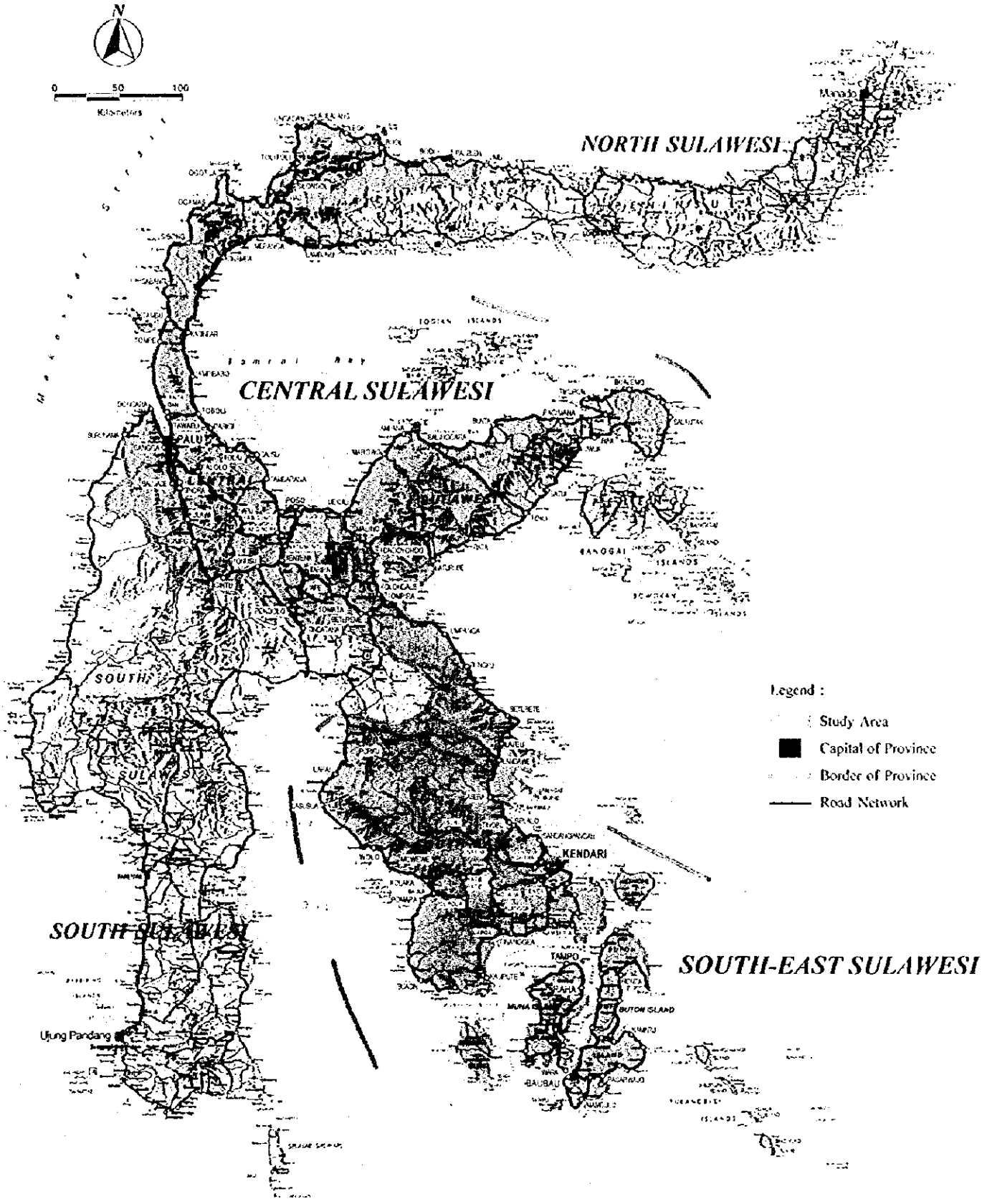


Figure 6.3 Future Road Network

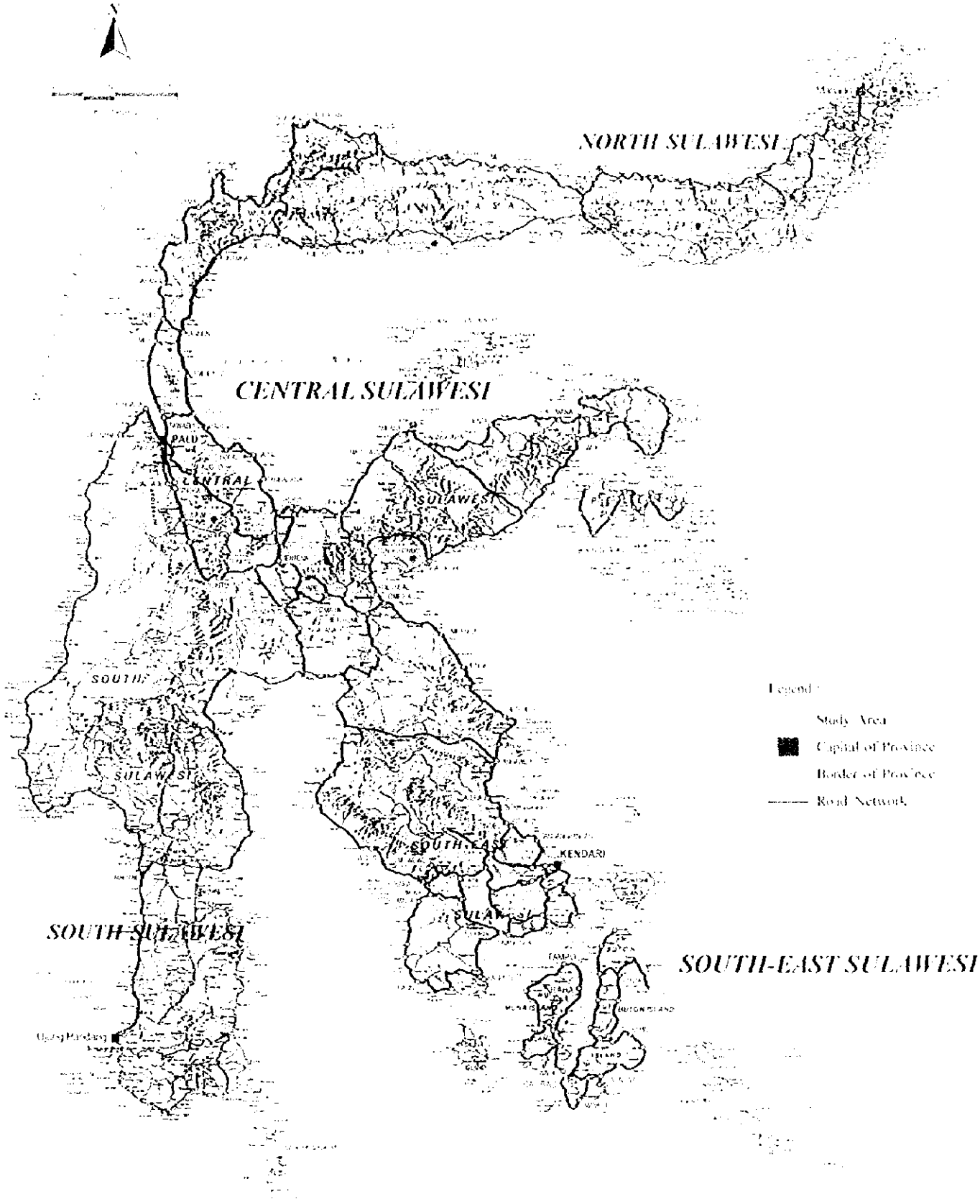


Figure 6.3 Future Road Network

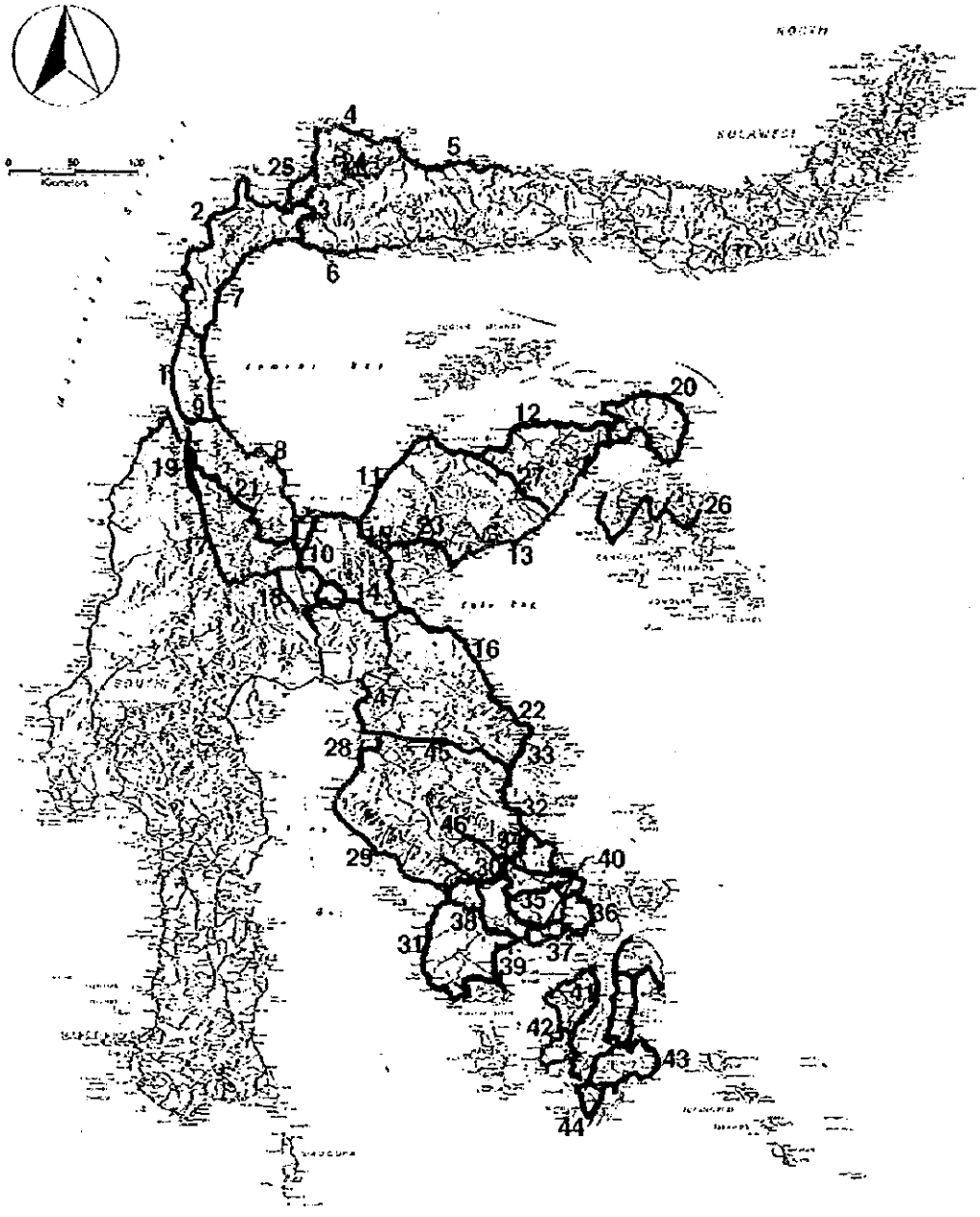


Figure 6.4 Location of Project Segment