CHAPTER 9 FUTURE TRAFFIC DEMAND FORECASTS

9.1 Traffic Assignment Cases

9.1.1 General

Using the present OD tables (2007), the future OD tables (2014, 2019 and 2024) and road networks of the various cases (with and without project) as described earlier in Chapter 7 of this report, a series of traffic assignments were conducted. These are the following:

1. A “Do-nothing” case for 2007, 2014, 2019 and 2024.

2. “With Project” case which assumes the implementation of each project out of the proposed 19 projects for 2007, 2014, 2019 and 2024.

3. A “Do-all” case which assumes the implementation of all proposed 19 projects for 2007, 2014, 2019 and 2024.

9.1.2 Projects

The Trans-Sulawesi Road consists of the West, Central and East Corridors. Each corridor was further divided into Projects taking into account the regional characteristics as well as the extension of road length. Figure 9.1.1 shows the projects proposed by the Study Team. Table 9.1.1 summarizes the characteristics of the Projects. These are:

TS-1 West Corridor (South): Jeneponto-Makassar-Parepare-Mamuju-Palu, 6 Projects.

TS-2 West Corridor (North): Palu-Kuandang-Manado-Bitung, 3 Projects.

TS-3 Central Corridor (South): Jeneponto-Watampone-Wotu-Poso-Toboli, 2 Projects.

TS-4 Central Corridor (North): Toboli-Gorontalo-Bitung, 2 Projects.

TS-5 East Corridor: Wotu-Kolaka-Kasiputih-Kendari-Kolonodale-Luwuk-Poso, 6 Projects.

Note that other national and provincial roads not indicated in Figure 9.1.1 are included in either of the above projects.

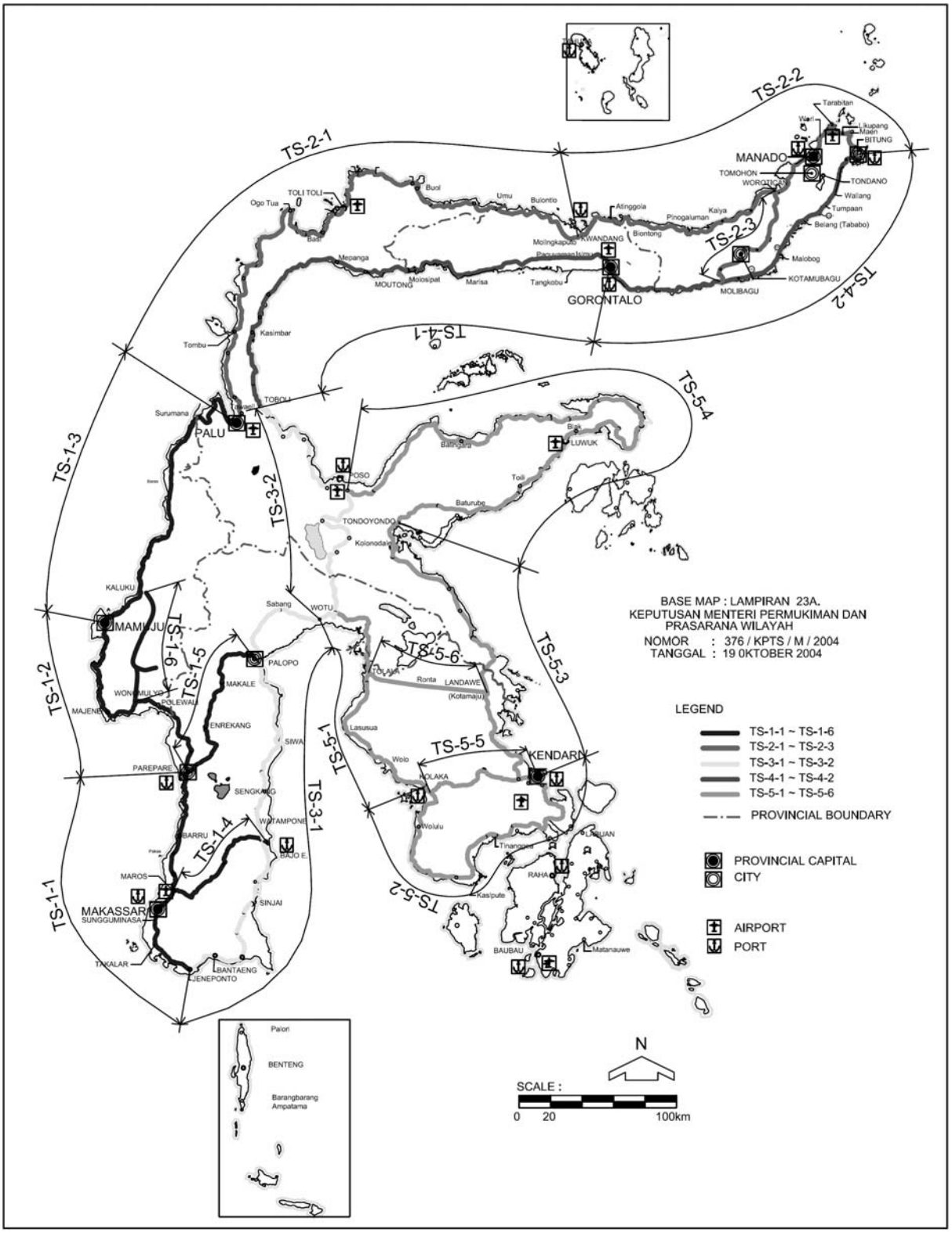


Figure 9.1.1 Proposed Corridors and Projects

Table 9.1.1 Characteristics of Proposed Projects

Package	Origin-Major Cities-Destination	Category	Length (km)				Width (m)	Traffic Volume (000 PCUs/day)
			Total	National		Prov'l		
				Arterial	K 1	K 2/3		
TS-1-1	Jeneponto - Makassar - Parepare Parepare - Mamuju Mamuju - Palu	TS MAIN CORRIDOR	229	150	79	0	3.0-16.9	2-70
		RELATED ROUTES	429	0	0	429		
		TOTAL	658	150	79	429		
TS-1-2	Maros - Bajoe Parepare - Palopo Wonomulyo - Kaluku	TS MAIN CORRIDOR	283	283	0	0	3.8-10.2	1-11
		RELATED ROUTES	409	0	117	291		
		TOTAL	692	283	117	291		
TS-1-3	Palu - Kwandang Kwandang - Manado - Bitung Molibagu - Worotican	TS MAIN CORRIDOR	348	348	0	0	4.4-6.0	4-14
		RELATED ROUTES	39	39	0	0		
		TOTAL	387	387	0	0		
TS-1-4	Jeneponto - Watampone - Wotu Wotu - Poso - Toboli Toboli - Gorontalo	PENINSULA CROSSING	144	144	0	0	6.0-8.0	6-9
		RELATED ROUTES	0	0	0	0		
		TOTAL	144	144	0	0		
TS-1-5	Gorontalo - Bitung Wotu - Kolaka Kolaka - Tinaggea - Kendari	PENINSULA CROSSING	223	12	211	0	4.3-7.1	2-12
		RELATED ROUTES	68	58	0	9		
		TOTAL	290	70	211	9		
TS-1-6	Kendari - Tondoyondo Tondoyondo - Luwuk - Poso Kolaka - Kendari	PENINSULA CROSSING	200	0	100	100	6.0	1
		RELATED ROUTES	0	0	0	0		
		TOTAL	200	0	100	100		
TS-2-1	Landawe - Tolala Jeneponto - Makassar - Parepare Parepare - Mamuju	TS MAIN CORRIDOR	895	20	875	0	3.4-8.4	1-7
		RELATED ROUTES	125	0	0	125		
		TOTAL	1,019	20	875	125		
TS-2-2	Mamuju - Palu Maros - Bajoe Parepare - Palopo	TS MAIN CORRIDOR	496	318	178	0	3.5-10.0	1-38
		RELATED ROUTES	903	98	212	594		
		TOTAL	1,399	416	390	594		
TS-2-3	Wonomulyo - Kaluku Palu - Kwandang Kwandang - Manado - Bitung	PENINSULA CROSSING	184	0	184	0	4.5-8.4	2-4
		RELATED ROUTES	0	0	0	0		
		TOTAL	184	0	184	0		
TS-3-1	Molibagu - Worotican Jeneponto - Watampone - Wotu Wotu - Poso - Toboli	TS MAIN CORRIDOR	571	268	256	47	3.9-9.7	1-10
		RELATED ROUTES	881	6	356	519		
		TOTAL	1,452	274	612	566		
TS-3-2	Toboli - Gorontalo Gorontalo - Bitung Wotu - Kolaka	TS MAIN CORRIDOR	381	381	0	0	4.2-5.5	1-5
		RELATED ROUTES	688	56	89	543		
		TOTAL	1,069	436	89	543		
TS-4-1	Kolaka - Tinaggea - Kendari Kendari - Tondoyondo Tondoyondo - Luwuk - Poso	TS MAIN CORRIDOR	553	529	24	0	4.0-7.0	1-7
		RELATED ROUTES	420	0	60	360		
		TOTAL	973	529	84	360		
TS-4-2	Kolaka - Kendari Jeneponto - Makassar - Parepare	TS MAIN CORRIDOR	464	0	459	5	3.5-11.0	1-15
		RELATED ROUTES	429	7	30	393		
		TOTAL	893	7	489	398		
TS-5-1	Parepare - Mamuju Mamuju - Palu Maros - Bajoe	TS MAIN CORRIDOR	384	384	0	0	3.9-5.6	1-4
		RELATED ROUTES	51	0	0	51		
		TOTAL	435	384	0	51		
TS-5-2	Parepare - Palopo Wonomulyo - Kaluku Palu - Kwandang	TS MAIN CORRIDOR	415	0	415	0	4.2-17.8	1-3
		RELATED ROUTES	645	0	149	496		
		TOTAL	1,060	0	564	496		
TS-5-3	Kwandang - Manado - Bitung Molibagu - Worotican Jeneponto - Watampone - Wotu	TS MAIN CORRIDOR	373	0	373	0	4.3-6.0	1-3
		RELATED ROUTES	0	0	0	0		
		TOTAL	373	0	373	0		
TS-5-4	Wotu - Poso - Toboli Toboli - Gorontalo Gorontalo - Bitung	TS MAIN CORRIDOR	970	0	503	466	3.5-6.0	1-3
		RELATED ROUTES	265	0	50	215		
		TOTAL	1,235	0	554	681		
TS-5-5	Wotu - Kolaka Kolaka - Tinaggea - Kendari Kendari - Tondoyondo	PENINSULA CROSSING	156	156	0	0	4.5-6.7	1-9
		RELATED ROUTES	156	0	14	142		
		TOTAL	312	156	14	142		
TS-5-6	Tondoyondo - Luwuk - Poso Kolaka - Kendari	PENINSULA CROSSING	150	0	150	0	6.0	1
		RELATED ROUTES	0	0	0	0		
		TOTAL	150	0	150	0		
TOTAL		TS MAIN CORRIDOR	6,361	2,681	3,163	518		
		PENINSULA CROSSING	1,056	311	645	100		
		RELATED ROUTES	5,508	264	1,077	4,167		
TOTAL			**12,926**	**3,256**	**4,885**	**4,785**		
					8,141	**4,785**		

9.1.3 Traffic Assignment Cases

Table 9.1.2 summarizes the traffic assignment cases conducted. The total number of cases amounts to 65. Note that these traffic assignments are mainly for the assessment of network performance and, among others, the prioritization of the proposed projects. The actual implementation program is hereinafter discussed based on this exercise.

Table 9.1.2 Traffic Assignment Cases as Tested

	2007	2014	2019	2024
"Do-nothing" case	*	*	*	*
"With Project" case for each of 19 Projects		*	*	*
"Do-all" case assuming all 19 Projects	*	*	*	*

9.2 Traffic Assignments Results

9.2.1 "Do-nothing" Case

This case has been explained earlier in Section 7.5 of this report (see Figure 7.5.9). This analysis was the basis for determining the planning directions of the arterial road network in Sulawesi. The "Do-nothing" case analysis shows the following:

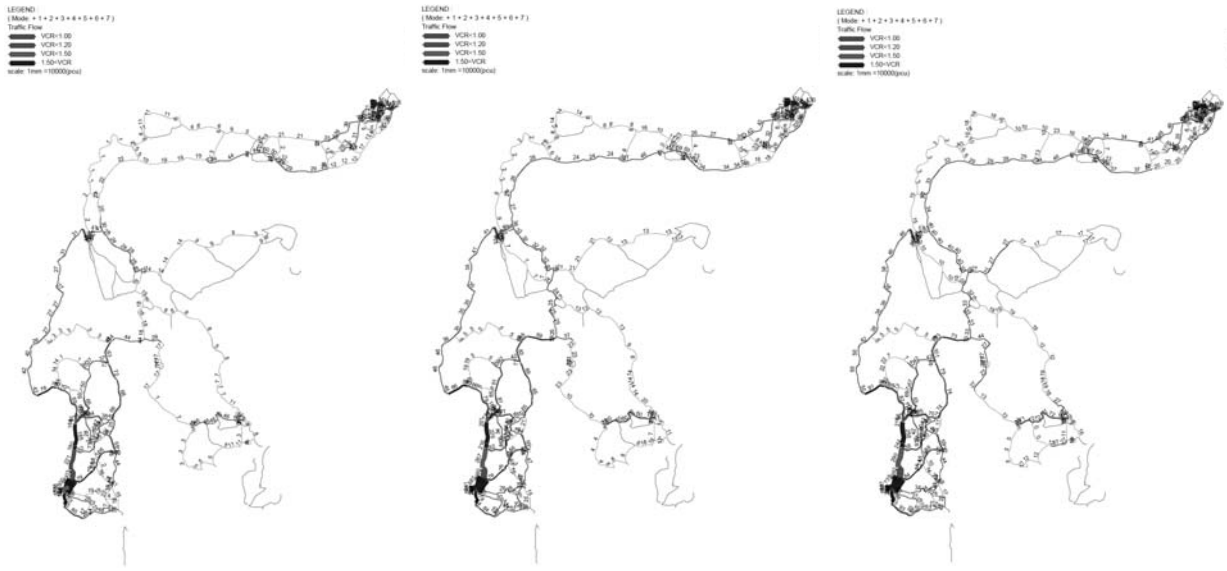
The distribution of traffic volume is concentrated around the major cities like Makassar, Manado, Palu and Kendari. Particularly around Makassar, traffic congestion which is currently only confined to the city will spread by 2024 to wider areas of South Sulawesi Province such as Parepare, Majene, Palopo and Masamba. However, in other areas traffic congestion will not be serious except for Manado and its vicinity.

The traffic volume on intercity roads of Sulawesi will increase up to 10,000 PCUs/day around Makassar by 2024. For the Makassar-Parepare section it will be large at 20,000-30,000 PCUs/day. Typically on other arterial roads in South Sulawesi Province, it will be 4,000-8,000. In other provinces, the traffic volume will exceed 5,000 PCUs/day by 2024 near provincial capital cities of Manado, Gorontalo, Palu, Mamuju and Kendari. However, it will still be small, below 3,000 PCUs/day on most inter-provincial roads.

With regard to the nautical highway, the traffic volume is currently very small, about 100 PCUs/day for Bajoe-Kolaka and about 30 PCUs/day for Pagimana-Gorontalo. In 2024, this volume will increase to about 450 PCUs/day and 100 PCUs/day respectively assuming the current modal shares (i.e. the same service level as at present).

9.2.2 "With Project" Case for Each of 19 Projects

A total of 57 traffic assignments were carried out in this practice. Each case assumes that one single project is completed while the other 18 projects remain unimplemented. Figure 9.2.1 exemplifies the distribution of assigned traffic for Project TS-1-5 (Parepare-Palopo). The same figures were prepared for other projects, although they look similar to each other, because most projects are improvement of existing roads and they have not much difference in traffic distribution. Because of this they were omitted from this report.



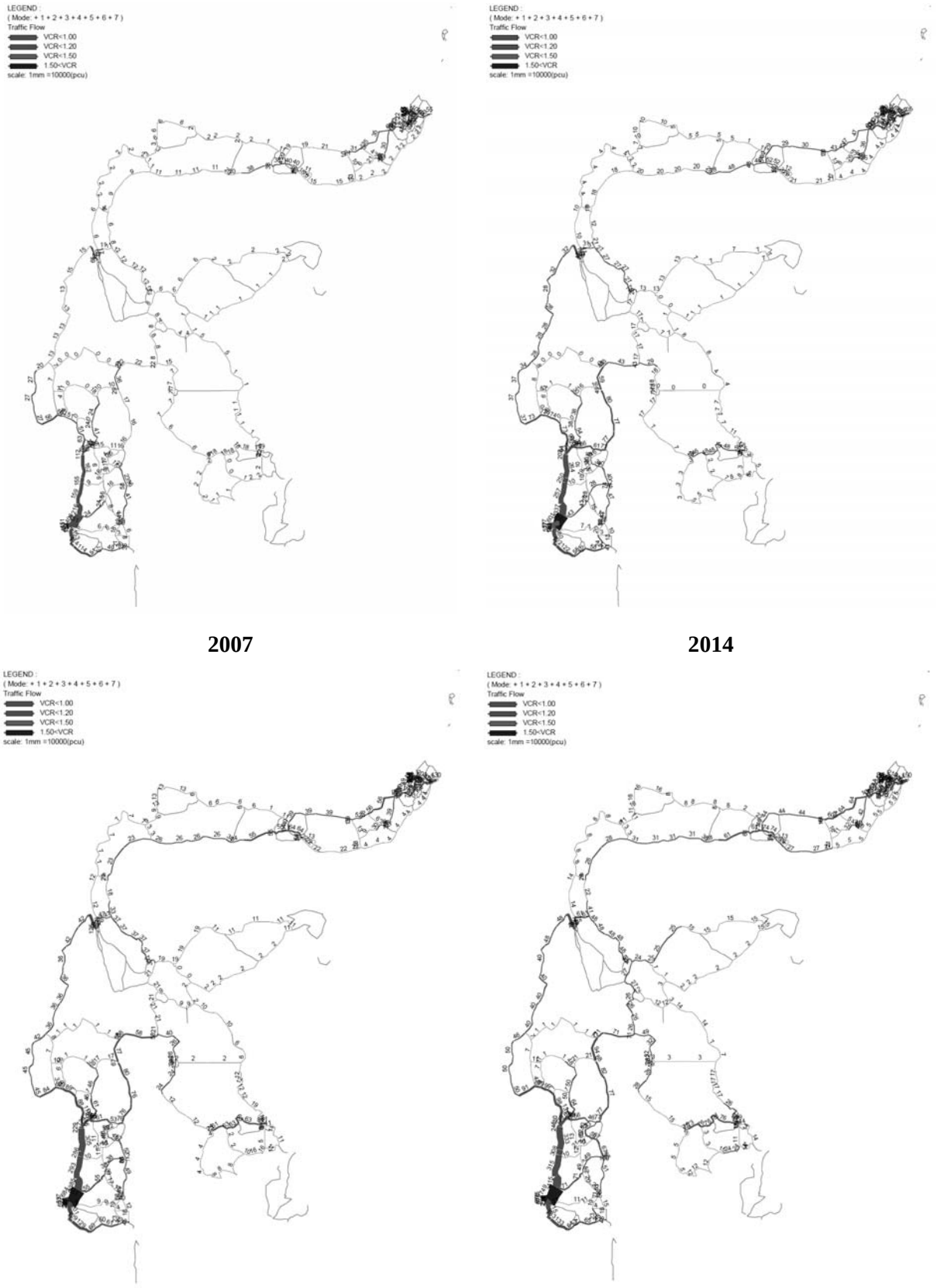
2014 **2019** **2024**

Figure 9.2.1 Result of Traffic Assignment (With Project TS-1-5)

9.2.3 "Do-all" Case with 19 Projects

Figure 9.2.2 presents the result of traffic assignment in the "Do-all" case. As compared to the "Do-nothing" case or the "With Project" case, traffic congestion is not foreseen except for the urban area in Makassar. Traffic distribution, however, does not differ much.

As for the nautical highway, the introduction of high-speed, large-capacities and low-cost RoRo ships are assumed.. Although its future traffic volume is difficult to estimate due to uncertain charge levels, its share in total inter-provincial traffic will presumably double by 2024; i.e. 25% between South Sulawesi and Southeast Sulawesi and 6% between Central Sulawesi and Gorontalo/North Sulawesi. It is surmised that traffic volume in 2024 will be 900 PCUs/day between Bajoe and Kolaka, and 200 PCUs/day between Gorontalo and Pagimana/Luwuk.



2007 **2014**

2019 **2024**

Figure 9.2.2 Result of Traffic Assignment ("Do-all" Case with 19 Projects)

CHAPTER 10 PRELIMINARY ENGINEERING STUDY AND COST ESTIMATES

10.1 Preliminary Engineering Study

In order to estimate rough improvement costs and elaborate the priorities of implementation the preliminary engineering study covers not only the arterial roads but also the collector roads of Sulawesi road network. It was carried out based on the new design standards of the "Government Road Regulation/Peraturaan Pemerrintah Nomor No. 34 Tahun 2006.

10.1.1 Identification of Improvement Measures

The types of improvement works for the proposed road network were identified based on the existing road condition and the need to maintain the required service levels of each road category. The following measures were deemed necessary to improve and increase the efficiency of the road network.

(1) Road network improvement

* New road construction (new bypass and new road)
* Betterment (re-construction of road structure and capacity expansion by widening)
* Maintenance (Periodic maintenance (overlay) and Routine maintenance)

The works, or projects, for the road network improvement were generally divided into three categories, i.e. "new road construction", "betterment" and "maintenance".

"New road construction" contains construction of new bypasses and new roads which are necessary for an efficient road network.

In this study, "betterment" contains four (4) kinds of works: (Betterment I), reconstruction without the widening of road structures which are currently in poor condition; (Betterment II), widening from the existing 3.5 – 5.4 m road to 6.0m; (Betterment III), widening from the existing 6.0m road to 7.0m; and (Betterment IV), widening from the existing 6.0/7.0m road to 2 x 7.0m. Each option (from Betterment I – IV) was assigned to the road links with due consideration of future traffic volumes.

"Maintenance" was further divided into "periodic maintenance" and "routine maintenance." Overlay work was part of periodic maintenance. The Study Team estimated the corresponding costs of the periodic maintenance (overlay) and routine maintenance for the Sulawesi Road Master Plan from 2008 to 2024.

(2) Upgrade of road classification

* Upgrade of functional classification (arterial and collector)
* Upgrade of administrative classification (national and provincial)

As stated in section 8.2.4 of Chapter 8, some road links are recommended for upgrading to higher classifications, since their traffic volumes have been increasing and the administrative/functional role of the cities that the links are connected to have changed.

(3) Staged application of new road standard regulation

As stated in section 8.2.5 of Chapter 8, "Staged application of new road standard regulation" is proposed in the development of the arterial and collector roads taking into account the existing road conditions and existing traffic volumes.

10.1.2 Proposed Design Standard and Typical Cross Section

This master plan study considered current design standards on the planning of road network improvement as stated in section 3.2 of Chapter 3. Since target roads of this study were mainly inter-urban roads the "Tata Cara Perencanaan Geometrik Jalan Antar Kota" and Decree No. 42/KPTS/Db/2007 corresponding to PP No.34/2006 under Act No. 38/2004 issued by the Department of Public Works' Directorate General of Highways were examined to set the typical cross sections and rough cost estimates.

Figure 10.1.1 shows the typical cross sections which are assumed as improvement measures in this Master Plan.

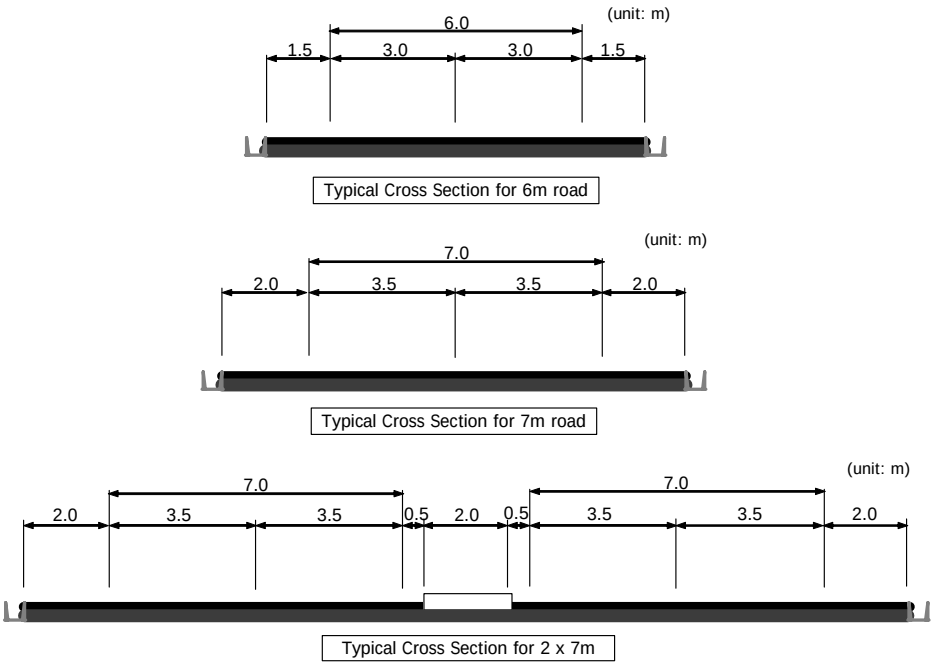


Figure 10.1.1 Typical Cross Sections for this MP Study

10.1.3 Estimated Quantities

Taking the traffic volume for 2024 which were forecasted and distributed in Chapter 9 as well as taking into account the new road standard regulations, road links were given optimum options (Betterment, new road construction or maintenance only) in the master plan. It is noted that "maintenance" works, including periodic maintenance (overlay) and routine maintenance, were necessary for all roads and were included in the cost estimates for the total length of the road network.

Considering the improvement measures mentioned above, the project quantity of this master plan is expressed in road length (km) and is shown in Table 10.1.1 below.

Table 10.1.1 Project Quantity (Road Length) by Improvement Measure and by Province

unit: km

PROVINCE/ROAD CATEGORY	BETTERMENT					NEW ROAD	MTNCE ONLY	TOTAL
	I	II	III	IV	TOTAL			
NORTH SULAWESI PROVINCE								
NATIONAL ROAD	109	638	368	29	1,144	0	188	1,332
ARTERIAL	0	0	315	15	329	0	22	351
COLLECTOR 1	109	638	53	15	814	0	167	981
PROVINCIAL ROAD	276	50	18	0	344	30	516	890
TOTAL	384	688	386	29	1,488	30	704	2,222
GORONTALO PROVINCE								
NATIONAL ROAD	60	73	320	0	453	0	151	604
ARTERIAL	0	0	306	0	306	0	0	306
COLLECTOR 1	60	73	14	0	147	0	151	299
PROVINCIAL ROAD	262	0	0	0	262	0	123	385
TOTAL	322	73	320	0	715	0	274	989
CENTRAL SULAWESI PROVINCE								
NATIONAL ROAD	419	0	724	0	1,142	0	1,179	2,322
ARTERIAL	0	0	724	0	724	0	20	743
COLLECTOR 1	419	0	0	0	419	0	1,160	1,578
PROVINCIAL ROAD	624	0	0	0	624	0	803	1,426
TOTAL	1,043	0	724	0	1,766	0	1,982	3,748
WEST SULAWESI PROVINCE								
NATIONAL ROAD	219	100	512	0	831	0	2	833
ARTERIAL	0	0	512	0	512	0	2	514
COLLECTOR 1	219	100	0	0	319	0	0	319
PROVINCIAL ROAD	143	100	0	0	243	0	45	288
TOTAL	362	200	512	0	1,074	0	47	1,121
SOUTH SULAWESI PROVINCE								
NATIONAL ROAD	110	349	767	162	1,389	16	275	1,679
ARTERIAL	0	0	657	134	791	16	72	879
COLLECTOR 1	110	349	110	27	598	0	203	800
PROVINCIAL ROAD	73	319	43	0	436	70	602	1,108
TOTAL	183	669	811	162	1,824	86	877	2,787
SOUTHEAST SULAWESI PROVINCE								
NATIONAL ROAD	419	0	464	0	882	150	339	1,372
ARTERIAL	0	0	464	0	464	0	0	464
COLLECTOR 1	419	0	0	0	419	150	339	908
PROVINCIAL ROAD	335	0	0	0	335	0	354	689
TOTAL	753	0	464	0	1,217	150	694	2,060
TOTAL	**3,046**	**1,630**	**3,215**	**191**	**8,083**	**266**	**4,577**	**12,926**

Betterment I: Re-construction without widening of road structure that is currently in poor condition
Betterment II: Widening from existing 3.5 – 5.4 m road to 6.0m
Betterment III: Widening from existing 6.0m road to 7.0m
Betterment IV: Widening from existing 6.0/7.0m road to 2 x 7.0m
New Roads include 6.0m roads, 7.0m roads and 2 x 7.0m roads.

After the implementation of this master plan, all national roads (arterial and collector K1) and provincial roads (collector K2/K3) in Sulawesi Island should have sufficient road widths that can accommodate future traffic volume (until the year of 2024) along with the required service levels.

Road length by width in the year of 2024 is summarized in Table 10.1.2.

Table 10.1.2 Road Length by Width in 2024

unit: km

PROVINCE/ROAD CATEGORY	CARRIAGEWAY WIDTH IN 2024				
	4.5m	6.0m	7.0m	2 x 7.0m	TOTAL
NORTH SULAWESI PROVINCE					
NATIONAL ROAD	236	671	396	29	1,332
ARTERIAL	0	0	336	15	351
COLLECTOR 1	236	671	60	15	981
PROVINCIAL ROAD	731	132	26	0	890
TOTAL	967	803	422	29	2,222
GORONTALO PROVINCE					
NATIONAL ROAD	138	128	338	0	604
ARTERIAL	0	0	306	0	306
COLLECTOR 1	138	128	33	0	299
PROVINCIAL ROAD	385	0	0	0	385
TOTAL	523	128	338	0	989
CENTRAL SULAWESI PROVINCE					
NATIONAL ROAD	1,572	6	743	0	2,322
ARTERIAL	0	0	743	0	743
COLLECTOR 1	1,572	6	0	0	1,578
PROVINCIAL ROAD	1,426	0	0	0	1,426
TOTAL	2,999	6	743	0	3,748
WEST SULAWESI PROVINCE					
NATIONAL ROAD	219	100	514	0	833
ARTERIAL	0	0	514	0	514
COLLECTOR 1	219	100	0	0	319
PROVINCIAL ROAD	188	100	0	0	288
TOTAL	407	200	514	0	1,121
SOUTH SULAWESI PROVINCE					
NATIONAL ROAD	171	429	902	178	1,679
ARTERIAL	0	0	729	150	879
COLLECTOR 1	171	429	173	27	800
PROVINCIAL ROAD	430	564	43	70	1,108
TOTAL	601	993	945	248	2,787
SOUTHEAST SULAWESI PROVINCE					
NATIONAL ROAD	582	316	474	0	1,372
ARTERIAL	0	0	464	0	464
COLLECTOR 1	582	316	10	0	908
PROVINCIAL ROAD	689	0	0	0	689
TOTAL	1,271	316	474	0	2,060
TOTAL	**6,767**	**2,446**	**3,437**	**277**	**12,926**

10.1.4 Packaging of Proposed Links of the SRMP

The SRMP network structure comprises the main trunk network and other network as follows.

- Main trunk network is the Trans Sulawesi Road Network (Trans Sulawesi Road main routes) which functions as the main backbone of the Sulawesi road network, providing for inter-regional travel.
- Main trunk network also includes the Peninsula crossing routes which connects each Trans Sulawesi road.
- Secondary network provides related routes throughout the length of Sulawesi, it provides for intra-regional travel.

The main trunk network is shown in Figure 10.1.2 and has a summary in Table 10.1.3. The same packaging was also used in the traffic demand forecast of this study as stated in Chapter 9.

13 packages for the Trans Sulawesi Road main routes and 6 packages for peninsula crossing roads are proposed in this master plan.

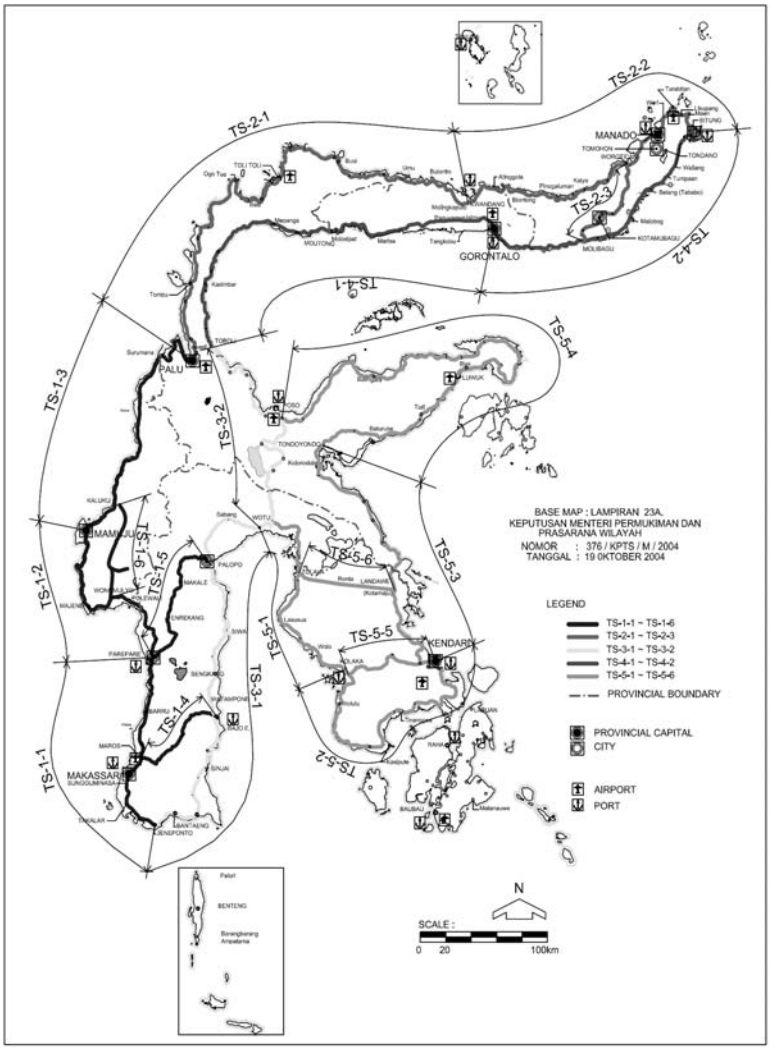


Figure 10.1.2 Main Trunk Network proposed in the MP

Table 10.1.3 List of Packages for the Main Trunk Network

TS No.	Corridor Name	Package Name	Category
TS-1	Trans Sulawesi West Corridor (South Sec.)	TS-1-1, TS-1-2, TS-1-3	Trans Sulawesi Main Routes
		TS-1-4, TS-1-5, TS-1-6	Peninsula Crossing Routes
TS-2	Trans Sulawesi West Corridor (North Sec.)	TS-2-1, TS-2-2	Trans Sulawesi Main Routes
		TS-2-3	Peninsula Crossing Routes
TS-3	Trans Sulawesi Central Corridor (South Sec.)	TS-3-1, TS-3-2	Trans Sulawesi Main Routes
TS-4	Trans Sulawesi Central Corridor (North Sec.)	TS-4-1, TS-4-2	Trans Sulawesi Main Routes
TS-5	Trans Sulawesi East Corridor	TS-5-1, TS-5-2, TS-5-3, TS-5-4	Trans Sulawesi Main Routes
		TS-5-5, TS-5-6	Peninsula Crossing Routes

In addition to the Main Trunk Network mentioned above, Secondary Network, which supports the Main Trunk Network, was also considered in the formulation of the master plan.

All arterial/collector roads other than the Trans Sulawesi Main Routes and the Peninsula Crossing Routes are relatively associated with the 19 packages and are included, as related roads, into the SRMP.

Table 10.1.4 shows the summary of road length of each package.

Table 10.1.4 Road Length by Package of Sulawesi Road Master Plan

NO.	PACKAGE	CATEGORY	TOTAL ROAD LENGTH (KM)			
			TOTAL	NATIONAL ROAD		PROVINCIAL ROAD
				Arterial	Collector 1	Collector 2 & 3
1	TS-1-1	TS MAIN CORRIDOR	229	150	79	0
		RELATED ROUTES	429	0	0	429
		TOTAL	658	150	79	429
2	TS-1-2	TS MAIN CORRIDOR	283	283	0	0
		RELATED ROUTES	409	0	117	291
		TOTAL	692	283	117	291
3	TS-1-3	TS MAIN CORRIDOR	348	348	0	0
		RELATED ROUTES	39	39	0	0
		TOTAL	387	387	0	0
4	TS-1-4	PENINSULA CROSSING	144	144	0	0
		RELATED ROUTES	0	0	0	0
		TOTAL	144	144	0	0
5	TS-1-5	PENINSULA CROSSING	223	12	211	0
		RELATED ROUTES	68	58	0	9
		TOTAL	290	70	211	9
6	TS-1-6	PENINSULA CROSSING	200	0	100	100
		RELATED ROUTES	0	0	0	0
		TOTAL	200	0	100	100
7	TS-2-1	TS MAIN CORRIDOR	895	20	875	0
		RELATED ROUTES	125	0	0	125
		TOTAL	1,019	20	875	125
8	TS-2-2	TS MAIN CORRIDOR	496	318	178	0
		RELATED ROUTES	903	98	212	594
		TOTAL	1,399	416	390	594
9	TS-2-3	PENINSULA CROSSING	184	0	184	0
		RELATED ROUTES	0	0	0	0
		TOTAL	184	0	184	0
10	TS-3-1	TS MAIN CORRIDOR	571	268	256	47
		RELATED ROUTES	881	6	356	519
		TOTAL	1,452	274	612	566
11	TS-3-2	TS MAIN CORRIDOR	381	381	0	0
		RELATED ROUTES	688	56	89	543
		TOTAL	1,069	436	89	543
12	TS-4-1	TS MAIN CORRIDOR	553	529	24	0
		RELATED ROUTES	420	0	60	360
		TOTAL	973	529	84	360
13	TS-4-2	TS MAIN CORRIDOR	464	0	459	5
		RELATED ROUTES	429	7	30	393
		TOTAL	893	7	489	398
14	TS-5-1	TS MAIN CORRIDOR	384	384	0	0
		RELATED ROUTES	51	0	0	51
		TOTAL	435	384	0	51
15	TS-5-2	TS MAIN CORRIDOR	415	0	415	0
		RELATED ROUTES	645	0	149	496
		TOTAL	1,060	0	564	496
16	TS-5-3	TS MAIN CORRIDOR	373	0	373	0
		RELATED ROUTES	0	0	0	0
		TOTAL	373	0	373	0
17	TS-5-4	TS MAIN CORRIDOR	970	0	503	466
		RELATED ROUTES	265	0	50	215
		TOTAL	1,235	0	554	681
18	TS-5-5	PENINSULA CROSSING	156	156	0	0
		RELATED ROUTES	156	0	14	142
		TOTAL	312	156	14	142
19	TS-5-6	PENINSULA CROSSING	150	0	150	0
		RELATED ROUTES	0	0	0	0
		TOTAL	150	0	150	0
TOTAL		TS MAIN CORRIDOR	6,361	2,681	3,163	518
		PENINSULA CROSSING	913	168	645	100
		RELATED ROUTES	5,652	408	1,077	4,167
TOTAL			**12,926**	**3,256**	**4,885**	**4,785**
					8,141	**4,785**

10.2 Cost Estimates

10.2.1 Conditions of the Cost Estimates

The major elements of the improvement measures for the SRMP include the following:

- New construction of a 4-lane road (2 x 7.0m carriageway).
- New construction of a 2-lane road (6.0m and 7.0m carriageway).
- Re-construction of roads that are currently in poor condition (Betterment I).
- Widening of the existing 4.5m carriageway road to a 6.0m road (Betterment II).
- Widening of the existing 4.5/6.0m carriageway road to a 7.0m road (Betterment III).
- Widening of the existing 6.0/7.0m carriageway roads to a 4-lane road (Betterment IV).
- Overlay (Periodic Maintenance) of the 4.5m, 6.0m and 7.0m carriageway roads.
- Routine Maintenance of the 4.5m, 6.0m and 7.0m carriageway roads.
- Reconstruction of the existing bridges.

Construction costs were estimated based on the results of the preliminary engineering study and their quantities. Conditions for the estimate were as follows:

- The SRMP projects are assumed to be executed by the contractor which has been selected through the competitive bidding. Accordingly unit prices used in this estimate were set through the examination of similar road improvement projects. However, cost data collected from each province and on-going projects were also referred.

- Unit costs include direct labor cost, equipment cost, material cost, and the indirect cost of overhead, tax (VAT) and the profit of the contractors.

- Unit costs do not include tax.

- Costs for land acquisition and compensation are not included in this estimate due to lack of information on roadside conditions

- Currency exchange rates used in this estimate were as follows:

Table 10.2.1 Currency Exchange Rates used in the Cost Estimates for the MP

(1) Indonesia Rupiah vs. US Dollar

Selling rate of Bank Indonesia on May, 16 2007

USD	IDR
1	9,322.00

(2) Indonesia Rupiah vs. Japanese Yen

Selling rate of Bank Indonesia on May, 16 2007

JPY	IDR
100	7,755.41
1	77.55
0.013	1.00

10.2.2 Unit Cost for Road Improvement

The unit costs for the cost estimate were set up through the following manner.

(1) Setting of Standard Unit Cost per km for the Road Improvement

Through the examination of unit cost per km of similar past as well as on-going projects in Sulawesi Island, the unit cost for road improvement (with widening existing 4.5m road to 6.0m) was set at Rp. 1,560 Mil./km, while the unit cost for new road construction (6.0m) was set at Rp. 3,400 Mil./km. These were adopted as standard unit costs.

(2) Adjustment by Scope and Road Width

Through the adjustment of the standard unit costs (widening from 4.5m to 6.0m and new 6.0m road construction), each unit cost for various scope and road widths which were necessary for future traffic demands were set as follows:

Table 10.2.2 Adjustment of Unit Costs for Road Improvement

Category	Scope of Work	Unit Cost (Mil. Rp./km)	Ratio
BETTERMENT			
Betterment I	Reconstruction of 4.5m road w/o widening	1,500	96%
	Reconstruction of 6.0m road w/o widening	1,800	115%
	Reconstruction of 7.0m road w/o widening	2,000	128%
Betterment II	Widening from 4.5m to 6.0m	1,560	100%
Betterment III	Widening from 4.5m to 7.0m	1,920	123%
	Widening from 6.0m to 7.0m	1,630	104%
Betterment IV	Widening from 6.0m to 2 x 7.0m	4,000	256%
	Widening from 7.0m to 2 x 7.0m	3,000	192%
NEW ROAD CONSTRUCTION			
New Road 1	New Construction of 6.0m road	3,400	100%
New Road 2	New Construction of 7.0m road	4,000	118%
New Road 3	New Construction of 2 x 7.0m road	8,000	235%

(3) Reconstruction of Bridges

1) Current Bridge Conditions and Rough Estimates for the Reconstruction of Bridges in Poor Condition in Sulawesi Island

The results of the examination of present bridge conditions in Sulawesi Island showed that 12.3% of the bridges (9.8% on the national road and 15.8% on the provincial road) need reconstruction, while 25.4% of the bridges (24.5% on the national road and 26.6% on the provincial road) are narrow bridges with width of less than 4.5m.

Table 10.2.3, Table 10.2.4 and Table 10.2.5 show the present bridge conditions for national roads and provincial roads respectively.

Table 10.2.3 Number of Bridges by Condition on National Roads

Province	No Damage/Good	Fair/Poor	Bad/Very Bad	Wooden/Unknown	Total
North Sulawesi	399 (67.5%)	109 (18.4%)	41 (6.9%)	42 (7.1%)	591 (100%)
Gorontalo	271 (95.4%)	10 (3.5%)	3 (1.1%)	0 (0%)	284 (100%)
Central Sulawesi	496 (53.6%)	381 (41.2%)	40 (4.3%)	8 (0.9%)	925 (100%)
West Sulawesi	178 (64.3%)	43 (15.5%)	20 (7.2%)	36 (13.0%)	277 (100%)
South Sulawesi	489 (70.5%)	194 (28.0%)	11 (1.6%)	0 (0%)	694 (100%)
South East Sulawesi	308 (53.8%)	140 (24.4%)	75 (13.1%)	50 (8.7%)	573 (100%)
Total	2,141 (64.0%)	877 (26.2%)	190 (5.7%)	136 (4.1%)	3,344 (100%)
			326 (9.8%), 5,510m		

Table 10.2.4 Number of Bridges by Condition on Provincial Roads

Province	No Damage/Good	Fair/Poor	Bad/Very Bad	Wooden/Unknown	Total
North Sulawesi	272 (71.2%)	51 (13.4%)	1 (0.3%)	58 (15.2%)	382 (100%)
Gorontalo	21 (38.9%)	0 (0%)	33 (61.1%)	0 (0%)	54 (100%)
Central Sulawesi	726 (92.8%)	9 (1.2%)	0 (0%)	47 (6.0%)	782 (100%)
West Sulawesi	63 (71.6%)	22 (25.0%)	2 (2.3%)	1 (1.1%)	88 (100%)
South Sulawesi	476 (69.6%)	127 (18.6%)	56 (8.2%)	25 (3.6%)	684 (100%)
South East Sulawesi	242 (45.4%)	117 (22.0%)	69 (12.9%)	105 (19.7%)	533 (100%)
Total	1,800 (71.3%)	326 (12.9%)	161 (6.4%)	236 (9.4%)	2,523 (100%)
			397 (15.8%), 6,049m		

Table 10.2.5 Number of Narrow Bridges with a Width of less than 4.5m

Province	National Road		Provincial Road	
	Narrow	Total	Narrow	Total
North Sulawesi	282 (47.7%)	591 (100%)	201 (52.6%)	382 (100%)
Gorontalo	75 (26.4%)	284 (100%)	28 (51.9%)	54 (100%)
Central Sulawesi	100 (10.8%)	925 (100%)	120 (15.3%)	782 (100%)
West Sulawesi	122 (44.0%)	277 (100%)	33 (37.5%)	88 (100%)
South Sulawesi	25 (3.6%)	694 (100%)	166 (24.3%)	684 (100%)
South East Sulawesi	215 (37.5%)	573 (100%)	124 (23.3%)	533 (100%)
Total	819 (24.5%)	3,344 (100%)	672 (26.6%)	2,523 (100%)

In the assumption that the average width is 6m and that bridge reconstruction cost amounts to Rp. 13 Mil./m2, the necessary cost would be Rp. 429 billion for bridges on national roads, and Rp. 472 billion for bridges on provincial roads.

2) Unit Cost for Bridge Reconstruction in the Road Improvement Section

Based on the above discussion on present bridge conditions the bridge reconstruction cost in the road improvement section was included into unit cost as follows:

Since the total number of bridges is 5,867nos. (3,344 + 2,523) and the total length of the existing road network is approximately 12,000km, the average number of bridge per unit length of road is 0.49nos/km. Which means that generally there is 1 bridge for every 2km of road.

Since about 25% of bridges are narrow bridges, 1 bridge in every 8km needs to be widened when the road section that contains the bridge is improved. Accordingly when assuming that the length and the width of bridge to be reconstructed is 25-30m (27m) and 6m respectively, and that reconstruction cost is Rp. 13 Mil./m2, the unit cost for bridge reconstruction would be 27m x 6m x Rp. 13 Mil./m2 /8km = Rp. 263 Mil./km.

Based on above assumptions and the adjustment by road widths, the unit costs of bridge reconstruction in the road improvement section were added to the road improvement unit costs. The total unit costs were set as shown in Table 10.2.6.

Table 10.2.6 Unit Costs for Cost Estimates

Category	Scope of Work	Unit Cost for Road Improve't (Mil. Rp./km)	Unit Cost for Br. Reconstruction (Mil. Rp./km)	Total Unit Cost (Mil. Rp./km)
BETTERMENT				
Betterment I	Reconstruc'n of 4.5m road w/o widening	1,500	300	1,800
	Reconstruc'n of 6.0m road w/o widening	1,800	350	2,150
	Reconstruc'n of 7.0m road w/o widening	2,000	400	2,400
Betterment II	Widening from 4.5m to 6.0m	1,560	300	1,860
Betterment III	Widening from 4.5m to 7.0m	1,920	400	2,320
	Widening from 6.0m to 7.0m	1,630	350	1,980
Betterment IV	Widening from 6.0m to 2 x 7.0m	4,000	800	4,800
	Widening from 7.0m to 2 x 7.0m	3,000	700	3,700
NEW ROAD CONSTRUCTION				
New Road 1	New Construction of 6.0m road	3,400	1,000	4,400
New Road 2	New Construction of 7.0m road	4,000	1,200	5,200
New Road 3	New Construction of 2 x 7.0m road	8,000	2,400	10,400

10.2.3 Unit Cost for Periodic Maintenance (Overlay)

Due to the traffic load which were mainly caused by heavy vehicles, the AC surface will be damaged through time and use even if they are well constructed and there is sufficient maintenance. Accordingly, the appropriate periodic maintenance (overlay) is essential for the efficient use of road assets.

It was assumed that overlay works and periodic maintenance are to be made in a 10-year interval after the new construction and betterment and another 5-year interval after another overlay.

Table 10.2.7 shows unit cost for overlay adopted in this master plan.

Table 10.2.7 Unit Cost of Overlay (Mil. Rp./km)

Road Category	Unit Cost of Overlay
4.5m road	600
6.0m road	750
7.0m road	850
2 x 7.0m road	1,200

10.2.4 Unit Cost for Routine Maintenance

In the period of intervals between the betterment and overlay or the intervals between the two overlays, routine maintenance works, including inspections, cleaning of road surface and drainage, cutting trees/grass, and sealing/patching works should be done in the appropriate manner.

Table 10.2.8 shows the unit cost for routine maintenance as adopted in this master plan.

Table 10.2.8 Unit Cost of Routine Maintenance (Mil. Rp./km)

Year	4.5m road		6.0m road		7.0m road		2 x 7.0m road	
	After Better't	After Overlay	After Better't	After Overlay	After Better't	After Overlay	After Better't	After Overlay
1	2	2	3	2	3	3	6	5
2	6	6	8	9	9	10	18	20
3	8	10	11	13	14	16	28	32
4	11	13	15	17	19	21	38	42
5	14	16	19	22	23	26	46	52
6	17		23		28		56	
7	20		27		33		66	
8	23		31		38		76	
9	26		35		42		84	
10	29		39		47		94	

10.2.5 Total Project Cost until 2024

Based on the project quantity and unit costs discussed above, total project cost for this master plan was estimated as shown in Table 10.2.9.

Table 10.2.9 Total Project Cost until 2024

		Project Cost (Mil. Rp.)															
		Improvement Measure (Betterment/New Road Construction)				Periodic Maintenance				Routine Maintenance				Total Project Cost until 2024			
		TOTAL	Arterial	K 1	K 2/3	TOTAL	Arterial	K 1	K 2/3	TOTAL	Arterial	K 1	K 2/3	TOTAL	Arterial	K 1	K 2/3
TS-1-1	TS MAIN CORRIDOR	1,368,170	1,146,401	221,769	0	306,042	229,063	76,978	0	148,854	115,174	33,680	0	1,823,066	1,490,638	332,427	0
	RELATED ROUTES	1,373,733	0	0	1,373,733	539,355	0	0	539,355	125,637	0	0	125,637	2,038,725	0	0	2,038,725
	TOTAL	2,741,903	1,146,401	221,769	1,373,733	845,397	229,063	76,978	539,355	274,491	115,174	33,680	125,637	3,861,790	1,490,638	332,427	2,038,725
TS-1-2	TS MAIN CORRIDOR	605,540	605,540	0	0	242,632	242,632	0	0	89,062	89,062	0	0	937,234	937,234	0	0
	RELATED ROUTES	505,060	0	212,740	292,320	386,649	0	74,574	312,075	72,463	0	23,977	48,487	964,172	0	311,290	652,882
	TOTAL	1,110,599	605,540	212,740	292,320	629,281	242,632	74,574	312,075	161,525	89,062	23,977	48,487	1,901,406	937,234	311,290	652,882
TS-1-3	TS MAIN CORRIDOR	799,478	799,478	0	0	296,119	296,119	0	0	109,947	109,947	0	0	1,205,544	1,205,544	0	0
	RELATED ROUTES	90,480	90,480	0	0	33,150	33,150	0	0	12,308	12,308	0	0	135,938	135,938	0	0
	TOTAL	889,958	889,958	0	0	329,269	329,269	0	0	122,256	122,256	0	0	1,341,483	1,341,483	0	0
TS-1-4	PENINSULA CROSSING	156,856	156,856	0	0	188,276	188,276	0	0	33,142	33,142	0	0	378,274	378,274	0	0
	RELATED ROUTES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL	156,856	156,856	0	0	188,276	188,276	0	0	33,142	33,142	0	0	378,274	378,274	0	0
TS-1-5	PENINSULA CROSSING	277,786	23,241	254,545	0	251,477	9,977	241,500	0	51,671	3,705	47,967	0	580,934	36,923	544,011	0
	RELATED ROUTES	135,674	118,339	0	17,335	64,137	57,147	0	6,990	19,460	17,026	0	2,433	219,271	192,512	0	26,759
	TOTAL	413,460	141,580	254,545	17,335	315,614	67,125	241,500	6,990	71,131	20,731	47,967	2,433	800,205	229,435	544,011	26,759
TS-1-6	PENINSULA CROSSING	372,000	0	186,000	186,000	150,000	0	75,000	75,000	52,220	0	26,110	26,110	574,220	0	287,110	287,110
	RELATED ROUTES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL	372,000	0	186,000	186,000	150,000	0	75,000	75,000	52,220	0	26,110	26,110	574,220	0	287,110	287,110
TS-2-1	TS MAIN CORRIDOR	273,204	0	273,204	0	1,233,268	37,018	1,196,250	0	121,528	2,492	119,037	0	1,628,001	39,510	1,588,491	0
	RELATED ROUTES	191,700	0	0	191,700	91,200	0	0	91,200	22,097	0	0	22,097	304,997	0	0	304,997
	TOTAL	464,904	0	273,204	191,700	1,324,468	37,018	1,196,250	91,200	143,625	2,492	119,037	22,097	1,932,998	39,510	1,588,491	304,997
TS-2-2	TS MAIN CORRIDOR	1,077,109	696,779	380,330	0	415,346	270,019	145,327	0	155,028	100,256	54,772	0	1,647,482	1,067,054	580,428	0
	RELATED ROUTES	1,031,906	202,715	142,200	686,991	967,518	103,725	259,013	604,781	164,380	32,673	32,395	99,312	2,163,805	339,113	433,608	1,391,084
	TOTAL	2,109,015	899,494	522,530	686,991	1,382,864	373,743	404,339	604,781	319,408	132,930	87,167	99,312	3,811,287	1,406,167	1,014,036	1,391,084
TS-2-3	PENINSULA CROSSING	330,738	0	330,738	0	145,280	0	145,280	0	47,230	0	47,230	0	523,247	0	523,247	0
	RELATED ROUTES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL	330,738	0	330,738	0	145,280	0	145,280	0	47,230	0	47,230	0	523,247	0	523,247	0
TS-3-1	TS MAIN CORRIDOR	1,015,316	551,683	376,361	87,271	510,808	227,504	248,114	35,190	157,318	84,471	60,597	12,251	1,683,443	863,658	685,072	134,712
	RELATED ROUTES	876,719	12,803	531,137	332,780	997,715	5,496	302,651	689,568	159,945	2,041	67,053	90,852	2,034,379	20,339	900,841	1,113,199
	TOTAL	1,892,035	564,486	907,499	420,051	1,508,523	233,000	550,765	724,758	317,264	86,512	127,650	103,102	3,717,822	883,998	1,585,913	1,247,911
TS-3-2	TS MAIN CORRIDOR	882,799	882,799	0	0	323,439	323,439	0	0	120,091	120,091	0	0	1,326,330	1,326,330	0	0
	RELATED ROUTES	463,127	129,101	0	334,026	829,277	47,300	133,860	648,117	106,824	17,562	10,905	78,357	1,399,228	193,963	144,765	1,060,500
	TOTAL	1,345,926	1,011,900	0	334,026	1,152,716	370,739	133,860	648,117	226,915	137,653	10,905	78,357	2,725,558	1,520,293	144,765	1,060,500
TS-4-1	TS MAIN CORRIDOR	1,255,727	1,227,473	28,255	0	480,675	449,721	30,955	0	172,749	166,979	5,771	0	1,909,151	1,844,172	64,980	0
	RELATED ROUTES	528,660	0	108,000	420,660	365,280	0	36,000	329,280	70,207	0	11,196	59,011	964,147	0	155,196	808,951
	TOTAL	1,784,387	1,227,473	136,255	420,660	845,955	449,721	66,955	329,280	242,956	166,979	16,967	59,011	2,873,298	1,844,172	220,176	808,951
TS-4-2	TS MAIN CORRIDOR	786,960	0	786,960	0	381,632	0	374,507	7,125	115,486	0	114,906	580	1,284,078	0	1,276,373	7,705
	RELATED ROUTES	264,586	0	53,190	211,396	540,541	12,336	17,730	510,475	65,903	830	5,514	59,559	871,030	13,166	76,434	781,430
	TOTAL	1,051,546	0	840,150	211,396	922,172	12,336	392,237	517,600	181,389	830	120,420	60,139	2,155,108	13,166	1,352,807	789,135
TS-5-1	TS MAIN CORRIDOR	880,923	880,923	0	0	326,759	326,759	0	0	121,324	121,324	0	0	1,329,005	1,329,005	0	0
	RELATED ROUTES	91,440	0	0	91,440	30,480	0	0	30,480	9,479	0	0	9,479	131,399	0	0	131,399
	TOTAL	972,363	880,923	0	91,440	357,239	326,759	0	30,480	130,803	121,324	0	9,479	1,460,405	1,329,005	0	131,399
TS-5-2	TS MAIN CORRIDOR	319,373	0	319,373	0	488,484	0	488,484	0	65,806	0	65,806	0	873,663	0	873,663	0
	RELATED ROUTES	582,210	0	203,310	378,900	676,866	0	122,466	554,400	99,688	0	25,532	74,155	1,358,764	0	351,308	1,007,455
	TOTAL	901,583	0	522,683	378,900	1,165,350	0	610,950	554,400	165,493	0	91,338	74,155	2,232,426	0	1,224,971	1,007,455
TS-5-3	TS MAIN CORRIDOR	546,958	0	546,958	0	282,406	0	282,406	0	68,714	0	68,714	0	898,078	0	898,078	0
	RELATED ROUTES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL	546,958	0	546,958	0	282,406	0	282,406	0	68,714	0	68,714	0	898,078	0	898,078	0
TS-5-4	TS MAIN CORRIDOR	493,200	0	196,200	297,000	1,210,061	0	659,246	550,815	136,391	0	68,794	67,597	1,839,652	0	924,240	915,412
	RELATED ROUTES	215,262	0	0	215,262	290,304	0	75,600	214,704	40,120	0	6,159	33,961	545,686	0	81,759	463,927
	TOTAL	708,462	0	196,200	512,262	1,500,365	0	734,846	765,519	176,511	0	74,953	101,558	2,385,338	0	1,005,999	1,379,339
TS-5-5	PENINSULA CROSSING	308,591	308,591	0	0	132,476	132,476	0	0	49,188	49,188	0	0	490,254	490,254	0	0
	RELATED ROUTES	131,760	0	0	131,760	173,936	0	26,666	147,270	24,428	0	2,349	22,079	330,124	0	29,016	301,109
	TOTAL	440,351	308,591	0	131,760	306,412	132,476	26,666	147,270	73,616	49,188	2,349	22,079	820,379	490,254	29,016	301,109
TS-5-6	PENINSULA CROSSING	660,000	0	660,000	0	112,500	0	112,500	0	33,315	0	33,315	0	805,815	0	805,815	0
	RELATED ROUTES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL	660,000	0	660,000	0	112,500	0	112,500	0	33,315	0	33,315	0	805,815	0	805,815	0
TOTAL	TS MAIN CORRIDOR	10,304,758	6,791,075	3,129,411	384,271	6,497,670	2,402,274	3,502,267	593,130	1,582,298	909,796	592,075	80,428	18,384,727	10,103,145	7,223,753	1,057,829
	PENINSULA CROSSING	2,105,970	488,688	1,431,282	186,000	980,009	330,730	574,279	75,000	266,765	86,034	154,621	26,110	3,352,744	905,451	2,160,183	287,110
	RELATED ROUTES	6,482,318	553,438	1,250,577	4,678,303	5,986,408	259,154	1,048,559	4,678,695	992,939	82,441	185,081	725,417	13,461,665	895,032	2,484,217	10,082,416
TOTAL		**18,893,045**	**7,833,201**	**5,811,271**	**5,248,574**	**13,464,087**	**2,992,157**	**5,125,105**	**5,346,825**	**2,842,003**	**1,078,271**	**931,777**	**831,955**	**35,199,136**	**11,903,628**	**11,868,153**	**11,427,355**
			13,644,471		**5,248,574**		**8,117,262**		**5,346,825**		**2,010,048**		**831,955**		**23,771,781**		**11,427,355**

CHAPTER 11 PROJECT EVALUATIONS

11.1 Evaluation Methods

11.1.1 Road Packages to be Evaluated

The Sulawesi Island Road Network Master Plan for the target year 2024 was presented in Chapter 8 of this report while future traffic demand was also forecasted for both the whole network and through individual road packages. Economic evaluations were carried out to provide necessary information for the prioritization of each road package from the aspect of the national economy.

For evaluation purposes the whole master plan road network in Sulawesi Island was divided and grouped into the 19 (nineteen) packages as explained in the previous chapter and shown below:

Table 11.1.1 Road Packages for Evaluation

Area category	Corridor	SQ No.	Package No.	Length (km)	Location
TS-1	Trans-Sulawesi(TS) Main Corridor (West-South Corridor)	1	TS-1-1	658	Jeneponto-Makkasar-Parepare
		2	TS-1-2	692	Parepare-Mamuju
		3	TS-1-3	387	Mamuju-Palu
	Crossing Roads in West-South area	4	TS-1-4	144	Maros-Bajoe
		5	TS-1-5	290	Parepare-Palopo
		6	TS-1-6	200	Wonomulyo-Kaluku
TS-2	TS Main Corridor (West-North Corridor)	7	TS-2-1	1,019	Palu-Kwandang
		8	TS-2-2	1,399	Kwandang-Manado-Bitung
	Crossing Road	9	TS-2-3	184	Molibagu-Worotican
TS-3	TS Main Corridor (Central-South Corridor)	10	TS-3-1	1,452	Jenoponto-Watampone-Wotu
		11	TS-3-2	1,069	Wotu-Poso-Tobori
TS-4	TS Main Corridor (Central-North Corridor)	12	TS-4-1	973	Tobori-Gorontalo
		13	TS-4-2	893	Gorontalo-Bitung
TS-5	TS Main Corridor (East Corridor)	14	TS-5-1	435	Wotu-Kolaka
		15	TS-5-2	1,060	Kolaka-Tinaggea-Kendari
		16	TS-5-3	373	Kendari-Tondoyondo
		17	TS-5-4	1,235	Tondoyondo-Luwuku-Poso
	Crossing Roads	18	TS-5-5	312	Kolaka-Kendari
	Roads in East-South area	19	TS-5-6	150	Landawe-Tolala
Total				12,925	

Source: JICA Study Team

11.1.2 Conditions for Comparison

The main purpose of economic evaluation is to provide one criteria for the prioritization of each road package. Comparisons among the packages were made based on the conditions summarized below:

1) Implementation Schedule: Detailed design and construction/improvement: 2010-2013 (4 years).
2) Evaluation period: 30 years after opening.
3) Annual disbursement during the implementation period: Total cost is equally allocated to the

four-year implementation period.

In addition, future traffic demand forecast was carried out assuming that the future road network consisted of the present road network plus individual road packages for the year 2014, 2019 and the target year 2024 (not in combination with other road packages).

11.2 Economic Costs

11.2.1 Construction/ Improvement Costs

Economic costs were estimated with the exclusion of such transfer items as taxes and duties from market prices. They are summarized as follows: Total economic cost of the road master plan for construction and improvement is estimated at Rp.17,003 billion using 2006 prices.

Table 11.2.1 Economic Cost (Construction/ Improvement)
(Rp. Million: 2006 Prices)

Package No.	Length (km)	Economic Cost (Rp.Million)
TS-1-1	658	2,467,713
TS-1-2	692	999,539
TS-1-3	387	800,963
TS-1-4	144	141,170
TS-1-5	290	372,114
TS-1-6	200	334,800
TS-2-1	1,019	418,414
TS-2-2	1,399	1,898,113
TS-2-3	184	297,664
TS-3-1	1,452	1,702,832
TS-3-2	1,069	1,211,334
TS-4-1	973	1,605,948
TS-4-2	893	946,392
TS-5-1	435	875,127
TS-5-2	1,060	811,425
TS-5-3	373	492,262
TS-5-4	1,235	637,616
TS-5-5	312	396,316
TS-5-6	150	594,000
	Total	17,003,741

Source: JICA Study Team

11.2.2 Economic Maintenance Costs

Maintenance costs are classified into annual routine maintenance costs and periodic maintenance costs which are converted into economic costs. Periodic maintenance costs is assumed to be expended for every six-year interval.

11.3 Economic Benefits

11.3.1 Quantified Economic Benefits

The following two types of benefits were quantitatively estimated through the following economic evaluation:

1) Savings in Vehicle Operating Costs (VOC savings), and
2) Savings in passenger Travel Time Costs (TTC Savings).

The above benefits were estimated based on the "With and Without Project Comparison Method". The situation in the "With Project comparison Method" means the case where each road package is implemented and road network is improved. On the other hand, the "Without Project Comparisn Method" means the case where the road network remains in the same condition with existing road networks or, in other words, a "Do nothing" situation.

The necessary input data for benefit estimation were as follows:

- Future traffic volume on links of future road network for both cases of "With" and "Without" project cases.
- Road network conditions (link length, average speed, and road roughness).
- Unit VOC (Rp/km/vehicle) and Unit TTC (Rp/hour/vehicle).

11.3.2 Vehicle Operating Costs (VOC)

The vehicle operating costs consist of the following: 1) Vehicle cost. 2) Fuel cost. 3) Tire cost. 4) crew cost. 5) Maintenance cost. and 6) Overhead cost for commercial vehicles. The basic data in the calculation of the VOC was obtained from the "Indonesian Road Management System (IRMS)" which is updated periodically. The IRMS defines the "Road User Costs (RUC)" as follows:

- RUC = VOCs + Passenger Travel Time Cost (TTC)

In the above formula, the VOC units were calculated through the application of the following equations:

- $VOCi = BASEi * NDXi$
- $NDXi = k1i + k2i/Vi + k3i*Vi^2 + k4i*IRI + k5i*IRI^2$

Where	VOCi	: Unit VOC for vehicle type (i) in Rp/km
	BASEi	: Base VOC for vehicle type (i) in Rp/km under the "good condition" with roughness 3
	NDXi	: VOC index for vehicle type (i)
	Vi	: Vehicle speed for vehicle type (i) in km/hour
	IRI	: Road roughness (m/km)
	k1---k5	: Coefficients by vehicle type

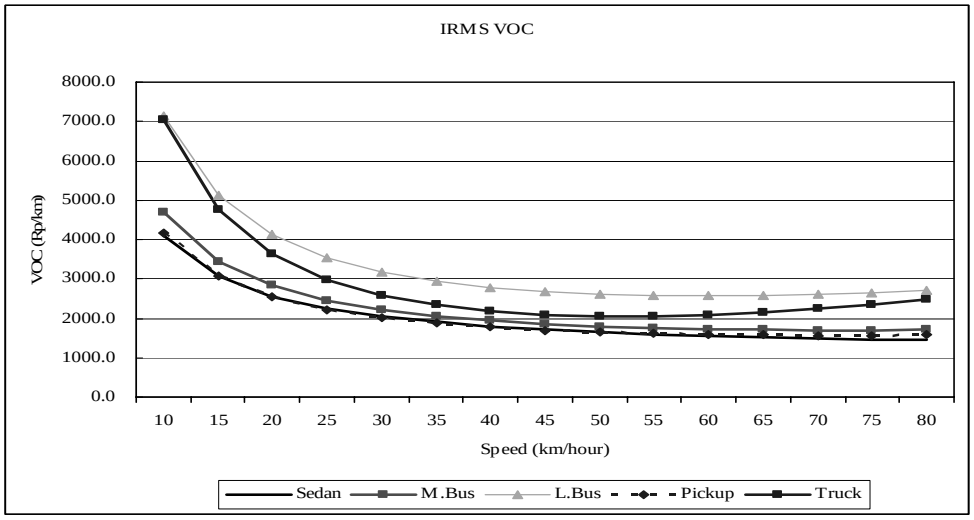
The latest base VOCs (BASEi) and the coefficients in the above equations are shown in Table 11.3.1 for 11 vehicle types:

Table 11.3.1 VOC Coefficients and Base VOC

No.	Vehicle Type	K1	K2	K3	K4	K5	Base VOC (Rp/km)
1	Sedan	0.66707	22.23983	0.000006808	0.012937	0.00139	1.396.10
2	Utility Passenger	0.57932	20.34176	0.000018379	0.014087	0.00093	1.186.77
3	Utility Freight	0.58382	20.30049	0.000018278	0.013313	0.00079	1,414.64
4	Light Bus	0.32475	21.93222	0.000028582	0.068937	-0.00007	1,724.67
5	Large Bus	0.32985	22.26215	0.000053281	0.012930	0.00069	2,735.78
6	Light Truck	0.42258	20.52269	0.000027740	0.044006	-0.00006	1,592.41
7	Medium Truck	-0.17257	28.62223	0.000100534	0.061250	0.00016	2,444.33
8	Heavy Truck	0.11065	21.20004	0.000085612	0.044117	0.00041	3,481.37
9	Truck Trailer	0.29038	13.69068	0.000068153	0.053472	0.00027	5,447.68
10	Tractor Trailer	0.59807	10.02214	0.000021525	0.044723	0.00009	7,180.32
11	Motor cycle	1.05130	13.71763	-0.000009124	0.009024	0.00052	201.90

Source: IRMS: Updating the VOC Equation Coefficients, 2006

The above base data and coefficients were applied to this Study after checking and comparing the calculated unit VOC values with those of other recent studies. Figure 11.3.1 indicates the estimated VOC curves explained by travel speed in a road roughness 3 case.



Source: JICA Study Team (drawn from the data of IRMS)

Figure 11.3.1 VOC Curves by Vehicle Type (IRI=3)

11.3.3 Passenger Travel Time Cost (TTC)

The savings in travel time cost are another important component of road users' benefit. IRMS estimated the unit value of travel time (Rp/hour/vehicle) at the 2006 price levels based on the traditional "income approach method," as shown in Table 11.3.2. Factors which were taken into account for the calculation of unit TTC per vehicle for IRMS were the following:

1) Monthly income of passengers by vehicle group.
2) Shadow Wage Rate (=0.85).
3) Monthly working hours (=191 hours).

4) Non-work time value (=28% of work time value).
5) Trip purpose percentage of work trips and non-work trips by vehicle group.
6) Average occupancy (number of passengers per vehicle).

Table 11.3.2 Passenger Travel Time Costs (Rp/hour/vehicle: 2006)

Passenger Monthly Income							
Vehicle Type	Sedan	Utility Passenger	Utility Freight	Light Bus	Large Bus	Truck	Motor-Cycle
Income/month (Rp)	2,640,000	836,000	748,000	836,000	836,000	748,000	1,056,000
Income at SWR	2,244,000	710,600	635,800	710,600	710,600	635,800	897,600
Working hours/month	191	191	191	191	191	191	191
Passenger TTC per Hour							
Work time value (Rp)	11,749	3,720	3,329	3,720	3,720	3,329	4,699
Non-work time value	3,290	1,042	932	1,042	1,042	932	1,316
% Work trips	50%	30%	75%	30%	30%	75%	50%
% Non-work trips	50%	70%	25%	70%	70%	25%	50%
Occupancy (persons)	2.0	8.0	1.0	16.0	32.0	1.0	1.2
TTC/passenger/hr	7,519	1,845	2,730	1,845	1,845	2,730	3,008
TTC/vehicle/hr (Rp)	15,038	14,763	2,730	29,525	59,050	2,730	3,609

Source: IRMS: Updating the VOC Equation Coefficients, 2006

In order to confirm the applicability of the above estimated time values to this Study, a comparison with a past study (*Heavy Loaded Road Improvement Project (HLIP) – Master Plan Review Study, December 2001*) was made as shown in Table 11.3.3.

Table 11.3.3 Comparison of Time Values

Category	Time Value/hour/person)			Vehicle Type	Time Value/hour/vehicle	
	HLIP 2001 (Sulawesi)*	IRMS 2006**			HLIP 2001 (Sulawesi)*	IRMS 2006**
Car user, working	9,735	11,749		Car	11,560	15,038
Bus user, working	3,809	3,720		Passenger Utility	12,850	14,763
Car user, non-working	2,920	3,290		Medium Bus	26,226	29,525
Bus user, non-working	1,143	1,042		Large Bus	53,996	59,050

Source: *: Heavy Loaded Road Improvement Project-II, Master Plan Review Study for National Network Roads, Final Report, Volume 2, December 2001.
**: IRMS: Updating the VOC Equation Coefficients, 2006.

It was judged that the time values in the IRMS 2006 as shown in Table 11.3.3 are in the acceptable ranges and thus they were applied to this Study.

The road users' costs (VOC and TTC) were calculated applying the above unit values (Rp/km/vehicle and Rp/hour/vehicle) to the results of traffic assignment simulations for both the "With Project" and "Without Project" cases. The economic benefit is defined as the difference of the total road users' cost between the "Without Project" and the "With Project" cases.

11.4 Economic Evaluation

11.4.1 Premises for Evaluation

In order to carry out the economic evaluation, the following preconditions were set.

- Price Level : Constant 2006 prices
- Evaluation Period : 30 years after opening to traffic
- Residual Value : No residual values were counted
- Opportunity Cost of Capital : 15%

11.4.2 Cost Benefit Streams and Evaluation Indicators

The following three kinds of evaluation indicators were calculated based on the conventional Discount Cash Flow method (DCF):

1) Economic Internal Rate of Return (EIRR)
2) Net Present Value (NPV)
3) Benefit/ Cost Ratio (B/C)

11.4.3 Results of Economic Evaluations

The cost and benefit streams are shown in Table 11.4.3 to Table 11.4.21. The results of the economic evaluation for the 19 road packages are summarized in Table 11.4.1:

Table 11.4.1 Results of Economic Evaluations

Package No.	EIRR (%)	NPV (*) (Rp. Million)	B/C (*)
TS-1-1	49.2%	6,558,766	5.74
TS-1-2	35.0%	1,888,702	4.02
TS-1-3	19.6%	182,727	1.41
TS-1-4	32.6%	214,970	2.76
TS-1-5	24.7%	208,969	1.80
TS-1-6	80.8%	2,364,937	13.42
TS-2-1	15.0%	-1,869	1.00
TS-2-2	18.6%	367,198	1.29
TS-2-3	16.6%	21,360	1.12
TS-3-1	21.2%	727,360	1.60
TS-3-2	18.6%	341,769	1.39
TS-4-1	13.1%	-140,158	0.85
TS-4-2	13.5%	-65,376	0.91
TS-5-1	12.0%	-108,797	0.78
TS-5-2	2.8%	-495,547	0.31
TS-5-3	10.2%	-91,422	0.70
TS-5-4	6.3%	-411,539	0.45
TS-5-5	14.0%	-22,998	0.91
TS-5-6	7.5%	-224,952	0.26

Source: JICA Study Team
(*): Discount Rate = 15%

The above results show that the Packages located in the West-South Corridor (TS-1 group), West-North section (TS-2 group) and Central south section (TS-3 group) will have high economic returns.

The results of the economic evaluations will be applied to the comprehensive overall evaluations together with other evaluation criteria in deciding the prioritized order of each package in the master plan network.

It should be noted that Packages that have low EIRRs in the above Table 11.4.1, such as TS-2-1, TS-4-1 to TS-5-6, will be improved if they are implemented in accordance with the Overall Implementation Schedule of the Master Plan as explained in Chapter 13. The revised results of the economic evaluation are summarized below:

Table 11.4.2 Revised Evaluations

Package No.	EIRR (%)	NPV (*) (Rp. Million)	B/C (*)
TS-2-1	26.7%	278,504	1.95
TS-4-1	14.6%	-25,301	0.97
TS-4-2	16.2%	43,168	1.08
TS-5-1	15.6%	12,769	1.05
TS-5-2	9.1%	-78,347	0.66
TS-5-3	16.7%	10,481	1.13
TS-5-4	19.5%	33,246	1.20
TS-5-5	20.8%	65,968	1.49
TS-5-6	10.2%	-24,353	0.56

Source: JICA Study Team
(*): Discount Rate = 15%

11.5 Supplemental Economic Analysis on Ferry Operations in Sulawesi Island

11.5.1 Comparisons of Economic Efficiency between Road and Ferry Transport

(1) Contents of Analysis

The Road Network Master Plan for Sulawesi Island formulates a future road network with a good combination of road and ferry links based on an environment friendly transportation system.

Due to Sulawesi's complex geographical shape (it has 4 peninsulas and 3 bays) road traffic movements from one peninsula to another take longer detour routes. Ferry services that will connect the various peninsulas will provide an important service in reducing the unnecessarily long trip lengths, including those by roads. As a result this will lessen vehicle operating costs and mitigate unnecessary environmental loads. In this analysis, a quantitative base of economic efficiency of the ferry transport will be presented comparing cost performances between road and ferry operations from the aspect of the national economy.

(2) Selected Ferry Routes for the Analysis

The following 6 (six) ferry routes were selected as candidates for the analysis:

1) Route between Bajoe and Kolaka (crossing the Bone Bay).
2) Route between Siwa and Lasusua (crossing the Bone Bay).
3) Route between Siwa and Kolaka (crossing the Bone Bay).
4) Route between Biwa and Pamafara (crossing the Bone Bay).
5) Route between Gorontalo and Pagimana (crossing the Tomini Bay).
6) Route between Gorontalo and Luwuk (crossing the Tomini Bay).

Among the selected candidate routes, the data/information of the Bajoe – Kolaka route was provided by the ferry operation agency ASDP Indonesia Ferry, through the Dinas Perhubungan of the South Sulawesi Province. Data on the route between Gorontalo and Pagimana was partly obtained from the Dinas Perhubungan of the Gorontalo Province, except for ferry operation costs. Information on the Siwa – Lasusua route was presented by the P.T. ASDP Indonesia Ferry.

11.5.2 Bajoe – Kolaka Ferry Route (Crossing the Bone Bay)

(1) Characteristics of Ferry Operation (Bajoe – Kolaka Route)

1) Ferry Operation Agencies and Ferry Ships

Currently, in the Bajoe – Kolaka route there is a total of nine ships which are operated by six agencies. These agencies are: PT ASDP, PT JL Ferry, PT JM Ferry, PT BLT Tama, PT JL Rahayu, and PT JM Madura. Specifications of the ferry operations are shown in **Table 11.5.1**.

Superannuated ferry ships that are still in service since they were acquired 40 years ago are operated on this route. The capacity of each ferry ship is not so large accommodating 11 to 25 truck units. The average capacity of the nine ships is about 16 trucks/ship.

Table 11.5.1 Specifications of Ferry Ships

Ferry No.	Acquired Year	Size of Ferry Ship			
		Length (m)	Width (m)	Capacity (in truck unit)	Capacity (in ton)
1	1992	44.50	14.00	15	360
2	1970	44.50	11.30	11	198
3	1968	71.57	12.42	16	288
4	1982	56.65	13.10	18	360
5	1968	62.06	13.46	18	360
6	1999	55.68	11.00	16	320
7	1980	55.72	16.20	25	500
8	1980	42.70	11.50	11	220
9	1983	57.35	13.20	18	360

Source: Dinas Perhubungan South Sulawesi Province, PT.ASDP Indonesia Ferry

2) Operation Frequency and Travel Time for Crossing

Present ferry operation frequencies between Bajoe and Kolaka are three round trips (total 2 x 3 = 6 trips). Not all ferry ships operate every day. Average crossing hours are about eight to nine hours per trip (one-way).

Table 11.5.2 Operation Frequencies and Crossing Hours

- Normal operation hour	From 17:00, 20:00 to 23:00
- Number of trips per day	From Bajoe: 3 trips From Kolaka: 3 trips = 3 round trips = (2 x 3 = 6 trips)
- Average Crossing hours	8-9 hours for one-way

Source: Dinas Perhubungan South Sulawesi Province, PT.ASDP Indonesia Ferry

3) Ferry Tariff (Fares)

The current tariff structures for passengers using the ferries in the Bajoe – Kolaka Route is shown below:

Table 11.5.3 Tariff Structures (as of November 2007)
(in Rp./unit)

Passenger	Adult	Children
Business	68.000	44,000
Economy	46,000	33,000
Vehicle		
Bicycle	65,000	
Motorcycle	124,000-318,000	
Car	876,000	
Minibus	1,766,000	
Bus	2,713,000	
Small Truck	1,295,000	
Truck	1,925,000	
Heavy Truck	2,824,000	

Source: Dinas Perhubungan South Sulawesi Province, PT.ASDP Indonesia Ferry

It can be seen that the route comparatively apply high tariffs at present. These tariffs are

equivalent to the Vehicle Operating Costs for 450 km (car), 730 km (minibus), 900 km (bus), 460 km (small truck), and 730 km (heavy truck).

(2) Past Trends of Ferry Transport Demands (Bajoe – Kolaka Route)

The Tables and Figures below show the past ferry user traffic trends of the Bajoe – Kolaka Route. The figures show a clear decreasing tendency in the traffic of vehicles and passengers (**Table 11.5.5, Figure 11.5.1, Figure 11.5.3**). The average daily traffic of vehicles in 2006 was only 88 vehicles (excluding motorcycles) and 312 passengers (based on the assumption of a 365 day operations). Presumably, one of the reasons for the modest traffic volume is the low capacity and low frequencies involved in the route: [(6 trips per day) x (average capacity 16 trucks per ship) = 96 trucks per day].

Table 11.5.4 Ferry User Traffic (Bajoe – Kolaka Route)

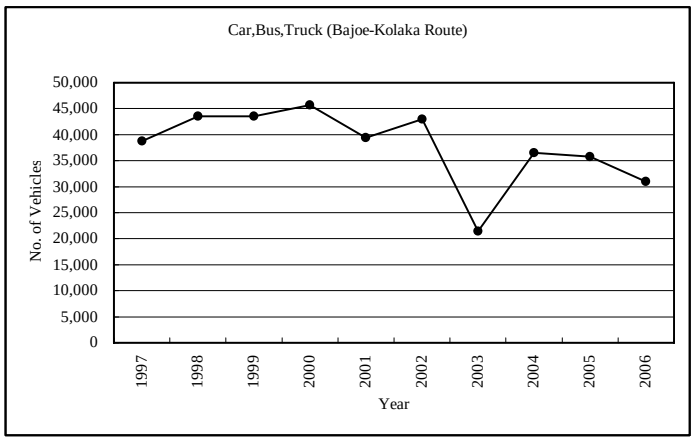
Year	Car	Small Bus	Large Bus	Small Truck	Heavy Truck	Sub-Total	Motorcycle	Passengers
2004	7,087	12,373	7,576	2,925	7,594	37,555	15,151	302,618
2005	7,191	8,627	1,698	5,414	12,497	35,427	15,794	142,586
2006	5,886	8,358	1,052	5,220	11,510	32,026	16,671	115,621
Traffic/day 2006	16	23	3	14	32	88	46	312

Source: Dinas Perhubungan South Sulawesi Province, PT.ASDP Indonesia Ferry

Table 11.5.5 Past Trends of Ferry User Traffic (1997 – 2006)

Year	Car, Bus, Truck (Unit)	Motorcycle (Unit)	Passenger (Persons)	Cargo (ton)
1997	38,775	12,785	414,206	11,264
1998	43,583	5,288	453,038	85,505
1999	43,514	6,838	447,914	-
2000	45,684	4,949	364,300	93,770
2001	39,466	7,612	304,084	67,212
2002	42,972	20,276	339,324	80,484
2003	21,413	10,059	182,562	37,516
2004	36,499	18,722	305,261	37,033
2005	35,727	16,926	150,040	-
2006	31,011	14,643	106,401	-
Growth % Per Annum	-2.5%	1.5%	-14.0%	18.5%

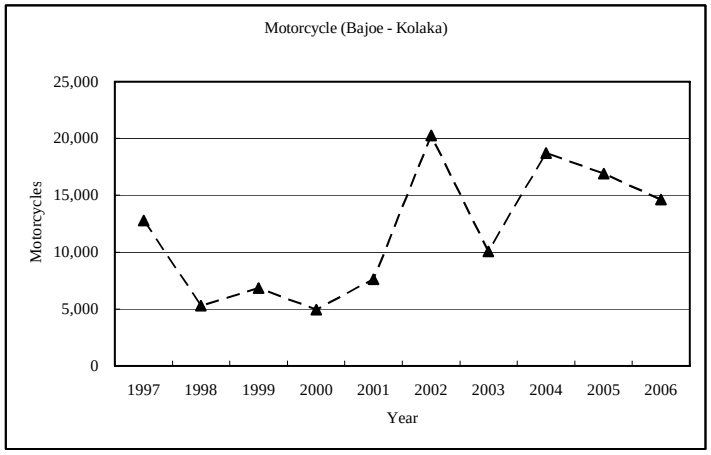
Source: Web site of ASDP Indonesia Ferry



Source: from Table 11.5.5

Figure 11.5.1 Past Trends of Vehicle Traffic (excluding motorcycles)

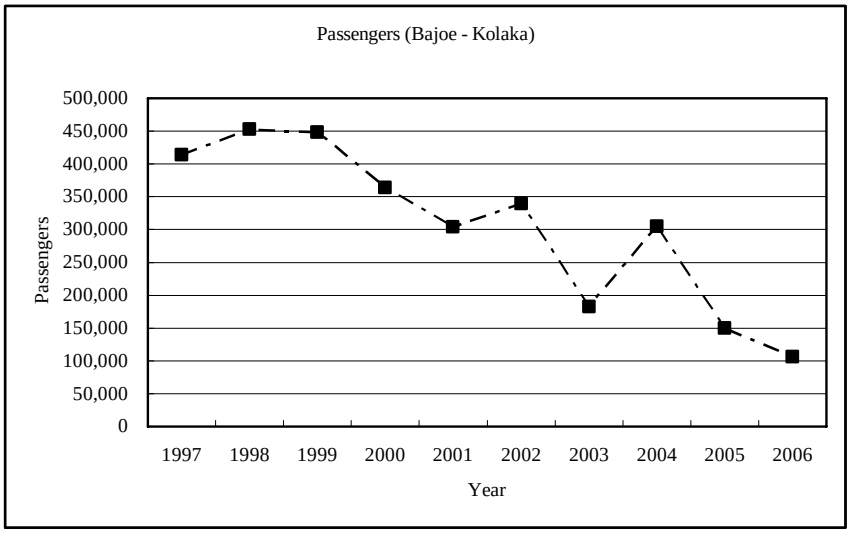
(Bajoe – Kolaka Route)



Source: from Table 11.5.5

Figure 11.5.2 Past Trends of Motorcycle Traffic

(Bajoe – Kolaka Route)



Source: from Table 11.5.5

Figure 11.5.3 Past Trends of Passenger Traffic

(Bajoe – Kolaka Route)

(3) Comparison of the Economic Efficiency between the Road and Ferry Modes (Bajoe – Kolaka Route)

1) Economic Costs to be compared

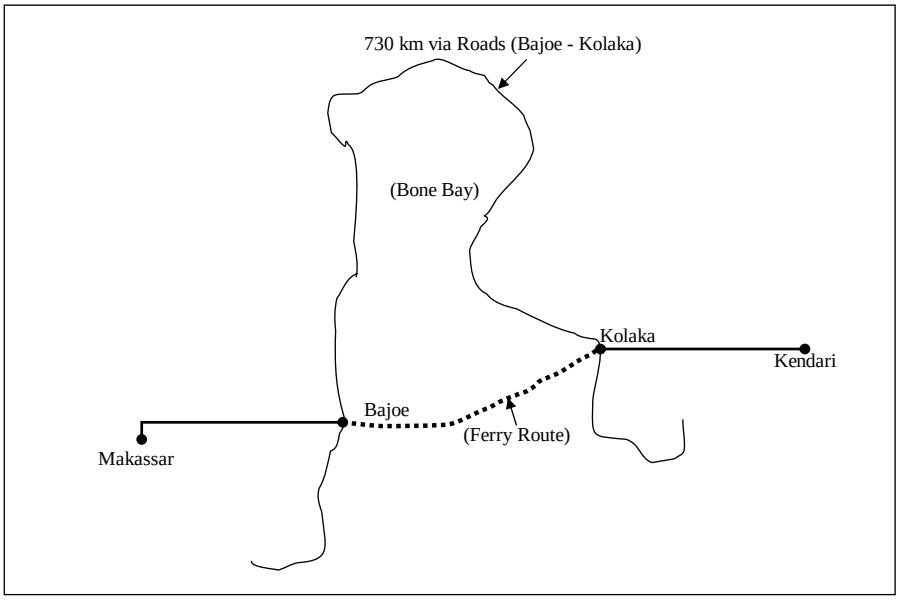
Generally, ferry transport is more efficient than road transportation from the point of view of transport costs and environment preservation. However, one question is how much ferry transport saves on transport costs. It should be noted that transport costs in this context are not the fares of ferry users or the tariffs levied on road toll gates. Economic costs in this regard are Vehicle Operating Costs (VOC) via roads and ferry operation costs when they ply across the bays.

2) Vehicle Operating Costs via Road (between Bajoe and Kolaka Routes)

The results of the Origin – Destination (OD) interview survey on the ferries plying the Bajoe and Kolaka routes showed that the main traffic OD pairs are the Bajoe – Kolaka route and the Makassr – Kendari route. Therefore, cost comparisons between traffic via roads and via ferry for these OD pairs is equivalent to the comparison of costs between the Bajoe and Kolaka route as access to/from Bajoe and Kolaka are used by both road users and ferry users **(Figure 11.5.4)**.

For analytical purposes, a hypothetical situation of "Without Ferry Operations" between Bajoe and Kolaka is assumed. In this situation, vehicles and passengers currently using ferry services

will be obliged to take longer road routes which is about 730 km. between Bajoe and Kolaka.



Source: JICA Study Team

Figure 11.5.4 Location of Ferry Routes (Bajoe-Kolaka) and Roads

Vehicle Operating Costs of this detour road route are calculated below:

Table 11.5.6 Estimation of VOC for Hypothetical Situation of "Without Ferry Case" (Bajoe – Kolaka Route)

Vehicles/ Passengers	Traffic in 2006 (*1)	Distance via roads (Bajoe – Kolaka)	Unit VOC By IRMS 2006 (Rp/km) (*2)	Total VOC (Rp.Million / year)
Car	5.886		1,944	8,348
Small Bus	8,358		2,411	14,700
Big Bus	1,052	729.5 km	2,998	2,301
Small Truck	5,220		2,788	10,615
Large Truck	11,510		3,852	32,346
Passengers (*3)	17,283	729.5 km	2,411	30,396
Motorcycle (*4)	3,439	729.5 km	2,411	6,048
			Total VOC	**104,754**

Note: (*1): From **Table 11.5.4** (PT. ASDP data)
(*2): Indonesian Road Management System 2006, assuming 40km/hour, road roughness = fair.
(*3): Passengers using ferries are assumed to divert to small buses (average occupancy = 6.69 persons)
(*4): Passengers of motorcycles are assumed to divert to small buses.

Therefore, in a hypothetical "Without Ferry Services" scenario in the Bajoe – Kolaka Route an additional total VOC will amount to Rp.104,754 Million per year in 2006 prices. In other words, current ferry operations in the Bajoe – Kolaka route will contribute to a VOC savings that is equivalent to the above amount in a year.

3) Economic Costs of Ferry Operations (Bajoe – Kolaka Route)

According to data from PT ASDP Bajoe, annual operation costs in the Bajoe – Kolaka route were Rp.9, 648 Million in 2005 and Rp.9, 513 Million in 2006, as shown below:

Table 11.5.7 Ferry Operation Costs (Bajoe – Kolaka Route)

Items	2005 (Rp. Million)	2006 (Rp. Million)	2006 **(Economic Cost)** (Rp. Million)
1) Direct Ferry Operation Costs			
- Ferry Crew Wages	575	680	680
- Fuel Cost	3,025	5,212	4,691
- Lubricant Oil Cost	268	292	263
- Ferry Boat Maintenance Cost	5,042	2,478	2,231
2) Ferry Terminal Operation Costs			
- Terminal Worker Wages	323	406	406
- Jetty Maintenance Cost	124	183	164
3) **General Administration Costs**	291	262	262
Total	9,648	9,513	**8,697**

Source: Dinas Perhubungan South Sulawesi Province, PT.ASDP Indonesia Ferry

The ferry operating costs above (2006) were converted into economic costs applying the conversion rate of 0.90 to the fuel, lubricant oil and maintenance costs which resulted in Rp.8,697 Million in 2006.

4) Cost Comparison between Ferry and Road – (Economic Benefit of Ferry)

Economic costs in a hypothetical "Without Ferry Operation" situation was estimated at Rp. 104,754 Million in 2006 (VOC total via road). On the other hand, economic ferry operation cost in a "With Ferry Operation (present actual situation)" model was estimated at Rp. 8,697 Million in 2006. The difference between two economic costs (**Rp. 96,057 Million** per year = Rp. 104,754 Million – Rp. 8,697 Million) will mean a kind of **economic benefit of the current ferry operation at Bajoe – Kolaka route** based on the "With and Without Comparison Methods". In other words current ferry operations will contribute to the national economy amounting to Rp. 96,057 million per year. The benefit of the current ferry operation is equivalent to 8.6% (Rp. 96,057 million x 17 years = Rp. 1,633 billion) of the total cost of the Master Plan Road Network in Sulawesi Island during the planning period (Rp. 18,894 billion, 2008 -2024: 17 years) assuming the same ferry traffic volumes in 2006 are maintained until 2024. It can also be said that the Economic Benefit/Cost Ratio (B/C Ratio) of the ferry operation is equal to 12.0 (=Rp.104,754 Million / Rp. 8,697 Million) in 2006.

11.5.3 Siwa – Lasusua Ferry Route (Crossing the Bone Bay)

(1) Characteristics of Siwa – Lasusua Route

1) Ferry Operation Agency and Ferry Ship (Siwa – Lasusua route)

The location of the Siwa – Lasusua ferry route is about 100 km north of the Bajoe – Kolaka route in the Bone Bay. The Origin – Destination information of traffic was not readily available.

Only one ferry ship is operated by the PT. ASDP Indonesia (Public) at the Siwa – Lasusua Route one other passenger ship is operated by a private sector.

The characteristic of the ferry in operation is shown below:

Table 11.5.8 Specification of Ferries

Name of Ferry	Acquired Year	Size of Ferry Ship			
		Length (m)	Width (m)	Capacity (in truck unit)	Capacity (in ton)
KMP. Poncan Moale	2005	44	11	-	621

Source: PT. ASDP (Persero), Cabang SIWA

2) Operating Frequency and Travel Time for Crossing the Siwa – Lasusua Route

It is reported that the operating frequency of one ship is only one trip per day and the average crossing time is four hours per one-way.

3) Ferry Tariff (Fares) (Siwa – Lasusua route)

The current tariff structure of this ferry route is presented below: Tariff level is about 20% - 50% of the Bajoe – Kolaka Route.

Table 11.5.9 Tariff Structures (as of December 2007)
(in Rp./unit)

Passenger	Adult	Children
	24,000	15,000
Vehicle		
Bicycle	31,000	
Motorcycle	43,000-112,000	
Car	306,000	
Minibus	405,000	
Bus	546,000	
Small Truck	304,200	
Truck	539,000	
Heavy Truck	949,000	

Source: PT. ASDP (Persero), Cabang SIWA

4) Traffic (Siwa – Lasusua Route)

The number of vehicles and passengers transported by the Siwa – Lasusua ferry in 2006 and 2007 are shown in the following table.

Table 11.5.10 Ferry User Traffic (Siwa – Lasusua Route)

Year	Car, Pickup	Small Bus	Large Bus	Small Truck	Truck	Heavy Truck	Sub-Total	Motor-cycle	Passengers
2006	1,010	174	1	1,579	1,824	143	4,731	2,831	28,790
2007 (*)	1,251	79	1	1,480	1,909	152	4,872	2,769	27,587
Traffic/day 2006							13	8	79

Source: PT. ASDP (Persero), Cabang SIWA
Note: (*): Data of 2007 covers from January to October 2007

This route transported 4,731 vehicles and 2,831 motorcycles in 2006. The average daily traffic volumes are only 13 vehicles, 8 motorcycles and 79 passengers. Due to only one trip service per day, traffic volumes were very low.

5) Economic Costs of the Ferry Operation of the Siwa – Lasusua Route.

The annual operation costs at the Siwa – Lasusua ferry were estimated at Rp. 3,051 Million in 2006 and Rp. 2,820 Million after conversions as shown below:

Table 11.5.11 Ferry Operation Costs (Siwa – Lasusua Route)

Items	2006 (Rp. Million)	2006 **Economic Cost)** (Rp. Million)
1. Direct Ferry Operation Costs		
- Ferry Crew Wages	444.8	444.8
- Fuel Cost	1,554.9	1,399.4
- Lubricant Oil Cost	32.5	29.3
- Ferry Boat Maintenance Cost	729.8	656.8
2. Ferry Terminal Operation Costs (*)	(*) 188.9	188.9
3. General Administration Costs	100.5	100.5
Total	3,051.4	**2,819.7**

Source: PT. ASDP (Persero), Cabang SIWA
Note: (*): Ferry terminal operation costs were not available from PT. ASDP Siwa. It is managed by the Transport Department of the Province. Therefore, it is estimated applying the same ratio of Bajoe – Kolaka ferry operation costs.

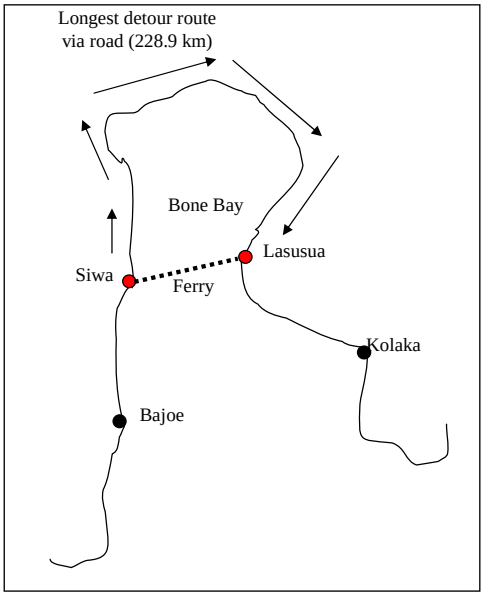
(2) Comparisons of Economic Efficiency between the Road and Ferry Models (Siwa – Lasusua Route)

Based on the same methodology applied to the Bajoe – Kolaka route, an economic efficiency comparison between the road and ferry models was made as explained below:

For the comparative analysis, two cases were prepared considering the detour distance via road.

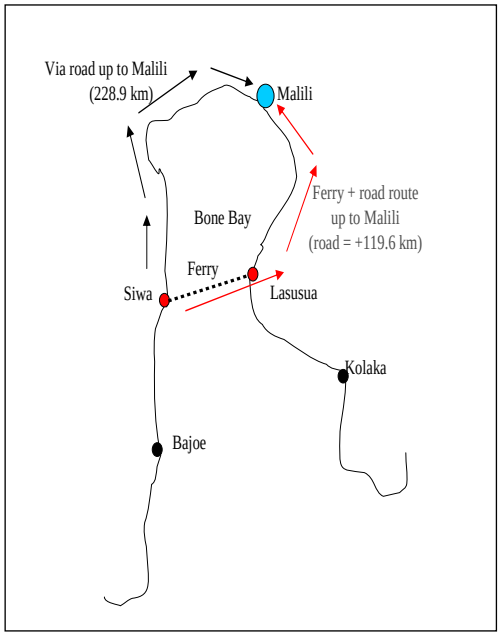
1) Case 1: Comparison using the longest detour route via road between Siwa and Lasusua Route: (348.5 km) and the ferry (Figure C.1)

2) Case 2: Comparison via road (from Siwa up to Malili): 228.9 km, and via ferry route (Siwa-Ferry-Lasusua-Malili): road section =119.6 km (Figure C.2).



Source: JICA Study Team

Figure 11.5.5 Longest Detour Route via Road (Case 1)



Source: JICA Study Team

Figure 11.5.6 Comparison of Two Routes: via Road and via Ferry Route (up to Malili) (Case 2)

For Case 1, calculations for the Vehicle Operating Costs (VOC) in a hypothetical situation ("Without Current Ferry Operation") is shown below:

Table 11.5.12 VOC Estimates in a Hypothetical "Without Ferry" Situation (Siwa – Lasusua Route)

Vehicles/ Passengers	Traffic in 2006 (*1)	Distance via roads (Siwa – Lasusua)	Unit VOC By IRMS 2006 (Rp/km) (*2)	Total VOC (Rp.Million / year)
Car	1,010		1,944	684.3
Small Bus	174		2,411	146.2
Big Bus	1	348.5 km	2,998	1.0
Small Truck	3,403		2,788	3,305.9
Large Truck	143		3,852	192.0
Passengers (*3)	4,303	348.5 km	2,411	3,615.8
Motorcycle (*4)	584	348.5 km	2,411	490.7
			Total VOC	**8,435.9**

Note: (*1): From **Table 11.5.10** (PT. ASDP data)
(*2): Indonesian Road Management System 2006, assuming 40km/hour, road roughness = fair.
(*3): Passengers using ferries are assumed to divert to small buses (average occupancy = 6.69 persons)
(*4): Passengers of motorcycles are assumed to divert to small buses.

Therefore, in Case 1, current ferry operations at Siwa – Lasusua route saves on economic costs by **Rp. 5,616 Million** per year (Rp. 8,436 Million of VOC – Rp. 2,820 Million of ferry economic operation cost). In other words, the Economic Benefit/Cost Ratio (B/C Ratio) of the ferry operation was 3.0 in 2006 (=Rp. 8,436 Million / Rp. 2,820 Million).

On the other hand, Case 2 does not show favorable results for ferry operations because the road distance from Siwa to Malili is sufficiently short to offset lower operational costs of the ferry and due to additional road distance from Lasusua to Malili as indicated below:

- Via road to Malili from Siwa: VOC expense from Siwa to Malili via road (228.9 km) = **Rp. 5,541 Million** per year.
- Via ferry route to Malili: Ferry operation cost (Rp. 2,820 Million per year) + VOC from Lasusua to Malili (Rp. 2,895 Million) = **Rp. 5,715 Million** per year.
- Economic cost via road route (Rp. 5,541 Million) < Cost via ferry route (Rp. 5,715 Million)

11.5.4 Gorontalo – Pagimana Ferry Route (Crossing the Tomini Bay)

(1) Characteristics of Ferry Operation (Gorontalo – Pagimana Route)

1) Ferry Ship in Operation and Traffic

At present, only one ship is operated by the PT. ASDP (Persero) on this route. Average crossing time is 10 hours (one-way). Vehicles and passengers transported in 2006 amounted to 5,700 vehicles (this includes cars and motorcycles) and 54,700 passengers.

Table 11.5.13 Specification of Ferries (Gorontalo-Pagimana)

Name of Ferry	Starting operation year	Size of Ferry Ship			
		Length (m)	Width (m)	Capacity (in truck unit)	Capacity (in ton)
KMP. Baronang	1993	45.3	12	15	526

Source: Dinas Perhubungan, Gorontalo Province

Table 11.5.14 Ferry User Traffic (Gorontalo-Pgimana)

Year	Car, Pickup	Small Bus	Large Bus	Small Truck	Truck	Heavy Truck	Sub-Total	Motor-cycle	Passengers
2006	2,993	-	-	-	-	45	3,038	2,639	54,673

Source: Dinas Perhubungan, Gorontalo Province

2) Ferry Tariff (Gorontalo – Pagimana)

Current tariff structure of this ferry route is shown below: These tariff rates are the same level of those of Bajoe-Kolaka route.

Table 11.5.15 Tariff Structures (as of December 2007)
(in Rp./unit)

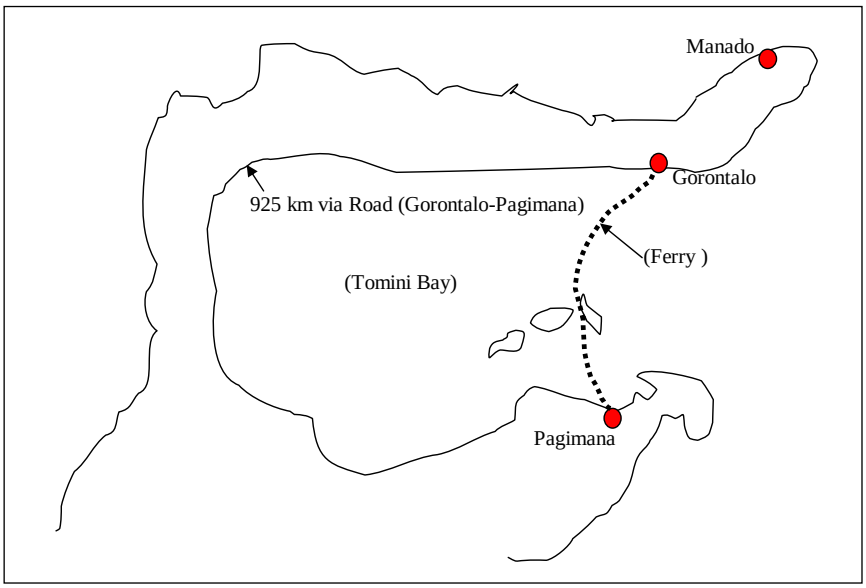
Passenger	Adult	Children
Business	63,500	37,300
Economy	47,400	30,100
Vehicle		
Bicycle	80,000	
Motorcycle	130,000	
Car	795,800	
Minibus	1,569,300	
Bus	2,143,100	
Small Truck	1,098,000	
Heavy Truck	2,059,700	

Source: Dinas Perhubungan, Gorontalo Province

(2) Comparison of Economic Efficiency between Road and Ferry Modes (Gorontalo – Pagimana)

1) Main Origins and Destinations using the Ferry

The results of the Interview Survey on the ferry route showed that the main Origins and Destinations (OD) of users in the Gorontalo – Pagimana route are the O-D pairs of North Sulawesi Province (Manado) – Central Province, and Gorontalo Province (Gorontalo) – Central Province). Therefore, cost comparison between via roads and via ferry is considered to be nearly equivalent to the comparison of costs between Gorontalo and Pagimana (**Figure 11.5.7**).



Source: JICA Study Team

Figure 11.5.7 Location of Ferry Route (Gorontalo – Pagimana)

2) Vehicle Operating Cost (VOC) via Road (between Gorontalo and Pagimana)

In the hypothetical situation of "Without Ferry Operation", vehicles and passengers using the current ferry (Gorontalo – Pagimana) will be obliged to take the longer road route which is about 925 km between Gorontalo and Pagimana. The Vehicle Operating Costs (VOC) of this detour route are calculated as follows:

Table 11.5.16 Estimation of VOC for Hypothetical Situation of a "Without Ferry Case" (Gorontalo – Pagimana Route)

Vehicles/ Passengers	Traffic in 2006 (*1)	Distance via roads (Gorontalo – Pagimana)	Unit VOC By IRMS 2006 (Rp/km) (*2)	Total VOC (Rp.Million / year)
Car	2,993		2,196	6,080
Small Bus	-		2,692	-
Big Bus	-	924.9 km	3,404	-
Small Truck	-		3,199	-
Large Truck	45		4,259	177
Passengers (*3)	8,172	924.9 km	2,692	20,345
Motorcycle (*4)	544	924.9 km	2,692	1,355
			Total VOC	**27,957**

Note: (*1): From **Table 11.5.14** (Data from Dinas Perhubungan Gorontalo Province)
(*2): Indonesian Road Management System 2006, assuming 30km/hour, road roughness = fair.
(*3): Passengers using ferries are assumed to divert to small buses (average occupancy = 6.69 persons)
(*4): Passengers of motorcycles are assumed to divert to small buses.

3) Economic Costs for Ferry Operations

Operation and maintenance costs of the ferry operation in the Gorontalo – Pagimana route (in economic cost) was not readily available. In this analysis, it is assumed that similar operation costs of the Bajoe – Kolaka route can be tentatively applied to the Gorontalo – Pagimana ferry route (= Rp. 8,697 Million/year in 2006). The actual operation costs of the Gorontalo – Pagimana route may be lower than the assumed operation costs because the number of ships operating and the traffic volumes on the Bajoe – Kolaka route are higher than the Gorontalo – Pagimana route.

4) Comparative Economic Costs between Road and Ferry Modes

The results of cost comparisons are summarized below:

- VOC via detour road route = Rp. 27,957 Million /year in 2006
- Economic Costs for Ferry Operation < Rp. 8,697 Million /year in 2006

Therefore,

- Saved economic costs by ferry operation > **Rp. 19,260 Million /year**
- Benefit/ Cost Ratio > 3.21 (=Rp. 27,957 Million / Rp. 8,697 Million)

11.5.5 Conclusions of the Economic Study on Ferry Operations

In conclusion, the results of the analysis above show the economic efficiency of ferry operations (economic benefit) on the three routes and it is recommended that the current ferry operations should be maintained and patronized together with the road network from the aspects of national economy and environmental protection (although current traffic demand is at low level).

CHAPTER 12 ENVIRONMENTAL ASPECTS AND CONCERNS IN THE MASTER PLAN

12.1 Basic Approaches

In conducting an environmental evaluation of the Master Plan, a strategic environmental assessment (SEA) was applied as a systematic process for comprehensively evaluating, at the earliest appropriate stage in the planning, a couple of alternative options for the overall road development program, thereby ensuring a full integration of the relevant biophysical, economic, and social aspects of the proposed Master Plan. In accordance with the SEA concept, environmental considerations were sufficiently incorporated into the Master Plan.

While a project-level environmental impact assessment (EIA) is implemented after specifying the detailed road development projects in the Master Plan, the SEA introduces early and strategic environmental considerations before the details on road alignments and their specifications are decided. In other words, the SEA method allows the Government of Indonesia to focus on the environmental effects for the optimum formulation of the Master Plan before specific road development projects are finalized. Thus, in comparison with a project-level EIA, the SEA can take into account a broader range of alternative proposals and mitigation measures in the procedures of formulating the Master Plan.

12.2 Objectives of the Strategic Environmental Assessment (SEA)

12.2.1 Objective of the SEA methodology

The main objective of the SEA method is to conduct a comprehensive impact assessment of the Master Plan by using a typical SEA methodology. It does not only deal with the negative impacts of the engineering, economic, and environmental aspects of the Master Plan but also the positive ones. The typical SEA process begins with screening and scoping, and ends up with mitigation measures.

12.2.2 Reference to the SEA methodology

Various efforts by the Government of Indonesia, as well as a series of technical assistance from the World Bank, have been made in the application of Strategic Environmental Assessment to Indonesia's environmental concerns. As reference, the Indonesian government has come up with a publication titled: "Kajian Lingkungan Strategik" (Asisiten Deputi Urusan Koordinasi Kebijakan, Deputi Bidang Kebijakan dan Kelembagaan, Kementerian Lingkungan Hindup, Mei 2002).

This Master Plan has been given a "Category A" classification in the JICA guidelines, which means that it is a project that might have significant negative impacts on the environment as well as on the communities in the affected areas. Consequently, public consultations in the Study are required to comply with the procedures stipulated in Clauses 3.2.3 of the guidelines. Clause 3.2.3.5

requires that, in accordance with the TOR, and in collaboration with the recipient governments, JICA should technically assist in the implementation of the IEE-level environmental and social studies and analyze alternative options including a "without project" scenario. Since the SEA process is more in-depth analysis than the IEE-level studies, the "Kajian Lingkungan Strategik" publication will be carefully considered based on the JICA guidelines.

12.3 SEA Methodologies

12.3.1 Collection of Baseline Data and Information

The collection of the baseline information was carried out to establish benchmarks for natural environmental parameters and their attributes, including the socio-economic conditions in the affected areas. This includes a description of the physical, biological, and socio-economic environments with reference to project location and the proposed activities in the Master Plan.

12.3.2 Identification of Evaluation Items

The details of the tentative primary evaluation items (i.e. engineering items), secondary items (i.e. economic and financial items), and tertiary items (i.e. environmental and social considerations items) were described. Evaluation items have been utilized for both impact assessment and the comparison of alternatives. The details of the evaluation items are explained in 12.5.

12.3.3 Impact Assessment

Impact assessment is designed to identify and assess the potential environmental impacts of proposed alternatives, thereby assisting in the design of appropriate mitigation measures. Impact assessment will be implemented among several alternatives. The results of the impact assessment will be streamlined in the impact assessment matrix.

12.3.4 Multi-Criteria Analysis (MCA)

The scope of the SEAi s not limited to environmental effects alone. The method provides a number of potential links with the socio-economic assessment, recognizing the idea of the SEA's interrelationships with socio-economic issues or sustainability concerns. The so-called multi-criteria analysis (MCA), which is a typical evaluation method that judges priorities under different development alternatives, has been employed as a key methodology for the overall SEA assessment. Since a wide range of positive effects and negative impacts are included in the evaluation criteria in the MCA, the methodology allows evaluators to utilize more practical evaluation procedures. The MCA provides a comprehensive evaluation matrix with different weights for each evaluation item, thereby aiding in the selection of alternatives. More concretely, the MCA has been conducted through the following steps: (1) Selection and streamlining of evaluation items, (2) Fixing evaluation indices and rating evaluation scores, (3) Calculating weights and total evaluation scores, and (4) Formulation of an MCA matrix.

(1) Selection and Streamlining of Evaluation Items

The selected evaluation items will be streamlined in the form of a 5-level evaluation system composed of the following: (1) Engineering items related to project conditions, (2) Economic and financial evaluation items related to project benefits and efficiency, and (3) Environmental and social condition items related to project effects and impacts.

(2) Fixing Evaluation Indices and Rating Evaluation Scores

A wide range of indicators explaining the quantitative and qualitative evaluations on the proposed alternatives were employed. Although it is desirable that evaluation indicators are quantifiable, indicators based on narrative descriptions of the evaluation items were likewise acceptable whenever difficulties in quantifying indicators arose. In order to obtain clear-cut evaluation results for selecting optimum alternatives, all the evaluation items were rated through the use of a 5-grade scoring system.

(3) Calculation of Weights in the Total Evaluation Score

To reflect the significance of the evaluations, the weight of each evaluation item was assumed, and the total evaluation score was calculated taking these weights into account. A five-grade evaluation score were applied for the evaluation.

(4) Formulation of the MCA Matrix

To summarize the results of the evaluation, an MCA matrix, which includes the weights and the scores of each evaluation item, was prepared. The alternatives were prioritized in accordance with the total evaluation score in the MCA matrix.

12.3.5 Recommendations for Mitigation Measures

As a preventive tool on a wide range of impacts on the natural environment, mitigation measures will be formulated and incorporated into the SEA process in order to ensure that the environmental degradation resulting from the Master Plan will be minimized. In accordance with the identified and assessed impacts, a comprehensive mitigation measures were prepared in a concrete way.

12.3.6 Stakeholder's Meetings

As an integral part of the SEA process, a series of stakeholder meetings have been held involving the representatives of various stakeholders in order to disseminate relevant information on the proposed Master Plan, as well as eliciting responses on possible positive and negative impacts as perceived by the stakeholders. Results will be shared in the SEA process.

The main objectives of the public consultation activities for the SEA process are:

- Enhance transparency in decision-making through the provision of information which will allow for the early identification and mitigation of impacts.
- Promote a more comprehensive understanding of the baseline environmental information.

- Provide stakeholders with relevant information on potential environmental effects at an early stage of the SEA process in order to avoid unnecessary controversies and delays in the decision-making process at latter stages due to public opposition arising from lack of understanding.

The JICA Guidelines on Environmental Considerations stipulates that in the environmental and social aspects in master planning, a series of stakeholder meetings has to be conducted in key stages of the study, i.e. during the preparation of the draft of the scoping items, during the formulation of a rough outline of environmental and social considerations, and during the preparation of the draft final report.

12.4 Baseline Information

(1) General Socio-economic Situation

In 2005, the population of Sulawesi was 15,981,056, which is about 7.30% of Indonesia's total population. Population density in the island was 81.2 /km^2, lower than the national average of 115.8 /km^2 and higher than the outer-island[1] average of 51.3 /km^2. Makassar is the biggest city in Sulawesi with a population of almost 1,195 thousand, followed by Manado with 406,000, Palu with 291,000, Kendari with 236,000, Gorontalo with 153,000, and Palopo with 129,000. Since there are limited plains in the island its aggregate urbanization ratio of 27.5% is still lower than the national average of 42.1%.

While population density was particularly higher in the southern part of South Sulawesi and the eastern part of North Sulawesi, it was lower in Central Sulawesi and Gorontalo. Makassar City had the highest population density with 7,749/km^2, followed by Gorontalo City with 2,557/km^2, and Manado City with 2,440/km^2.

The annual average population growth ratio of Sulawesi progressively diminished from 2.24% (1971-80), 1.86% (1980-90), 1.86% (1990-1995), 1.62% (1995-00), and to 1.19% (2000-05). Its annual average growth ratio in 2000-05 (1.19%) was slightly lower than the national average of 1.30%. However, during this period, the annual growth ratio of Gorontalo (2.04%), Southeast Sulawesi (1.69%), and West Sulawesi (1.52%) was higher, while that of South (0.96%), Central (1.07%), and North Sulawesi (1.25%) was lower than the national average.

In 2005, total GRDP in the island was Rp.73,089 billion (in constant prices since 2000) contributing only 4.2% to the country's GDP (Rp.1,749,546 billion) while its population accounted for 7.30% of Indonesia's total population. Agriculture (including plantations, fishery, forestry, and livestock) plays a vital role in the economy of Sulawesi, contributing 9.7% to the national total for agriculture. On the other hand, manufacturing and financial/business respectively accounted for only 1.6% and 2.6% of the national total for these sectors.

[1] In this Study, outer islands refer to other islands except Java and Bali.

Table 12.4.1 Sectoral GRDP of Sulawesi and Indonesia, 2005 Current Prices

(Unit: Rp. 1,000)

Sector	Sulawesi (A)	Indonesia (B)	Ratio (A / B)
Agriculture	24,605,974	254,391,300	9.67%
Mining and Quarrying	4,973,952	162,642,000	3.06%
Manufacturing	7,854,917	491,699,500	1.60%
Electricity, Gas and Water Supply	600,151	11,596,600	5.18%
Construction	5,251,014	103,403,800	5.08%
Trade, Restaurant and Hotel	10,706,564	294,396,300	3.64%
Transport and Communication	5,867,008	109,467,100	5.36%
Financial and Business	4,209,374	161,959,600	2.60%
Services	9,020,094	159,990,700	5.64%
Total	73,089,047	1,749,546,900	4.18%

Source: BPS Indonesia, 2005

(2) Topography

Sulawesi Island is composed mainly of highlands rising over 200m above sea. Its lowlands are concentrated mostly in the southern part, i.e. in South Sulawesi and Southeast Sulawesi Province. Rice paddies and crop cultivation is very active in South Sulawesi Province. In the lowlands of West Sulawesi Province, which is the newer one, the main industry is agriculture with palm plantations relatively on the west part along the Makassar Strait. Lead and nickel mining as well as asphalt are the main mining activities in Southeast Sulawesi Province.

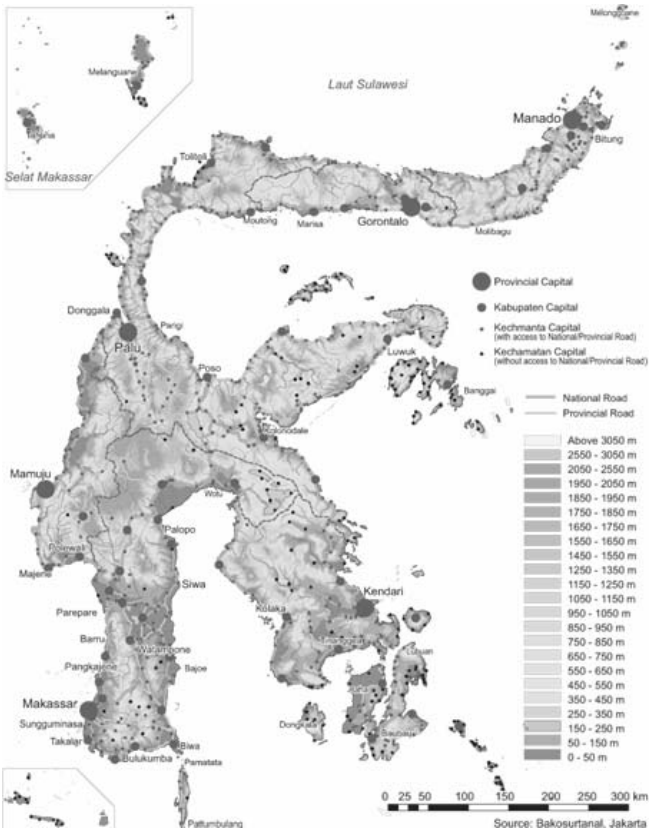
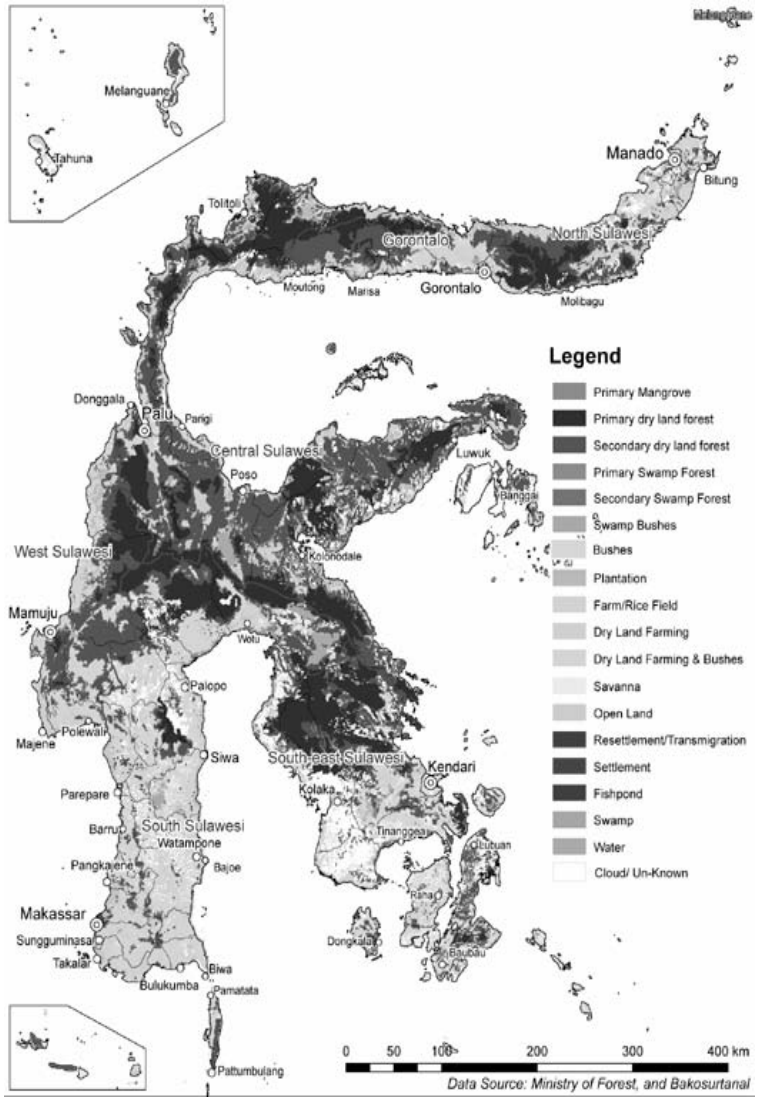


Figure12.4.1 Topography in Sulawesi Island

On the other hand, Central Sulawesi, Gorontaro and North Sulawesi Province, on the other hand, have scarcely any lowlands. These areas have some mineral resources such as gold, natural gas etc. North Sulawesi Province has many active volcanoes, and they have been an important tourism resource for Sulawesi Island.



Paddy Field around Makassar City

Figure 12.4.2 Land Use in Sulawesi Island

(3) Land Use

Forest areas spread out almost from the central to the northern regions. South Sulawesi with its flat plains is relatively the agriculture granary of Sulawesi Island. Corn cultivation, palm and coconut plantations abound throughout the northern part of North Sulawesi Province and center of Gorontaro Province. Palm plantations are also found in the western coastal area of West Sulawesi Province.

On the other hand, North Sulawesi, Gorontaro and Central Sulawesi Province have few arable lands. However, they have an extensive array of well-known National Parks and Nature Reserves. These conservation areas are home to various endangered and endemic fauna and flora, and have unique biodiversities that have been attracting worldwide attention.

(4) Conservation Area

The United Nations' Convention on Biological Diversity, the Convention on International Trade in Endangered Species of Wild Fauna and Flora; CITES, and Ramsar Convention on Wetlands are ratified by Indonesia Government. The Conservation Area and Directorate Authority is an agency that prescribes to the Conservation on Biological Diversity.

Presently, there is no available area for the Ramsar Convention on Wetlands although the Rawa Aopa Warumohai National Park in Southeast Sulawesi is being proposed as one such site.

Conservation areas are categorized into six classifications and defined as follows;

Table 12.4.2 Classification of Conservation areas in Indonesia

Classification	Definition
Nature Reserve	Most essential area for the preservation and conservation of biodiversities, rare species of fauna and flora, particularly to be dispensable for the management, operation control and protection.
Wildlife Reserve	Important area for the preservation and conservation of biodiversities, rare species of fauna and flora, to be dispensable for the management, operation control and protection under strict regulations.
National Park	Important area for the preservation and conservation of biodiversity, rare species of fauna and flora, to be opened to the public for education and recreation purposes.
Nature Recreational Park	Relatively low importance for the preservation and conservation of biodiversity, rare species of fauna and flora, to be opened to the Public for recreation and education purposes.
Hunting Game Reserve	Of low importance for the preservation and conservation of biodiversity, rare species of fauna and flora, with permitted hunting for specific animals (i.e.boars, deer and some fishes)
Grand Forest Park	Necessary for the conservation of forests for the purpose of reservoir Protection.

The permission and prohibition items in each conservation area are shown in **Table 12.4.3**.

The item with the most severe restraint area is "Nature Reserve," and there are 18 regions nominated as such in Sulawesi Island. The second item with serious restraint is "Wildlife Reserve", and there are 16 such regions. However, despite these stated restraints and restrictions in actual conditions there is illegal poaching from residents or other offenders in and around the conservation areas where illegal offenders hunt the endemic and/or protected animals either for selling and/or consumption.

The detailed data of the conservation area in Sulawesi Island in 2001 are arranged in **Table 12.4.4**. Its nature reserve area is about 40 km2, and its wildlife reserve area is about 21 km2. The national park is about 263 km2 in size and about 6.5 times as large as the nature reserve. The essential conservation area as above three areas is occupied about 0.2 % of Sulawesi Island.

Table 12.4.3 Permission and Prohibition of Conservation areas in Indonesia

Conservation Area / Activities	Nature Reserve	Wildlife Reserve	National Park	Nature Recreational Park	Hunting Game Reserve	Grand Forest Park
Cultivation of edible cropps	×	×	×	×	×	×
Cultivation of fruite trees	×	×	×	○	○	○
Migration	×	×	×	×	×	×
Commercial cutting	×	×	×	×	×	×
Gathering of useful plants and firewoods	×	○	×	×	×	○
Hunting	×	×	×	×	○	○
Fishery	×	×	○	×	○	○
Camping	×	○	○	○	○	○
Gathering for research	×	△	△	△	△	△
Management and preservation for ecosystem	×	○	○	○	○	○
Transfusion and replantation of internal species	×	○	○	○	○	○
Gathering of wisteria and bamboo	×	×	×	△	×	×
Development for mineral rsources	×	△	△	△	△	△
Management and preservation for wild animals and plants	×	○	○	○	○	○
Entry of tourists	×	○	○	○	○	○
Migration and replantation of extraneous species	×	×	×	×	×	○

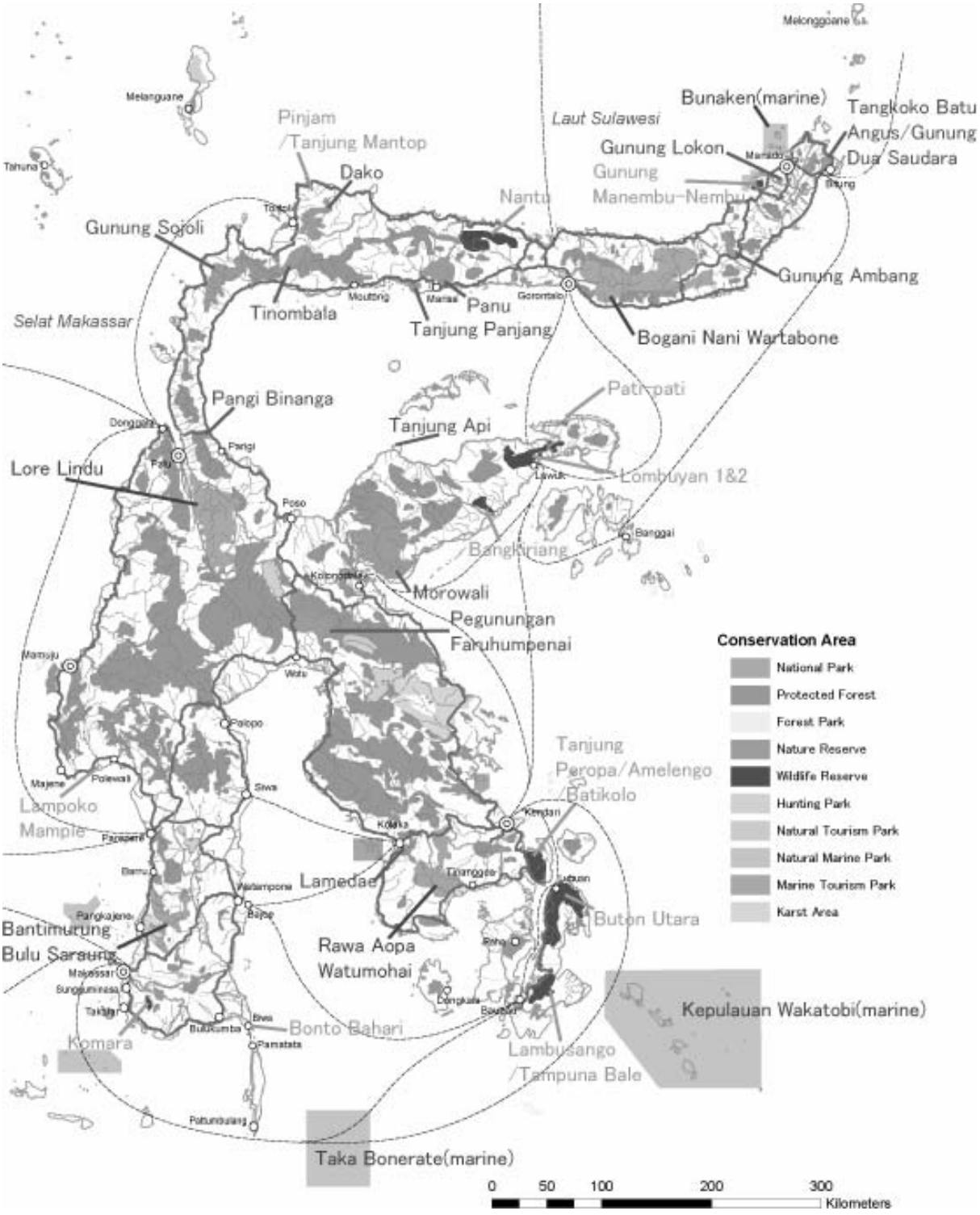
: Field Report of UNDP/FAO National Park Development Project INS/78/061

Remarks ○: Permission
△: Particular Privilege
×: Prohibition

Table 12.4.4 Data of Conservation Areas in Sulawesi Island

Classification	No.	Conservation Area Name	Area (ha)	Province Name
Nature Reserve (Cagar Alam)	1	Tnagkoko Batu Angus	3,196	North Sulawesi Province
	2	Gunung Dua Saudara	4,299	North Sulawesi Province
	3	Gunung Lokon	100	North Sulawesi Province
	4	Gunung Ambang	8,638	North Sulawesi Province
	5	Tangale	113	Gorontalo Province
	6	Mas Popaya Raja	160	Gorontalo Province
	7	Panua	45,000	Gorontalo Province
	8	Tanung Api	4,246	Central Sulawesi Province
	9	Morowali	225,000	Central Sulawesi Province
	10	Pangi Binanga	6,000	Central Sulawesi Province
	11	Pegunungan Faruhumpenai	90,000	South Sulawesi Province
	12	Kalaena	110	South Sulawesi Province
	13	Ponda-Ponda	80	South Sulawesi Province
	14	Bulu Saraung	5,690	South Sulawesi Province
	15	Bantimurung	1,000	South Sulawesi Province
	16	Karaenta	1,000	South Sulawesi Province
	17	Lamedae	500	Southeast Sulawesi Province
	18	Napabalano	9	Southeast Sulawesi Province
		Sub-Total	395,141	
Wildlife Reserve (Suaka Margasatwa)	1	Nantu	31,215	North Sulawesi Province
	2	Gunung Manebbu-Nembu	6,500	North Sulawesi Province
	3	Karangkelang Utara dan Selatan	21,400	Gorontalo Province
	4	Pinjam/Tanjung Mantop	1,613	Central Sulawesi Province
	5	Dolangan	463	Central Sulawesi Province
	6	Pati-Patai	198	Central Sulawesi Province
	7	Lombuyan 1 & 2	3,665	Central Sulawesi Province
	8	Bangkiriang	12,500	Central Sulawesi Province
	9	Lampoko Mampie	2,000	West Sulawesi Province
	10	Komara	3,390	South Sulawesi Province
	11	Bonto Bahari	4,000	South Sulawesi Province
	12	Tanjung Peropa	38,000	Southeast Sulawesi Province
	13	Tanjung Amelengo	850	Southeast Sulawesi Province
	14	Tanjung Batikolo	5,500	Southeast Sulawesi Province
	15	Buton Utara	82,000	Southeast Sulawesi Province
		Sub-Total	213,293	
National Park (Taman Nasional)	1	Bunaken (Marine)	89,065	North Sulawesi Province
	2	Bogani Nani Wartabone	287,115	North Sulawesi/Gorontalo Province
	3	Lore Lindu	229,000	Central Sulawesi Province
	4	Taka Bonerate (Marine)	530,765	South Sulawesi Province
	5	Rawa Aopa Watumohai	105,194	Southeast Sulawesi Province
	6	Kepulauan Wkatobi (Marine)	1,390,000	Southeast Sulawesi Province
		Sub-Total	2,631,139	
Nature Recreational Park (Taman Wisata Alam)	1	Batu Angus	635	North Sulawesi Province
	2	Batu Putih	615	North Sulawesi Province
	3	Air Terjun Wera	250	Central Sulawesi Province
	4	Danau Matano	30,000	South Sulawesi Province
	5	Danau Towuti	65,000	South Sulawesi Province
	6	Nanggala 3	500	South Sulawesi Province
	7	Sidrap	500	South Sulawesi Province
	8	Lejja	1,265	South Sulawesi Province
	9	Cani Sirenrang	3,125	South Sulawesi Province
	10	Kepulauan Kapoposang	50,000	South Sulawesi Province
	11	Bantimurung	18	South Sulawesi Province
	12	Goa Patunuang	1,500	South Sulawesi Province
	13	Malino	3,500	South Sulawesi Province
	14	Mangolo	5,200	Southeast Sulawesi Province
	15	Tirita Rimba	500	Southeast Sulawesi Province
	16	Teluk Lasolo	81,800	Southeast Sulawesi Province
		Sub-Total	244,408	
Hunting Game Reserve (Taman Buru)	1	Landusa Tomata	5,000	Central Sulawesi Province
	2	Komara	4,610	South Sulawesi Province
		Sub-Total	9,610	
Grand Forest Park (Taman Hutan Raya)	1	Palu	8,100	Central Sulawesi Province
	2	Murhum	8,146	South Sulawesi Province
		Sub-Total	16,246	
		Total	3,509,837	

Source : Directorate of Conservation Area, Directorate General of Forest Protection and Naure Conservation, the Department of Forestry (December 2001)



Source: Eco-regional Conservation Assessment Sulawesi – Indonesia Sulawesi Road M/P & F/S JICA study team data Year 2007

Figure 12.4.3 Location of the Major Conservation Areas in Sulawesi Island

(5) Biodiversity

Wallace's Line passes through the west side of Sulawesi Island while Weber's Line is at the east side. Both these lines are very essential for zoology, botany and biology. In the taxonomy of its fauna and flora, Sulawesi Island is similar to Madagascar Island of Africa.

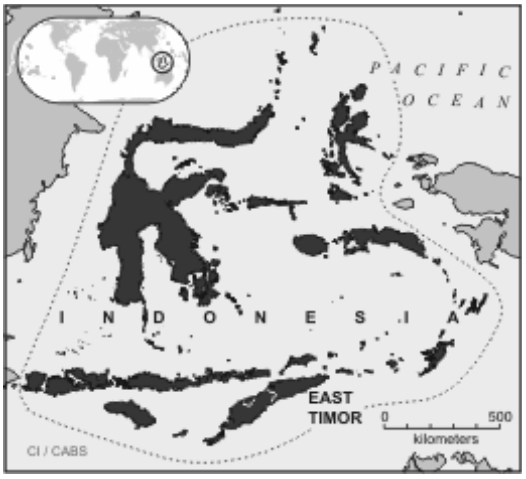
Wallacea is famous and rich in biogeography. It consists of many islands in Eastern Indonesia and includes Sulawesi Island (178,700 km2). Sulawesi is the biggest island in the group occupying about 53% of the total land area and is located in northwest part of Wallacea.

Wallacea has a large number of species that is found nowhere else in the world, in part because it is tropical and made up of many islands and also because of its complex geological history. Its total number of species is estimated at about 11,400 with a high potential of unconfirmed species in Wallacea's biogeographic realm. The area contributes to their isolation and the evolution of many unique species.

Table 12.4.5 Diversity and Endemism in Wallacea

Taxonomic Group	Species	Endemic Species	Percent Endemism	Endemic Species (samples)
Plants	10,000	1,500	15.0%	
Mammals	222	127	57.2%	babirusa, anoa, tarsiers, kuskus, sulawesi palm civet, celebes black macaque etc.
Birds	647	262	40.5%	maleo, matinan flycatcher, white-tipped monarch, taliabu masked-owl, sulawesi red-knobbed hornbill etc.
Reptiles	222	99	44.6%	calamorhabdium, rabdion, cyclotyphlops etc.
Amphibians	48	33	68.8%	sulawesi toad, green flog, common green turtle etc.
Freshwater Fishes	250	50	20.0%	halfbeak, goby, oryzia etc.
	11,389	2,071	18.2%	

Threat Categories: CR = Critically Endangered; EN = Endangered; VU = Vulnerable; EW = Extinct in the Wild
Endemism: Single = endemic to one hotspot; Multiple = not endemic to any one hotspot, but to the combined area of two or more hotspots



Source: Biodiversity Hotspots –Wallacea-

Figure 12.4.4 Location of Wallacea

Most of these endemic and essential species can be found in the conservation areas such as national parks, nature reserves and so on. Since endangered species, such as Maleo which is in the Red Data Book, are part of the critical biodiversity, the development of the conservation areas should be controlled by the regional government.

There are still a lot of endemic species that are not totally known and confirmed, including their habitat, surrounding conditions, nesting, etc. This necessitates the development of research and investigation for fauna and flora in Sulawesi Island to further confirm and study essential species their biodiversity for the foreseeable future.

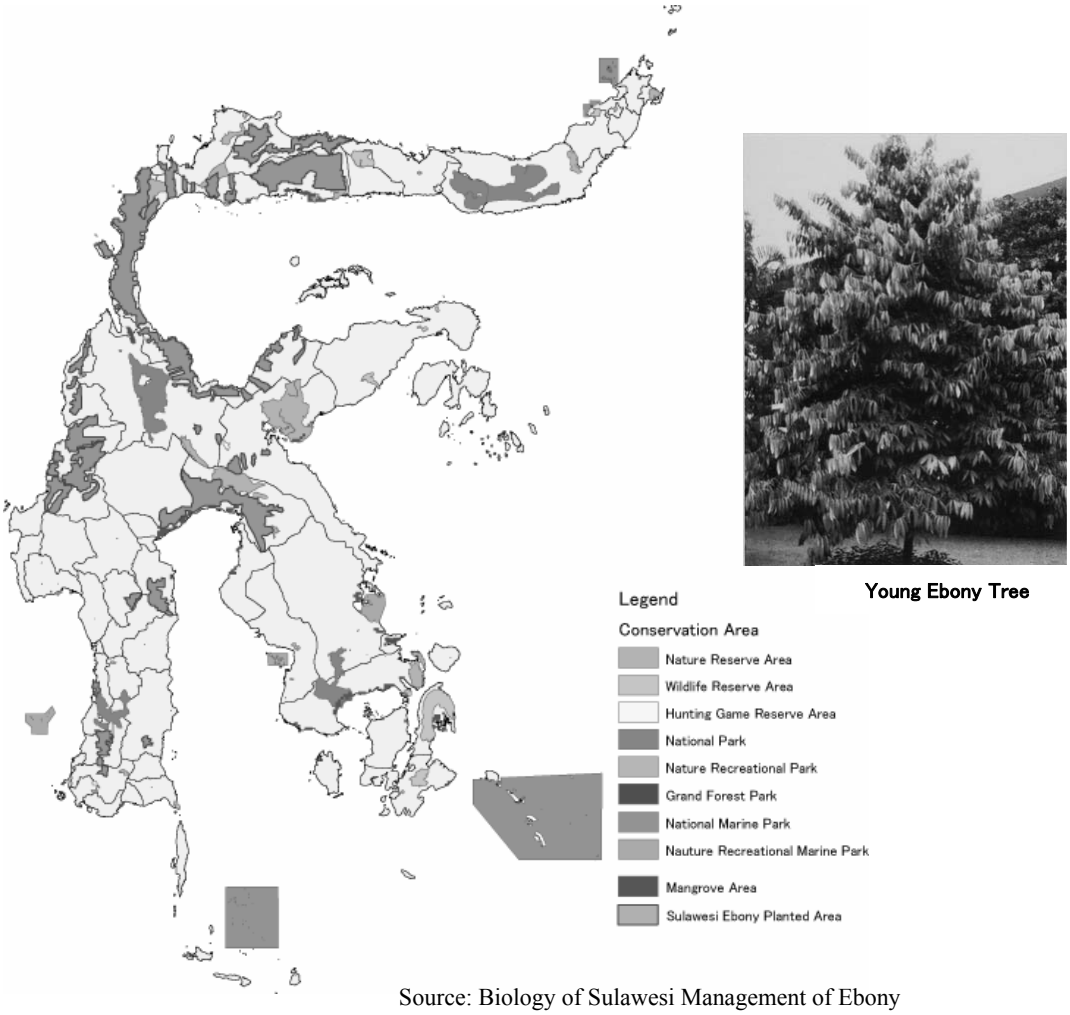
1) Plants

Although the flora of the island region is not well-known, it is estimated that there are about 10,000 species of vascular plants, with roughly 1,500 endemic species and at least 12 endemic genera. There are about 500 endemic species on Sulawesi and percent endemism is about 5%.

The mmangrove and ebony are protected and prohibited from being cut down. The mangrove is distributed throughout the coastal areas of Gorontaro, South Sulawesi and Southeast Sulawesi Province. The Sulawesi ebony tree is scattered mainly in mountainous areas of Central Sulawesi, West Sulawesi and South Sulawesi Province. Central Sulawesi is a well known source of ebony trees and their cutting for export is prohibited without the proper processing and procedures.

Ebony Tree (Kayu Hitam)

Source : Provincial Tourist Board



Young Ebony Tree

Source: Biology of Sulawesi Management of Ebony

Figure 12.4.5 Location of the Major Conservation Areas in Sulawesi Island

2) Birds

There are about 650 regularly occurring bird species in Wallacea, and roughly 262 (about 40 %) of these are endemic. There are also 29 endemic genera. As a testimony to the diversity and endemism of Wallacea, ten Endemic Bird Areas (EBAs) have been included in the hotspot by BirdLife International.

Sulawesi has the largest fauna, with 356 species, including 96 endemics. Some 50 bird species are threatened with extinction in this hotspot.

Among them the maleo (Macrocephalon maleo, EN) is famous for their behavior. This chicken-like bird builds earth mounds (including dummy mounds) wherein they bury their eggs. The young birds come out of their mounds after three months already feathered in adult plumage.

Maleo (Celebes Mound Builder)

Blyth's Hornbill

Lilac-cheeked Kingfisher

Sulawesi golden owl

Source : Provincial Tourist Board

Table 12.4.6 Main Endemic Birds of Sulawesi Island

Species name	Number	Remaks (for example)
Eagles and Hawks	6	Sulawesi serpent-eagle etc.
Mound Builders	2	Maleo etc.
Rails	3	Blue-faced rail etc.
Snipe	1	Sulawesi Woodcock
Pigeons and Dove	8	White-bellied imperial pigeon etc.
Parrots	9	Ornate lorikeet etc.
Cuckoos	4	Yellow-billed Malkoha etc.
Masked Owls	2	Sulawesi owl etc.
True Owls	2	Ochre-bellied boobook owl etc.
Nightjars	1	Diabolical nightjar
Kingfishers	6	Lilac-breasted kingfisher etc.
Bee-eaters	1	Purple-bearded bee-eater
Rollers	1	Sulawesi roller
Hornbills	2	Sulawesi dwarf hornbill etc.
Woodpeckers	2	Sulawesi woodpecker etc.
Cuckoo-Shrikes	5	Sulawesi cuckoo-shrike etc.
Babblers	2	Sulawesi babbler etc.
Thrushes	4	Great shortwing etc.
Warblers	2	Sulawesi leaf-warbler etc.
Flycatchers	6	Rufous-throated flycatcher etc.
Whistlers	3	Sulphur-bellied whistler etc.
Flowerpeckers	3	Crimson-crowned flowerpecker etc.
Sunbirds	3	Red-faced honeyeater etc.
White-eyes	3	Pale-bellied white-eye etc.
Mynas and Starlin	5	White-necked myna etc.
Wood-swallows	1	Ivory-backed woodswallow
Crows	1	Piping crow
total	88	

Source : The Ecology of Sulawesi (Ecology of Indonesia Series)

3) Mammals

More than 125 of Wallacea's 220-plus mammal species are found nowhere else in the world and they have a high level of mammal endemism. If endemism is recalculated to exclude more than 125 species of bats (because they disperse easily) in the Madagascar and Sundaland hotspots, the level of mammal endemism of Wallacea still stands at an astonishing 88 percent.

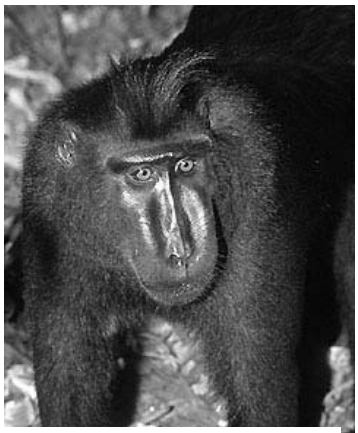
Source : Provincial Tourist Board

One of the most unusual mammals in Sulawesi is the babirusa (Babyrousa babyrussa, VU) that is very famous and protected. Babirusas (literally "pig-deer" in Bahasa-Indonesian) are pig-like animals characterized by the male's long recurved tusks that penetrate its upper lip.

Source : Provincial Tourist Board

Another famous protected mammal is two species of anoas, or dwarf buffaloes, which are endemic to the forests of Sulawesi. The lowland anoa (Bubalus depressicornis, EN) and the mountain anoa (Bubalus quarlesi, EN) can be found in the conservation areas, national parks and forests of Sulawesi.

A number of endemic primates are also found in Sulawesi island. There are at least seven species of endemic macaques and at least five species of endemic tarsiers. The Celebes black Macaque is seriously threatened with extinction among endemic macaques in Sulawesi. Another rate primate is the spectral tarsier which are tiny, goggle-eyed creatures that resemble mammalian tree frogs more than monkeys. They can be found in various conservation areas and national parks.



Source : Provincial Tourist Board

The Sulawesi palm civet (Macrogalidia musschenbroekii, VU), which as the name suggests is found only in Sulawesi. The palm civet along with around 25 species of rodents still range the islands.

Unfortunately, about one-third of endemic mammals in this hotspot are threatened with extinction.

Table 12.4.7 Mammals of Sulawesi Island

Species name	Number	Remaks (for example)
Phalangers	3	Dwarf cuscus etc.
Shrews	9	Long-tailed shrew etc.
Frut Bats	23	Sulawesi rousette etc.
Tomb Bats	5	Philippine sheath-tailed bat etc.
False Vampires	1	Lesser false vampire
Horseshoe Bats	4	Sulawesi horseshoe bat etc.
Leaf-nosed Bats	6	Dusky leaf-nosed bat etc.
Evening Bats	21	Grey large-footed bat etc.
Free-tailed Bats	2	Sulawesi hairless bat etc.
Rats	46	Sulawesi giant-rat etc.
Squirrels	8	Sulawesi lomg-nosed squirrel etc.
Porcupines	1	Javan porcupine
Monkeys	4	Black-crested macaque etc.
Tarsiers	1	Sulawesi tarsier
Civets	3	Sulawesi civet etc.
Buffalo	2	Lowland anoa, Mountain anoa
Deer	1	Rusa
Pigs	2	Babirusa, Sulawesi pig
total	142	

Source : The Ecology of Sulawesi (Ecology of Indonesia Series)

4) Amphibian

The amphibian species of Sulawesi Island is not yet fully documented and studied. There is a need to conduct further studies and surveys regarding endemic amphibian species to confirm their nature and biodiversity.

The confirmed amphibian species in Sulawesi Island at present are shown in Table 12.4.8.

Table 12.4.8 Amphibian Species of Sulawesi Island

Species name	Number	Remaks (for example)
Toads	2	Bufo celebensis etc.
Narrow-mouthed toads	7	Oreophryne variabilis etc.
True frogs	14	R. arathooni etc.
Tree frogs	4	Polypedetes leucomystax etc.
total	27	

Source : The Ecology of Sulawesi (Ecology of Indonesia Series)

Yellow and brown toad

Sulawesi green toad

Source : Provincial Tourist Board

5) Reptiles

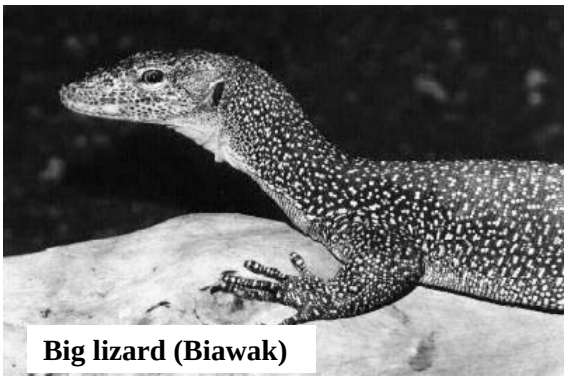
The confirmed species of snakes in Sulawesi Island at present are shown in Table 12.4.9. There are 64 snake species in Sulawesi Island, which includes poisonous varieties such as cobras, etc.

Table 12.4.9 Snakes of Sulawesi Island

Species name	Number	Remaks (for example)
Blind snakes	3	Rhamphotyphlops braminus etc.
Cylinder snakes	2	Cylindrophis melanotus etc.
Pythons	3	Candoia carinata etc.
Sunbeam snakes	1	Xenopeltis unicolor
Wart snakes	1	Acrochordus granulatus
Colubrid snakes	40	Psammodynastes pulverulentus etc.
Cobras, Coral snakes and Sea snakes	12	Bungarus candidus etc.
Vipers	2	Trimeresurus wagleri etc.
total	64	

Source : The Ecology of Sulawesi (Ecology of Indonesia Series)

The confirmed lizards in Sulawesi Island at present are shown in Table 12.4.10. There is information that crocodiles inhabit the northern part of Central Sulawesi Province. A big lizard of over 1m in length can also be found in and around Makassar City. Although it looks ferocious, the lizard is very timid.



Big lizard (Biawak)

Source : Provincial Tourist Board

Table 12.4.10 Reptiles of Sulawesi Island

Species name	Number	Remaks (for example)
Agamidae	7	Bronchocoela cristatella etc.
Dibamidae	1	Dibamus novaeguineae
Gekkonidae	10	Cosymbotus platyurus etc.
Scincidae	29	Carlia melanopogon etc.
Crocodylidae	2	Crocodylus porosus etc.
total	49	

Source : The Amphibians and Reptailes of Sulawesi, with Notes on The Distribution and Chromosomal Number of Frogs

The confirmed turtle species in Sulawesi Island are shown in Table 12.4.11. Turtle egg laying areas around Sulawesi Island is shown in Figure 12.4.6.

Table 12.4.11 Turtle Species of Sulawesi Island

Species name	Number	Remaks (for example)
Cheloniidae	4	
Dermochelyidae	1	
Emydidae	2	Cuora amboinensis etc.
Testudinidae	1	Indotestudo forsteni
total	8	

Source : The Amphibians and Reptailes of Sulawesi, with Notes on The Distribution and Chromosomal Number of Frogs

Common green turtle

Source : BAPEDALDA

Figure 12.4.6 Location of Turtles Egg-laying areas around Sulawesi Island

6) Freshwater Fishes

Nearly all of the more than 300 freshwater fish species are found in Wallacea and about 75 of these species are endemic. On the island of Sulawesi alone, there are nearly 70 known fish species, about three-quarters of which are endemic. The Malili Lakes in South Sulawesi have at least 15 endemic and quite beautiful telmatherinid fishes, including three endemic Oryzias, two endemic halfbeaks, and seven endemic gobies.

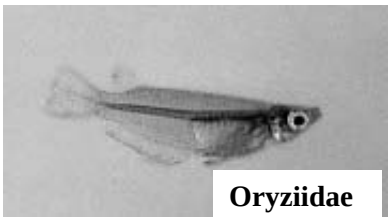
Other than helping promote the natural wonders of Sulawesi Island, there is an evident hope that the areas' remarkable endemic species will bring both national and international attention to the areas to help promote its protection and likewise improve the development of the local people.

There is a need to strike a good balance between safeguarding biological diversity, the traditional way of life of the communities, and allowing sustainable development and improved access to basic services such as healthcare, education and transport. The communities of Sulawesi Island are perhaps the key stakeholders in the conservation of its natural reserves and Sulawesi Island as a whole.

Table 12.4.12 Freshwater Fishes in Sulawesi's Rivers

Species name	Number	Remaks (for example)
Gobiidae	2	Sicyopterus sp. etc.
Eleotridae	2	Oxyeleotris marmorata etc.
Cichlidae	2	Oreochromis mossambicus Trewavas etc.
Cyprinidae	3	Osteochilus hasselti etc.
Channidae	1	Channa striata
Belontiidae	1	Trichogaster trichopterus
Aplocheilidae	1	Aplocheilus panchax
Clariidae	1	Clarias batrachus
Scorpaenidae	1	Pterois sp.
Poeciliidae	2	Poecilia reticulata Schuster etc.
Centropomidae	1	Chanda sp.
Oryziidae	2	Oryzias celebenis etc.
Hemirhamphidae	2	Hemirhamphus sp. etc.
total	21	

Source : The Inland Fishes and The Distribution of Adrianichthyoidea of Sulawesi Island, with Special Comments on The Endangered Species in Lake Poso



Oryziidae

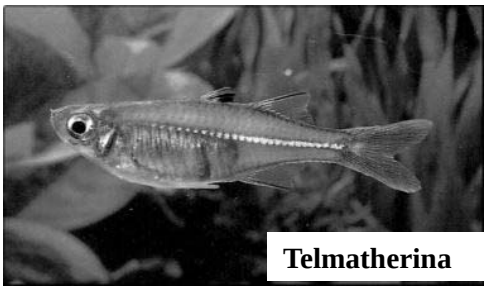
Dermogenys pusillus

Source : Provincial Tourist Board

Table 12.4.13 Freshwater Fishes of Sulawesi's Lakes

Species name	Number	Remaks (for example)
Adrianichthyidae	3	Adrianichthys kruyti etc.
Oryziidae	6	Oryzias celebensis etc.
Gobiidae	3	Webrgobius amadi etc.
Hemirhampidae	4	Dermogenys megarrhamphus etc.
Eleotridae	2	Ophieleotris aporos etc.
Atherinidae	3	Telmatherina celebensis etc.
Belontiidae	1	Trichogaster trichopterus
Cyprinidae	3	Cyprinus carpio etc.
Channidae	1	Channa striata
Poeciliidae	1	Poecilia reticulata
Aplocheilidae	1	Aplocheilus panchax
Clariidae	2	Clarias batrachus etc.
Cichlidae	2	Oreochromis mossambica etc.
Anguillidae	1	Anguila sp.
Anabantidae	2	Anabas testudineus etc.
total	35	

Source : The Inland Fishes and The Distribution of Adrianichthyoidea of Sulawesi Island, with Special Comments on The Endangered Species in Lake Poso



Telmatherina

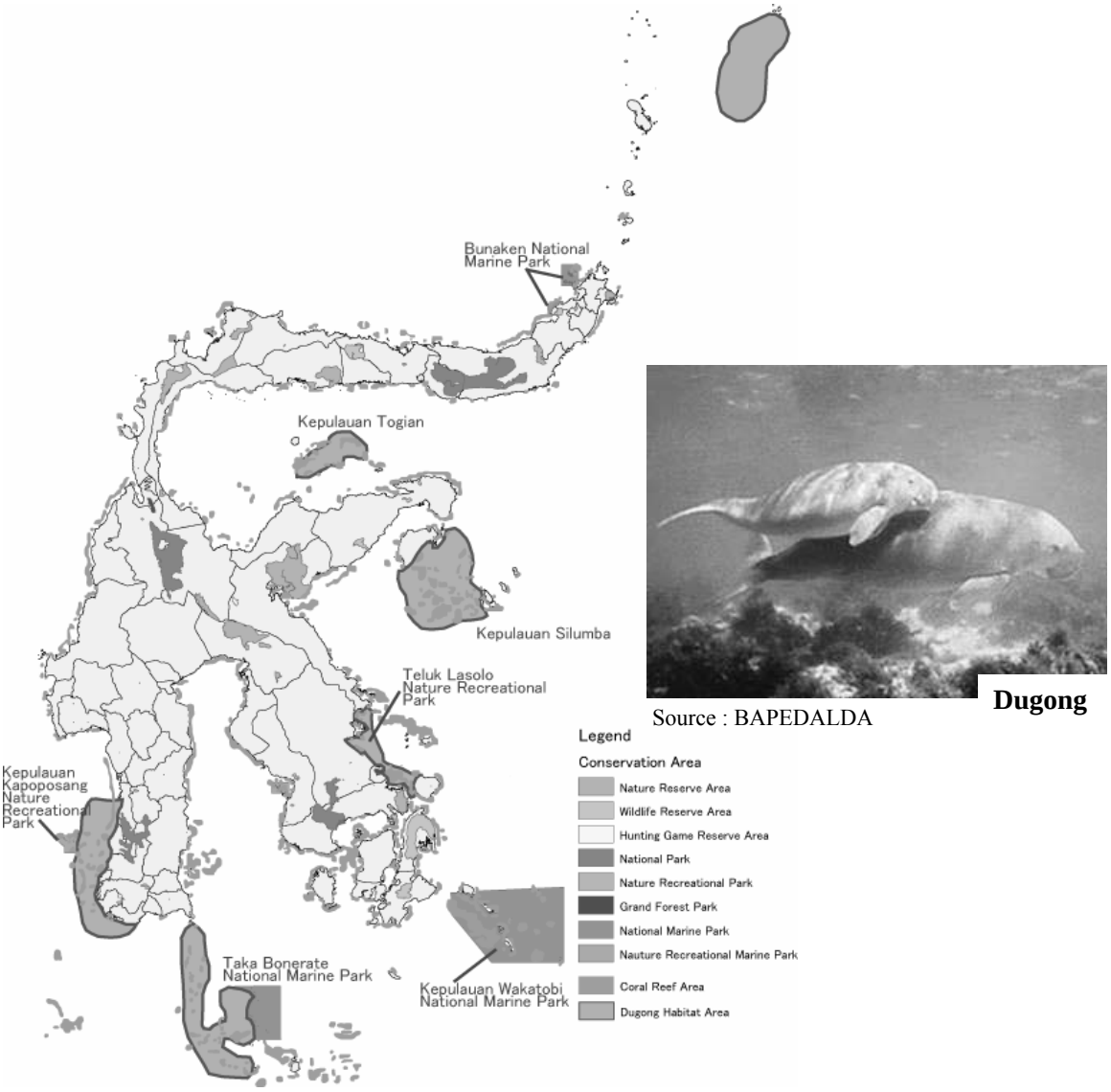
Oryzias celebensis

Source : Provincial Tourist Board

7) Coral Reefs and the Dugong Habitat around Sulawesi Island

Important coral biodiversity is scattered around Sulawesi Island as shown in Figure 12.4.7. The coral reef is useful for the preservation of the biodiversity and fishery production. In addition, it is favorable for tourism resources. Sulawesi Island has three National Marine Parks and two Nature Recreational Marine Parks.

Dugong habitat areas can be found around Sulawesi Island and they venture into some National Marine Parks and coral reef areas. The International Union for Conservation of Nature and Natural Resources (IUCNNR) lists the dugong as a species vulnerable to extinction, while the Convention on International Trade in Endangered Species limits or bans the trade of derived products based on the population involved including the dugong.



Dugong

Source : BAPEDALDA

Figure 12.4.7 Location of Coral Reefs and Dugong habitat around Sulawesi Island

(6) Air Pollution

The main industries in Sulawesi Island are agriculture, processing of agricultural products, mining and cement products etc. Therefore, air pollution sources are mainly motorcycles and vehicles, it is assumed that the growth of traffic volume will be directly connected with the deterioration of air quality.

The air quality condition in the Mamminasata area where Makassar, the biggest city of Sulawesi Island is located, is not so bad as showed by the result of on-site survey. Although TSP (dust) densities and PM_{10} levels showed relatively high levels other items produced lower values compared with air quality environmental standards.

If the regulation on strict exhaust gas emission is processed, it can be assumed that air quality conditions will not dramatically worsen even if future traffic volumes will increases. Moreover, the increasing use of bio-fuels (i.e. ethanol and bio-diesel oil) is expected to contribute to this phenomenon.

Table 12.4.14 Air Quality Condition in the Mamminasata Area (2007)

	NO.	SO_2 µg/Nm3	CO µg/Nm3	NO_2 µg/Nm3	O_3 µg/Nm3	HC µg/Nm^3	PM_{10} µg/Nm3	TSP µg/Nm3	Pb µg/Nm3
Urban Area	Sungguminasa crosspoint	17.2	133.7	32.5	3.9	15.6	79.0	322.2	0.003
	Batua Raya street	14.7	101.3	42.5	5.9	15.8	80.7	239.1	0.005
Sub-urban Area	Kantor Bupati Maros	10.0	84.3	25.9	3.8	16.3	43.8	168.2	0.003
	Daya crosspoint	9.8	148.3	31.2	2.9	14.0	84.6	169.3	0.006
	Hertasning street	10.7	101.0	33.7	4.4	14.3	77.1	126.3	0.004
	Limbung (National road)	10.8	135.3	30.9	4.2	23.8	42.4	150.2	0.003
	Kantor Bupati Takalar	9.3	101.4	35.4	4.7	19.3	44.9	146.3	0.002
Rural Town Area	Mandai crosspoint (New road)	9.5	95.9	34.6	4.9	13.4	39.5	121.3	0.003
	Palleco (National road)	11.5	133.1	29.5	5.1	17.0	41.0	140.3	0.001
	Galesong Utara (Takalar)	11.9	89.5	34.0	4.5	12.4	57.2	110.3	0.001
	Samata (Gowa)	13.7	90.4	40.4	4.3	15.8	57.2	113.0	0.001
	ADS street (Manggala)	13.7	128.9	39.3	5.9	19.0	48.5	152.3	0.002
Rural Area	Baronbong (National road)	11.9	84.3	36.2	4.1	14.7	68.7	124.5	0.001
	Moncongloe (Maros)	10.6	117.5	30.3	4.2	13.3	53.8	150.6	0.001
	Panaikang (Gowa)	11.0	87.9	39.6	4.2	14.6	59.0	124.1	0.001
	Bontmaranu (Gowa)	9.8	92.2	31.7	4.4	12.4	58.4	96.1	0.001
	Malino street (Gowa)	12.7	105.7	35.2	5.5	18.8	62.5	123.3	0.001
	Bajeng (Gowa)	11.9	102.1	32.3	4.8	14.7	58.9	145.6	0.001
Environmental Standard	National standard for ambient air quality *2)								
	measured duration 1 hour	900	30,000	400	235	-	-	-	-
	measured duration 3 hours	-	-	-	-	160	-	-	-
	measured duration 24 hours	365	10,000	150	-	-	150	230	2.00
	Local standard for ambient air quality *3)								
	measured duration 1 hour	900	30,000	400	230	-	-	-	-
	measured duration 3 hours	-	-	-	-	160	-	-	-
	measured duration 24 hours	360	10,000	150	-	-	150	230	2.00

Notes: Exceeding the standard value
Source:
*1) Sulawesi Road M/P & F/S JICA study team data Year 2007
*2) Government Regulation regarding Control of Air Pollution No.41-1999
*3) Governor's Regulation of South Sulawesi Province No. 14-2003
*4) Governor's Dgree of the Minister for Environment concerning Guidekines for Establishment of Environmental Quality Standards No.2-1988
*5) Governor's Dgree of South Sulawesi Province No.465-1995

(7) Noise Levels

Compared with air quality levels, the noise levels along Mamminasata's main areas have worser conditions. The main reasons for these are the large volume of motorcycle usage, the driving customs of local drivers and the frequent usage of motorcycle horns.

It is anticipated that the introduction of better muffler technologies as well as the intensification of noise controls and regulations will be quickly applied. Also important are the mitigation measures on soundproofing as well as air conditioning on hospitals and schools near national roads. Buffer zones such as roadside trees along main lines is likewise effective in reducing traffic noise.

Table 12.4.14 Noise Levels in the Mamminasata Region

	NO.	L_{50} dB(A)		Average	Remarks
		daytime	night		
Urban Area	Sungguminasa crosspoint	76.2	66.5	71.3	National road
	Batua Raya street	73.6	65.7	69.4	City road
Sub-urban Area	Kantor Bupati Maros	72.8	66.2	69.5	National road
	Daya crosspoint	75.1	63.8	69.5	National road
	Hertasning street	74.8	60.2	67.5	City road
	Limbung (National road)	71.9	59.0	65.5	National road
	Kantor Bupati Takalar	70.3	56.0	63.2	National road
Rural Town Area	Mandai crosspoint (New road)	71.9	54.3	63.1	National road
	Palleco (National road)	71.3	54.4	62.8	National road
	Galesong Utara (Takalar)	58.8	49.5	54.1	Provincial road
	Samata (Gowa)	64.0	55.9	60.0	City road
	ADS street (Manggala)	65.9	51.2	58.6	City road
Rural Area	Baronbong (National road)	70.9	62.3	66.6	National road
	Moncongloe (Maros)	66.2	59.1	62.6	Kabpaten road
	Panaikang (Gowa)	60.0	52.8	56.4	Kabpaten road
	Bontmaranu (Gowa)	60.9	51.9	56.4	Kabpaten road
	Malino street (Gowa)	70.2	57.4	63.8	Provincial road
	Bajeng (Gowa)	58.6	50.9	54.7	Kabpaten road
Environmental Standard	Area classification		National	Provincial	
	Commercial and Service		70.0	70.0	
	Industry		70.0	70.0	
	Office Buildings and Commercial		65.0	65.0	
	Recreation		70.0	65.0	
	Government and Public Facilities		60.0	60.0	
	Housing and Settlement		55.0	55.0	
	Green Open Space		50.0	50.0	

Notes: Exceeding the standard value
Source:
*1) Sulawesi Road M/P & F/S JICA study team data Year 2007
*2) Government Regulation regarding Control of Air Pollution No.41-1999
*3) Governor's Regulation of South Sulawesi Province No. 14-2003

(8) Proposed Specie Indicator on Natural Environment Grades

The Study Team proposes a specie indicator on the following animals:

Babirusa is the strangest and most famous animal species in Sulawesi Island. It inhabits the mountainous areas especially North Sulawesi, Gorontaro and Central Sulawesi provinces.

The anoa branches into two separate species: the mountain and lowland anoa. Although its habitat is widely distributed throughout Sulawesi its number are rapidly decreasing.

Celebes black macaque is most kwown primate species that inhabits Sulawesi Island. The habitat area of this species is mainly located in the Tangkoko Natural Reserve in North Sulawesi Province.

The spectral tarsier inhabits a wide range of mountainous areas as well as the conservation area of Sulawesi Island. Its habitat are in Tangkoko and Morowali Nature Reserves.

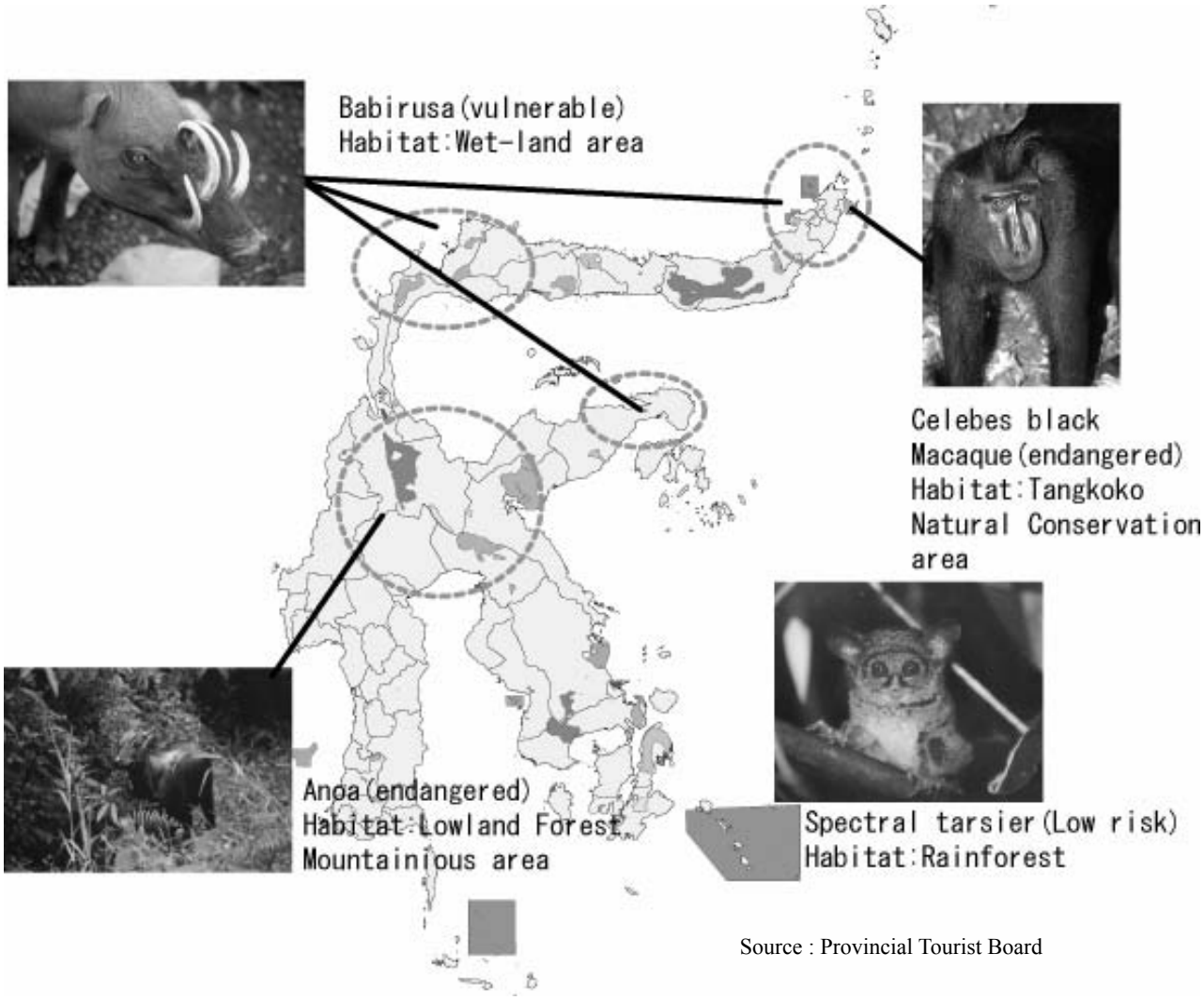


Figure 12.4.8 Selected Indicator species (Mammals)

The maleo is a remarkable bird species whose habitat is widely spread throughout Sulawesi

Island except for South Sulawesi Province. Its known habitat area are the Tangkoko Nature Reserve, Bogani Nani Wartabone National Park, Lore Lindu National Park, Morowali Nature Reserve, Rawa Aopa Watomohai National Park and other areas.

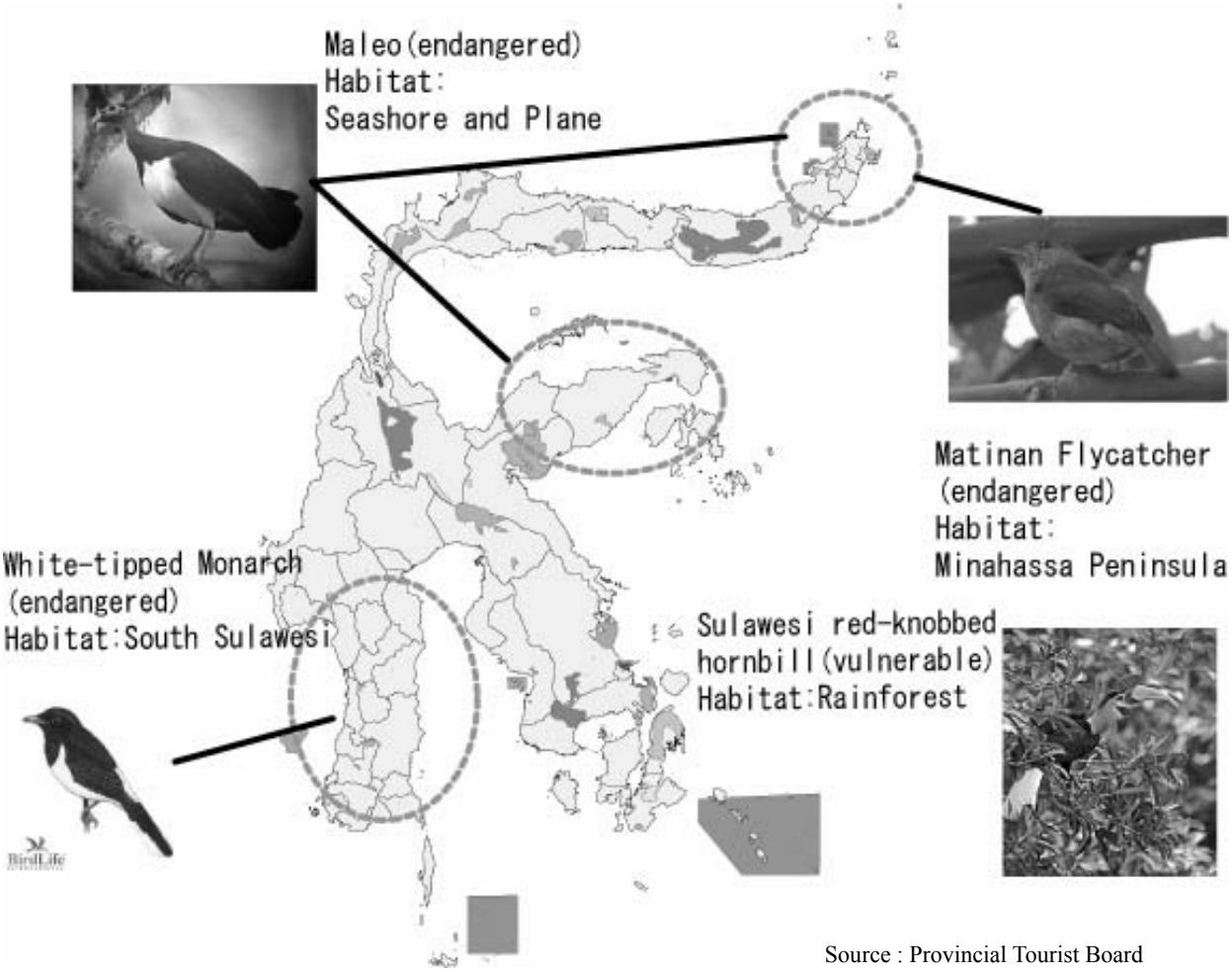


Figure 12.4.9 Selected Indicator species (Birds)

12.5 Evaluation of Pollution

(1) Pre-Construction

It has been surmised that pre-construction impacts impacts on the natural environment is almost non-existent. Even tehn, it is still important to anticipate the method of construction, plans, schedules and the corresponding mitigation measures in this phase. The proper construction machine schedule, process of construction, manpower plans and other preparatory activities are requisites in the arrangement of smooth construction activities so as to ensure the reduction of negative impacts on the natural environment.

The road development plan basically does not pass through nature reserves and national park areas. In cases of improvement (i.e. widening, pavement construction, etc.) for existing roads that passes through nature reserve and national park areas, it is preferable to consider and prepare programs for selecting protection zones, alternative areas and the use of other effective mitigation measures for fauna and flora (especially above-mentioned the indicator species).

(2) Construction

1) Air Pollution

Impacts on air quality are relatively small considering that the number of construction machines and conveyance trucks and vehicles are limited. On the other hand, since construction will mainly be done during the dry season, countermeasures will be necessary to reduce dust and TSP particles.

Dust and TSP from the construction will be generated in a short period during the land leveling stage (excavation and filling). They can be minimized through countermeasures such as sprinkling water and road cleaning. Air pollution caused by the operation of construction machines can also be reduced by regular machine maintenance and efficiently scheduled operations.

2) Noise and Vibrations

Noise from construction machines can be reduced through regular maintenance and the efficient scheduling of operations. Noises in and around the construction areas should be monitored so that timely countermeasures can be undertaken. For example, it has been evaluated that noise impacts can be reduced through the proper scheduling of the operating hours of construction machines, especially near sensitive facilities such as the hospitals, schools and mosques.

The number of the vehicles and machines of construction is limited. The impacts of noise and vibration will be able to control by using proper mitigation measures, and the claim of noise and vibration by residential people will be reduced. Therefore, the environmental impact during the construction phase may be forecast and evaluated based on the result of study and appropriate

countermeasures for noise and vibration.

3) Water Pollution

BOD_5, COD and Total Suspended Solid (TSS) have relatively high indexes around highly dense or populated areas. However, in general the density of heavy metals has been surmised to be low considering that there are few polluting factories along the rivers.

Road construction however will increase the TSS in nearby river bodies. But they can be minimized through the installation of temporary sedimentation ponds during the early stage of construction. Pollution will also be limited because turbid water will be generated in a limited period during excavation and ground filling. Construction of bridge piers in the rivers should adopt the steel sheet pile method or other similar methods in order to avoid water turbidity.

Drainage water should be discharged after treating it properly of TSS, pH, oil and grease. It is also important to enforce regular monitoring to evaluate conditions and ensure river water standards. Storm water from construction sites will be more difficult to analyze because it is affected by a variety of conditions such as rainfall, reclamation, ground and soil. Therefore, environmental impacts may be evaluated through planned studies, programmed countermeasures and the scheduled monitoring of water pollution.

4) Fauna and Flora

If some unique species and/or other rare fauna and flora are discovered in the construction phase, it will be necessary to take the proper measures, such as instituting limited protection zones, considering alternative areas, etc.

There are countless fruit trees around houses and along roads. These trees should be protected as much as possible from the project, since most of these fruit trees are a source of money income for residents. An eco-friendly road project should design buffer zones including some existing crops.

(3) Post-Construction

1) Air Pollution (NOx)

The Study Team proposes the mathematical method in estimating the exhaust coefficient of the total NOx volume from the total road network. The exhaust coefficient of small and large vehicles with average speeds is shown Table 12.5.1. The flow of the mathematical method for the NOx volume forecast is shown in Figure 12.5.1.

Table 12.5.1 Exhaust Coefficient by Vehicle Type (NOx)

average speed (km/h)	p1	p2
10	0.34	3.79
20	0.29	3.33
30	0.24	2.87
40	0.20	2.41
50	0.21	2.16
60	0.23	1.90
70	0.25	2.10
80	0.27	2.29

NOx volume = (A1 x p1 + A2 x p2) x Q

A1 : Small Vehicles Volume (vehicles/day)
A2 : Large Vehicles Volume (vehicles/day)
Q : Traffic Volume (vehicles/day)

The effect of Proposed Project (road improvement, some realignments and so on) is evaluated by comparing the NOx volumes of both cases (i.e. with and without-project). In the "with-project" case increases in average speeds as a result of road improvements such as widening, alignment, pavement etc. is expected.

The average speed of all road networks in the "without-project" case has been calculated to be 25.4 km/h, while for the "with-project" case it is 35.4 km/h.

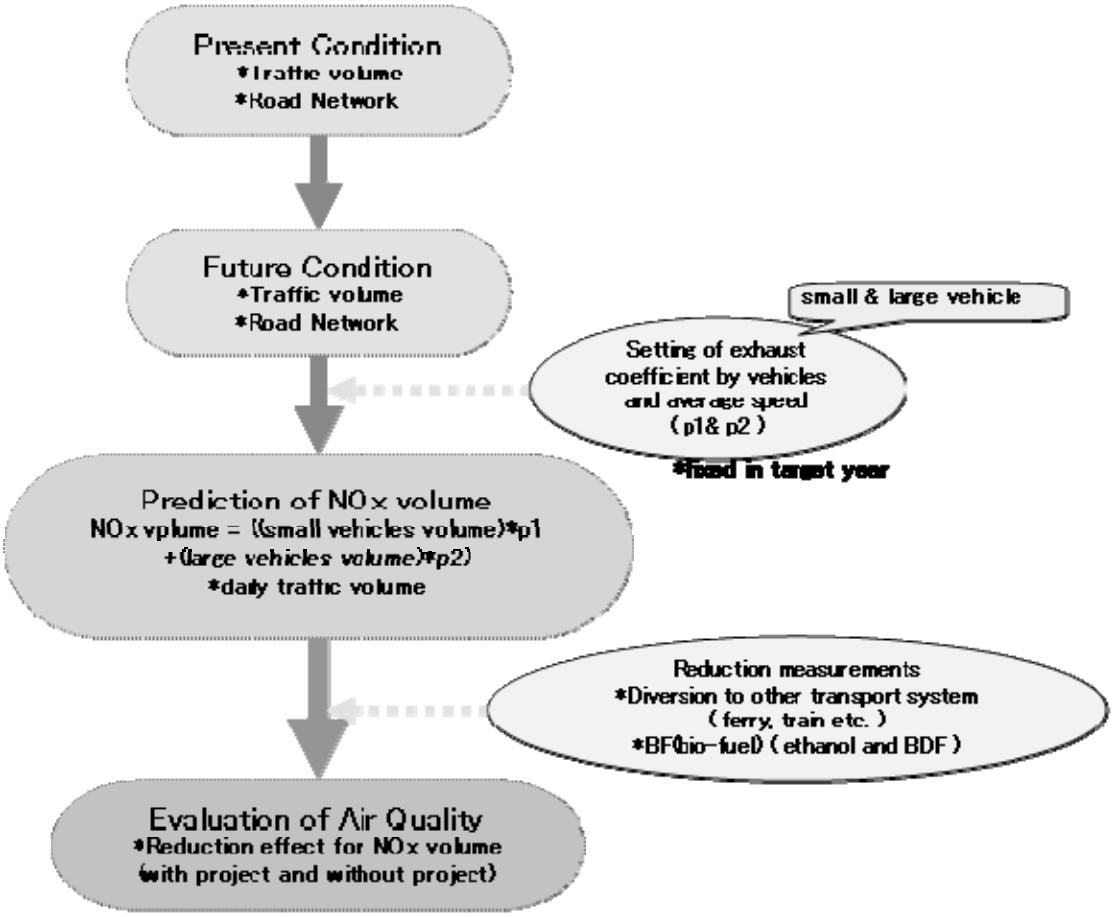


Figure 12.5.1 Prediction Flows in NOx Volumes

The increase in average speed (10 km/h up) is expected, while the reduction of NOx volume (14 %) is also anticipated in the implementation of the project (i.e. road improvement etc.). The anticipated NOx volumes is shown in Table 12.5.2.

Table 12.5.2 Results of NOx Volumes

	2007 present	2024 without	2024 with
NOx (g/km/day)	402.9	954.9	821.2
2024/2007	-	237.0%	203.8%
with/without	-	-	86.0%

Since bio-diesel fuel (BDF) and bio-ethanol will be used for construction machines, trucks and other vehicles the efficient reduction of air pollution is expected. BDF and bio-ethanol have been studied and developed as substitute fuels in Indonesia.

BDF is refined through the chemical reduction of palm oil and/or used oil. Bio-ethanol is produced by fermentation and distillation from sugar cane and corn. The merits and demerits in the se of bio-fuels are shown below:

Merits of BDF use:

- Reduction of SO2, NO2, SPM, Pb
- High safety and simple for usage
- Possible for mixing normal diesel fuel

Demerits of BDF use:

- Higher price than normal diesel fuel (about 1.5~2 times)
- Tough to get because limited distribution route

Merits of bio-ethanol use:

- No CO2
- Recyclable energy from vegetable.
- High efficiency of thermal energy.
- Possible for mixing with normal gasoline.

Demerits of bio-ethanol use:

- Price comparable with gasoline but production is limited.
- Hard to source due to limited distribution routes.

2) Noise Levels

The Study Team proposes the multi repression analysis among the traffic volume, vehicle composition ratio, urbanization levels and road grade in each survey point. Urbanization is classified into 5 levels: urban, semi-urban, city, town and rural. Road grade is also classified into 5 grades: national provincial, prefectural, county, town and village road. The flow of multi repression analysis for noise level forecast is shown in Figure 12.5.2.

The data applied in the multi repression analysis was the result of an on-site noise survey in the Mamminasata area for 2009.

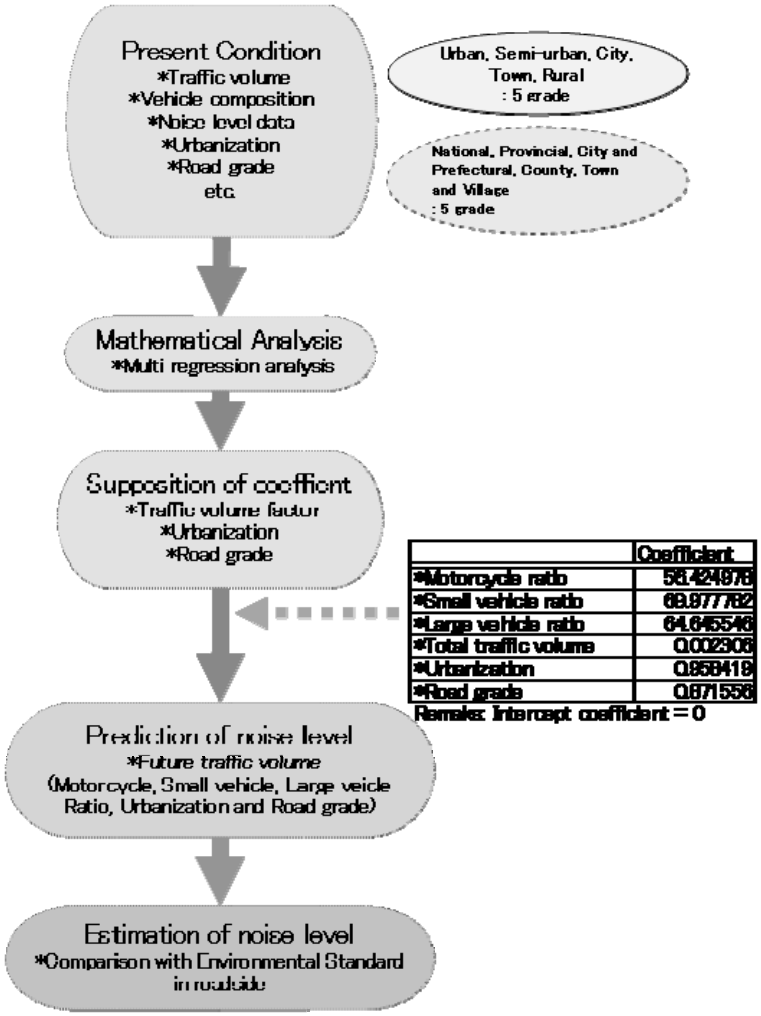


Figure 12.5.2 Prediction Flows of Noise Levels

The results of the forecasts are shown in Table 12.5.3 to Table 12.5.8. Around Manado, Palu, Makassar and Kendari City, where traffic will be concentrated, it is assumed that peak noise levels will exceed the 70 dB(A) environmental standard especially in and around commercial areas. Since traffic density is expected to increase in the future the necessary countermeasures especially in areas where hospitals and schools are located should be planned and put in place to protect them against the impact of noise pollution.

Table 12.5.3 Results of Forecast Peak Noise Levels in 2024 (around Manado area)

unit:vehicle/day

Section	link	2024 with								Noise level
		Motorcycle	Car/Taxi	Mini Bus	Large Bus	Pickup	Small Truck	Large Truck	Total	
Manado-1	169	332	270	682	160	320	126	20	1,910	**68.9**
Manado-2	311	1,742	1,840	2,838	800	1,022	1,174	436	9,852	**69.7**
Manado-3	**312**	3,766	2,674	6,620	1,644	3,134	2,734	1,322	21,894	**72.3**
Manado-4	**311**	7,176	5,546	12,836	3,066	4,124	3,716	1,462	37,926	**76.2**
Manado-5	**313**	4,866	3,944	8,804	2,086	2,190	2,250	960	25,100	**74.3**
Manado-6	**309**	5,232	4,320	9,510	2,240	2,034	2,154	878	26,368	**75.4**
Manado-7	**392**	3,766	2,730	6,644	1,644	3,134	2,734	1,322	21,974	**73.2**
Manado-8	**393**	3,766	2,730	6,644	1,644	3,134	2,734	1,322	21,974	**72.3**
Manado-9	L1	1,802	1,392	3,210	770	1,028	932	386	9,500	**72.2**
Manado-10	L77	3,158	2,210	5,990	1,280	692	854	422	14,606	**71.0**

Remarks: Noise level is shown as peak (maximum level).

Table 12.5.4 Result of Forecast Peak Noise Levels in 2024 (around Gorontalo area)

unit:vehicle/day

Section	link	2024 with								Noise level
		Motorcycle	Car/Taxi	Mini Bus	Large Bus	Pickup	Small Truck	Large Truck	Total	
Gorontalo-1	145	1,816	1,124	2,014	432	414	1,044	424	7,268	**68.3**
Gorontalo-2	**146**	182	300	238	372	268	620	612	2,592	**69.2**
Gorontalo-3	**147**	616	100	416	6	106	84	4	1,332	**65.4**
Gorontalo-4	**380**	2,228	1,194	1,716	748	366	706	464	7,422	**68.6**
Gorontalo-5	363	2,228	1,194	1,716	748	366	706	464	7,422	**68.6**
Gorontalo-6	**384**	2,228	1,194	1,716	748	366	706	464	7,422	**69.5**
Gorontalo-7	**371**	182	300	238	372	268	620	612	2,592	**69.2**
Gorontalo-8	374	804	1,190	1,622	684	408	878	492	6,078	**69.5**
Gorontalo-9	L75	798	400	654	378	374	704	616	3,924	**69.0**
Gorontalo-10	L76	574	794	938	576	320	980	404	4,586	**69.6**

Remarks: Noise level is shown as peak (maximum level).

Table 12.5.5 Results of Forecast of Peak Noise Levels in 2024 (around Palu area)

unit:vehicle/day

Section	link	2024 with								Noise level
		Motorcycle	Car/Taxi	Mini Bus	Large Bus	Pickup	Small Truck	Large Truck	Total	
Palu-1	55	1,124	908	1,342	514	514	1,154	516	6,072	**68.7**
Palu-2	56	612	950	1,128	514	252	1,078	234	4,768	**68.9**
Palu-3	58	868	534	550	324	282	1,212	354	4,124	**67.5**
Palu-4	85	924	862	1,178	214	426	1,118	86	4,808	**68.4**
Palu-5	**525**	1,124	908	1,342	514	514	1,154	516	6,072	**68.7**
Palu-6	542	1,506	1,002	1,588	716	684	1,314	678	7,488	**69.5**
Palu-7	**586**	3,992	1,650	3,930	358	886	2,850	526	14,192	**70.5**
Palu-8	**589**	3,992	1,650	3,930	358	886	2,850	526	14,192	**69.6**
Palu-9	**L8**	1,506	1,002	1,588	716	684	1,314	678	7,488	**68.7**
Palu-10	**L95**	1,506	1,002	1,588	716	684	1,314	678	7,488	**69.5**

Remarks: Noise level is shown as peak (maximum level).

Table 12.5.6 Results of Forecast of Peak Noise Levels in 2024 (around Mamuju area)

unit:vehicle/day

Section	link	2024 with								Noise level
		Motorcycle	Car/Taxi	Mini Bus	Large Bus	Pickup	Small Truck	Large Truck	Total	
Mamuju-1	34	244	1,106	666	456	500	1,754	308	5,034	**69.5**
Mamuju-2	35	244	1,106	666	456	500	1,754	308	5,034	**69.5**
Mamuju-3	**37**	756	934	936	172	278	886	86	4,048	**68.4**
Mamuju-4	49	6	36	0	18	8	6	0	74	**60.0**
Mamuju-5	213	774	984	1,002	200	416	1,068	172	4,616	**69.7**
Mamuju-6	214	18	82	106	40	154	254	86	740	**69.5**
Mamuju-7	**L119**	6	36	0	18	8	6	0	74	**60.0**
Mamuju-8	**L122**	12	46	106	22	146	248	86	666	**69.5**

Remarks: Noise level is shown as peak (maximum level).

Table 12.5.7 Results of the Forecast of Peak Noise Levels in 2024 (around Makassar area)

unit:vehicle/day

Section	link	2024 with								Noise level
		Motorcycle	Car/Taxi	Mini Bus	Large Bus	Pickup	Small Truck	Large Truck	Total	
Makassar-1	7	122	54	470	78	94	236	18	1,072	69.7
Makassar-2	8	1,988	584	3,038	16	182	680	2	6,490	68.9
Makassar-3	9	614	1,612	1,968	454	680	1,526	286	7,140	70.2
Makassar-4	63	380	794	324	140	194	640	48	2,520	70.2
Makassar-5	152	20,988	19,042	16,106	1,224	3,642	6,204	292	67,498	79.0
Makassar-6	153	20,988	19,042	16,106	1,224	3,642	6,204	292	67,498	79.0
Makassar-7	195	20,988	19,042	16,106	1,224	3,642	6,204	292	67,498	79.0
Makassar-8	194	268	168	360	242	118	338	154	1,648	69.7
Makassar-9	206	5,874	4,972	6,850	348	1,130	2,124	234	21,532	71.3
Makassar-10	207	5,874	4,972	6,850	348	1,130	2,124	234	21,532	71.3

Remarks: Noise level is shown as peak (maximum level).

Table 12.5.8 Results of the Prospects of Peak Noise Levels in 2024 (around Kendari area)

unit:vehicle/day

Section	link	2024 with								Noise level
		Motorcycle	Car/Taxi	Mini Bus	Large Bus	Pickup	Small Truck	Large Truck	Total	
Kendari-1	108	1,334	2,368	1,342	1,358	1,884	1,544	68	9,898	69.6
Kendari-2	273	550	50	346	6	50	72	0	1,074	65.5
Kendari-3	284	718	434	310	124	634	328	22	2,570	67.4
Kendari-4	286	1,334	2,368	1,342	1,358	1,884	1,544	68	9,898	69.6
Kendari-5	287	690	64	434	10	62	94	0	1,354	64.7
Kendari-6	385	568	724	1,998	114	306	774	24	4,508	70.5
Kendari-7	387	1,240	114	780	16	112	166	0	2,428	64.6
Kendari-8	388	690	64	434	10	62	94	0	1,354	64.7
Kendari-9	388	550	50	346	6	50	72	0	1,074	66.4
Kendari-10	387	550	50	346	6	50	72	0	1,074	65.5

Remarks: Noise level is shown as peak (maximum level).

3) Water Pollution

It has been assumed that there will be no wastewater discharge from the target roads in the project operation phase.

12.6 Results of the SEA Process

12.6.1 Setting-up Alternative Options for SEA

The basic requirement of the SEA assessment calls for a comparison of several alternative options which includes the "Zero Option" alternative. To get the best and optimum solution for the improvement of the island-wide road network plan all options for the Master Plan will be compared with other possible alternatives including the "Zero Option".

- ***Option 1 (Zero Option): The existing road network will be properly maintained without new investment in addition to the existing roads.***
- ***Option 2 (Road Network Improvement): The road network will be improved with additional investment on the existing road network.***
- ***Option 3 (Road Network plus Marine Transport Improvement): The road network will be improved together with the improvement of accessibility through marine transport.***

Although the Master Plan for an arterial road network will be a road improvement plan focused on realignment, upgrading, rehabilitation, strengthening, and maintenance associated with some strategically important new road development projects, it also includes the nautical highway concept, which is an energy-saving maritime transport effectively incorporated into the road network, considering the long winding coastlines and its traditionally high modal share.

12.6.2 Formulation of Environmental Impact Matrix

Unlike the normal project-level EIA, an environmental impact matrix under the SEA is designed to roughly grasp the environmental impacts deriving from each alternative option. The benchmarks and weights for the environmental impact matrix under the SEA are streamlined below. The benchmarks include the global environmental items as well as local environmental items. Higher priorities are given to greenhouse effects, increases in energy consumption and impacts on air quality and on biodiversity.

Table 12.6.1 Benchmarks and Weights for Environmental Impact Matrix

Benchmarks	Weight
1. Global Environmental Items	
1-1 Greenhouse Effect	15%
1-2 Energy Consumption	15%
2. Local Environmental Items	
2-1 Impacts on Air Quality	15%
2-2 Impacts on Noise and Vibration	5%
2-3 Impacts on Biodiversity	15%
2-4 Improvement of BHN and Poverty Reduction	10%
2-5 Impacts on Isolated Ethnics	10%
2-6 Scale of Involuntary Resettlement	10%
2-7 Impacts on Exploitation of Mineral Resources	5%

12.6.3 Identification of Major Environmental Impacts

The following are the major environmental impacts resulting from the improvement of the road network:

(1) Air Pollution

The Study Team proposes the mathematical method estimating the exhaust coefficient in total NOx volume of the overall road network. The effect of the proposed road network improvement (road improvement, some realignments and so on) is evaluated by comparing the NOx volume of the alternative options. By implementing the proposed road network improvement (road improvement etc.), the increase in average speeds (10 km/h up) is estimated along with the expected reduction of NOx volume (14 %). In addition to these is the expected reduction of air pollution since bio diesel fuels (BDF) and bio-ethanol will be used for construction machines, trucks and other vehicles.

(2) Noise and Vibration

The Study Team proposes the multi regression analysis for the traffic volume, vehicle composition ratios, urbanization levels, and road grades in each survey point. Data applied in the multi regression analysis was the result of an on-site noise survey in the Mamminasata area.

In the results around Manado, Palu, Makassar and Kendari City where traffic will be concentrated, it is assumed that peak noise levels will exceed 70 dB(A) environmental standard especially in and around commercial areas. It is assumed that traffic density will increase in the future, thus the necessity for countermeasures especially for sensitive receptors such as hospitals and schools.

(3) Biodiversity

If some unique species and/or other rare species are encountered during the construction phase of the road network improvement, it will be necessary to take the proper measures for such species of fauna and flora. Such measure will include proposing limited protection zones, transfer to other areas etc. For example, the Lore Lindu National Park and the Morowali Nature Reserve are conservation areas. The Lore Lindu National Park has a 2,290 km² area which covers both lowlands and mountain forests with an altitude range of 200 – 2,610m. On the other hand, located on the eastern arm of the Central Sulawesi, Morowali Nature Reserve is a 225,000ha protected area of almost intact primary forests. The Master Plan is designed not to affect these “conservation areas” in the region.

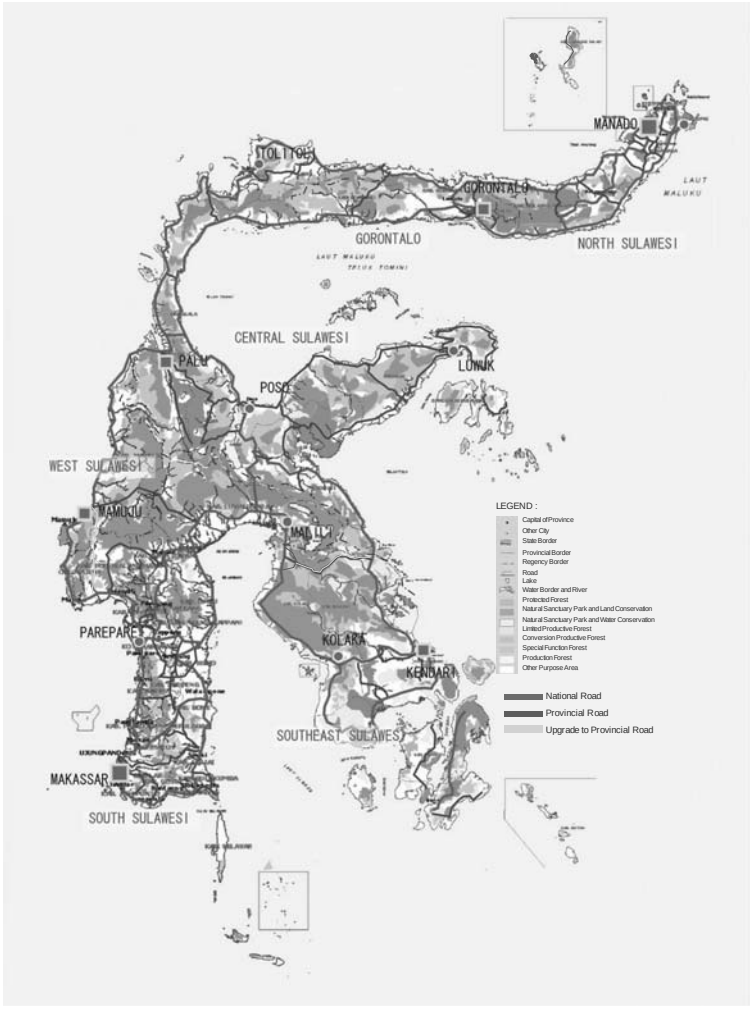


Figure 12.6.1 Conservation Areas and Road Network

(4) Forest and Livelihood of Indigenous Minorities

There are 40 to 50 indigenous ethnic minorities in Sulawesi Island, including the mountainous areas of Central and Eastern Sulawesi. The ”Wana” tribe is one of typical indigenous ethnic minorities. The Morowali Nature Reserve, which was established in 1980 by the Indonesian government and encompasses 225,000 hectares of upland and coastal areas is part of the cultural minorities' area. The “Wana” inhabits the northeastern and eastern portions of the reserve. The rest of the Morowali is uninhabited except for a small number of “Wana” settlements to the west, and a number of fishing villages along its coastal shores to the south. Vegetation includes mangroves and lowland alluvial plain forests along its southern coastlines, lowland and in the rain forests in the higher elevations where the “Wana” have adapted an upland rainforest habitat. The “Wana” obtains most of their diet from slash and burn horticulture. Other isolated ethnic minorities also cut trees for food and income. However, there are also a number of ethnic minorities who practice environmental conservation and do not practice slash and burn techniques.

There is a probability that the road network improvement under the Master Plan might will affect

local inhabitants' traditional livelihoods usch as the cutting of rattan. The areas that will be affected by the improvement of the road network under the Master Plan is estimated at 82 ha alongside the planned road network. This estimated area also leads to the significant reduction in carbon stock due to the following process:

- According to recent research, the reduction of forest areas per ha will result in: a) the reduction of carbon stock by approximately 58 ton per annum; and b) the carbon release by approximately 580 ton at the time the trees where cut.
- However, since there are no exact data on carbon stock, it is very difficult to accurately calculate the reduced amount of carbon stock per annum.
- Based on the above estimation of the reduction of carbon stock per ha, the reduction of the forest area will result in the reduction of carbon stock approximating 4,756 tons per annum. (82 ha x 58 ton per ha per annum)

Table 12.6.2 Results of the Estimates of the Affected Forest Areas

Category	Length by Topography (km)*			Total Length	Road passing in Forestry (Road Length in Hilly Area x estimated ratio in		Average Existing Road Width	Average Road Widening Width by 2024**	Estimated Area of forest to be affected by road improvement in 2024	
	Flat	Rolling	Hilly	(km)	%	km	(m)	(m)	(m2)	(Ha)
			a		b	c =a x b		d	e = c x d	
National	5,322 75%	915 13%	853 12%	7,091 100%	20%	171	5	2	341,382	34
Provincial	3,072 62%	833 17%	1,072 22%	4,977 100%	30%	322	4.5	1.5	482,580	48
Total	8,394 70%	1,748 14%	1,926 16%	12,068 100%		492			823,962	82

Notes: * Classification of topography is for the road design.
** Average road widening includes some road realignments.

(5) Assessment improvement of the BHN/Poverty Reduction and Road Network

The improvement of the road network is aimed at achieving a multi-growth poles development in the Island instead of single growth pole for Makassar through the strengthening of economic linkages between adjacent provinces. In addition to this function, the improved road network will also contribute to ***rural–urban and inter-urban transport***, thereby improving accessibility to important facilities and markets from the farming communities. The improvement of the road network that connects to the secondary roads through an all-season network of roads supports a full range of access to basic human needs.

(6) Horticulture Development in Coastal Zones and the Road Network

In the coastal zones of the Sulawesi Island, there are many shrimp horticulture ponds which where created through the cutting of mangrove trees. In South Sulawesi Province, there are also shrimp horticulture ponds which where converted from paddy fields. Since shrimp horticulture ponds become unproductive after a couple of production cycles, the creation of new ponds has

become a continuous necessity for local shrimp farmers. As a result, horticulture activities tend to expand. The improvement of the road network might further activate shrimp horticulture, especially in the western coastal zone of Sulawesi Island.

(7) Exploitation of Mineral Resources and Road Network

There is a wide range of undeveloped mineral resources in Sulawesi Island. These mineral resources include gold, silver, nickel, zinc, lead, etc. There is plenty of nickel ore within iron deposits in the central part of Sulawesi. For example, nickel production in Soroako is one of the largest laterite nickel mining operations in the entire world. At present, there are two companies conducting nickel mining in Indonesia, the state-owned PT AnekaTambang and PT Inco. PT Inco has constructed several facilities including:

(a) Refineries
(b) Two hydroelectric power plants
(c) A port along the Malili River, which empties into the Gulf of Bone
(d) A natural gas and oil terminal in Tanjung Mankasa, and pipelines 50 km. long to deliver oil to the smelters in Soroako.
(e) A road connecting the smelters in Soroako with the port in Malili.
(f) Complete urban living facilities, including housing, a hospital, an airfield, a bus terminal, a market, office space and a golf course.

In the long-term, it is likely that road network improvement will make it easier for foreign investors to develop the mining potential in the region.

(8) Road Network and Palm Plantation

Palm oil production is booming in developing countries because oil palm is relatively cheap to grow and produces yields up to five times those of other oil crops. Indonesia is second only to Malaysia in the production of palm oil. The industry is dominated by three classes of producers: state-owned, smallholder, and large-scale private producers. Plots of land are prepared by private developers and transferred to small farmers. These private developers supervise smallholder operations and purchased their crops. Companies were given a range of incentives, including access to credit at concessionary rates for estate development, planting, and processing.

Since palm oil is required to be processed immediately after harvesting, it is necessary to shorten production time from harvesting to extraction. Therefore, active palm oil productions can be linked to road development for the smooth delivery of palm products to factories. The improvement of the road network will accelerate palm tree plantation and production activities.

(9) Socio-economic Impacts on Isolated Cultures

The Master Plan is required to harmonize the so-called “isolated culture” in the region so as not to hamper the culture of local indigenous ethnic communities. Most of the inhabitants of Sulawesi are identified to a particular ethnic group. The term of “isolated people” is associated with the

indigenous ethnic communities. According to the definition by the Social Minister's Decree, No.5 of 1994, "isolated people" is referred to as the groups of people who live or are nomadic in geographically remote and isolated areas and are socially and culturally alienated and/or still underdeveloped compared to other Indonesian communities in general. Some of those ethnic groups are socially and economically isolated, and it is likely that these isolated communities are affected by the influx of modernization and other technologies, goods and products which might convert traditional systems and ways of life, if new road developments are not carefully designed to avoid these impacts. For example, the indigenous Wana people live throughout the Molowari Reserve and consist of about 600 household families who follow a traditional lifestyle.

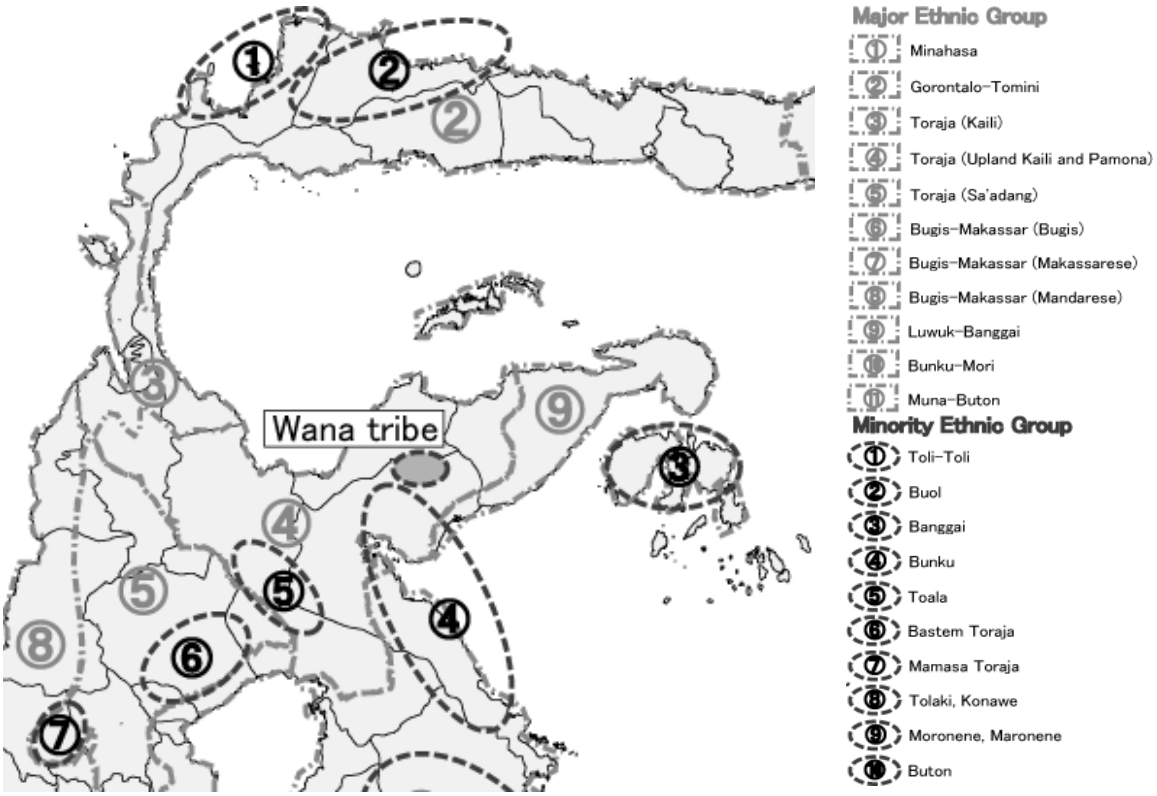


Figure 12.6.2 Major Ethnic Areas

If these isolated communities are willing to benefit from the improved road access associated with the construction of feeder roads in addition to the improvement of the road network, a wide range of benefits will be delivered to those isolated communities. Even if this does not happen, the road network improvement of the Master Plan will not basically affect the isolated communities, since the road network is carefully designed so as not to affect the indigenous local communities.

12.6.4 Results of the Environmental Impact Matrix

The environmental impact matrix under the SEA through each road development package is shown in Annex 12.1 to 12.3, implying that the environmental impacts on roads along major cities are relatively more serious than in other rural areas. This is due to the large traffic volume

on roads along major cities.

12.6.5 Results of the Multi-criteria Analysis (MCA)

The scope of the SEA is not limited to environmental effects alone. The SEA provides a number of potential links with the socio-economic assessments, thereby recognizing the idea of the SEA's interrelationships with socio-economic issues or sustainability concerns. The so-called multi-criteria analysis (MCA), which is a typical evaluation method that judges priorities under different development alternatives, was employed as a key methodology for the overall SEA assessment. Since a wide range of positive effects and negative impacts are included in the evaluation criteria in the MCA, the methodology allows evaluators to utilize more practical evaluation procedures. The MCA provides a comprehensive evaluation matrix with different weights for each evaluation item, thereby aiding in the selection of alternatives. More concretely, the MCA has been conducted through the following steps: (1) Selection and streamlining of evaluation items, (2) Fixing evaluation indices and rating evaluation scores based on the 5-grade scoring system, (3) Calculating weights and total evaluation scores, and (4) Formulation of an MCA matrix.

The original MCA table has been slightly modified to simplify evaluation benchmarks. Higher priorities are given to the engineering items in the primary level, while higher priorities are given to the global and local environmental factors at the combined weight levels.

Table 12.6.3 Benchmarks and Weights of the Multi-criteria Analysis

Evaluation Benchmarks	Weight		Combined Weight
1. Engineering Items			
1-1 Consistency to Upper-level Plan	40%	25%	10%
1-2 Balance and Efficiency of Road Network		25%	10%
1-5 Responsiveness to Traffic Demand		50%	20%
2. Economic and Financial Items			
2-1 Scale of Beneficiaries	30%	25%	7.5%
2-2 Investment Efficiency		25%	7.5%
2-3 Contribution to Production and Investment		25%	7.5%
2-4 Improvement of Access to Public Infrastructures		25%	7.5%
3. Environmental Items			
3-1 Global Environmental Factors	30%	50%	15%
3-2 Local Environmental Factors		50%	15%

12.6.6 Conclusion of Multi-criteria Analysis

As shown in the Annex 12.4 to 12.6, "Option 3" obtained the highest scores among the three alternative options. In conclusion, "Option 3" was selected as the best solution. The detailed explanation for the conclusion is shown below:

- "Option 1" (Zero Option): "Option 1 (Zero Option)" just aims to maintain the existing road network without any new investment and will not significantly increase the responsiveness to the traffic volume, while negative impacts on the global and local environment in the region would be limited. At the same time, "Option 1" will not significantly contribute to

production and investment in the region due to its capacity to respond to the increasing traffic demand.

- "Option 2" (Road Network Improvement Only): Since "Option 2" focuses on realignment, upgrading, rehabilitation, strengthening, and maintenance associated with some strategically important new projects without the improvement of accessibility through marine transport, the traffic volume on the road network in the region would be the largest among all the options. Because of this, the negative impacts on the global and local environment would be relatively larger than "Option 3". The degree of the reduction in energy consumption and emission per traffic volume is relatively higher than "Option 3".

- Road Network plus Marine Transport Improvement: Since "Option 3" focuses on realignment, upgrading, rehabilitation, strengthening, and maintenance associated with some strategically important new projects together with the improvement of accessibility thorugh marine transport which is more environmentally friendly than the road network development, the traffic volume on the road network in the region would be relatively smaller than "Option 2." Therefore, negative impacts on the global and local environment would be relatively smaller than "Option 2". Since "Option 3" is a road improvement plan together with the concept of a nautical highway which is the improvement of accessibility through marine transport, the degree of the reduction in energy consumption and emission per traffic volume is relatively lower than "Option 2". The evaluation on other benchmarks remains almost the same as that of "Option 2".

ANNEX 12.1 5-grade Scores (1: Smallest Positive Impacts/Largest Negative Impacts → 5: Largest Positive Impacts/Smallest Negative Impacts)

Road \ Evaluation				Environmental Factors									
				Global Environmental Factors		Local Environmental Factors							
				Green House Gas Effect	Consumption of Energy	Air Quality	Noise/Vibration	Biodiveristy	Improvement of Regional BHN/Poverty Reduction	Impacts on Ethnic Minorities	Scale of Uinvoluntary Resettlement	Exploitation of Minieral Resources
Weight				0.15	0.15	0.15	0.05	0.15	0.10	0.10	0.10	0.05
Road	TS-1	TS-1-1	Jeneponto - Makassar - Parepare	2	2	2	3	5	2	1	2	5
		TS-1-2	Parepare - Mamuju	3	3	3	4	3	3	1	2	4
		TS-1-3	Mamuju - Palu	3	3	2	4	4	3	1	3	4
		TS-1-4	Maros - Bajoe	3	3	3	4	4	3	1	2	4
		TS-1-5	Parepare - Palopo	4	4	4	4	3	4	3	4	4
		TS-1-6	Wonomulyo - Kaluku	4	4	4	4	3	4	2	4	4
	TS-2	TS-2-1	Palu - Kwandang	4	4	5	5	2	3	2	4	2
		TS-2-2	Kwandang - Manado - Bitung	4	4	5	5	3	4	2	4	4
		TS-2-3	Molibagu - Worotican	4	4	5	5	2	3	2	4	3
	TS-3	TS-3-1	Jenoponto - Watampone - Wotu	3	3	4	4	2	3	3	2	3
		TS-3-2	Wotu - Poso - Toboli	3	3	4	4	2	3	3	2	3
	TS-4	TS-4-1	Toboli - Gorontalo	4	4	5	5	2	3	3	4	4
		TS-4-2	Gorontalo - Bitung	4	4	5	5	2	3	3	4	4
	TS-5	TS-5-1	Wotu - Kolaka	4	4	5	5	3	4	4	4	4
		TS-5-2	Kolaka - Tinaggea - Kendari	4	4	5	5	3	4	4	4	3
		TS-5-3	Kendari - Tondoyondo	3	3	4	4	4	3	3	4	2
		TS-5-4	Tondoyondo - Luwuk - Poso	4	4	4	2	2	4	4	4	2
		TS-5-5	Kolaka - Kendari	4	4	5	5	2	3	3	4	3
		TS-5-6	Landawe - Tolala	4	4	5	5	2	3	3	4	3
Average				3.58	3.58	4.16	4.32	2.79	3.26	2.53	3.42	3.42

Indicator (Score/Average Score: Average Score = 100)

Evaluation Item / Road				Environmental Factors									Average
				Global Environmental Factors		Local Environmental Factors							
				Green House Gas Effect	Consumption of Energy	Air Quality	Noise/Vibration	Biodiveristy	Improvement of Regional BHN/Poverty Reduction	Impacts on Ethnic Minorities	Scale of Uinvoluntary Resettlement	Exploitation of Minieral Resources	
Weight				0.15	0.15	0.15	0.05	0.15	0.10	0.10	0.10	0.05	
Road	TS-1	TS-1-1	Jeneponto - Makassar - Parepare	0.56	0.56	0.48	0.70	1.79	0.61	0.40	0.58	0.58	0.70
		TS-1-2	Parepare - Mamuju	0.84	0.84	0.72	0.93	1.08	0.92	0.40	0.58	0.58	0.76
		TS-1-3	Mamuju - Palu	0.84	0.84	0.48	0.93	1.43	0.92	0.40	0.88	0.88	0.84
		TS-1-4	Maros - Bajoe	0.84	0.84	0.72	0.93	1.43	0.92	0.40	0.58	0.58	0.80
		TS-1-5	Parepare - Palopo	1.12	1.12	0.96	0.93	1.08	1.23	1.19	1.17	1.17	1.11
		TS-1-6	Wonomulyo - Kaluku	1.12	1.12	0.96	0.93	1.08	1.23	0.79	1.17	1.17	1.06
	TS-2	TS-2-1	Palu - Kwandang	1.12	1.12	1.20	1.16	0.72	0.92	0.79	1.17	1.17	1.04
		TS-2-2	Kwandang - Manado - Bitung	1.12	1.12	1.20	1.16	1.08	1.23	0.79	1.17	1.17	1.11
		TS-2-3	Molibagu - Worotican	1.12	1.12	1.20	1.16	0.72	0.92	0.79	1.17	1.17	1.04
	TS-3	TS-3-1	Jenoponto - Watampone - Wotu	0.84	0.84	0.96	0.93	0.72	0.92	1.19	0.58	0.58	0.84
		TS-3-2	Wotu - Poso - Toboli	0.84	0.84	0.96	0.93	0.72	0.92	1.19	0.58	0.58	0.84
	TS-4	TS-4-1	Toboli - Gorontalo	1.12	1.12	1.20	1.16	0.72	0.92	1.19	1.17	1.17	1.08
		TS-4-2	Gorontalo - Bitung	1.12	1.12	1.20	1.16	0.72	0.92	1.19	1.17	1.17	1.08
	TS-5	TS-5-1	Wotu - Kolaka	1.12	1.12	1.20	1.16	1.08	1.23	1.58	1.17	1.17	1.20
		TS-5-2	Kolaka - Tinaggea - Kendari	1.12	1.12	1.20	1.16	1.08	1.23	1.58	1.17	1.17	1.20
		TS-5-3	Kendari - Tondoyondo	0.84	0.84	0.96	0.93	1.43	0.92	1.19	1.17	1.17	1.05
		TS-5-4	Tondoyondo - Luwuk - Poso	1.12	1.12	0.96	0.46	0.72	1.23	1.58	1.17	1.17	1.06
		TS-5-5	Kolaka - Kendari	1.12	1.12	1.20	1.16	0.72	0.92	1.19	1.17	1.17	1.08
		TS-5-6	Landawe - Tolala	1.12	1.12	1.20	1.16	0.72	0.92	1.19	1.17	1.17	1.08
Average				1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

ANNEX 12.3 **Overall Scores with Weights**

Road / Evaluation Items				Environmental Factors									Overall Scores with Weights
				Global Environmental Factors		Local Environmental Factors							
				Green House Gas Effect	Consumption of Energy	Air Quality	Noise/Vibration	Biodiveristy	Improvement of Regional BHN/Poverty Reduction	Impacts on Ethnic Minorities	Scale of Uinvoluntary Resettlement	Exploitation of Minieral Resources	
Weight				0.15	0.15	0.15	0.05	0.15	0.10	0.10	0.10	0.05	
Road	TS-1	TS-1-1	Jeneponto - Makassar - Parepare	0.08	0.08	0.07	0.03	0.27	0.06	0.04	0.06	0.03	0.73
		TS-1-2	Parepare - Mamuju	0.13	0.13	0.11	0.05	0.16	0.09	0.04	0.06	0.03	0.79
		TS-1-3	Mamuju - Palu	0.13	0.13	0.07	0.05	0.22	0.09	0.04	0.09	0.04	0.85
		TS-1-4	Maros - Bajoe	0.13	0.13	0.11	0.05	0.22	0.09	0.04	0.06	0.03	0.84
		TS-1-5	Parepare - Palopo	0.17	0.17	0.14	0.05	0.16	0.12	0.12	0.12	0.06	1.10
		TS-1-6	Wonomulyo - Kaluku	0.17	0.17	0.14	0.05	0.16	0.12	0.08	0.12	0.06	1.06
	TS-2	TS-2-1	Palu - Kwandang	0.17	0.17	0.18	0.06	0.11	0.09	0.08	0.12	0.06	1.03
		TS-2-2	Kwandang - Manado - Bitung	0.17	0.17	0.18	0.06	0.16	0.12	0.08	0.12	0.06	1.11
		TS-2-3	Molibagu - Worotican	0.17	0.17	0.18	0.06	0.11	0.09	0.08	0.12	0.06	1.03
	TS-3	TS-3-1	Jenoponto - Watampone - Wotu	0.13	0.13	0.14	0.05	0.11	0.09	0.12	0.06	0.03	0.85
		TS-3-2	Wotu - Poso - Toboli	0.13	0.13	0.14	0.05	0.11	0.09	0.12	0.06	0.03	0.85
	TS-4	TS-4-1	Toboli - Gorontalo	0.17	0.17	0.18	0.06	0.11	0.09	0.12	0.12	0.06	1.07
		TS-4-2	Gorontalo - Bitung	0.17	0.17	0.18	0.06	0.11	0.09	0.12	0.12	0.06	1.07
	TS-5	TS-5-1	Wotu - Kolaka	0.17	0.17	0.18	0.06	0.16	0.12	0.16	0.12	0.06	1.19
		TS-5-2	Kolaka - Tinaggea - Kendari	0.17	0.17	0.18	0.06	0.16	0.12	0.16	0.12	0.06	1.19
		TS-5-3	Kendari - Tondoyondo	0.13	0.13	0.14	0.05	0.22	0.09	0.12	0.12	0.06	1.04
		TS-5-4	Tondoyondo - Luwuk - Poso	0.17	0.17	0.14	0.02	0.11	0.12	0.16	0.12	0.06	1.07
		TS-5-5	Kolaka - Kendari	0.17	0.17	0.18	0.06	0.11	0.09	0.12	0.12	0.06	1.07
		TS-5-6	Landawe - Tolala	0.17	0.17	0.18	0.06	0.11	0.09	0.12	0.12	0.06	1.07
Average				0.15	0.15	0.15	0.05	0.15	0.10	0.10	0.10	0.05	1.00

ANNEX 12.4 5-grade Scores (1: Lowest → 5: Highest)

Evaluation Item (Alternative)			Weight: Primary Weight	Weight: Secondary Weight	Weight: Total Weight	Alternatives: Option 1 (Zero Option)	Alternatives: Option 2 (Road Network Only)	Alternatives: Option 3 (Road Network + Ferry Improvement)	Average
Engineering Items	1-1	Consistency for Upper-level Plan	0.40	0.25	0.10	3	3	4	3.33
	1-2	Balance and Efficiency of Road Network		0.25	0.10	3	3	4	3.33
	1-3	Responsiveness to Traffic Demand		0.50	0.20	2	3	4	3.00
Economic and Financial Items	2-1	Scale of Beneficiaries	0.30	0.25	0.08	1	3	4	2.67
	2-2	Investment Efficiency		0.25	0.08	2	3	3	2.67
	2-3	Contribution to		0.25	0.08	1	4	5	3.33
	2-4	Improvement of Access to Public Infrastructure		0.25	0.08	1	4	5	3.33
Environmental Items	3-1	Global Environmental Items	0.30	0.50	0.15	4	2	3	3.00
	3-2	Local Environmental Items		0.50	0.15	4	3	2	3.00
Total						2.33	3.11	3.78	3.07

ANNEX 12.5 Indicator (Score/Average Score, Average Score = 100)

Evaluation Item \ Alternative			Weight			Alternatives		
			Primary Weight	Secondary Weight	Total Weight	Option 1 (Zero Option)	Option 2 (Road Network Only)	Option 3 (Road Network + Ferry Improvement)
Engineering Items	1-1	Consistency for Upper-level Plan	0.40	0.25	0.10	0.90	0.90	1.20
	1-2	Balance and Efficiency of Road Network		0.25	0.10	0.90	0.90	1.20
	1-3	Responsiveness to Traffic Demand		0.50	0.20	0.67	1.00	1.33
Economic and Financial Items	2-1	Scale of Beneficiaries	0.30	0.25	0.08	0.38	1.13	1.50
	2-2	Investment Efficiency		0.25	0.08	0.75	1.13	1.13
	2-3	Contribution to		0.25	0.08	0.30	1.20	1.50
	2-4	Improvement of Access to Public Infrastructure		0.25	0.08	0.30	1.20	1.50
Environmental Items	3-1	Global Environmental Items	0.30	0.50	0.15	1.33	0.67	1.00
	3-2	Local Environmental Items		0.50	0.15	1.33	1.00	0.67
Total						0.76	1.01	1.23

ANNEX 12.6 Overall Scores with Weights

Evaluation Item / Alternative			Weight			Alternatives		
			Primary Weight	Secondary Weight	Total Weight	Option 1 (Zero Option)	Option 2 (Road Network Only)	Option 3 Road Network + Ferry Improvement)
Engineering Items	1-1	Consistency for Upper-level Plan	0.40	0.25	0.10	0.090	0.090	0.120
	1-2	Balance and Efficiency of Road Network		0.25	0.10	0.090	0.090	0.120
	1-3	Responsiveness to Traffic Demand		0.50	0.20	0.133	0.200	0.267
Economic and Financial Items	2-1	Scale of Beneficiaries	0.30	0.25	0.08	0.028	0.084	0.113
	2-2	Investment Efficiency		0.25	0.08	0.056	0.084	0.084
	2-3	Contribution to		0.25	0.08	0.023	0.090	0.113
	2-4	Improvement of Access to Public Infrastructure		0.25	0.08	0.023	0.090	0.113
Environmental Items	3-1	Global Environmental Items	0.30	0.50	0.15	0.200	0.100	0.150
	3-2	Local Environmental Items		0.50	0.15	0.200	0.150	0.100
Total						0.843	0.979	1.179

12.6.7 Formulation of Mitigation Measures

The SEA should include measures to mitigate negative environmental impacts. The term "mitigation" refers to the elimination, reduction or control of negative environmental impacts which might be derived from the implementation of the Master Plan.

The protection of forests is central issue in the road network development since they are important to the economic well being and livelihood of the indigenous societies who live in or around them. In addition, the reduction of greenhouse gas emissions through the reduction of energy consumption is also critical. Frequently discussed energy conservation methods include increasing the fuel efficiency of vehicles by improving the average travel speed. Other suggested indictors and/or mitigation measures against global warming include the CO2 volume of total road network in Sulawesi Island, the coverage and the promotion of bio-fuels in the areas affected by the project (road improvement etc.), as well as the diversion of other traffic measurements.

(1) CO2 Reduction through Traffic Efficiency

The Study Team proposes the mathematical method estimated by the exhaust coefficient in total CO2 volumes of the total road network. The exhaust coefficient of the average speeds of small and large vehicles is shown in Table 12.6.4. The flow of mathematical method for CO2 volume prediction is shown in Figure 12.6.3.

Table 12.6.4 Exhaust Coefficients by Vehicle Type (CO2)

average speed (km/h)	p1	p2
10	99	237
20	67	182
30	54	155
40	46	137
50	42	127
60	40	122
70	39	123
80	40	129

CO2 volume = (A1 x p1 + A2 x p2) x Q

A1 : Small Vehicles Volume (vehicles/day)
A2 : Large Vehicles Volume (vehicles/day)
Q : Traffic Volume (vehicles/day)

The effect of the project (road improvement, some new road networks and so on) was evaluated by comparing the CO2 volume of both cases (with and without-project). In case of the "with-project" case the increase in average speeds as a result of road improvements, such as widening, alignment, pavement and so on, is expected.

In the "without-project" case where road improvements are not implement traffic volume will merely increase year after year according to the traffic demand. It is surmised that the average speed of all road networks in the "without-project" case by 2024 is similar to present conditions in 2007.

The average speed of road network in the "without-project" case is calculated at 25.4 km/h, in the "with-project" case it is 35.4 km/h.

Operating vehicles volume in the road network is shown in Table 12.6.5. The total number by 2024 in the "without-project" case is about 2.2 times compared with that for 2007. The number of car/taxi is about 3.5 times.

Table 12.6.5 Volume Results of Operating Vehicles (Vehicles x km)

unit : vehicles・km

	Motorcycle	Car/Taxi	Mini Bus	Large Bus	Pickup	Small Truck	Large Truck	Total
2007	6,487,144	1,716,814	4,547,178	788,478	1,297,655	2,208,865	308,679	17,354,813
2024without	15,138,685	5,944,999	7,723,995	1,642,161	2,780,173	4,695,661	652,007	38,577,681
2024 with	14,699,166	5,657,593	7,373,247	1,595,602	2,678,221	4,520,979	633,651	37,158,458
2024without/2007	233.4%	346.3%	169.9%	208.3%	214.2%	212.6%	211.2%	222.3%
2024 with / 2007	226.6%	329.5%	162.1%	202.4%	206.4%	204.7%	205.3%	214.1%

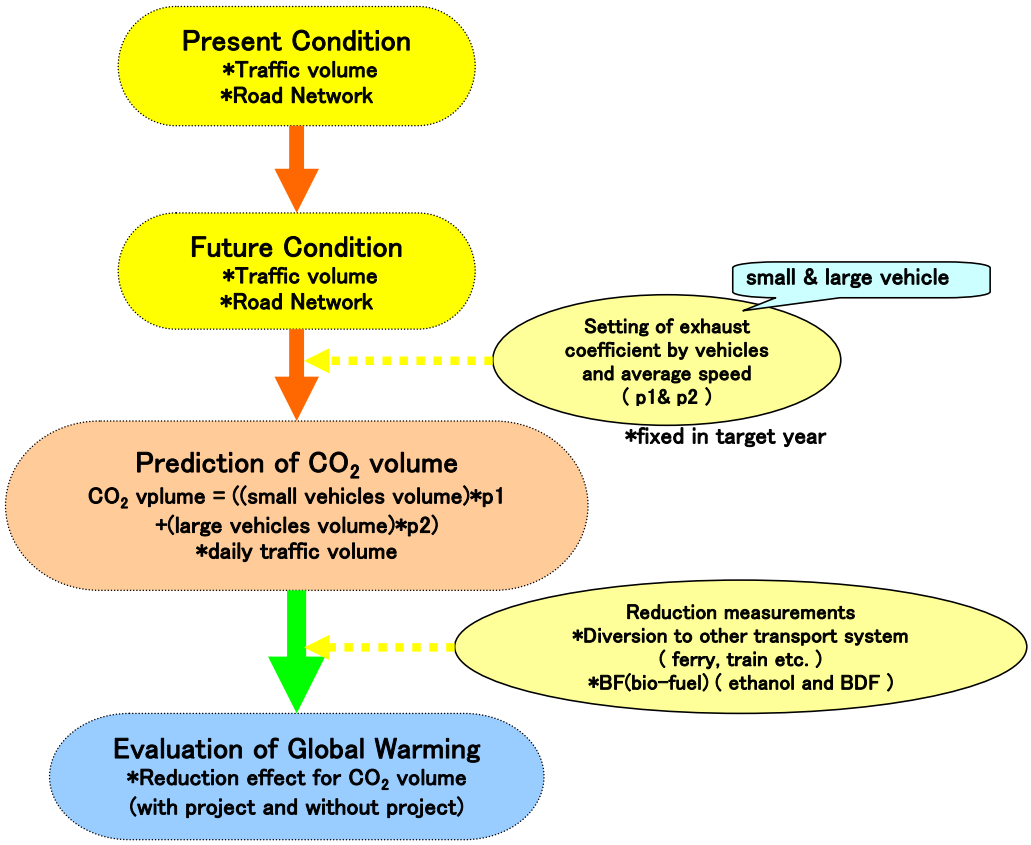


Figure 12.6.3 Prediction Flow of CO2 Volumes

The increase in average speeds (10 km/h upwards) is expected in the implementation of the project (road improvement etc.). At the same time reduction of CO2 volumes (21.1%) is likewise expected. Results of the forecast in CO2 volumes is shown in Table 12.6.5.

The CO2 volume is expected to decrease twice other than in 2007, notwithstanding the operating vehicle volume increases of over 2.1 times in the 2024 "with-project" case.

Table 12.6.6 Estimation Results in CO2 Volumes

	2007 present	2024 without	2024 with
CO2 (g-CO2/km/day)	89,342.7	225,316.2	177,662.1
2024/2007	-	252.2%	198.9%
with/without	-	-	78.9%

In this way, the reduction of the forest area associated with the road network improvement projects under the MP is estimated at 82 ha. In general, there are a couple of trial calculations as below.

1) The annual reduction amount of the absorption of CO2 per ha is estimated 58 ton.

2) The increased amount of CO2 at the time of cutting trees is estimated at 580 ton per ha.

In accordance with these general trial calculations, there is a possibility that the reduction of CO2 absorption might further increase.

The improvement of the road network in Sulawesi Island will contribute to the so-called "the concept of the"Carbon Neutral" through the reduction of CO2 associated with the improvement of the average travel speed of vehicles. This positive effect derived from the improvement of the average travel speed of the vehicles will also contribute to the reduction of other emissions such as NOx.

Meanwhile, in Indonesia, there are many vehicles which are not compliance with the current standard stipulated by the inspection regulation and system. Special considerations should be given to this matter, since this might harm the positive effects generated from the improvement of the average travel speed of the vehicles and the promotion of the usage of bio-fuel gas.

(2) Promotion of Bio-fuel Usage

In March 2006, the Indonesian government recognized the mixing of 10% bio diesel fuel (BDF) into diesel oil and 10% bio-ethanol into gasoline. The promotion of bio-fuel as an alternative energy source was advanced through regulatory relaxation with the aim the share of the bio-fuel share 3% of all energy sources by 2010 and 20% by 2025.

If all goes well the Government politics in energy goes smoothly, the 20% reduction of CO2 will be expected in 2024.

BDF is the byproduct of the chemical reduction of palm oil, jatropha and/or used oil. The merits of of its use are the following:

- Redcues SO2, NO2, SPM, Pb.
- Ensures high safety and the simple usage.
- Potentially mixes with normal diesel fuel.

On the other hand, the demerits of BDF use include its relatively higher prices compared with normal diesel fuel (about 1.5~2 times) and the difficulty in its sourcing due to the present limitation of its distribution network.

Bio-ethanol is produced by fermentation and distillation of sugar cane, corn and some grasses. The merits of bio-ethanol are the folowing:

- No CO2 in exhausts.
- Recyclable energy from vegetable.
- Ensures high efficiency of thermal energy.
- Potentially mixes with normal gasoline.

The demerits of bio-ethanol are similar to those of the BDF.

(3) Reforestation

The targets of proposed road improvement project by 2024 are the national and provincial roads. There is no perfect new road construction, and most programs merely consists road widening and betterment. The mountainous sections of the target roads amount to about 16%. The Study Team surmises that the national road that passes through forested areas is about 20% of them while for provincial road it is about 30%.

Countermeasures on forest reduction are proposed including reforestation in public and/or private areas, and roadside greening during project implementation.

As green planting programs are conducted along the roads, they will create new environmental awareness among passengers and road users who will appreciate the environmental beauty and comfort of their travel along the road network including the residents along the system. The planting of trees will be effective in absorbing CO2 and producing O2 and in case fruit bearing trees they will help in the supply of food for residents.

Table 12.6.7 Samples of Recommended Tree Species for Tree Planting

Specific Purpose	Scientific Name	Local Name
CO_2 absorber and O_2 producer	*Agathis Alba*	Damar
	Leucena leucocephala	Lamtoro gung
	Acasia auriculiformis	Akasia
Food producer	*Artocarpus integra*	Nangka
	Artocarpus heterophylla	Sukun
	Anacardium occidentale	Jambu Mente
Wood materials	*Paraserianthes falcataria*	Sengon
	Swietenia macrophylla	Mahoni
	Tectona grandis	Jati super
	Tamarindus indica	Asam Jawa

These environmental countermeasures, although not directly involved in the project, will be very fruitful for the environment and the surrounding inhabitants of the areas along the road system. By encouraging the green plantation, environmental conditions in the surrounding areas will be improved.

An environmental adoption program when incorporated with the maintenance and management system of the roadside greening, will be of great help to the overall program. This system will contract to the village communities the planting and maintenance of the roadside trees, and in turn the village community gets the right to harvest and sell the fruits. Government agencies will supply the seedlings of the fruits trees,

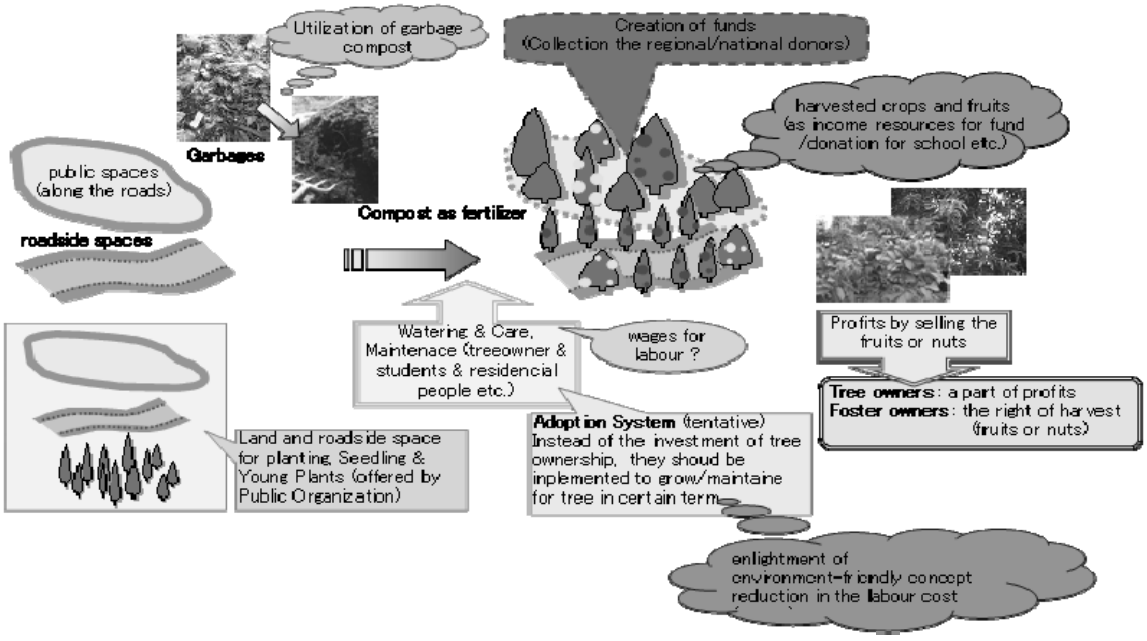


Figure 12.6.4 Proposed Adoption System

Under the current agreements in the Kyoto Protocol and the Marrakech Accords, possibilities under the protocol's Clean Development Mechanism (CDM) are limited to afforestation and reforestation, known as AR CDM. In other words, they allow the planting of new trees to establish additional links, but they do not allow crediting for the reduction of emissions from existing sinks through sustainable forest management. To date almost 1000 CDM projects are currently being conducted or have undergone the approval process, but almost all of these are in the energy sector. This is due to the fact that applications for large-scale AR CDMs are quite complicated, and the simplified CDM was approved in COP 9. By using this simplified mechanism for the CDM, small-scale and community-based CDM projects are recommended for reforestation.

(4) Diversion of Traffic System

The reduction measurement of CO2 is proposed through the diversion of other traffic systems such as the ferry and the train. However, potentials for the train system is fairly low considering its cost-benefit performance and so on. On the other hand, although ferry services has an effective CO2 reduction the demand for ferry transportation is presently still low. If the demand for ferry transportation in the proposed nautical highway increases in the future, suitable effects in CO2 reductions will be expected.

It has also beeon considered that components that passes through nature reserves and/or national parks will be more effective when diverted to the ferry system. As an example, the road improvement that passes through the Morowali Nature Reserve in Central Sulawesi, will be more practical when diverted to the ferry serviceI so as to help contribute to the conservation of the area's wildlife and biodiversity.

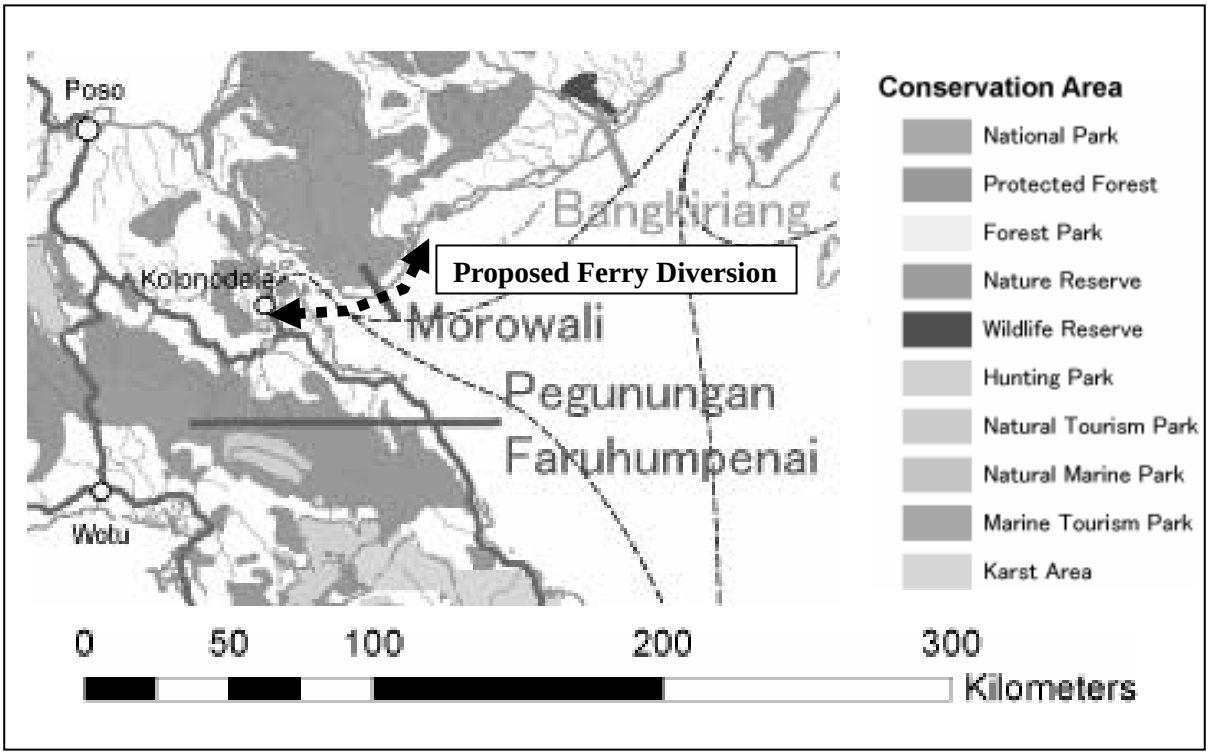


Figure 12.6.5 Proposed Ferry Diversion in the Morowali Area

12.7 Conclusion and Recommendations

Since "Option 3" focuses on realignment, upgrading, rehabilitation, strengthening, and maintenance associated with some strategically important new projects, together with the improvement of accessibility through marine transport, which is more environmentally friendly than road network development, the traffic volume on the road network in the region would be relatively smaller than "Option 2." Therefore, negative impacts on the global and local environment would be relatively smaller than "Option 2". Since "Option 3" is a road improvement plan which has a nautical highway component the degree of the reduction in energy consumption and emission per traffic volume is relatively lower than "Option 2". Several mitigation measures such as the promotion of bio-fuels and reforestation are recommended to mitigate the negative impacts of the Master Plan.

CHAPTER 13 IMPLEMENTATION PROGRAM

13.1 General

Sulawesi Road Master Plan is formulated at the target year 2024. The implementation program of the Master Plan is composed of the following terms:

- Short-term plan (7 years: 2008 - 2014)
- Medium-term plan (5 years: 2015 – 2019)
- Long-term plan (5 years: 2015 – 2024)

In order to establish a realistic and effective implementation program, the Study Team adopted the following conditions for the implementation program of the Master Plan as follows:

(1) Implementation plan focused on the development programs

Improvement plans in the Master Plan are divided into the following programs:

Development program: New construction and betterment (reconstruction and widening).
Maintenance program: Periodic maintenance and routine maintenance.

Since the target of the Master Plan is to upgrade the original function or strengthen the capacity of the existing road network, its implementation programs is mainly focused on the development programs.

(2) Support for the implementation of existing high priority development programs

The Master Plan should support the realization of existing development programs, especially the "Northeastern Indonesia Regional Development Program" that has been developed through the cooperation of both the Indonesian and Japanese governments.

The road development plans as recommended in the development program should be included in this implementation program. The Study team recommends the implementation of "Trans-Sulawesi Mamminasata Road (Maros-Takalar) since the project was confirmed to be economically feasible with a high economic internal rate of return and the Environmental Impact Assessment was already completed in accordance with the JBIC guidelines and Indonesian AMDAL laws.

(3) Early implementation of poor bridge rehabilitation

Although the existing roads and bridges were improved and rehabilitated in the past various bridges still remain narrow and in poor condition. The reconstruction of these bridges is part of the road betterment work in the Master Plan. However, in some sections the betterment of these roads are part of the medium-term and long-term plans.

Because the collapse of a bridge on a major road will have an adverse impact on local socio-economic activities, it is recommended that bridges identified as Grade III "Poor", Grade IV "Bad" and Grade V "Impassable" (including wooden bridges) should be improved as soon as

possible and their implementation be placed under the "Urgent Bridge Repair Program".

13.2 Project Prioritization

13.2.1 Methodology

The multi-criteria analysis (MCA) methodology was adopted in the prioritization of the 19 proposed projects. The analytical procedure is as follows:

A. Selection of factors to be evaluated
B. Allocation of weights to each factor
C. 5-grade scoring of each factor
D. Normalization of scores for each factor
E. Calculation of weighted scores of each Project
F. Ranking of Projects (prioritization)

(1) Selection of items to be evaluated

The following were chosen as evaluation factors:

- Economic indicator (EIRR)
- Accessibility to potential development areas
- Influenced population by Project
- Improvement of basic human needs
- Negative impacts on social environment
- Negative impacts on natural environment
- Maturity /existing initiative

(2) Allocation of weights to each factor

The following weights were allocated for each factor. They were tested by sensitivity analysis explained hereafter.

- Economic indicator (EIRR): 30%
- Accessibility to potential development areas: 10%
- Influenced population by Project: 10%
- Improvement of basic human needs: 10%
- Negative impacts on social environment: 10%
- Negative impacts on natural environment: 10%

Maturity/existing initiative: 20%

(3) 5-grade scoring of each factor

For each factor a 5-grade scoring was conducted based on the following criteria:

- Economic indicator (EIRR)
  5: 40% or above
  4: 30%~40%

3: 20%~30%

2: 10%~20%

1: below 10%

- Accessibility to potential development areas

  5: linking national activity centers (PKN) included in the 1st 5-year plan

  4: linking regional activity centers (PKW) included in the 1st 5-year plan

  3: linking national/regional activity centers included in the 2nd 5-year plan

  2: linking national/regional activity centers included in the 3rd/4th 5-year plan

  1: other intercity roads

- Influenced population by project

  In terms of 2024 projected population of all kabupatens along each project

  5: 3.00 million or more

  4: 2.25~2.99 million

  3: 1.50~2.24 million

  2: 0.75~1.49 million

  1: 0.74 million or less

- Improvement of basic human needs

  Qualitative assessment based on per capita GRDP and poverty ratio of the project areas (Please refer to Chapter 12 for details).

- Negative impacts on social environment

  Qualitative assessment based on resettlement requirements, possible impact on minorities and required countermeasures for disaster prevention and traffic safety (Please refer to Chapter 12 for detail).

- Negative impacts on natural environment

  Qualitative assessments from the point of view of air quality, noise, bio-diversity and greenhouse gas emissions (Please refer to Chapter 12 for details).

- Maturity/existing initiatives

  In terms of percentage covered by committed projects by the AusAID, WB, ADB and local programs.

  5: 80% or more

  4: 60~79%

  3: 40~59%

  2: 20~39%

  1: 19% or less

  Note that coverage was estimated per project distribution maps and were not based on accurate records.

(4) Normalization of scores for each factor

The 5-grade scoring explained above is a factor-specific independent evaluation which did not consider possible biases which may exist between other factors. Thus, initial scoring should be

normalized so that average scores would be similar for all factors, which is a rather mathematical process.

(5) Calculation of weighted scores for each project

The final score per project was calculated using the weight allocated for each factor and the normalized index scores.

(6) Ranking of Projects (prioritization)

The proposed projects were ranked using the final score per project calculated above.

13.2.2 Prioritization of Proposed Projects

Table 13.2.1, Table 13.2.2 and Table 13.2.3 show the procedures and results of project prioritization. TS1-1 (Jeneponto – Makassar - Parepare) was ranked the highest, followed by TS3-1 (Jeneponto – Watampone – Wotu), TS1-6 (Wonomulyo – Kaluku), TS1-2 (Parepare - Mamuju) and TS1-4 (Maros – Bajoe). The peninsula-crossing roads and the arterial roads from Southeast Sulawesi to Central Sulawesi generally attained lower rankings.

Table 13.2.1 5-Grade Scoring of the Proposed Projects

5-Grade Score（1：Lowest - 5：Highest）

Evaluation / Project Road				Basic Profile				Evaluation Factors						
								Economic Factors			Environmental Factors			
				Total Length (km)	Width of Pavement (m)	Investment and Construction Cost (Rp. Billion)	Traffic Volume (000PCUs/day)	Economic Indicator (EIRR)	Accessibility to Potential Development Areas	Number of Beneficiaries	Improvement of Basic Human Needs	Negative Impacts on Social Environment	Negative Impacts on Natrural Environment	Maturity / Existing Initiative
Weight								0.30	0.10	0.10	0.10	0.10	0.10	0.20
Link No.	TS-1	TS-1-1	Jeneponto - Makassar - Parepare	658	3.0-16.9	3,740	2-70	5	5	5	2	1	4	1
		TS-1-2	Parepare - Mamuju	692	3.8-10.2	1,173	1-11	4	4	2	3	3	3	2
		TS-1-3	Mamuju - Palu	387	4.4-6.0	1,011	4-14	2	5	2	3	2	3	3
		TS-1-4	Maros - Bajoe	144	6.0-8.0	275	6-9	4	5	2	3	2	2	4
		TS-1-5	Parepare - Palopo	290	4.3-7.1	585	2-12	3	4	2	4	4	2	5
		TS-1-6	Wonomulyo - Kaluku	200	6.0	432	1	5	1	2	4	4	2	1
	TS-2	TS-2-1	Palu - Kwandang	1,019	3.4-8.4	1,043	1-7	2	5	3	3	5	3	2
		TS-2-2	Kwandang - Manado - Bitung	1,399	3.5-10.0	2,671	1-38	2	5	3	4	3	3	3
		TS-2-3	Molibagu - Worotican	184	4.5-8.4	393	2-4	2	3	2	3	5	2	4
	TS-3	TS-3-1	Jeneponto - Watampone - Wotu	1,452	3.9-9.7	2,431	1-10	3	2	5	3	4	4	5
		TS-3-2	Wotu - Poso - Toboli	1,069	4.2-5.5	1,777	1-5	2	2	2	3	4	2	1
	TS-4	TS-4-1	Toboli - Gorontalo	973	4.0-7.0	1,860	1-7	2	3	3	3	4	3	2
		TS-4-2	Gorontalo - Bitung	893	3.5-11.0	1,433	1-15	2	3	3	3	4	3	3
	TS-5	TS-5-1	Wotu - Kolaka	435	3.9-5.6	1,053	1-4	2	1	2	4	3	4	4
		TS-5-2	Kolaka - Tinaggea - Kendari	1,060	4.2-17.8	1,090	1-3	1	3	2	4	3	3	5
		TS-5-3	Kendari - Tondoyondo	373	4.3-6.0	384	1-3	2	3	2	3	4	3	1
		TS-5-4	Tondoyondo - Luwuk - Poso	1,235	3.5-6.0	1,238	1-3	1	4	3	4	4	3	4
		TS-5-5	Kolaka - Kendari	312	4.5-6.7	465	1-9	2	4	2	3	5	2	3
		TS-5-6	Landawe - Tolala	150	6.0	1,221	1	1	1	1	3	5	2	4
Average / Total				12,926	-	24,276	-	2.47	3.32	2.53	3.26	3.63	2.79	3.00

Table 13.2.2 Normalized Index Scores of the Proposed Projects

Index: Score/Average

Evaluation / Project Road				Basic Profile				Evaluation Factors							Average
								Economic Factors			Environmental Factors				
				Total Length (km)	Width of Pavement (m)	Investment and Construction Cost (Rp. Million)	Traffic Volume (000PCUs/day)	Economic Indicator (EIRR)	Accessibility to Potential Development Areas	Influenced Population by Project Roads	Improvement of Basic Human Needs	Negative Impacts on Social Environment	Negative Impacts on Natrural Environment	Maturity / Existing Initiative	
Weight								0.30	0.10	0.10	0.10	0.10	0.10	0.20	
Link No.	TS-1	TS-1-1	Jeneponto - Makassar - Parepare	658	3.0-16.9	3,740	2-70	202.13	150.79	197.92	61.29	27.54	143.40	33.33	116.63
		TS-1-2	Parepare - Mamuju	692	3.8-10.2	1,173	1-11	161.70	120.63	79.17	91.94	82.61	107.55	66.67	101.47
		TS-1-3	Mamuju - Palu	387	4.4-6.0	1,011	4-14	80.85	150.79	79.17	91.94	55.07	107.55	100.00	95.05
		TS-1-4	Maros - Bajoe	144	6.0-8.0	275	6-9	161.70	150.79	79.17	91.94	55.07	71.70	133.33	106.24
		TS-1-5	Parepare - Palopo	290	4.3-7.1	585	2-12	121.28	120.63	79.17	122.58	110.14	71.70	166.67	113.17
		TS-1-6	Wonomulyo - Kaluku	200	6.0	432	1	202.13	30.16	79.17	122.58	110.14	71.70	33.33	92.74
	TS-2	TS-2-1	Palu - Kwandang	1,019	3.4-8.4	1,043	1-7	80.85	150.79	118.75	91.94	137.68	107.55	66.67	107.75
		TS-2-2	Kwandang - Manado - Bitung	1,399	3.5-10.0	2,671	1-38	80.85	150.79	118.75	122.58	82.61	107.55	100.00	109.02
		TS-2-3	Molibagu - Worotican	184	4.5-8.4	393	2-4	80.85	90.48	79.17	91.94	137.68	71.70	133.33	97.88
	TS-3	TS-3-1	Jeneponto - Watampone - Wotu	1,452	3.9-9.7	2,431	1-10	121.28	60.32	197.92	91.94	110.14	143.40	166.67	127.38
		TS-3-2	Wotu - Poso - Toboli	1,069	4.2-5.5	1,777	1-5	80.85	60.32	79.17	91.94	110.14	71.70	33.33	75.35
	TS-4	TS-4-1	Toboli - Gorontalo	973	4.0-7.0	1,860	1-7	80.85	90.48	118.75	91.94	110.14	107.55	66.67	95.20
		TS-4-2	Gorontalo - Bitung	893	3.5-11.0	1,433	1-15	80.85	90.48	118.75	91.94	110.14	107.55	100.00	99.96
	TS-5	TS-5-1	Wotu - Kolaka	435	3.9-5.6	1,053	1-4	80.85	30.16	79.17	122.58	82.61	143.40	133.33	96.01
		TS-5-2	Kolaka - Tinaggea - Kendari	1,060	4.2-17.8	1,090	1-3	40.43	90.48	79.17	122.58	82.61	107.55	166.67	98.50
		TS-5-3	Kendari - Tondoyondo	373	4.3-6.0	384	1-3	80.85	90.48	79.17	91.94	110.14	107.55	33.33	84.78
		TS-5-4	Tondoyondo - Luwuk - Poso	1,235	3.5-6.0	1,238	1-3	40.43	120.63	118.75	122.58	110.14	107.55	133.33	107.63
		TS-5-5	Kolaka - Kendari	312	4.5-6.7	465	1-9	80.85	120.63	79.17	91.94	137.68	71.70	100.00	97.42
		TS-5-6	Landawe - Tolala	150	6.0	1,221	1	40.43	30.16	39.58	91.94	137.68	71.70	133.33	77.83

Table 13.2.3 Final Scores and Priority of the Proposed Projects

Evaluation Matrix

Evaluation / Project Road				Basic Profile				Evaluation Factors							Total Weighted Index (Index x Weight)	Priority Order
								Economic Factors			Environmental Factors					
				Total Length (km)	Width of Pavement (m)	Investment and Construction Cost (Rp. Million)	Traffic Volume (000PCUs/day)	Economic Indicator (EIRR)	Accessibility to Potential Development Areas	Influenced Population by Project Roads	Improvement of Basic Human Needs	Negative Impacts on Social Environment	Negative Impacts on Natrural Environment	Maturity / Existing Initiative		
Weight								0.30	0.10	0.10	0.10	0.10	0.10	0.20	1.00	
Link No.	TS-1	TS-1-1	Jeneponto - Makassar - Parepare	658	3.0-16.9	3,740	2-70	60.64	15.08	19.79	6.13	2.75	14.34	23.33	142.06	1
		TS-1-2	Parepare - Mamuju	692	3.8-10.2	1,173	1-11	48.51	12.06	7.92	9.19	8.26	10.75	20.29	116.99	4
		TS-1-3	Mamuju - Palu	387	4.4-6.0	1,011	4-14	24.26	15.08	7.92	9.19	5.51	10.75	19.01	91.72	12
		TS-1-4	Maros - Bajoe	144	6.0-8.0	275	6-9	48.51	15.08	7.92	9.19	5.51	7.17	21.25	114.63	5
		TS-1-5	Parepare - Palopo	290	4.3-7.1	585	2-12	36.38	12.06	7.92	12.26	11.01	7.17	22.63	109.44	6
		TS-1-6	Wonomulyo - Kaluku	200	6.0	432	1	60.64	3.02	7.92	12.26	11.01	7.17	18.55	120.56	3
	TS-2	TS-2-1	Palu - Kwandang	1,019	3.4-8.4	1,043	1-7	24.26	15.08	11.88	9.19	13.77	10.75	21.55	106.48	7
		TS-2-2	Kwandang - Manado - Bitung	1,399	3.5-10.0	2,671	1-38	24.26	15.08	11.88	12.26	8.26	10.75	21.80	104.29	8
		TS-2-3	Molibagu - Worotican	184	4.5-8.4	393	2-4	24.26	9.05	7.92	9.19	13.77	7.17	19.58	90.93	14
	TS-3	TS-3-1	Jeneponto - Watampone - Wotu	1,452	3.9-9.7	2,431	1-10	36.38	6.03	19.79	9.19	11.01	14.34	25.48	122.23	2
		TS-3-2	Wotu - Poso - Toboli	1,069	4.2-5.5	1,777	1-5	24.26	6.03	7.92	9.19	11.01	7.17	15.07	80.65	17
	TS-4	TS-4-1	Toboli - Gorontalo	973	4.0-7.0	1,860	1-7	24.26	9.05	11.88	9.19	11.01	10.75	19.04	95.18	10
		TS-4-2	Gorontalo - Bitung	893	3.5-11.0	1,433	1-15	24.26	9.05	11.88	9.19	11.01	10.75	19.99	96.13	9
	TS-5	TS-5-1	Wotu - Kolaka	435	3.9-5.6	1,053	1-4	24.26	3.02	7.92	12.26	8.26	14.34	19.20	89.25	15
		TS-5-2	Kolaka - Tinaggea - Kendari	1,060	4.2-17.8	1,090	1-3	12.13	9.05	7.92	12.26	8.26	10.75	19.70	80.06	18
		TS-5-3	Kendari - Tondoyondo	373	4.3-6.0	384	1-3	24.26	9.05	7.92	9.19	11.01	10.75	16.96	89.14	16
		TS-5-4	Tondoyondo - Luwuk - Poso	1,235	3.5-6.0	1,238	1-3	12.13	12.06	11.88	12.26	11.01	10.75	21.53	91.62	13
		TS-5-5	Kolaka - Kendari	312	4.5-6.7	465	1-9	24.26	12.06	7.92	9.19	13.77	7.17	19.48	93.85	11
		TS-5-6	Landawe - Tolala	150	6.0	1,221	1	12.13	3.02	3.96	9.19	13.77	7.17	15.57	64.80	19

13.2.3 Sensitivity Test

A sensitivity test was carried out by changing the weights allocated to evaluation factors. The assumptions adopted were the following:

1) The weight of Economic Indicator (EIRR) changed from 30% (Base Case) to 20% and 10% downward, as well as from 40% to 50% upward.

2) The weight of Maturity/Existing Initiative was always fixed at 20%.

3) The remaining weights were equally shared by the other five factors.

The results are presented in Table 13.2.4. Results were quite stable except for some projects that fluctuated several ranks.

Table 13.2.4 Result of the Sensitivity Test with Different Weights for Economic Indicator (EIRR)

Sensitivity Analysis

Link No.			Evaluation / Project Road	Basic Profile				Priority Order				
				Total Length (km)	Width of Pavement (m)	Investment and Construction Cost (Rp. Billion)	Traffic Volume (000PCUs/day)	Base Case (EIRR=30%)	EIRR=10%	EIRR=20%	EIRR=40%	EIRR=50%
	TS-1	TS-1-1	Jeneponto - Makassar - Parepare	658	3.0-16.9	3,740	2-70	1	1	1	1	1
		TS-1-2	Parepare - Mamuju	692	3.8-10.2	1,173	1-11	4	7	4	3	3
		TS-1-3	Mamuju - Palu	387	4.4-6.0	1,011	4-14	12	13	13	12	12
		TS-1-4	Maros - Bajoe	144	6.0-8.0	275	6-9	5	9	7	5	4
		TS-1-5	Parepare - Palopo	290	4.3-7.1	585	2-12	6	6	8	6	6
		TS-1-6	Wonomulyo - Kaluku	200	6.0	432	1	3	12	5	2	2
	TS-2	TS-2-1	Palu - Kwandang	1,019	3.4-8.4	1,043	1-7	7	3	3	7	7
		TS-2-2	Kwandang - Manado - Bitung	1,399	3.5-10.0	2,671	1-38	8	4	6	8	8
		TS-2-3	Molibagu - Worotican	184	4.5-8.4	393	2-4	14	14	14	13	13
	TS-3	TS-3-1	Jeneponto - Watampone - Wotu	1,452	3.9-9.7	2,431	1-10	2	2	2	4	5
		TS-3-2	Wotu - Poso - Toboli	1,069	4.2-5.5	1,777	1-5	17	18	18	17	16
	TS-4	TS-4-1	Toboli - Gorontalo	973	4.0-7.0	1,860	1-7	10	10	11	10	10
		TS-4-2	Gorontalo - Bitung	893	3.5-11.0	1,433	1-15	9	8	10	9	9
	TS-5	TS-5-1	Wotu - Kolaka	435	3.9-5.6	1,053	1-4	15	16	16	14	14
		TS-5-2	Kolaka - Tinaggea - Kendari	1,060	4.2-17.8	1,090	1-3	18	17	17	18	18
		TS-5-3	Kendari - Tondoyondo	373	4.3-6.0	384	1-3	16	15	15	15	15
		TS-5-4	Tondoyondo - Luwuk - Poso	1,235	3.5-6.0	1,238	1-3	13	5	9	16	17
		TS-5-5	Kolaka - Kendari	312	4.5-6.7	465	1-9	11	11	12	11	11
		TS-5-6	Landawe - Tolala	150	6.0	1,221	1	19	19	19	19	19
Total				12,926	-	24,276	-	-	-	-	-	-

13.3 Executing Agencies and Implementing Organizations

13.3.1 Executing Agencies

(1) National Road

The Directorate General of Highways (DGH: Bina Marga) of the Ministry of Public Works will be the executing agency responsible for the construction, operation as well as maintenance of the national road network. For the detailed design and construction stage, a Project Management Unit (PMU) will be established in Bina Marga in the case of donor supported projects. The PMU will represent the DGH and act as project employer.

Due to its character as a regional representative of the DGH in technical matters, the Balai Besar VI was assigned the responsibility of planning and monitoring of construction, operation and maintenance, and quality assurance of the national roads and bridges. It also conducts periodic maintenance of the national road network on the Sulawesi Island. Routine maintenance is conducted by force account of each province or regency government using the APBN allocated by the DGH.

(2) Provincial Roads

The Praswill and Dinas PU of each provincial government are responsible for the construction, operation and maintenance of the provincial road networks in each jurisdiction. The Praswill, or Dinas PU, acts as the executing agency of each project.

The planning and program execution of provincial road routes and their periodic maintenance are also conducted by the Praswill, or Dinas PU, of each province in the method described in **Table 13.3.1**.

Table 13.3.1 Maintenance Methods of Each Province

Province	No. of Maintenance Force (person)	Routine Maintenance	Periodic Maintenance
1. North Sulawesi	34	Fully Direct	Fully Contract
2. Gorontalo	27	Fully Direct	Fully Contract
3. Central Sulawesi	36	Fully Direct	Fully Contract
4. South Sulawesi	22	Fully Direct	Fully Contract
5. West Sulawesi	26	50% Direct:50%Sub Contract	Fully Contract
6. South East Sulawesi	34	Mostly Direct	Fully Contract
7. Balai Besar VI	36	Mostly Contract out to Provinces	Fully Direct but actual works by contractors

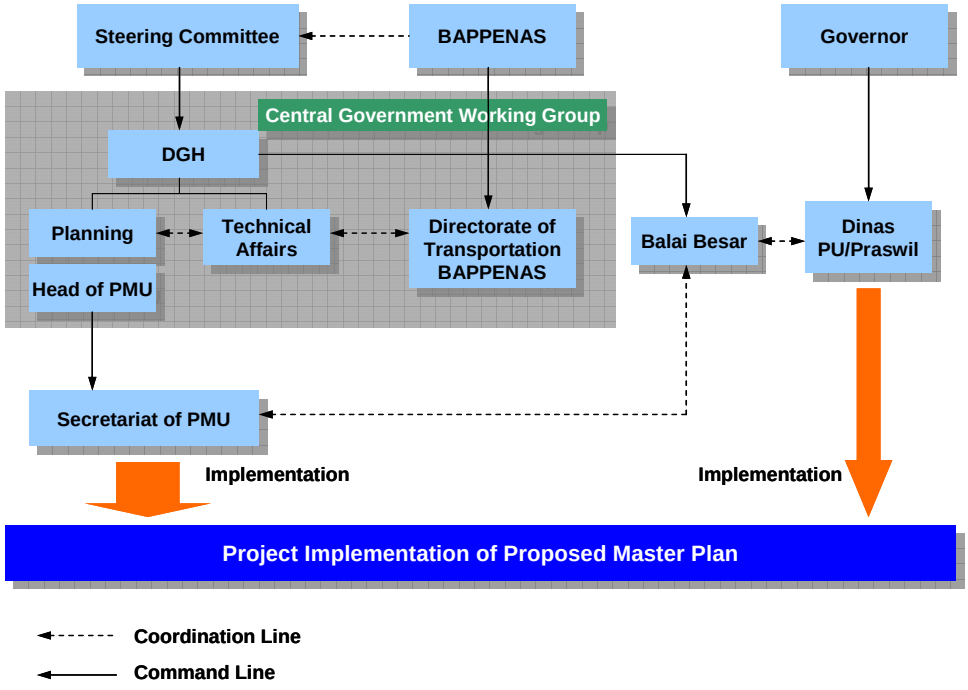
Source: JICA Study Team, as of November 2007

13.3.2 Implementing Organizations

Since the Master Plan proposal involves comprehensive road network development of both

national and provincial roads through an integrated manner and requires maximum utilization of resources at all possible levels, for the implementation of the proposed master plan. A type of implementing organization for the donor supported national and provincial road project is as illustrated in Figure 13.3.1 which facilitates the necessary coordinative efforts and the utilization of resources in both the central and the regional governments.

In this type of organization, a working group would be set up at the central government level and would have a steering committee to monitor the activities of the working group. The working group should be composed of the DGH (including the head of PMU of the project) of Ministry of Public Works and the Directorate of Transportation of BAPPENAS. It should function as the center of inter-governmental coordination for project implementation using the Balai Besar, and possibly the BAPPEDA, as a regional channel and the PMU as the project implementation body. Close coordination should be required at the regional level between the Balai Besar and the Dinas PU/Praswil of the regional governments, and possibly between the working group through the MPW and BAPPENAS, as well as the regional Governors.



Source: JICA Study Team

Figure 13.3.1 Possible Organization for Integrated Implementation of National and Provincial Road Project

13.4 Maintenance Plans

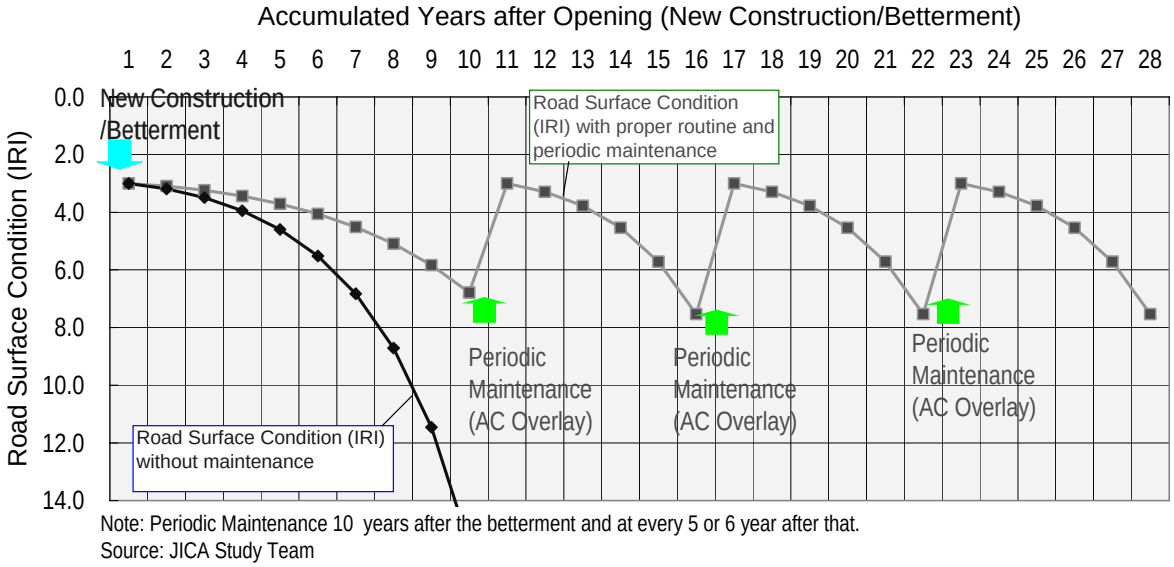
13.4.1 Maintenance Issues

(1) Necessity of Sufficient Budget for Road Maintenance

Sustainability of the road facilities after development, or betterment, is the most important issue.

New, or rehabilitated roads, will deteriorate through vehicle loading, weathering and aging. Maintenance reduces the rate of pavement deterioration, lowers vehicle operational costs, saving time costs, and provides continuous service for road users and communities. On the other hand, overloaded vehicles (e.g. trucks) shorten pavement life significantly. Road maintenance is defined as a process that optimizes overall performance of the roadway over time. Maintenance should be supported by system of information (data), planning, budgeting, and through practices with sound techniques.

The following figure illustrates a typical road surface deterioration having no maintenance and with proper maintenance for a typical road at approximately ADT 3,000 pcu.



Note: Periodic Maintenance 10 years after the betterment and at every 5 or 6 year after that.
Source: JICA Study Team

Figure 13.4.1 Typical Road Surface Deterioration With and Without Maintenance

The International Roughness Index (IRI) for a new pavement is approximately 3.0 and its deterioration accelerates after the IRI exceeds approximately 4-5 if no proper maintenance is made.

Insufficient budget allocation for road maintenance, especially when there is economic or budget constraints, causes serious road deterioration. Both development and maintenance budgets for national roads has increased substantially in the 2006 – 2008 budgets reflecting better central administration policy compared with the 2004 – 2005 budgets. However, it should be noted that insufficient budgets is still the most critical issue for both provincial and regency roads. A total amount of Rp 386 - 579 billion, which is 1.0%-1.5% of the road asset values, is required annually for the routine maintenance of national, provincial and regency roads in Sulawesi as estimated in Table 13.4.1.

Table 13.4.1 Annual Budget Requirements for Routine Maintenance Work

Road Status	Length (km)	Estimated Road Asset Value		Required Budget (Bil. Rp)
		Bil Rp./km	Amount (Bi.Rp.)	1.0% – 1.5% of Asset
National Road	8,100	1.4	11,340	113 – 170
Provincial Road	4,800	1.1	5,280	53 – 79
Regency Road	44,000	0.5	22,000	220 – 330
Total	56,900		38,620	386 – 579

Source: JICA Study Team

(2) Road Maintenance Capacity Development and Current Administration

The Road Maintenance Improvement Project was implemented in two phases from 1992-2001 under the JBIC's soft loan finance. The objective of the project was institutional strengthening and capacity development for routine maintenance of national and provincial roads of over 60,000 km. The Road Maintenance Units (RMU) was established at about 100 Caban Dinas (Branch Office of the MPW) in Phase 1 and around 240 Caban Dinas in Phase 2 throughout the country. Maintenance equipment and tools were supplied to the RMUs and trainings were provided for working skill and management capacity development for human resources. Standard Routine Maintenance Manuals were also prepared for road and equipment maintenance.

These RMUs were transferred to the provincial PW (Dinas PU) or Regency PW (Dinas PU Kabupaten) in line with autonomy progress. Currently, the routine maintenance of the national roads was under the responsibility of the Dinas PU using the national budget (APBN). The responsibility was moved back to Balai Besar VI/MPW since January 2007, however routine maintenance work is still conducted by the Dinas PU.

The management, planning and execution of maintenance works are currently under responsibility of the following agencies:

- National roads by the DGH through the Balai Besar VI (Regional Office for Sulawesi) of central government
- Provincial roads by the Praswil or the Dinas PU of Provincial governments
- Regency roads (Kabupaten roads) by Dinas PU of Regency/City governments.

The routine maintenance for national roads is conducted through the normal budget accounts of the provincial or the regency government using the APBN (national budget). Routine maintenance for provincial roads is conducted through the inherent budget accounts of the provincial or regency governments using the APBD I (provincial budget). The periodic maintenance for both national and provincial roads is contracted out to the private sector. Those for city and regency roads are executed by contracts or force accounts by the APBD II.

Besides budget concerns, insufficient capacities, including management, equipment and skills, is one of the most urgent issues in the national, provincial and regency road maintenance to

overcome. According to the spot survey conducted in South Sulawesi Province, some of the equipment supplied under the Road Maintenance Improvement Project is still used but many require repairs or replacements.

13.4.2 Road Maintenance Plan for Arterial and Collector Roads

Road maintenance consists of the following: routine maintenance, periodic maintenance and emergency works. Routine maintenance is an activity that should be undertaken each year. It is mostly a labor intensive work compared with the periodic maintenance that is equipment based. The design period for new or betterment projects are 10 years. The first periodic maintenance is required 10 years after the opening of the road. In principle, since the design life for periodic maintenance is five years maintenance should be repeated every 5-8 years depending on the level of traffic. The required maintenance activities are classified in Table 13.4.2.

Table 13.4.2 Required Maintenance Activities for Road Facilities

Category	Classification	Routine	Periodic	Emergency
Roadway	Road surface (AC pavement)	Crack sealing Patching	Overlay, partial reconstruction	Damage or road cut-off by slope failures, scouring, etc.
	Shoulders and approaches	Vegetation control		
		Spot failure repair		
Drainage	Culverts	Cleaning		Cleaning debris
	Roadside Drains	Cleaning		Cleaning debris
Roadside	Embankments			Slope failure, settlement
	Cut slopes	Removal of fallen rock/boulders		Slope failure repair (grouted riprap, rock net)
Bridges	Superstructure	Drainage	Repainting (steel)	Joint repair
	Foundation			Scouring protection / repair
	Others	Approach road settlement		
Traffic control device	Information and regulation signs, markings, etc.		Repainting of markings	Replacement of crushed signs, etc.
Safety devise	Guard rails, barriers, etc.			Replacement of crushed guard rails, signs, barriers, etc.

The above physical activities need equipment, materials, tools, personnel and budget. The maintenance can be conducted either through the usual budget accounts or through contracts.

Emergency works consist of unexpected repairs or activities. Approximately 25% of the national roads and 40% of the provincial roads are classified as having rolling or hilly terrains. Even roads along coastal lines often traverse mountainous terrain except these in South Sulawesi Province.

Heavy rainfalls amounting 2,000 mm – 4,000 mm per year regularly cause slope failures/landslides or scouring in the mountain roads during the rainy season, often cutting off traffic for several days. These natural disasters give additional cost burdens on road maintenance efforts.

13.4.3 Approach for Asset Management and Road Funds

(1) Definition of Road Asset Management

The asset management approach should be applied for sustainability of road facilities and services,. Asset management can be defined as a "comprehensive and structured approach to the long term management of assets as tools for the efficient and effective delivery of community benefits"[1]. Or "systematic process of effectively maintaining, upgrading and operating assets, combining engineering principles with sound business practice and economic rationale, and providing the tools to facilitate a more organized and flexible approach to making decisions necessary to achieve the public's expectations"[2].

(2) IRMS and BMS

The Integrated Road Management System (IRMS) was locally introduced in the late 1980s and was periodically updated as a tool for systematic road management. With appropriate modification, the IRMS can be used as a tool for asset management. The latest version is the 2007 version. The system is based on the road inventory database which has several modules including planning, budgeting, economic evaluation and design. The IRMS covered both national and provincial roads up to the year 2004. However, provincial roads were transferred and managed by the provincial public works in line with the 2004 New Road Law and Autonomy Law. One of the major problems of the IRMS is its complication. Only a few well-rained personnel can use them. A more compact and user friendly system should be developed for both provincial and regency roads management.

The Bridge Management System (BMS) was introduced in line with the development of the Road Design Systems in the early 1990s. However, the system has not been updated for a long time and its data are outmoded and could not be used for planning and management. A new system should be developed for an efficient and effective bridge management.

(3) Approach for Road Fund Establishment

The key factor in good maintenance practices is financial and budgeting sustainability which is based on an efficient and effective management system. Stable funding sources should be established to sustain maintenance programs. Two approaches can be used for this: budget approach and road fund approach. The former is a public expenditure that is covered by either the national or provincial budgets. Fuel taxes, vehicle registration fees, and others levies are used as general taxes and are then allocated for the road sector budget. The road fund approach allows road

[1] Austroads 1997 for improving asset management practice
[2] OECD

users to pay for the cost of road use. Revenues from the road use is then applied to cover road costs. The former is currently being practiced in Indonesia while the latter is being envisioned as one of the future challenging endeavors.

The road fund is an instrument that is generally used a main source for financing road maintenance and other road expenditures. Since the mid-1950s, this approach has been used in such countries as the USA, Japan, New Zealand. Road users pay user charges mainly in the form of a gasoline levy. Gasoline levies are the most economical and efficient collection method since they are collected at refineries or at ports of import. The road fund is free from budget fluctuations as it is generally managed and distributed by an independent board. In recent years, the road fund approach has become widespread and applied in many developing countries (more than 30 countries), including Ethiopia, Ghana, Benin, Kenya, Uganda, Honduras, Laos, etc. The first priority of the instrument is the sufficient collection of funds to cover for road maintenance. Currently, several countries have even attained a 90% collection rate for the required fund maintenance. Sources from the road fund could also be used for road safety, overload control and others, including road asset management activities.

A study was made in Indonesia focusing on the appropriateness of establishing a road fund under the World Bank's financial cooperation (EIRTP-1). However, as its application has not yet started, there is a need to strengthen current approaches to secure present maintenance costs.

13.4.4 Overloaded Vehicle Control System

(1) Regulations

In 1999, the Ministry of Communications and Ministry of Public Works, Bina Marga issued "Surat No. UM-0103-Db/898" touching on road re-classification due to serious pavement damages from overloaded and heavy vehicles. The decree from the Minister of the MOC, No.KM13 Year 2001, paved the way for the designation of road classification in Sulawesi. Under the decree, roads were classified into Class I, II, IIIA, IIIB and IIIC.

Table 13.4.3 Axle Load Limit Criteria by Road Class

Class	Maximum Size of Vehicles	Maximum Axle Load (ton)
I	W= 2.5m, L=18m	>10
II	W=2.5m, L=18m	10
IIIA	W=2.5m, L=18m	8
IIIB	W=2.5m, L=12m	
IIIC	W=2.1m, L=9 m	

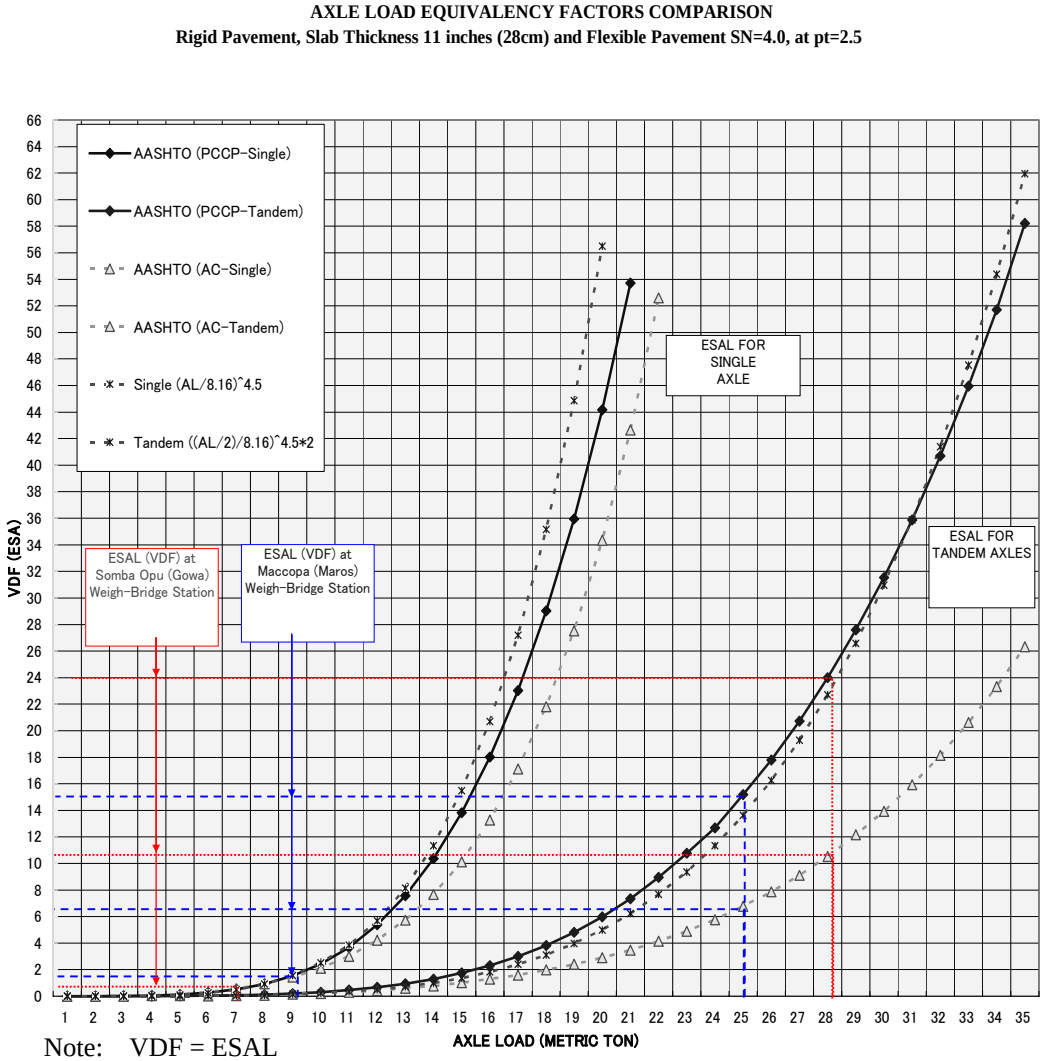
All national roads in Sulawesi were classified into either IIIA or IIIB. The maximum axel loads allowed on public roads is 8 tons.

(2) Present Situation of Overloading and Weigh Bridge Stations

As part of a traffic survey for the FS on the prioritization of roads in the Mamminasata Metropolitan Area, an axle load survey was conducted in April 2007. The survey showed that

approximately 47% - 64% of trucks were overloaded (refer to Volume II, FS Report). Especially overloaded were 3-axle trucks carrying construction materials (sand, gravel and soil), agricultural products and cement trucks. Overloading was significant with maximum axle loads reaching 25-28 tons.

Overloading has a highly negative effect on pavements, road safety and traffic capacity. Negative effects can be assessed through the vehicle damage factor (VDF/ESAL). Vehicle damage factors increases from the 4th to 5th power of the axle load as illustrated in **Figure 13.4.2** (a case in the Mamminasata Metropolitan Area, which illustrates that overloading control is extremely important in the proper maintenance of pavement life.



Note: VDF = ESAL
Source: JICA Study Team

Figure 13.4.2 Effects of VDF on Overloading and Vehicle Damage Factors

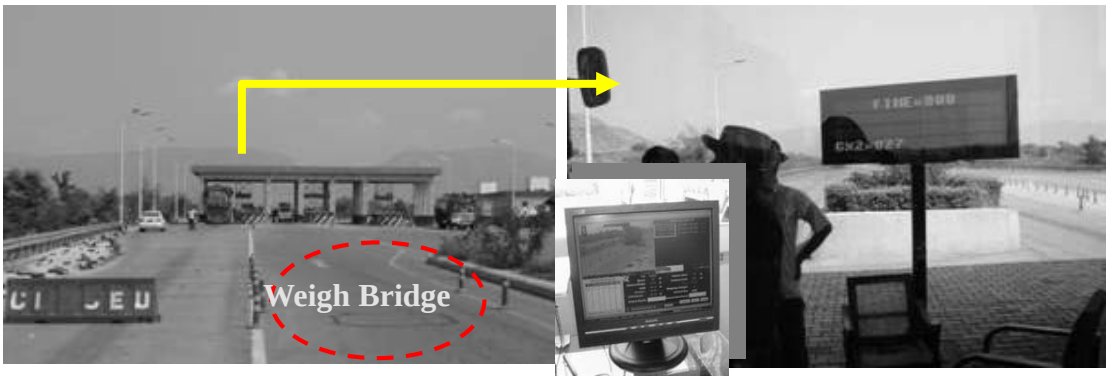
Weigh bridges are located on the national road network throughout the island and they are operated by the Provincial Transport Agencies. However, existing weigh bridges are not used effectively and efficiently. In addition, countless overloaded trucks have used alternatives routes to skip overload control stations.

(4) Measures for Overloaded Vehicle Control

Measures that will improve the function of overloaded vehicle control include the following:

- Improve transparency in axle and gross weight control methods and operations.
- Increase the number of weighing stations at strategic points of arterial and collector roads to prevent overloaded trucks from skipping control station through alternative routes.
- Strengthen education for vehicle owners and drivers.
- Introduce MST 10 ton routes (Class II roads) for heavy loaded road routes.

The Study Team recommends the introduction of a computer-assisted system at weighing stations as shown in Figure 13.4.3. In the system, when a heavy vehicle passes on a weigh bridge its gross weight is transmitted to a computer wherein the magnitude of overloading and the corresponding fines are automatically identified and indicated on an electronic board.



Source: JICA Study （2nd Kohat Tunnel FS） in Pakistan

Figure 13.4.3 Example of Computer-Assisted Overload Control System

This system is expected to contribute to the substantial reduction of overloaded vehicles since records are stored in computers and they are checked by supervisors and third parties. The private sector is also encouraged to participate in the operation of the weigh bridges in cooperation with the traffic police. Transport agencies should remain as administrators and supervisors of private operators.

Another important measure that can minimize overloading is the education of transport operators and drivers through the provision of information and guidance on overloading policies and the corresponding fine system. Information on overload control practices should also be opened to the public.

In addition to the above measures, a policy review will be required for the upgrading of some road links, from Class IIIA/IIIB to Class II, especially those constantly used by heavy vehicles including trailers, so that the MST 10 tons (VDF 2.5) can be applied. This will increase the design strength of pavement by about 2.5 times compared with MST 8.0 ton (VDF 1.0).

13.5 Funding Requirement and Financing Plans

13.5.1 Funding Requirements of the Proposed Master Plan

Funding requirements for implementing the entire Master Plan for 2008-2024, including the maintenance and development of both national and provincial road network has been appropriately estimated. As shown in **Table 13.5.1** the entire investment cost, which include both development and maintenance, is estimated at Rp 35,199 billion (National Road: Rp 23,771 billion and Provincial Road: Rp 11,428 billion). The investment is further broken down to the following terms: Short-term (2008-2014), Medium-term (2015-2019) and Long-term (2020-2024).

Table 13.5.1 Funding Requirement for Proposed Master Plan

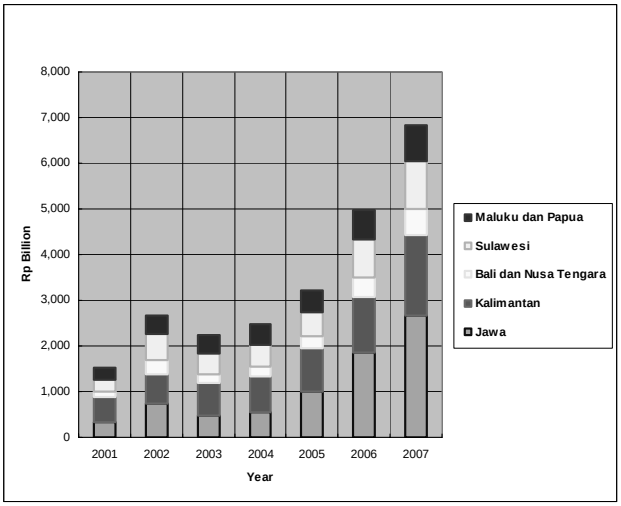
Improvement measures	Total Project Cost			
	Arterial Road	Collector Road	Total	Amount
	(km)	(km)	(km)	Rp Billion
A. National Road (Arterial road + Collector (K-1) road)				
Development Cost	3,123	2,946	6,069	13,644
Periodic and Routine Maintenance Costs	3,256	4,885	8,141	10,127
Total A				**23,771**
B. Provincial Road (Collector road K-2 & K-3)				
Development Cost	0	2,342	2,342	5,249
Periodic and Routine Maintenance Costs	0	4,785	4,785	6,179
Total B	0	7,127	7,127	**11,428**
Total A+B				**35,199**

Source: JICA Study Team

13.5.2 Possible Budget Envelope

(1) Recent Trends in Budget Allocations for National and Provincial Roads

Development of the national road network has been funded by the APBN budget allocated through the Bina Marga. The recent trend in budget allocation from the Bina Marga to the Regions is shown in **Figure 13.5.1**. The budget for Sumatra is excluded to eliminate the effects of the large budget allocation due to the earthquake/tsunami catastrophe in 2003. As shown in the figure the total Bina Marga budget has doubled since 2005. A similar trend is observed for the



Source: Bina Marga, Note: Excluded Sumatra data

Figure 13.5.1 Trend of National Road Budget

Sulawesi Region total. The current government has a clear focus on the improvement of the nation's road infrastructure.

However it should be noted that the transport sector budget of the GOI had experienced drastic decreases from 1993-1994 down to 1/6 to 1/7 in 2001[3] in terms of GDP share due to the financial crisis and the decentralization policy of the central government. The current increase of the Bina Marga Budget may be considered as a reactionary process aimed at resuming the 1993-1994 budget levels based on the policy change of the current regime focusing on the development of the nation's infrastructure. In addition, Bina Marga is preparing a multi-year contract package for the comprehensive improvement of the Western Corridor of Sulawesi Island and other routes which will contribute again to a large increase of the national road budget of the Sulawesi Region in 2008 and 2009.

As for the provincial road development budgets the average annual growth rate has been about 6% from 2002-2007.

(2) Possible Budget Envelope Estimates

Estimation of the Budget Envelope is conducted on the basis of project budget only (construction/betterment and periodic/routine maintenance), from which the general administration cost, headquarter cost (for DGH) and planning & control costs are excluded.

The estimates are based on the following conditions:

Budget Growth Assumptions:

Development Budget for National Roads: The multi-year package for the Western Corridor (2008-2009) will increase the Sulawesi Region's budget to Rp 2 trillion level[4] in 2008, then keep the 2008 level for the Short-term. It will decrease by 30% for the Medium-term and decrease by another 30% for the Long-term.

Development Budget for Provincial Roads: Following the same pattern, the 2008 level will be maintained for the Short-term, then decrease by 30% for the Medium-term and decrease by another 30% for the Long-term.

Maintenance Budget for National Roads: Following the same pattern as above for the Short-term, but will increase by 30% for the Medium-term, and increase by another 30% for the Long-term.

Maintenance Budget for Provincial Roads: Follows the same pattern of the Maintenance Budget for National Roads.

[3] The ratio of total development expenditure against GDP was about 9% in 1993/94 which decreased down to about 3% in 2000. The ratio of development expenditure for Transport, Meteorology and Geophysics against GDP was about 1.5% in 1993/94 which decreased down to 0.2% in 2001.

[4] The figure is based on the interview with Balai Besar VI.

The total possible budget envelope estimates is shown in **Table 13.5.2** and **Figure 13.5.2.** It is about Rp 35.4 trillion for the entire period (2008-2024), and includes the development and maintenance costs of both the national and provincial road networks of the Sulawesi Region.

Table 13.5.2 Possible Budget Envelopes for National and Provincial Roads

		Short-term			Increase Ratio	Medium-term			Increase Ratio	Long-term			Total
		Rp Bil.	Years	Rp Bil.		Rp Bil.	Years	Rp Bil.		Rp Bil.	Years	Rp Bil.	Rp Bil.
National Road	Dev. Budget	1,233	7	8,631	(−) 30%	863	5	4,316	(−) 30%	604	5	3,021	15,967
	Maintenance	680	7	4,760	(+) 30%	884	5	4,420	(+) 30%	1,149	5	5,746	14,926
	Total	1,913		13,391		1,747		8,736		1,753		8,767	30,893
Provincial Road	Dev. Budget	185	7	1,295	(−) 30%	130	5	648	(−) 30%	91	5	453	2,396
	Maintenance	96	7	672	(+) 30%	125	5	624	(+) 30%	162	5	811	2,107
	Total	281		1,967		254		1,272		253		1,264	4,503
Total	Dev. Budget	1,418	7	9,926		993	5	4,963		695	5	3,474	18,363
	Maintenance	776	7	5,432		1,009	5	5,044		1,311	5	6,557	17,033
	Total	2,194		15,358		2,001		10,007		2,006		10,031	35,396

Source: JICA Study Team

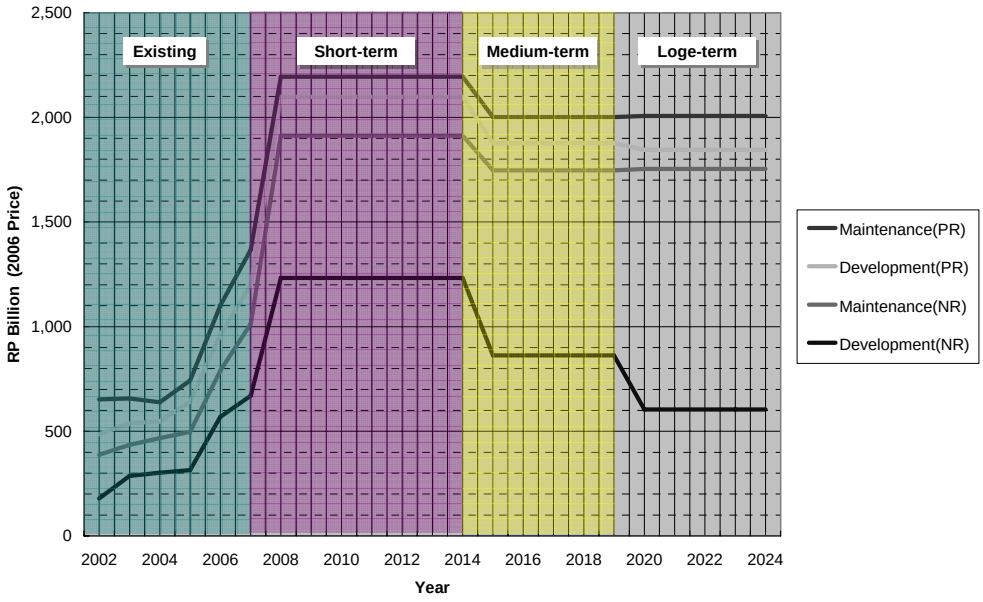
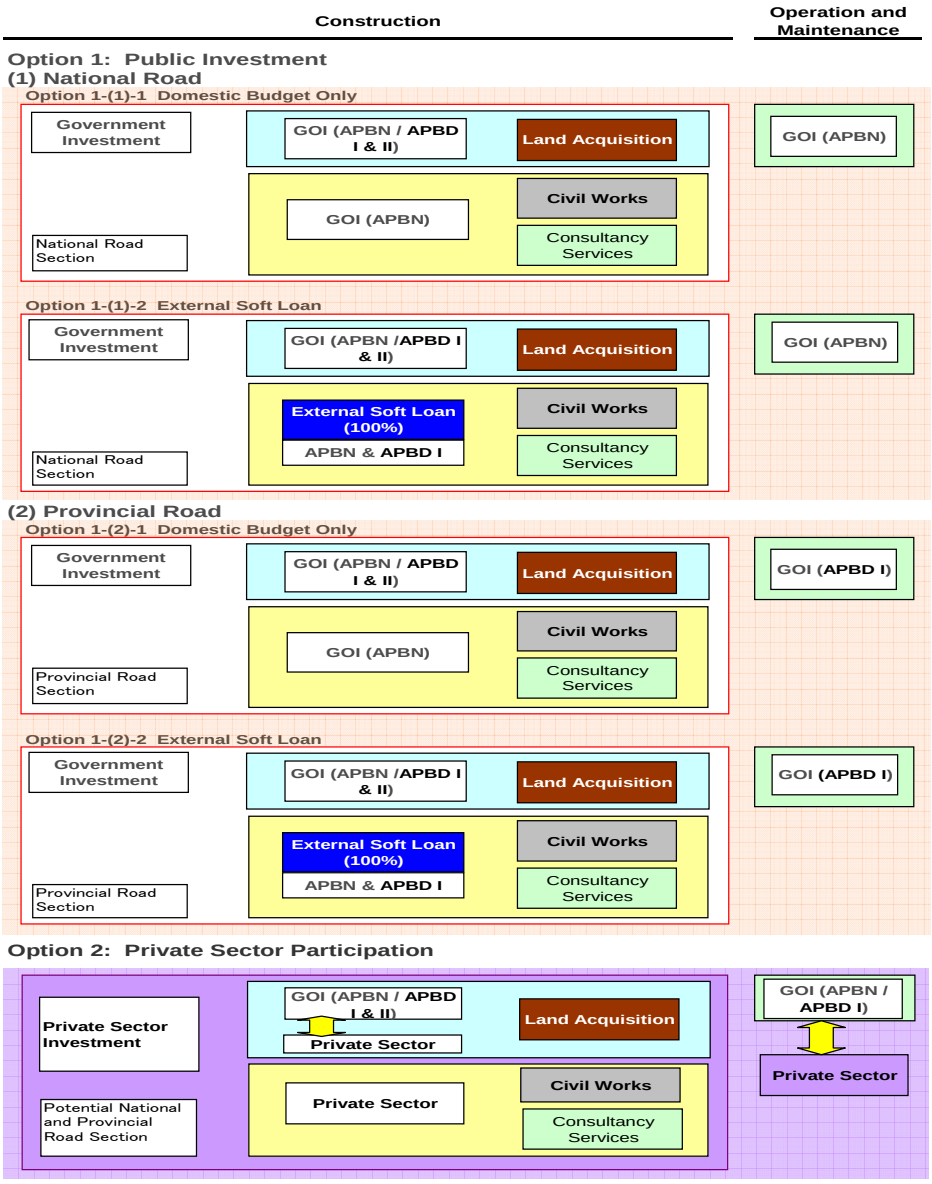


Figure 13.5.2 Possible Budget Envelope for National and Provincial Roads

13.5.3 Estimated Financing Plan

(1) Financing Methods

General Financing methods for the development and maintenance of national and provincial roads are illustrated in **Figure 13.5.3**. An external soft loan is applicable for the development of both national and provincial roads. According to the current EIRTP-2 practice, the external soft loan for the development of provincial road is utilized on the basis of an on-granting mechanism with an on-granting agreement between the MOF and the grant receiver (Province) and with the Ministry of Public Works as the implementing agency of the loan program.



Note: Excluding VAT and Administration cost
Source: JICA Study Team

Figure 13.5.3 Financing Methods for National and Provincial Road

(2) Potential Funding Sources for Provincial Road Development

The following are potential funding sources which could be utilized for the development of provincial roads:

1) **Funding from the Line Ministry (APBN):** National Budget from the Bina Marga when a road sector (APBN) allocated for the development of a national road could be allocated for the development of Provincial Road on the basis that the road itself has a strategic nature, and preferably connects with a national road network.

2) **External Soft Loan/Grant (APBN):** The Ministry of Finance prepares both the on-granting scheme for the Regional Government (PMK 52 /2006: Peraturan Menteri Keuangan, Nomor 52/PMK 010 /2006) and the on-lending scheme of the External Loan (PMK 53 /2006). However, due to the limited financial capacities of the Regional Government, only the on-granting practices of the External Loan have been adopted so far. The on-granting program may be extended both to the Provincial and Kabupaten/Kota governments. As described above the project funding for the ERITP 2 project is implemented on an on-granting basis of 30% - 90%.

3) **DAK (Special Allocation Fund: APBN allocated to APBD):** DAK is one category of balancing funds from the GOI to the Regional Government. DAK has been allocated to the road sector expenditures of the Kabupaten/Kota Governments in the last two years. It was started this year for the Provincial Governments based on the proposal from the Regional Governments. However, the DAK allocated to the road sector should be used in accordance with the PU's instruction (Peraturan Menteri Pekerjaan Umum Nomor: 39 /PRT/M/2006) which stipulates 70% share for maintenance and 30% for the improvement/construction.

4) **General Provincial Budget (APBD I):** Although limited, the General Provinicial Budget (APBD I) is the major funding source for both the development/improvement and maintenance of regional roads. APBD I is financed through regional tax/levy revenues and the Balancing Fund from the GOI such as the Revenue Sharing, the General Allocation Fund (DAU) and the Special Allocation Fund (DAK). For the Sulawesi Provinces their revenue for 2006 was composed of 32% of their own local revenues and 68% by the balancing fund from the GOI.

5) **Private Funding:** When traffic volume is large and toll charges can be applied for road users, private funding may be tapped for the development and operation/maintenance of both national and provincial road sections.

13.6 Implementation Schedules

13.6.1 Implementation Plan Concepts

To establish realistic and effective implementation schedules, the following concepts were applied:

(1) Completion of on-going project in the short-term

All of the on-going improvement projects being implemented or committed by international funding agencies and domestic funds, such as the EINRIP by the AusAID, Road Improvement through a Multi Year Contract (2007-2009) by the Bina Marga, shall be completed in the short-term plan (2008 -2014).

(2) Implementation of "Urgent Bridge Repair Program" in the short-term plan

"Urgent bridge repair program" should cover the whole network of national roads and provincial roads and should be implemented in the short-term plan taking into account the safety of traffic as well as the adverse impacts on local socio-economic activities.

(3) Allocation of the project in accordance with order of priorities

The project shall be distributed in the short-term, medium-term and long-term in accordance with the order of priorities which has been developed through the project evaluation in terms of economic feasibility, social and natural environmental impacts and maturity of the project.

13.6.2 Road Investment Plan

Based on the financing plan discussed in Section 13.5, the Study Team prepared the road investment plans with three alternatives focused on development cost, as follows:

Case 1: Equal Investment Plan (Development cost is allocated equally in the short-term, medium-term and long-term).

Case 2: Intermediate Investment Plan between Case 1 and Case 3.

Case 3: Early Investment Plan (60% of development cost is allocated positively in the short-term plan)

The maintenance cost is allocated into the short-term (20%), medium-term (30%) and long-term (50%) taking into consideration the progress of the road improvement work through new construction and betterment. The above distribution patterns on maintenance costs are similarly applied to all the cases.

Table 13.6.1 (1) to Table 13.6.1 (3) shows the road investment plan including the prospect of road budget in each term. The Study team recommends Case 3 as the most realistic and effective investment plan taking into consideration the right balance in investment costs and the budget in

all periods. It concludes as follows:

(1) The road investment and prospect road budget in Case 3 are balanced if a current road budget for national road is secured continuously by the end of the master plan in 2024. This means, that all proposed roads in the master plan would be improved to the planned design and will be completed in accordance with the implementation of the schedule without delay.

(2) The possibility of the national budget being used for national road would be sufficient, so that all the national roads will have all weather conditions with high design standards and sufficient traffic capacity by the year 2024.

If there are roads with increasing traffic volumes they should be improved and widened using the balance budget. It is also advised that the improvement and strengthening of the existing road maintenance system and management system including traffic safety should be implemented simultaneously using the balance of budget.

(3) Prospects for budget of development and road maintenance always have constraints in all the periods. Therefore, it is necessary to look for additional fund sources in order to complete the improvement of the provincial road network. Provincial road is the important transport network in addition to the Kabupaten road that would support local socio-economic activities. However, these roads are usually left unattended and in poor condition due to lack of funds for improvement and maintenance.

The Study Team, therefore, recommends that the central government provides the strategic financial assistance to the provincial government in order to support the development of the provincial roads including the kabupaten roads. (Kabupaten road plays an important role as a means of local transport and spans 44,000km in Sulawesi, while national road and provincial road cover 12,900km in total).

13.6.3 Bridge Investment Plan

The total length of bridges on national and provincial roads is approximately 55,000m and 38,000m, respectively. As planned in Section 8.2.8, 326 numbers (5,510 m in length) and 397 numbers (6,050 m in length) of bad conditioned bridges will be replaced in the short-term plan (2008 -2014) irrespective traffic volumes to solve bottle necks in the arterial road network.

The required investment cost for “Urgent Bridge Repair Program” is included in either development or maintenance budget of the road investment plan.

Table 13.6.1 (1) Proposed Investment Allocation & Financing Plan (Case 1: Equal Investment Plan)

(1) Proposed Investment Allocation Plan

US$1.0 = Rp. 9,322, Rp 1.0 = ¥ 0.013

Improvement measures	Total Project Cost				Short-term (2008-2014)			Medium-term (2015-2019)			Long-term (2020-2024)			Remarks
	Arterial Road	Collector Road	Total	Amount	Length		Amount	Length		Amount	Length		Amount	
	(km)	(km)	(km)	Rp Billion	(km)	(%)	Rp Billion	(km)	(%)	Rp Billion	(km)	(%)	Rp Billion	
A. National Road (Arterial road + Collector (K-1) road)														
Development Cost	3,123	2,946	6,069	13,644	2,023	33%	4,835	2,023	33%	4,404	2,023	33%	4,404	Rp.431Billion of Urgent Bridge Repair on National Road (345Nos or 6,000m) is included in the short-term plan
Periodic and Routine Maintenance Costs	3,256	4,885	8,141	10,127	1,628	20%	2,025	2,442	30%	3,038	4,071	50%	5,064	Urgent overlay of pavement (675km) is required in the short-term
Total A				**23,771**	3,651		**6,861**			**7,443**			**9,468**	
B. Provincial Road (Collector road K-2 & K-3)														
Development Cost	0	2,342	2,342	5,249	781	33%	2,052	781	33%	1,598	781	33%	1,598	Rp.431Billion of Urgent Bridge Repair on Provincial Road (397Nos or 6,500m) is included in the short-term plan
Periodic and Routine Maintenance Costs	0	4,785	4,785	6,179	957	20%	1,236	1,436	30%	1,854	2,393	50%	3,090	Urgent overlay of pavement (982km) is required in the short-term
Total B	0	7,127	7,127	**11,428**	1,738		**3,288**			**3,452**			**4,688**	
Total A+B				**35,199**	**10,149**			**10,895**			**14,156**			

(2) Prospect of Road Budget

Expected Budget			Short-term (2008-2014)	Medium-term (2015-2020)	Long-term (2020-2024)	Remarks
			Total Amount	Total Amount	Total Amount	
A. National Road	Development Budget	15,968	8,631	4,316	3,021	
	Difference (surplus /▲shortage)		3,796	▲ 88	▲ 1,383	
	Maintenance Budget	14,926	4,760	4,420	5,746	
	Difference (surplus /▲shortage)		2,735	1,382	683	
	Total (A)	**30,894**	**13,391**	**8,736**	**8,767**	
	Difference (surplus /▲shortage)		6,530	1,293	▲ 701	
B. Provincial Road	Development Budget	2,396	1,295	648	453	
	Difference (surplus /▲shortage)		▲ 757	▲ 950	▲ 1,145	
	Maintenance Budget	2,107	672	624	811	
	Difference (surplus /▲shortage)		▲ 564	▲ 1,230	▲ 2,279	
	Total (B)	**4,503**	**1,967**	**1,272**	**1,264**	
	Difference (surplus /▲shortage)		▲ 1,321	▲ 2,180	▲ 3,424	
Total A+B		**35,397**	**15,358**	**10,008**	**10,031**	
Difference (surplus /▲shortage)		198	5,209	▲ 887	▲ 4,125	

Table 13.6.1 (2) Proposed Investment Allocation & Financing Plan (Case 2: Intermediate Plan)

(1) Proposed Investment Allocation Plan

US$1.0 = Rp. 9,322, Rp 1.0 = ¥ 0.013

Improvement measures	Total Project Cost				Short-term (2008-2014)			Medium-term (2015-2019)			Long-term (2020-2024)			Remarks
	Arterial Road	Collector Road	Total	Amount	Length		Amount	Length		Amount	Length		Amount	
	(km)	(km)	(km)	Rp Billion	(km)	(%)	Rp Billion	(km)	(%)	Rp Billion	(km)	(%)	Rp Billion	
A. National Road (Arterial road + Collector (K-1) road)														
Development Cost	3,123	2,946	6,069	13,644	3,035	50%	7,110	2,124	35%	4,632	910	15%	1,903	Rp.431Billion of Urgent Bridge Repair on National Road (345Nos or 6,000m) is included in the short-term plan
Periodic and Routine Maintenance Costs	3,256	4,885	8,141	10,127	1,628	20%	2,025	2,442	30%	3,038	4,071	50%	5,064	Urgent overlay of pavement (675km) is required in the short-term
Total A				**23,771**	4,663		**9,135**			**7,670**			**6,967**	
B. Provincial Road (Collector road K-2 & K-3)														
Development Cost	0	2,342	2,342	5,249	1,171	50%	2,927	820	35%	1,686	351	15%	636	Rp.431Billion of Urgent Bridge Repair on Provincial Road (397Nos or 6,500m) is included in the short-term plan
Periodic and Routine Maintenance Costs	0	4,785	4,785	6,179	957	20%	1,236	1,436	30%	1,854	2,393	50%	3,090	Urgent overlay of pavement (982km) is required in the short-term
Total B	0	7,127	7,127	**11,428**	2,128		**4,163**			**3,540**			**3,726**	
Total A+B				**35,199**	**13,298**			**11,210**			**10,692**			

(2) Prospect of Road Budget

Expected Budget			Short-term (2008-2014)	Medium-term (2015-2020)	Long-term (2020-2024)	Remarks
			Total Amount	Total Amount	Total Amount	
A. National Road	Development Budget	15,968	8,631	4,316	3,021	
	Difference (surplus /▲shortage)		1,521	1,278	1,118	
	Maintenance Budget	14,926	4,760	4,420	5,746	
	Difference (surplus /▲shortage)		2,735	1,382	683	
	Total (A)	**30,894**	**13,391**	**8,736**	**8,767**	
	Difference (surplus /▲shortage)		4,256	1,066	1,800	
B. Provincial Road	Development Budget	2,396	1,295	648	453	
	Difference (surplus /▲shortage)		▲ 1,632	▲ 1,038	▲ 183	
	Maintenance Budget	2,107	672	624	811	
	Difference (surplus /▲shortage)		▲ 564	▲ 1,230	▲ 2,279	
	Total (B)	**4,503**	**1,967**	**1,272**	**1,264**	
	Difference (surplus /▲shortage)		▲ 2,196	▲ 2,268	▲ 2,462	
Total A+B		**35,397**	**15,358**	**10,008**	**10,031**	
Difference (surplus /▲shortage)		**35,397**	2,060	▲ 1,202	▲ 661	

Table 13.6.1 (3) Proposed Investment Allocation & Financing Plan (Case 3: Early Investment Plan)

(1) Proposed Investment Allocation Plan

US$1.0 = Rp. 9,322, Rp 1.0 = ¥ 0.013

Improvement measures	Total Project Cost				Short-term (2008-2014)			Medium-term (2015-2019)			Long-term (2020-2024)			Remarks
	Arterial Road	Collector Road	Total	Amount	Length		Amount	Length		Amount	Length		Amount	
	(km)	(km)	(km)	Rp Billion	(km)	(%)	Rp Billion	(km)	(%)	Rp Billion	(km)	(%)	Rp Billion	
A. National Road (Arterial road + Collector (K-1) road)														
Development Cost	3,123	2,946	6,069	13,644	3,641	60%	8,402	1,821	30%	3,878	607	10%	1,364	Rp.431Billion of Urgent Bridge Repair on National Road (345Nos or 6,000m) is included in the short-term plan
Periodic and Routine Maintenance Costs	3,256	4,885	8,141	10,127	1,628	20%	2,025	2,442	30%	3,038	4,071	50%	5,064	Urgent overlay of pavement (675km) is required in the short-term
Total A				**23,771**	5,270		**10,428**			**6,916**			**6,428**	
B. Provincial Road (Collector road K-2 & K-3)														
Development Cost	0	2,342	2,342	5,249	1,405	60%	3,376	703	30%	1,348	234	10%	525	Rp.431Billion of Urgent Bridge Repair on Provincial Road (397Nos or 6,500m) is included in the short-term plan
Periodic and Routine Maintenance Costs	0	4,785	4,785	6,179	957	20%	1,236	1,436	30%	1,854	2,393	50%	3,090	Urgent overlay of pavement (982km) is required in the short-term
Total B	0	7,127	7,127	**11,428**	2,362		**4,612**			**3,201**			**3,614**	
Total A+B				**35,199**	**15,040**			**10,117**			**10,042**			

(2) Prospect of Road Budget

Expected Budget			Short-term (2008-2014)	Medium-term (2015-2020)	Long-term (2020-2024)	Remarks
			Total Amount	Total Amount	Total Amount	
A. National Road	Development Budget	15,968	8,631	4,316	3,021	
	Difference (surplus /▲shortage)		229	**438**	**1,657**	
	Maintenance Budget	14,926	4,760	4,420	5,746	
	Difference (surplus /▲shortage)		2,735	1,382	683	
	Total (A)	**30,894**	**13,391**	**8,736**	**8,767**	
	Difference (surplus /▲shortage)		**2,963**	**1,820**	**2,339**	
B. Provincial Road	Development Budget	2,396	1,295	648	453	
	Difference (surplus /▲shortage)		▲ 2,081	▲ 700	▲ 72	
	Maintenance Budget	2,107	672	624	811	
	Difference (surplus /▲shortage)		▲ 564	▲ 1,230	▲ 2,279	
	Total (B)	**4,503**	**1,967**	**1,272**	**1,264**	
	Difference (surplus /▲shortage)		▲ 2,645	▲ 1,929	▲ 2,350	
Total A+B		**35,397**	**15,358**	**10,008**	**10,031**	
Difference (surplus /▲shortage)		198	318	▲ 109	▲ 11	

13.6.4 Implementation Plan of Proposed Project

Nineteen packages of the road project is allocated in the short-, medium-, and long-terms in accordance with the prioritization as well as the ceiling of the road investment plan (Case 3) and the results of the implementation plan, as shown in Table 13.6.2.

The following conditions were assumed in preparing for the implementation schedule:

1) The construction period is estimated taking into account the construction costs of each package as follows:

Construction cost	Construction period
Less than Rp. 500 Billion	2 years
Rp.500 Billion – Rp.1,000 Billion	3 years
Rp.1,000 Billion – Rp. 1,500 Billion	4 years
More than Rp. 1,500 Billion	5 years – 7 years

Table 13.6.2 Summary of Project Implementation Schedule

Project		Package No.	Location	Priority by EIRR	Length	Const. Cost	Implementation Schedule (Rp.Billion)																
							Short-term							Medium-term					Long-term				
					km	(Rp.Billion)	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
(I) Road Development Project																							
1. Proposed Project																							
TS-1	TS Main Corridor (West south Corridor) including connected provincial roads	TS-1-1	Jeneponto – Makassar – Parepare	1	658	2,742				(AusAID, APBN included)													
TS-1		TS-1-2	Parepare – Mamuju	4	692	1,111																	
TS-1		TS-1-3	Mamuju – Palu	12	387	890			(WB)														
TS-1	Crossing Road	TS-1-4	Maros – Bajoe	5	144	157																	
TS-1		TS-1-5	Parepare – Palopo	6	290	414																	
TS-1		TS-1-6	Wonomulyo – Kaluku	3	200	372				(APBN included)													
TS-2	TS Main Corridor (West-North section) including connected provincial roads	TS-2-1	Palu – Kwandang	7	1,019	465																	
TS-2		TS-2-2	Kwandang – Manado – Bitung	8	1,399	2,109								(APBN included)									
TS-2	Crossing Road	TS-2-3	Molibagu – Worotican	14	184	331																	
TS-3	TS Main Corridor (Central south section) including connected provincial roads	TS-3-1	Jeneponto – Watampone – Wotu	2	1,452	1,892					(Aus AID included)												
TS-3		TS-3-2	Wotu – Poso – Toboli	17	1,069	1,346			(WB)														
TS-4	TS Main Corridor (Central north section) including connected provincial roads	TS-4-1	Toboli – Gorontalo	10	973	1,785																	
TS-4		TS-4-2	Gorontalo – Bitung	9	893	1,052			(AusAID, APBN)														
TS-5	TS Main Corridor (East Corridor) including connected provincial roads	TS-5-1	Wotu – Kolaka	15	435	972																	
TS-5		TS-5-2	Kolaka – Tinanggea – Kendari	18	1,060	902			(AusAID/APBN)														
TS-5		TS-5-3	Kendari – Tondoyondo	16	373	547			(AusAID)														
TS-5		TS-5-4	Tondoyondo – Luwuk – Poso	13	1,235	709																	
TS-5	Crossing Road	TS-5-5	Kolaka – Kendari	11	312	440			(WB)														
TS-5		TS-5-6	Landawe – Tolala	19	150	660																	
2. On-going or committed projects in the Short-term Plan																							
	EINRIP by AusAID, EIRTP by WB																						
	Other Road Improvement by APBN Multi Year Contract (2007 – 2009)																						
	Manado Bypass, Gorontalo Bypass and other Priority Roads																						
3. Recommended priority projects proposed in the Master Plan																							
	Urgent Bridge Repair Program (Repair of Bridges in Grade 4, Grade 5 and Wooden Bridges)																						
	Priority Roads Projects proposed in this Master Plan Study (Expected finance: Yen Loan, APBN, APBD and others)																						
	Trans Sulawesi Mamminasata Maros – Takalar Section (Expected finance: Yen Loan, APBN and others)																						
	Priority urban roads in Mamminasata including Hertasning Road, Abdullah Daeng Sirua Road, Mamminasa Bypass, Tg Bunga-Takalar Road and other important roads																						
	Bridge Reconstruction Projects in Southeast Sulawesi Province and others																						
Total Road Development Cost (I)					12,925	18,894	1,689	2,231	1,821	1,789	1,581	1,344	1,322	1,146	1,206	1,213	964	698	436	491	302	330	330
							11,778							5,227					1,889				
II. Road Maintenance*																							
	Urgent Pavement Repair Program (Repair of Pavement in Class III and Class IV)						Urgent Repair of Deteriorated Pavement																
	Routine and Periodic Maintenance						Routine & Periodic Maintenance							Routine & Periodic Maintenance					Routine & Periodic Maintenance				
Total Road Maintenance Cost (II)					12,925	16,305	300	350	450	500	511	550	600	750	900	1,000	1,100	1,140	1,250	1,400	1,650	1,800	2,054
							3,261							4,890					8,154				
Grand Total (I)+(II)					12,925	35,199	1,989	2,581	2,271	2,289	2,092	1,894	1,922	1,896	2,106	2,213	2,064	1,838	1,686	1,891	1,952	2,130	2,384
							15,039							10,117					10,043				

Notes 1: * Bad conditioned road links (Class IV) will be given higher priority under the road maintenance programs irrespective of EIRR.
2: * Road maintenance program could be changed to betterment program at the time of detailed project planning under IRMS by reviewing the validation of each road link on both economical, technical and other aspects.
Source: JICA Study Team

2) The construction costs of each package includes the development cost only, while the ceiling amount in each term is allocated based on the road investment plan of Case 3 as follows:

Short-term : Rp. 11,779 Billion
Medium-term : Rp. 5,226 Billion
Long-term : Rp. 1,889 Billion

3) Specific projects which were considered in the short-term plan:

(a) On-going projects:

EINRIP by AusAID (2007-2009), Road Improvement by multi-year contract (2007-2009) by DGH, Manado and Gorontalo Bypass and other important roads.

(b) Recommended priority development projects (Expected fund):

- Priority road projects including urgent bridge repair program*

  (Yen Loan, APBN, APBD, others)

- Trans Sulawesi Mamminasata from Maros to Takalar

  (Yen Loan, APBN, others)

- Priority Arterial Roads in Mamminasata Metropolitan Area*

  (Yen Loan, APBN, APBD, others)

- Bridge Reconstruction Project in Southeast Province and others.

Notes: i) **In case of Yen Loan:** This is soft loan ODA and appropriate for implementing of large scale projects with an EIRR of more than 15%.

ii) **In case of Japanese Grant:** This aid is appropriate for implementing projects that contribute to basic human needs of the local people even if their EIRR is less than 15%. For the urgent bridge repair program by the Japanese grant, for example, the program should be for the road routes in islands and inland areas, where securing of access is important for community life (school, health care centers, markets, etc) and regional development, though economic priority is relatively low. The numbers of bridges subjected to the Urgent Bridge Repair Program are as shown in Table 13.6.3. About 40% of these bridges are located in Southeast Sulawesi Province and, therefore, the priority of implementation can be considered for this province in case of the Japanese grant.

Table 13.6.3 Urgent Bridge Repair Program by Province

Province	No Damage/Good	Fair/Poor	Bad/ Very Bad	Wooden/ Unknown	Total	Bad, Very Bad & Wooden	
North Sulawesi	671	160	42	100	973	142	20%
	69%	16%	4%	10%	100%	15%	
Gorontalo	292	10	36	0	338	36	5%
	86%	3%	11%	0%	100%	11%	
Central Sulawesi	1,222	390	40	55	1,707	95	13%
	72%	23%	2%	3%	100%	6%	
West Sulawesi	241	65	22	37	365	59	8%
	66%	18%	6%	10%	100%	16%	
South Sulawesi	965	321	67	25	1,378	92	13%
	70%	23%	5%	2%	100%	7%	
South East Sulawesi	550	257	144	155	1,106	299	41%
	50%	23%	13%	14%	100%	27%	
Total	**3,941**	**1,203**	**351**	**372**	**5,867**	**723**	100%
	67%	21%	6%	6%	100%	12%	

Source: JICA Study Team

(c) Maintenance projects and programs:

- Urgent pavement repair program for road conditions of poor and bad.

  (Yen Loan, APBN, APBD, others)

Notes: i) Bad conditioned road links (Class IV) will be given higher priority under the road maintenance programs irrespective of EIRR.

ii) Capacity development programs (equipment, methodology, staff capability, etc) for routine maintenance will also be implemented.

Based on the above conditions, the economic analysis was conducted for each case of the implementation program. As a result, the economic benefit, based on the VOC and TTC, derived from Case 3 of implementation plan and the master plan road network, is expected to be Rp. 338,082 Billion from 2012 to 2044 in total. It has the following economic indices:

Total project cost including maintenance cost	: Rp. 52,735 Billion
Accumulated benefit (Period: 2012 – 2044)	: Rp. 338,082 Billion
Economic internal rate of return (EIRR)	: 21.5%
Net Present Value	: Rp. 6,475 Billion
B/C ratio	: 1.58

The above indices justify that the projects proposed in the master plan are economically viable and feasible. Table 13.6.4 shows the result of economic calculation for Case 3 in the implementation program.

Table 13.6.4 Calculation of Economic Analysis (Case 3)

(Rp. Million)

No.	Year	Development Cost	O & M		Total Cost (C)	Benefit (B)	BALANCE (B-C)
			Routine	Periodic			
	2007	0	0	0	0	0	0
	2008	963,360	108,602	297,870	1,369,832	0	-1,369,832
	2009	1,201,860	155,059	345,810	1,702,729	0	-1,702,729
	2010	1,389,060	155,858	913,830	2,458,748	0	-2,458,748
	2011	1,752,435	126,900	43,590	1,922,925	589,242	-1,333,683
	2012	1,852,560	159,857	482,070	2,494,487	745,025	-1,749,461
	2013	1,721,700	151,779	2,356,740	4,230,219	1,120,014	-3,110,206
	2014	1,719,293	159,857	450,105	2,329,254	1,178,561	-1,150,694
	2015	977,070	141,480	487,830	1,606,380	4,512,141	2,905,761
	2016	992,798	147,094	1,197,015	2,336,906	5,024,450	2,687,544
	2017	1,064,798	150,548	43,590	1,258,935	5,453,383	4,194,448
	2018	922,343	157,202	482,070	1,561,614	5,908,838	4,347,223
	2019	746,528	155,993	2,356,740	3,259,260	6,495,267	3,236,007
	2020	458,250	149,929	450,105	1,058,284	7,498,449	6,440,165
	2021	434,850	159,857	487,830	1,082,537	8,026,431	6,943,894
	2022	212,550	159,857	1,197,015	1,569,422	8,554,413	6,984,991
	2023	297,000	157,984	43,590	498,574	9,082,395	8,583,821
	2024	297,000	159,857	482,070	938,927	9,109,878	8,170,951
1	2025	0	159,857	2,356,740	2,516,597	9,503,145	6,986,548
2	2026	0	159,857	450,105	609,962	9,896,412	9,286,450
3	2027	0	159,857	487,830	647,687	10,289,679	9,641,992
4	2028	0	159,857	1,197,015	1,356,872	10,682,946	9,326,074
5	2029	0	159,857	43,590	203,447	11,076,213	10,872,766
6	2030	0	159,857	482,070	641,927	11,469,480	10,827,553
7	2031	0	159,857	2,356,740	2,516,597	11,862,747	9,346,150
8	2032	0	159,857	450,105	609,962	12,256,014	11,646,052
9	2033	0	159,857	487,830	647,687	12,649,281	12,001,594
10	2034	0	159,857	1,197,015	1,356,872	13,042,548	11,685,676
11	2035	0	159,857	43,590	203,447	13,435,815	13,232,368
12	2036	0	159,857	482,070	641,927	13,829,082	13,187,155
13	2037	0	159,857	2,356,740	2,516,597	14,222,349	11,705,752
14	2038	0	159,857	450,105	609,962	14,615,616	14,005,654
15	2039	0	159,857	487,830	647,687	15,008,883	14,361,196
16	2040	0	159,857	1,197,015	1,356,872	15,402,150	14,045,278
17	2041	0	159,857	43,590	203,447	15,795,417	15,591,970
18	2042	0	159,857	482,070	641,927	16,188,684	15,546,757
19	2043	0	159,857	2,356,740	2,516,597	16,581,951	14,065,354
20	2044	0	159,857	450,105	609,962	16,975,218	16,365,256
Total		17,003,453	5,754,848	29,976,765	52,735,065	338,082,117	285,347,052

Source * JICA Study Team

EIRR	21.5%
NPV (*): Rp. Million	6,475,266
B/C (*)	1.58

(*) Discount Rate=15%

CHAPTER 14 CONCLUSIONS AND RECOMMENDATIONS

14.1 Conclusions

14.1.1 Regional Development

01 **Needs of Regional Development: A r**eview of the natural conditions as well as the demographic and economic situations of Sulawesi Island reveals that there remains much to be improved in the development of its economy and the enhancement of social welfare. For instance, the per-capita GRDP of the Sulawesi remains at of 60% of the national average. Such a gap should not increase in the planned period up to 2024. Likewise, regional development should not merely focus on economic activities and social welfare but include the protection of the environment since degradation has been observed in various parts of the island.

02 **Development Objectives of Sulawesi:** Sulawesi Island is expected to lead the development of Eastern Indonesia as touted at the central and regional planning levels. Because of its geographical location, human resources, and fundamentals for economic growth Sulawesi has enough potential to assume such a role. In order to spearhead the development of Eastern Indonesia and improve its, the overall objectives of the Sulawesi Island regional development should attain the following objectives i) balanced development of Sulawesi as the leading growth island in Eastern Indonesia and as a gateway to other Asian countries, and ii) sustainable development of an environment-friendly Sulawesi with less poverty and less potential of other risks.

03 **Spatial Structure:** The spatial development framework of Sulawesi Island has been discussed at the central and regional levels, as well as in the six provinces. The existing framework of the RTRWN (National Spatial Plan, Oct. 2007) is now part of the national activity centers of Makassar, Manado, Palu, Gorontalo, Luwuk and Kendari and the national strategic activity centers of Melonguane and Tahuna in North Sulawesi. Based on RTRWN, a spatial structure is discussed in the course of this Study from workshops and other discussions. It was also noted that Mamuju which has been designated as the regional activity center could be a national activity center. These national activity centers will be networked to form a cluster all over Sulawesi and it is further proposed that sub-clusters should be promoted in the northern, central, and southern economic linkages.

04 **Development Framework:** Social and economic development frameworks have been discussed and formulated. It has been forecasted that Sulawesi's population would increase from 15.7 million in 2005 to 19.7 million by 2024, at the average annual growth rate of 1.20%. A corresponding increase in its labor force is estimated to reach nearly 3.5 million. The urban population would increase from 28.0% in 2005 to 35.8% by 2024. Inter-provincial migration is predicted, particularly immigration to the international/inter-regional centers and, to lesser degree, to the intra-regional centers. The economic framework has been set in terms of the GRDP by province and regency. The overall economic growth rate is set at 7.0% on an annual average (4.5% in the agriculture sector and 8.0% in the non-agriculture sector).

14.1.2 Transport Development

05 **Modal Shares in Passenger Transport: F**or long distance travel of more than about 500 km (as the crow flies) air transport will become dominant in the future. Considering the progress of airport development and the emerging LCCs (low-cost carriers), the modal share of air transport will reach 50% to 100%. Road transport will share less than 50% in this distance range. The role of provincial buses will be limited, confined to around less than 30% of the road transport share. However, for short- to medium-distance travel of up to 500 km, road transport will play a major role with a share of 100% to 50%, although it decreases with distance. The share of public transport (provincial bus and small buses including the "petepete") will be around 30% of the road transport share. The ferry mode will play an auxillary but important role for some specific OD pairs such as Makassar-Kendari route. The ferry mode is regarded as a part of the road network in this study, with its share sometimes reaching more than 50% of all person trips for some zone pairs.

06 **Modal Shares in Cargo Transport:** Maritime transport will be dominant also in the future for long-distance transport of more than about 500 km (as the crow flies). Currently, its modal share is more than 60% for major routes. In the future, this modal share is expected to decrease slightly due to the expected increase of high-value products. The remaining 40% share will be shouldered by road transport (i.e. trucks). For short- to medium-distance transport of up to 500 km, road transport will play a major role along with passenger transport with a share of 100 to 40%, although they decreases with distance. As mentioned earlier, the ferry is considered part of the road network. Although ferries carry trucks loaded with cargoes, its role in cargo transport is not so significant at present. In the future, however, its role can be strengthened if the ferry system is upgraded.

07 **Road Network:** The road network of Sulawesi will basically be composed of two-lane roads. This is because at present the traffic volume of inter-city roads is mostly below 3,000 PCUs. Sulawese needs an all-weather characteristics for its road network. Recently, huge efforts were made by several donors to maintain Sulawesi's roads. Ideally, this should be continued in the future observing the principle of sustainable responsibility sharing among local governments. In order to realize the regional development plan of this study, strategic feeder roads are essential to link strategic points. Some existing roads may require additional improvements such as widening and pavement strengthening. Towns, villages, and other inhabited areas along the main roads of Sulawesi need traffic safety and environmental measures as local residents are potentially at risk by a rapid through traffic. Toll roads are proposed in Sulawesi, and the National Spatial Plan (Oct. 2007) included eight (8) freeways, i.e. Manado-Bitung, Manado-Tomohon, Maros-Mandai-Makassar, Makassar-Sungguminasa, Sungguminasa-Takalar, Limboto-Gorontalo, Ujung Pandang I and Makassar IV. Of these Ujung Pandang I and Makassar IV is either under operation or construction. The study covers Manado-Bitung, however, Manado-Tomohon and Limboto-Gorontalo were not included. Three (3) urban toll roads in the Mamminasata Metropolitan Area, were recommend to be urban arterials roads, not as freeways (see the Feasibility Study part of this study for details).

08 **Ferry and Passenger Shipping Service:** The demand for ferry and passenger ship services is still large. In 2005 inter-island passengers by air reached approximately 1.3 million, while passenger ships transported 1.9 million. However, intra-island travel by air transport has increased rapidly after the implementation of the "open-skies" policy, bringing down airfare rates to competitive levels. Ferry and passenger shipping services are both decreasing in terms of passenger number and cargo volume. Approximately 55% of intra-island passengers now travel by air, while the number of ferry passengers is decreasing. Second-hand ferry boats operating in Sulawesi are so superannuated that safe and on-time services become difficult. Safe and high-speed services will be necessary for the mode to recover and increase its demand.

09 **Railway:** The railway development plan for Sulawesi is indicated in the Sulawesi Island Spatial Plan. The two sections of Makassar - Parepare and Manado - Gorontalo are proposed as high priority projects, while other projects are given lower priority. The proposed routes are competing with the road projects that have been proposed already or are proposed in this study. According to the past studies, these railways were planned mainly for freight not for passengers,. Judging from the estimated volume of traffic demand, there are concerns that these railways would not be financially feasible (financial evaluation is not provided in the past studies) if implemented at present. These projects should thus be studied in detail in the near future when the capacity of existing transport infrastructure has been reached.

10 **Air:** With the "open skies" policy taking effect, it is expected that air will become the principal mode in long-distance passenger movement in Sulawesi as the economy further develops and incomes increase. At the same time, however, flight delays and a series of recent air mishaps have exposed poor safety standards of the aircrafts and this could have an adverse impact to the "open skies" policy. A safe and punctual operation is essential to increase inter- and intra-island air transport demand.

14.1.3 Road Development and Sulawesi Road Master Plan

11 **Road Development Policy:** This study aims to formulate the arterial road master plan for the Sulawesi Island to support its regional and economical development. The Study Team established eight (8) development policies taking into consideration the existing road condition and the forecasted traffic demand. Each road development policy is related to one of the economic development strategies.

12 **Staged Application of New Road Design Standard:** The GOI had issued "Government Road Regulation/Peraturaan Pemerintah Nomor No.34 Tahun 2006 Tentang Jalan (PP No. 34 Year 2006)" replacing PP No. 26 Year 1985. One of the major changes in the new regulation is roadway and carriageway widths. The Study Team judged that it was not financially and technically feasible to apply the new road regulation to all road projects. Therefore the Study Team recommends the following: 1) Primary arterial roads should be widened to the standard 7.0m carriageways by the target year of 2024, 2) Primary collector roads should be widened stage by stage to 7.0m based on

the present and future traffic demands, 3) Periodic and routine maintenance should be given first priority to sustain the national and provincial road assets.

13 **Needs for Capacity Expansion, Pavement Improvement and Bridge Rehabilitation:** The Study Team examined the existing roads to identify the needs of capacity expansions in the "Do-nothing" case (Zero Option) for 2024. The sections that need widening were identified based on the road standard recommended by the Study Team through an analysis on demand/supply relations using the present road capacity and projected future traffic volumes. As a result, it revealed that out of 12,100 km of arterial and collector roads, 4,700 km needs widening to 6-7m, and 7,350 km require reconstruction without widening. The pavement condition was evaluated based on the existing road inventory data. The study revealed that about 33% or 3,900 km of the total length of existing roads were in poor, or bad, condition and needs urgent rehabilitation. The study also revealed that more than 20% of existing bridges were under poor, bad, or impassable conditions, and likewise needed urgent repairs.

14 **Sulawesi Road Master Plan:** The Sulawesi road master plan was established based on the improvement plan of existing roads in terms of capacity expansion, pavement improvement and bridge rehabilitation. By completing the master plan road network by 2024, the following benefits are expected:

i) A harmonized economic development in Sulawesi would be expected through the strengthening of economic linkages between the six provinces due to the completion of Trans-Sulawesi Road which will feature a high all weather standard.

ii) Improvement of basic human needs as well as poverty alleviation would be expected in the rural areas and isolated islands through the strengthening of the road network system and the completion of missing links.

iii) Development of processing industries utilizing potential resources in Sulawesi would be expected as a result of the increase in accessibility to potential areas.

iv) The natural environment and isolated cultural communities would be properly protected by the road development with due consideration to proper environmental protection.

v) The increase in environmental loads in Sulawesi would be minimized with the incorporation of energy-saving transport ferry services in the road network system (nautical highway).

15 **Future Traffic Demand Forecasts:** The distribution of traffic volumes are concentrated around the major cities such as Makassar, Manado, Palu and Kendari. Although in Makassar traffic current traffic congestion is only confined around the city by 2024 it will spread to a wider area such as Parepare, Majene, Palopo and Masamba. In other areas, however, traffic congestion will not be serious except for Manado and its vicinities.

16 **Preliminary Engineering Study:** The preliminary engineering study was conducted to estimate rough improvement costs as well as to determine priorities for project implementation. The road network is divided into 19 packages with proper consideration of the unique characteristics of the Trans Sulawesi Road as well as other existing roads. Unit costs for the improvement and maintenance works were estimated with refererences to similar projects recently implemented in Sulawesi. As a result, total investment cost was estimated at Rp. 35,200 billion. Of this amount the national roads, including arterial and collector K-1 roads, accounts for Rp. 23,770 Billion while the provincial roads accounts for Rp. 11,430 billion.

17 **Project Evaluation:** Economic evaluation was conducted to prioritize the proposed 19 projects and as a factor for project evaluation. The study revealed that the projects located on the West-South Corridor (TS-1 group), West-North corridor (TS-2 group) and Central-South corridor (TS-3 group) have high EIRRs of more than 15%, except for the TS-2-1. On the other hand, the projects located on the Central-North corridor (TS-4 group) and East corridor (TS-5 group) have a lower EIRR of less than 15%.

18 **Implementation program:** The implementation program has been prepared taking into consideration the cost requirement, result of prioritization and fund availability.

19 **Prospect on Road Budget:** In latter years, the road budgets have recovered rapidly to the budget scale of 1990's. However, it is not realistic to assume that the road budgets would increase continuously for a long term. Therefore, the Study Team considers that the road development budget will remain at present levels for the time being until 2024, which is the end of the long term. In other words, the road development budget will decrease according to the progress of the implementation of the improvement projects, but the maintenance budget will increase in tandem with the increase in improved road lengths. The total available budget is estimated at Rp. 35,400 Billion; Rp. 30,890 Billion for central government (national) and Rp. 4,500 Billion for provinces.

20 **Road Investment Plan:** The Study Team examined three alternative investment plans, namely: Case 1: Equal allocation type, Case 2: Intermediate type, and Case 3: Early Investment type. Case 3 was recommended due to the following reasons: 1) The estimated annual budget and expenditure are balanced, 2) Road improvement is realized earlier, and 3) Effects on regional development would be larger.

However, it was found that the estimated budget for development and maintenance for provincial road somewhat falls short in all the periods, while the national road budget seems sufficient. Financial support to the provincial government will be necessary to realize the proposed improvement of the provincial roads.

21 **Implementation Program:** Implementation program was prepared based on the prioritization of projects as well as the road investment plans. In making the implementation plan, the Study Team considered the following factors: 1) All improvement projects being implemented or committed by international funding agencies and domestic funds, such as EINRIP by AusAID

and Road Improvement by Multi Year Contact (2007-2009) by Bina Marga, should be completed in the short-term plan (2008 -2014), and 2) "Urgent bridge repair program" should be implemented in the short-term plan.

22 **Economic Analysis in the Master Plan**: As a result of the economic analysis for implementing Case 3, it was recognized that the project is economically feasible and viable with a high economic EIRR at 21.5%, a B/C ratio at 1.58 and an NPV at Rp. 6,475 Billion.

14.1.4 Environmental Considerations

23 **Results of the SEA analysis**: As a result of the multi-criteria Analysis under the Strategic Environmental Assessment (SEA), the road network improvement, including the ferry improvement "Option 3" was selected as the best solution for the Master Plan. Since "Option 3" focuses on realignment, upgrading, rehabilitation, strengthening, and maintenance associated with some strategically important new projects together with the improvement of accessibility through marine transport which is more environmentally friendly than the road network development only (Option 2). Also, negative impacts on the global and local environment would be relatively smaller than "Option 2". "Option 3" is a road improvement plan which includes an additional nautical highway concept resulting to a wholistic approach of improvement of accessibility by marine transport, reduction in energy consumptions and the decrease in emissions per traffic volume which is relatively lower than "Option 2".

14.1.5 Rural Road Development Plan and Asbuton Use

24 **Local Road Study**: The arterial roads study subjected national and provincial roads. However, a study on local roads (regency and city roads) was proposed at the workshops and seminars. JICA accepted the proposal since improvement of local roads is also important for support of regional development. The Study Team has conducted a supplemental survey for local road development planning and use of natural asphalt produced in Buton Island as pavement materials for local roads.

25 **Issues of Local Roads**: The road network in Indonesia is comprised of national, provincial, local and other roads. The total length of national and provincial roads is 12,920 km in Sulawesi. The total length of local roads (regency and city roads) is 43,860 km, which is approximately 3 times of the national and provincial roads. As high poverty areas are located in isolated inland and island areas, local roads rehabilitation (betterment and periodic maintenance) is very important for support of regional economy by improving transport efficiency for agricultural inputs and outputs. The condition of local roads is worse and asphalt pavement ratio is lower than the national and provincial roads. A large part of the bridges on local roads are wooden bridges of bad condition and required urgent replacement. As the road budgets for most of the local governments are insufficient, support by the central government is necessary. Capacity development is also required for road asset management, planning, implementation and maintenance.

26 **Road Rehabilitation Targets and Investment Cost**: The Study Team has established two road development and rehabilitation targets for short term (2010-2014), medium term (2015-2019) and long term (2020-2024) on road condition and asphalt paved road length. The good conditioned roads will be increased from 56% to 85% by 2024. The asphalt paved road will be increased from 41% to 70% by 2024. A total of 6,000 km of road will be either upgraded from the current district road to regency road or constructed new. The total regency/city roads will become 50,000 km by 2024. The required total investment cost is estimated at Rp 20,270 billion including routine maintenance.

27 **Natural Asphalt (Asbuton)**: Amount of the Asbuton deposit in Buton Island is estimated at 660 million tons and this is equivalent to 170 million tons of oil asphalt (bitumen). Approximately 500,000 of Asbuton was produced per year in the middle of 1980s and used for pavement through the nation. However, production was reduced in the 1990s due to its higher price compared with oil asphalt and technical problems (durability). However, oil asphalt price has substantially increased in line with the crude oil price increase as asphalt is by-product in the oil refinery processing. Indonesia imported about 600,000 tons of asphalt and the GOI intends to use Asbuton for substituting the imported asphalt. While, new technology has been developed to secure durability of Asbuton pavement.

14.2 Recommendations

14.2.1 Regional Development

01 **Direction of Industrial Development:** The agricultural sector should focus on the further enhancement of productivity of any crops as the expansion of available lands is limited. Particularly, crops for product processing should be strategically promoted in addition to the enhancement of productivity of the staple food. Industrial development should focus on the agro-processing industries in order to enhance value-added in Sulawesi and secure employments especially for the younger generations who would flow out from the rural villages in the course of the planned period. Industries should be located in the growth poles and connected to the surrounding urban and rural areas. Trade should also be promoted more aggressively for exports of processed products, particularly to the ASEAN and BRIC countries. Transfer trade and inter-regional trade should also be promoted as a center for development of Eastern Indonesia.

02 **Role of Energy Resource Development:** Sulawesi could play two roles in the energy resource development of Indonesia. Firstly, Sulawesi should become one of the energy resource producer on the basis of its natural gas and oil production in the Central Province, especially in Luwuk. Moreover, bio-energy development such as bio-diesel fuel (BDF) from coconuts and/or Jatropha has a high potential of contributing to the energy problems and climate change issues. Secondarily, Sulawesi should be a support center for the energy exploitation in eastern Indonesia through its geographical and sociological advantages in the region. Ample resources of labor forces, food, and construction materials in Sulawesi are prerequisite for the energy development in Kalimantan and Papua, wherein these resources are limited.

03 **Necessity of Cluster Development:** For regional development as well as industrial and trade development, clusters should be formed not only at the provincial level but also at the regional and island levels. Some examples of clusters have been discussed in the course of this study, including a cacao-based cluster, fruit-based cluster and bio-diesel fuel (BDF) clusters. Special attention has been paid to the BDF clusters, as they would promote linkages among the agricultural and industrial sectors as well as contribute to the reduction of pollutant emission that would otherwise increase in Sulawesi.

04 **Infrastructure Development for Growth and Poverty Reduction:** For development of growth poles and their network over the island, as well as the development of industries and trades, and for poverty eradication in the mountainous rural areas and remote islands, the improvements in infrastructure are prerequisites. Transportation should be improved to strengthen networking over Sulawesi and to enhance economic activities as well as social communication including welfare. In addition, the systems for energy supply and electric power supply should be secured and their environmental loads should be minimized.

05 **Necessity of Institutional Enhancement:** By activating the economy and improving the

infrastructure, it appears that the economic framework laid down for Sulawesi would be attainable though it should be further verified through the proper planning of respective development programs and projects. It should be additionally noted that the institutional settings for regional development should be further strengthened along with capacity development at all levels of the public and private sectors. It is therefore recommended that the proposed regional development would be implemented together with capacity development, inclusive of institutional building.

06 **Utilization of Master Plan Study:** The regional development as proposed in this study has been planned to show directions, frameworks and strategies for the development of Sulawesi Island. It could be sufficient for the formulation of an arterial road network over the island, as well as to guide any other regional development. It is expected that the proposed direction and framework would be referred to in the formulation of the provincial-level development plans, as well as in the inter-regional coordination for the development goals.

07 **Necessity of Master Plan Review:** Since the economic and other environments surrounding Sulawesi would change, it is recommended that the framework and strategy should be reviewed and updated after fiver years, or after the implementation of the short-term plan period. The development programs and projects under the mid-term plan should be formulated on the basis of the updated framework.

14.2.2 Transport Development

08 **Consideration on International Linkage:** The international linkage proposed in the concept of BIMP-EAGA should be strengthened by improving air and shipping services between Northern Sulawesi (Manado and Gorontalo) and Mindanao (Davao and General Santos) of the Philippines. The islands located in between these two points, such as Sangihe and Talaud, have large potentials for trade, tourism and fishery. The arterial road network of Sulawesi should be considered as an integral part of the global transport network such as Asian/ASEAN Highways. The design standard of arterial roads in Sulawesi should desirably be in accordance with the criteria of the ASIAN and ASEAN Highways considering its possible expansion in the future.

09 **Construction of All-weather Stable Road Network:** The road network master plan proposed in this study should basically be more of a road improvement plan with a focus on widening, realignment, rehabilitation, strengthening and maintenance coupled with some new projects with strategic importance. The road should be all-weather, ensuring accessibility throughout the year even for isolated areas and islands. The durability of the roads, in terms of axle loads should also be considered based on the recommendation of the HLRIP study.

10 **Nautical Highway (Upgraded Ferry Service):** Energy-saving maritime transport should be effectively incorporated in the road network considering the long winding coastlines. Port facilities should be improved together with the feeder roads to/from the ports. In addition, an inter-peninsula nautical highway using high-speed low-cost RoRo ships should be developed to link the east coast of Sulawesi; Makassar - Bajoe(Siwa)=Kolaka - Kendari=Luwuk - Pagimana=Gorontalo - Manado.

Although the traffic volume on the ferries is not large yet, this will grow if the nautical highway is operated more efficiently using modern ships and upgraded facilities. Alternative land routes should be developed at the same time for the nautical highway because the latter nearly becomes unnavigable during the rainy season.

11 **Airport Development:** Long- and medium-distance passenger travel by air will grow rapidly because of the lowering airfares due to the proliferation of LCCs (low-cost carriers). Airport development should be promoted as proposed in the National Spatial Plan; Hasanuddin and Sam Ratulangi (primary), Djalaludin, Mutiara and Wolter Monginsidi (secondary), and Tanpa Padang, Melonguane and Bubung (tertiary).

12 **Railway Projects:** Some railway projects have been proposed for Sulawesi. However, the estimated traffic demand for these railways is generally small, and their financial viability is quite doubtful due to the absence of financial analyses in past studies. Since inter-city roads currently have enough capacity to absorb increasing traffic demands, the implementation of railway projects should better be studied in the future when road capacities has been met.

14.2.3 Road Development and Sulawesi Road Master Plan

13 **Necessity of Economic Evaluation Review:** Economic evaluation in this study was conducted in order to determine the priorities of the proposed projects. Therefore, it was done under the same conditions using future estimated traffic volumes by 2024. The Study Team advises that the feasibility of each project in terms of EIRR, B/C etc. should be evaluated again to justify project viability at the time when the project is being implemented.

14 **Control of Overloading Vehicles:** Sustainability of road facilities after development or betterment is one of the most important issues. Overloaded vehicles are one of the critical issues which significantly shortens pavement life. In addition to improvement measures such as stricter enforcement on axle load and gross weight, additional installation of weighing stations at strategic points, strengthening of education for vehicle owners and drivers, and the introduction of MST 10 ton routes (Class II roads) for the heavy loaded routes, the Study Team recommends the introduction of a computer-assisted system at weighing stations. When heavy vehicles pass on a weigh bridges, their gross weight is transmitted to a computer and the magnitude of overloading and the corresponding fines are instantly recorded and automatically shown on an electrical board. This tool will **bring** an effective impact for overloading controls.

15 **Introduction of Road Fund:** Insufficient maintenance budget allocation for road maintenance, especially during budgetary constraints, has caused serious road deterioration. Both development and maintenance budget for the national road has increased substantially in 2006 – 2008 reflecting the change in the central administration policy compared with the 2004 – 2005 budgets. However, insufficient budget is still the most critical issue for both provincial and regency roads. A total amount of Rp 374 - 562 billion, which is 1.0%-1.5% of the road asset values, is required annually for the routine maintenance of national, provincial and regency roads in Sulawesi.

In order to overcome budget shortages, utilizing the road fund is one of the instruments that can generally be used as the main source of financing road maintenance and other road expenditures

Since the 1950s, this approach has been used in the USA, Japan, and New Zealand and is the most economical and efficient collection method since it allows the collection of levies at refineries or ports of import. In recent years, the road fund approach has been applied in many developing countries (more than 30 countries), and several of these countries have successfully collected 90% of the required fund for road maintenance. Some of the road fund could be used for road safety, overload controls, road asset management activities, etc.

16 **Allocation of Road Budget to Provincial Roads:** Budgetary insufficiency is a critical issue in maintaining road facilities and sustaining the road function, especially for the provincial and kabupaten roads. Although there are several potential funding sources which could be utilized for development and maintenance of these roads, for a realistic and reliable funding source the Study Team suggests the utilization of external soft loan for the development of provincial road based on on-grant mechanisms with on-grant agreements between the MOF and the grant receiver (Province) and the Ministry of Public Works as the executing agency of the loan program. The Study Team is convinced that this funding method is the best suitable source for making up the lack of provincial budgets not only for road development but also for periodic/routine maintenance of roads..

17 **Support for Implementation of Existing Priority Development Program:** The master plan study should support the realization of existing priority development program, especially the "Northeastern Indonesia Regional Development Program" which is being promoted in cooperation with both the Indonesian and Japanese governments. The road development plans recommended in this program should be included in the implementation program of this study. The Study Team recommends, among others, the early implementation of the "Trans Sulawesi Mamminasata Road (Maros-Takalar) since the project was confirmed to be economically feasible with a high EIRR and an Environmental Impact Assessment (AMDAL) was already approved by the Governor of South Sulawesi Province in September 2007.

18 **Early Implementation of Poor Bridge Rehabilitation and Deteriorated Pavement:** Although existing roads and bridges have been improved and rehabilitated in the past, many bridges still remain narrow and in poor condition. The reconstruction of these bridges is included as part of the betterment work in the master plan. However, the betterment of these roads in some sections belong to the medium- and long-term plans. But since potential collapses on major routes would have an adverse impact on local socio-economic activities, it is recommended that these bridges (identified as Grade IV "Bad" or Grade V "Impassable" in addition to wooden bridges) should be reconstructed or replaced in the short-term plan, titled the "Urgent Bridge Repair Program".

Rehabilitation of deteriorated pavements should also be implemented as soon as possible.

Pavement conditions classified as Class III "Poor" or Class IV "Bad" should be removed either through overlays or reconstructions in the short-term plan as much as possible.

14.2.4 Environmental Considerations

19 **Environmental Mitigation Measures under the SEA analysis**: The SEA should include measures to mitigate negative environmental impacts brought about by the road network improvement plan. A couple of mitigation measures that will reduce CO2 volumes of the total road network in Sulawesi Island are recommended. Those measures should include the coverage and the promotion of bio-fuels, the minimization of the affected forest areas by reforestation projects, and the diversion of other traffic measures. The reduction in the CO2 volume will also help in fighting global warming.

14.2.5 Rural Road Development Plan and Asbuton Utilization

20 **Integrated Road Projects and Programs including Local Roads**: Integrated road projects and programs should be implemented for national, provincial and local roads for attaining synergy effects on regional development. The programs should include capacity development in management, planning, execution and maintenance. The ongoing EIRTP will be a project scheme to be referred with some improvement.

21 **Support by Central Government**: The financial basis of regional governments is weak and available own budget is limited. The Study Team recommends that the central government should support regional governments for attaining the road rehabilitation targets set planned in this study while the regional governments should bear part of the cost for retaining ownership.

22 **Development and Use of Natural Asphalt (Asbuton)**: The development of Asbuton will make contribution to both national and regional economy. The central government should keep a stable policy on the use of Asbuton to assure the domestic demand. While, public financial assistance should be extended for capacity development of the state owned company for renewing the old facilities of Asbuton production, transport, stocking and shipment. Development of bitumen extraction technology from Asbuton and special plant is necessary for exporting the refined Asbuton to overseas markets. GOI should make appropriate policies and laws for inducing foreign investments as Asbuton refinery project requires a large amount of cost for plant development, installation and operation.

14.2.6 Recommended Action Plan for Realization of the Project

23 **Recommended Action Plan for Project Realization:** In order to realize the projects proposed in the master plan, the Study Team recommends that the Indonesian government should take an appropriate action to arrange the financial assistance of Japan as shown below, and/or other donor agencies in addition to an Indonesian budget:

i) **In case of Yen Loan:** This aid is suitable for implementing large scale projects with an

EIRR of more than 15%. It is necessary to conduct a SAPROF to determine the scope of work, selection of subjected road links, schedule and amount of loan, etc, before an appraisal of the Yen loan. The Study Team therefore recommends that the government of Indonesia requests the Japanese government for the implementation of the SAPROF immediately after completion of this Master Plan Study. It is advised that the priority projects derived form the feasibility study on Priority Arterial Roads for South Sulawesi Province should be included in the scope of this loan. The Study team also advises that the road improvement plan should include not only national and provincial roads but also the kabpaten roads in order to enhance the regional development. The project should also include capacity development of regional governments and technical cooperation programs.

ii) **In case of Japanese Grant:** This aid is suitable for implementing a project with an EIRR of less than 15% if the project contributes to basic human needs of the local people. The Study Team advises the application of this scheme for implementing the "Urgent bridge repair program" and recommends that the Indonesian government take the necessary actions to the Japanese government as soon as possible.