4.3 Trade Promotion

(1) Overview of Sulawesi Trades

The trade of Sulawesi is composed of six types; i.e., i) domestic distribution within Sulawesi, ii) regional export, iii) international export, iv) regional import, v) international import, and vi) international transfer trade.

Export

The following table shows the estimated volume of agricultural products produced and traded in and exported from Sulawesi in order of value of commodities exported to the overseas.

Table 4.3.1 Agriculture Products Produced and Exported from Sulawesi (2006)

(Unit: '000 tons)

Commodity	Total Output	Distributed Volume	Domestic Distribution	Regional Export	International Export	
	Volume	Volume	Volume	Volume	Volume	Value
Unit	'000 tons	'000 tons	'000 tons	'000 tons	'000 tons	US$ Mill.
Agriculture Products						
Cocoa	350	350	0	0	350	560.0
Wheat Flour	603	362	231	46	85	51.0
Wheat	730	127			127	26.7
Animal Feed	170	170	0	0	170	13.6
Cassava	940	940	910	0	30	11.7
Coffee	57	57	52	0	5	8.6
Corn	1,300	1,130	1,060	50	20	2.0
Rice	5,300	4,240	4,030	210	0	0
Sweet Potato	160	130	130	0	0	0
Peanut	70	60	60	0	0	0
Soybean	27	27	27	0	0	0
Forestry Products						
Wood Processed	n.a.	60	0	0	60	55.2
Log	5	5	5	0	0	0
Rattan	21	21	12	9	0	0
Fishery Products						
Crustacean	11	11	0	0	11	75.0
Marine Fish	347	332	309	0	23	66.0
Inland Fish	125	100	100	0	0	0
Livestock Products						
Cow	89	71	71	0	0	0
Goat	19	19	19	0	0	0
Broiler	113	100	100	0	0	0
Total	10,426	8,312	7,116	315	881	977.6

Source: Cargo throughput data obtained from PELINDO, data of economic statistics prepared by each province, trade statistics prepared by the Ministry of Trade are compiled and summarized by the JICA Study Team

Note:

1. The unit price of the major products is estimated based on the relevant trade statistics of 2003.
2. Distributed volume means that the volume of product either processed or not but distributed in Sulawesi and its external market of both regional and abroad.
3. Wheat is not produced in Sulawesi. Whole volume of wheat is imported from Australia in a form of seed and in bulk.

The volume of mining products produced in Sulawesi and value of related commodities exported to the overseas is shown in the following table.

Table 4.3.2 Mining Products Produced and Traded in Sulawesi (2006)

(Unit: '000 tons)

Commodity	Total Output	Distributed Volume	Domestic Distribution	Regional Export	International Export	
	Volume	Volume	Volume	Volume	Volume	Value
Unit	'000 tons	'000 tons	'000 tons	'000 tons	'000 tons	US$ Mill.
Mining Products						
Nickel						
Nickel Ore	600	543	0	0	543	190.0
Ferro-nickel		33	0	0	33	58.7
Cement						
Clinker	300	263	0	0	263	21.0
Cement	2,000	2,000	837	1,152	11	8.3
Total	2,900	2,839	837	1,152	850	278.0

Source: JICA Study Team
Note: The unit price of mining products is based on the trade statistics of Sulawesi in 2003

As shown in the above tables, the total volume of commodities produced in Sulawesi in 2006 was around 13.3 million tons (agriculture products of 10.4 million tons and mining products of 2.9 million tons) and these are processed into the commercial products of which volume is around 11.1 million tons in total. The type of process of agriculture products is limited to drying, de-husking, polishing etc. but not processing into final products which can be marketed directly in the market of consumer countries in the world.

Understandably, cacao, coconut oil, coffee and nickel are major export products. Their positions in the world trade are summarized in the following table.

Table 4.3.3 Ranking of Major Export Products in the World (2005)

Cocoa		Indonesia			Sulawesi			
Rank	County	Volume ('000 tons)	Share (%) In Volume	Value (US$ Million)	Sulawesi Volume ('000 tons)	Sulawesi Value ($ Million)	Share (%) In Volume	Share (%) In Value
1	Cote d'Ivore	1,351	39					
2	**Indonesia**	572	16	595	351	346	62	58
3	Ghana	497	14					
4	Nigeria	361	10					
5	Brazil	155	5					
	Others	535	15					
	World Total	3,471	100				10	
Coconut Oil (CNO)		**Indonesia**			**Sulawesi**			
Rank	County	Volume ('000 tons)	Share (%) In Volume	Value (US$ Million)	Sulawesi Volume ('000 tons)	Sulawesi Value ($ Million)	Share (%) In Volume	Share (%) In Value
1	Philippines	1,184	60					
2	**Indonesia**	497	25	170	292	115	60	67
	Others	319	15					
	Total	2,000	100				15	

Coffee		**Indonesia**			**Sulawesi**			
Rank	County	Volume (‘000 tons)	Share (%) In Volume	Value (US$ Million)	Sulawesi Volume (‘000 tons)	Sulawesi Value ($ Million)	Share (%) In Volume	Share (%) In Value
1	Brazil	1,987	32					
2	Vietnam	793	13					
3	**Indonesia**	793	13	274	4	7	0.5	2.5
4	Colombia	694	11					
5	Mexico	310	5					
	Others	1,632	26					
	World Total	6,209	100				0	
Nickel Ore		**Indonesia**			**Sulawesi**			
1	Russia	315	21					
2	Australia	210	14					
3	Canada	196	13					
4	**Indonesia**	140	9	1,932	33	455	24	24
5	New Caledonia	122	8					
	Others	517	34					
	Total	1,500	100	962				

Source: FAO Statistics and U.S. Geological Survey, Mineral Commodity Summaries, January 2006 and cargo loading data of Sulawesi Southeast.

Import

The value and volume of agricultural products and mining products imported into Sulawesi is summarized in the following tables.

Table 4.3.4 Agriculture Products Imported into Sulawesi (2006)

Commodity	**Total Output**	**Distributed Volume**	**Domestic Distribution**	**Regional Import**	**International Import**	
	Volume	Volume	Volume	Volume	Volume	Value
Unit	‘000 tons	‘000 tons	‘000 tons	‘000 tons	‘000 tons	US$ Mill.
Agriculture Products						0
Sugar	0	17	17	0	17	4.0
Tapioca Flour	0	11	11	11	0	0
Cooking oil	0	148	148	148	0	0
Coconut oil	0	34	34	34	0	0
Copra	0	60	60	60	0	0
Forestry Product						0
Log	0	106	106	106	0	0
Wood	0	10	10	10	0	0
Plywood	0	8	8	8	0	0
Fertilizer	0	257	257	234	23	97.0
Total	0	651	651	611	40	101.0

Source: JICA Study Team

Table 4.3.5 Mining and Non-agriculture Products Imported into Sulawesi (2006)

Commodity	Total Output	Distributed Volume	Domestic Distribution	Regional Import	International Import	
	Volume	Volume	Volume	Volume	Volume	Value
Unit	'000 tons	'000 tons	'000 tons	'000 tons	'000 tons	US$ Mill.
Fuel	0	2,450	2,450	2,450	0	0
Coal	0	520	520	520	0	0
Gypsum	0	51	51	51	0	0
Asphalt	0	44	44	26	18	2.6
Total	0	3,065	3,065	3,047	18	2.6

Source: PEMASARAN VII, PERTAMINA Fuel Supply Record 2006 for fuel. Port cargo traffic data of PELINDO IV is used for other item.
Note: Both fuel and coal are imported from Balikpapan, East Kalimantan

Table 4.3.6 Industrial and Consumable Products Imported into Sulawesi (2006)

Commodity	Total Output	Distributed Volume	Domestic Distribution	Regional Import	International Import	
	Volume	Volume	Volume	Volume	Volume	Value
Unit	'000 tons	'000 tons	'000 tons	'000 tons	'000 tons	US$ Mill.
Steel Product	0	50	50	50	0	0
Automobiles		300	300	300	0	0
General goods	0	398	398	392	6	n.a.
Total	0	2,005	2,005	1,981	24	0

Source: Cargo traffic data obtained from PELINDO IV.
Note: General goods mean the consumables, office equipment and other industrial products.

Transfer Trade

As for the international transfer trade, Sulawesi imports around 730,000 tons (2005) of wheat from Australia and unloads it at Makassar for stocking. Then it is re-exported in a form of wheat as it is or in a form of wheat flour after processing with a volume of around 127,000 tons and shipped to other Asian countries. The rest of the wheat is processed into wheat flour, then, distributed within Sulawesi (230,000 tons) and to other regions in Indonesia, especially in Eastern Indonesia (46,000 tons). Therefore, Sulawesi can be regarded as a hub for wheat transfer in southeast Asia and distribution in Indonesia.

Sulawesi is located at the center part of Eastern Indonesia. This geographical condition makes Sulawesi the gateway to or hub of Eastern Indonesia in general and to and from Northeastern Indonesia in particular. This geographical advantage given to Sulawesi should be strategically utilized not only for the development and betterment of the economy of Sulawesi but also for Eastern Indonesia as a whole. The major commodities traded with Eastern Indonesia are as shown in the following.

Table 4.3.7 Volume of Trade in Region by Sulawesi

Export Product	Volume (tons)	Origin Port
Agriculture Products		
Rice	213,000	Makassar
Wheat flour	9,450	Makassar
Molasses	13,000	Gorontalo
Animal feed	47,000	Gorontalo
Corn	32,000	Gorontalo
Vegetable oil	23,300	Bitung
Fruits and vegetables	5,300	Makassar
Wood processed	24,000	Makassar
Mining Products		
Rock and stones	955,000	Pantloan
Cements	954,000	Bringkasi

Trade Summary

The volume and value of products traded in Sulawesi is summarized in the following tables.

Table 4.3.8 Major Export and Import Commodities of Sulawesi

Sector	Export Commodities
Agriculture	Cocoa, vegetable oil, crustaceans, fish and marine products, coconut oil and its products, cassava, coffee
Mineral and mining	Nickel, nickel-alloy
Manufacturing	Garment, wood processed
Sector	**Import Commodities**
Agriculture	Sugar, oil palm for cooking oil, fertilizer
Mineral and mining	Coal for nickel and other mineral processing, gypsum for cement production
Manufactured goods	Steel, garment, transport equipment, general consumable goods, etc.

Table 4.3.9 Summary of Volume and Value of Products Traded in Sulawesi

Commodity	Distributed Volume	Domestic Distribution	Regional Distribution	International Trade	
	Volume	Volume	Volume	Volume	Value
Unit	'000 tons	'000 tons	'000 tons	'000 tons	US$ Mill.
Agriculture Products Exported	8,312	7,116	315	881	977.6
Mining Products Exported	2,839	837	1,152	850	278.0
Sub-total of Exports	11,151	7,953	1,467	1,731	1,255.6
Agriculture Products Imported	651	651	611	40	101.0
Mining Products Imported	3,065	3,065	3,047	18	2.6
Industrial and Consumables	2,005	2,005	1,981	24	0
Sub-total of Imports	5,721	5,721	5,639	82	103.6
Grand Total	16,872	13,674	7,106	1,819	1,359.2

Source: JICA Study Team

Agriculture product accounts for around 78% of the total volume of production. Of the total 8.3 million tons, around 7.0 million or 76% is consumed within Sulawesi and around 315,000 tons or 24% is distributed to the region surrounding Sulawesi. The total export volume of products is 3.2 million tons, of which around 45% is distributed to the other regions in Indonesia, mostly in Eastern Indonesia, and the remaining 55% is exported to the overseas market. The total export value of Sulawesi products was around US$ 1.3 billion. Of the total export value, the agriculture products account for around 78% and mining products for around 22%.

The volume of agriculture products exported to the other regions from Sulawesi accounts for 4.6% of the total domestic consumption volume. The volume of mining products, or mainly cement exported to other regions from Sulawesi, is more than the volume consumed within Sulawesi.

The total volume of products imported by Sulawesi is 4.4 million tons. The industrial and consumable products account for about 45% of the imported value. This means that Sulawesi depends on most of the industrial products (e.g., steel, machinery) and all consumable products to import either from other regions of Indonesia or abroad.

(2) Strategies for Trade Promotion

As reviewed in the foregoing section, nearly 80% of the international trades of Sulawesi are dependent on agriculture and agro-processed products, and attention to the trade promotion should

be focused on this specific sector.

At the level of the central government, the National Mid-term Development Plan for 2004-2009 puts emphasis on the promotion of the non-oil and gas products, improving their international competitiveness. At the same time, the Ministry of Trade is implementing the Five-year Strategy (2004-2009) with the aim of attaining the export growth at the rates ranging from 5.7% (2005) to 10.1% (2009) as well as the growth of trade industry at the rates of 7.5% to 8.9%.

Specific attention is to be paid to the "10+10+3 Program" initiated by the Indonesian government through the inter-ministerial meetings. Among the 10-main export products, included are cacao, coffee, oil palm and shrimp which are major products in Sulawesi. (Other six products are: textile, rubber products, electronics, forest products, footwear, automobile parts.) 10-potential export products also include processed foods and fish/fish products which are produced in Sulawesi. (Other eight products are: jewelry, handicrafts, spices, leather products, medical instruments, medical herbs, stationery and essential oil.) 3-services under the Program focus on design, IT and manpower (e.g., engineering services). In formulating the strategy for Sulawesi trade promotion, these policies of the central government should be well taken into account.

In line with the central government policy and strategy, NAFED has been implementing its programs for export promotion, as well as the enhancement of added values to export products and the support to export players especially SMEs. The outline of the NAFED activities is briefly summarized in the following.

Table 4.3.10 Outline of NAFED's Activities under 10 + 10 + 3 Program

Activity	Outline
Market Intelligence	Direct observation activity on potential products market, market segment, competitor's strategy and the country condition of market target as an activity of market penetration of Indonesian products. Results of market intelligence will be disseminated on line and off line.
Indonesia Design Power (IDP)	Product development using design approach as a strategy. In 2007, 90 prototypes are planned to be created that are going to be used as Indonesian icons as registered trademarks.
Product Development in Cooperation with TPOs	Development of design and packaging in good quality suitable for overseas market by cooperating with overseas experts (CBI, NMCP, and SIPPO)
Development of Cluster of Export Products	Development of leather and jewelry industry complementarily through strategic cooperation with associations and related institutions.

Source: "Priority Program", NAFED 2007

Some strategies for Sulawesi trade promotion are proposed, though preliminary as they are, as summarized in the following.

1) <u>Trade promotion in the context of agricultural and industrial development strategies</u>

As noted above, most of traded products in Sulawesi are agriculture-based and industrial strategies are mainly focusing on processing of agro-products to enhance the value added on local products. Consequently, the trade promotion strategy should be integrated into the agricultural and industrial development programs so as to attain the overall goals.

It appears in Sulawesi, however, that the authorities concerned with agriculture, industry and trade are less coordinated each other in jointly implementing the programs promoted by the

central and provincial governments. Coordination at the DINAS level in each province is much to be improved, as well. Joint efforts have been made in a limited manner among DINAS in Sulawesi provinces, as well as with NAFED.

Such coordination appears to be essential particularly in promoting clusters within and across the boundary of provinces. Likewise, coordination should be promoted within the private sector, not only in the trade sector but also in the agricultural and industrial sectors. Therefore, it is proposed that coordination among the authorities concerned and the private sector be strategically promoted not only for trade promotion but also for the promotion of agro-based processing industries in Sulawesi. NAFED is suggested to take initiative in such coordination and joint efforts.

2) Emphasis on trades of the processed products

Large parts of the agricultural products have been traded in the form of raw materials without processing, with the resultant low value added in Sulawesi and low contribution of the manufacturing industry to the regional economy. The authorities concerned should encourage enterprises to process local products as much as possible.

Processing in the production centers will at the same time contribute to the reduction of inland and maritime transportation costs that would be increased as a result of heightening in fuel prices, as well as to the reduction of the environmental loads. Location of processing factories in the "growth poles" planned under the spatial structure in Sulawesi would be recommended in this context.

Import of raw materials from the islands nearby Sulawesi should also be encouraged to secure stable supply of raw materials for processing in Sulawesi. For instance, copra for processing of coconut-based products could be procured from North Maluku and other islands and manufactured in BIMIDO in North Sulawesi and/or Kendari in Southeast Sulawesi. Fishes could also be caught around the islands nearby Sulawesi and processed in factories in such "growth poles" located seaside.

3) Promotion of Transfer Trade and Inter-regional Trade

As reviewed in the foregoing section, transfer trade is rather limited to wheat and wheat flour at Makassar port. In view of the geographical location of Makassar and Bitung, much more transfer trades should be promoted strategically. Likewise, inter-regional trades are relatively limited though regional port facilities have been recently improved.

On the other hand, a large number of warehouses are located in the Makassar port area. Most warehouses appear to have been used only for storing without any processing and valued added at warehouses. Such a system would not contribute to the industrial promotion and the enhancement of value added in Sulawesi.

Transfer trades could be strategically promoted for processing of agricultural products in Sulawesi in view of the fact that agricultural products are quite seasonal. For instance, while

the period of processing into juice from Sulawesi fruits will be prolonged as much as possible making use of the differentiated harvesting seasons in Sulawesi (e.g., between eastern and western South Sulawesi), raw materials would be imported from ASEAN countries in the northern hemisphere during the period when harvesting in Sulawesi is out of season, thus juice factories could be operated almost throughout the year.

4) Aggressive Promotion of Exports to BRIC

It appears that the export promotion of Sulawesi has remained rather passive though various measures have been taken for it by the central and provincial governments as well as by associations of producers. There has been no break-through that encourages the producers and traders in Sulawesi. Being passive, the producers remain unfamiliar with the trend of demand in the existing and potential markets.

Exports of Indonesian products to BRIC, particularly to China, have been increasing in recent years. China would be one of the target countries for export promotion of the Sulawesi products. It is therefore recommended that Sulawesi promote exports to China more aggressively.

An idea for aggressive promotion of exports to China is to open an "antenna shop" in Hong Kong or in appropriate locations in China, where Sulawesi products are sold to understand the preference of the market and the trade opportunities are taken directly with buyers in the market. Such an antenna shop is effective for the producers to understand the market trends and preference. It would be more effective than the trade fairs and other exhibitions to be held in Indonesia. It is suggested that BKPRS (Regional Development Cooperation Board of Sulawesi) or other appropriate institutions would study such an idea and take proper measures for aggressive promotion of Sulawesi exports to China.

5) Promotion of Logistic Service Industry

In parallel with the trade promotion as well as the promotion of agro-processing and other industrialization, the logistic service industry should be systematically promoted in Sulawesi. The logistic service industry would include, but not limited to, transportation, cargo handling, storing, distribution and re-distribution, bottling, packaging and raveling, as well as custom clearance and other services. Unfortunately, these logistic services in Sulawesi have been rather independently operated with less efficiency and transparency.

In view of the widely distributed production centers over Sulawesi and with the view of promoting better transportation services among such centers, the logistic service industry should be strategically promoted by the private sector, if necessary with the public support. The logistic service industry could be located in such growth poles as international/inter-regional centers (Makassar, Manado and Palu) and inter-regional centers (Gorontalo, Mamuju, Parepare and Kendari) following the spatial development plan. The logistic service industry would also contribute for promotion of transfer trades and inter-regional trades as discussed above.

4.4 Cluster Development

(1) Overview of Cluster Development

The term "cluster" has become popular; however, a common understanding of the term is not readily defined. A working definition has been given as a "geographical concentration of related industries and institutions". In Indonesia, "*Sentra*" is a similar term to the cluster as it is defined as a geographical concentration of manufacturers in the same sector. According to the available data of the Ministry of Industry, there were nearly 9,800 *sentra* over the country, including about 1,100 (11.2%) in Sulawesi. For instance, seaweed cultivators concentrated along the southern coastal zone of South Sulawesi are regarded as seaweed *sentra*.

The definition of cluster leaves some flexibility in its application, and nowadays the geographical concentration is not always the necessity to form a cluster as the communication and transportation facilities are being developed and the marketing system for respective industries has been changing.

Under the long-term national development plan (RPJM: 2005-2025), the Indonesian government has applied a cluster approach to strengthen the competitiveness of industries based on the analysis of the value chain. The plan proposes to develop clusters in respective categories and regions for the prioritized industrial products. The proposed strategy and plan appears to be appropriate for application in Sulawesi, and clusters should be developed in a flexible manner regardless of their geographical concentration as in the case of *sentra.*

The cluster approach has been applied to the master plan for integrated regional development of Mamminasata in South Sulawesi. Although the proposed clusters have not been realized yet, the approach has been agreed upon by stakeholders. The cluster approach is considered to be recommendable particularly for the conglomeration of agro-based industries and their marketing as their harvesting periods are seasonal and the year-round operation is difficult with a single agricultural product.

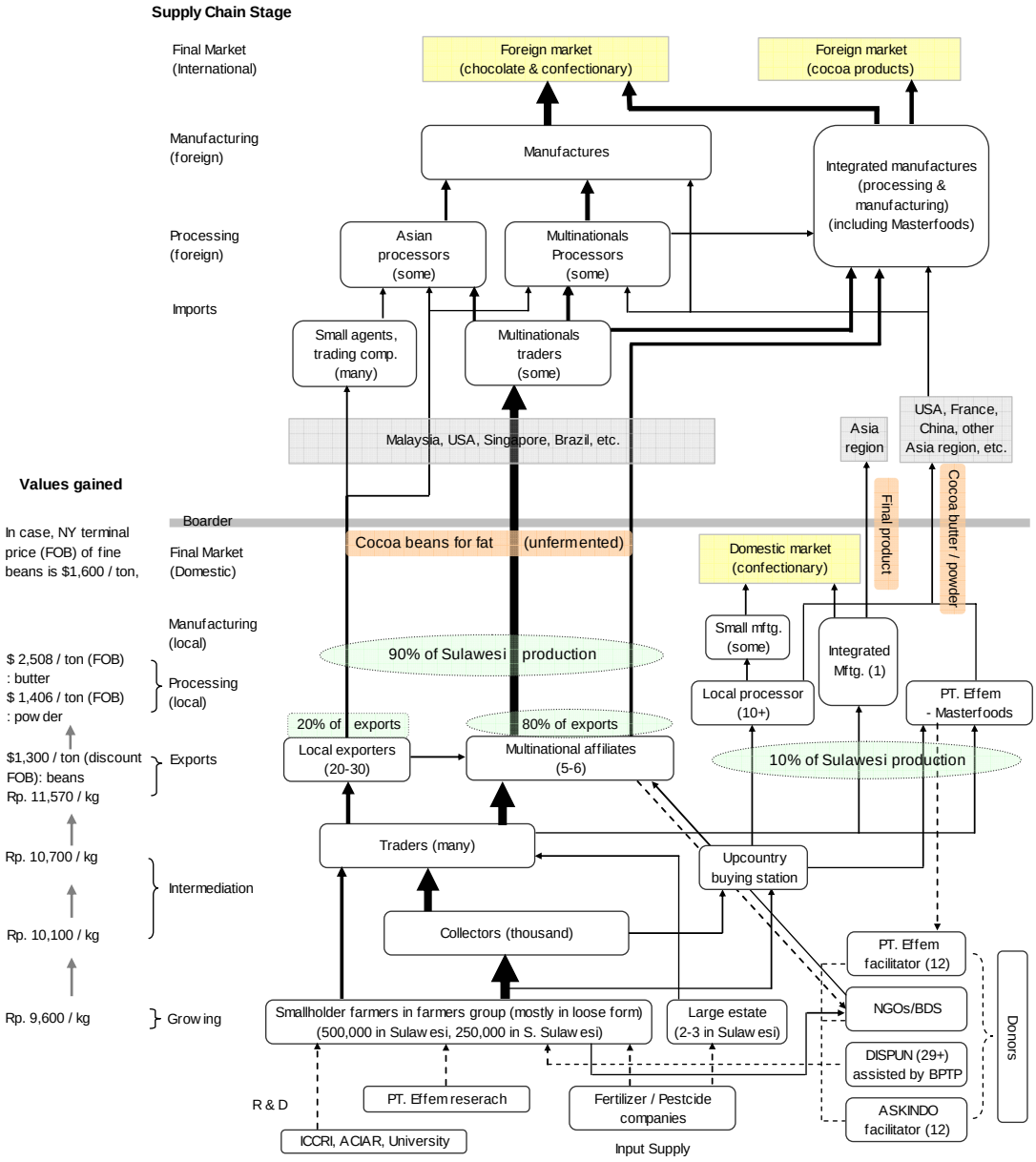
(2) Strategy for Cluster Development

From the viewpoint of spatial structure over Sulawesi, it might be possible to consider that the island would form a cluster in regional development. Regardless of the diversified geographical locations, industries and other economic activities could be integrated by linkages in order to enhance the value chain. More practically, the spatial structure for Sulawesi has been proposed by classifying provisionally into the northern, central, western and southern economic linkages. These classifications, however, will not necessary means that the cluster should be promoted within the boundaries of such economic linkages.

Some ideas and strategies for cluster formation in Sulawesi have been discussed and proposed and they are introduced in the following.

1) Cacao-based Cluster

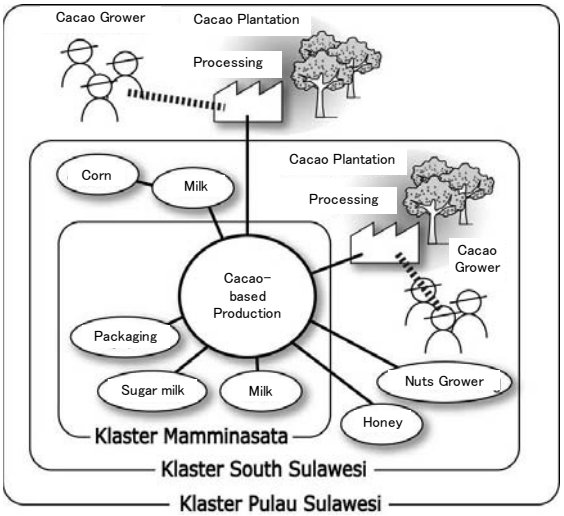
Cacao is a leading export crop of Sulawesi. However, 90% of the production has been exported in the form of cacao beans, and local processing into cacao butter/powder and final products is limited to 10% as shown in the following diagram.



Source: The Study on The Improvement of Farmers' Income: Agricultural Processing and Rural Micro Finance in Indonesia

Figure 4.4.1 Supply Chain of Cocoa in Sulawesi

For the development of Sulawesi, more cacao beans should be processed into cacao butter and powder in Sulawesi and manufactured into confectionary and other cacao-based products. Such processing and manufacturing could be combined with the local production of sugar, milk, nuts and other products and a cacao-base cluster could be promoted in Sulawesi. The following diagram shows an image of cacao-based cluster proposed under the Mamminasata master plan.



Source: JICA Study Team

Figure 4.4.2 Image of Cacao-based Cluster

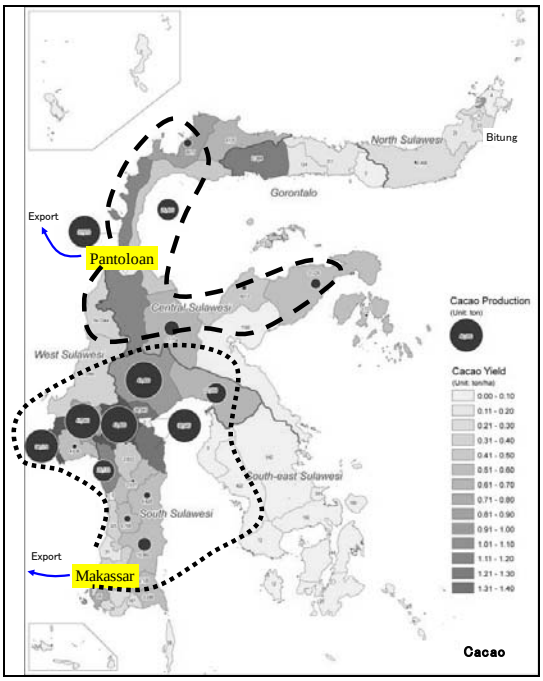


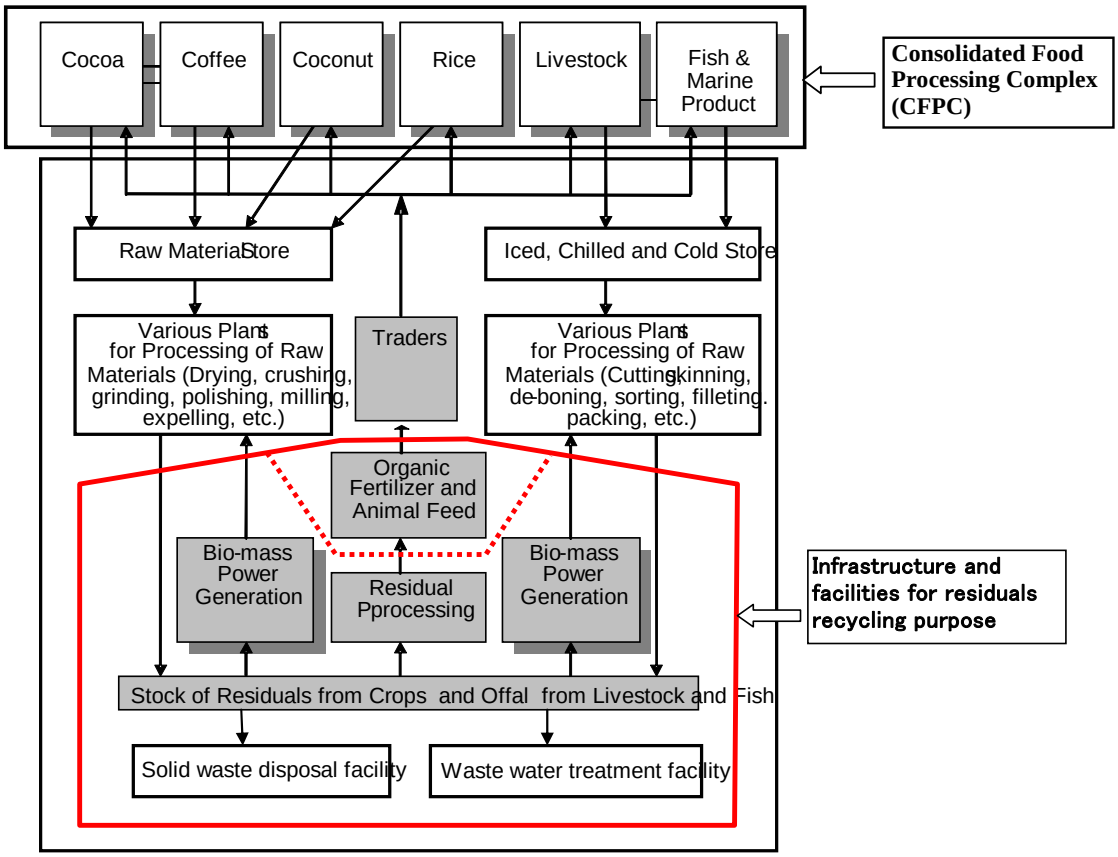
Figure 4.4.3 Cacao Export from Makassar and Pantoloan Ports

In view of the cacao production in Sulawesi, as illustrated in the figure, such a cacao-based cluster could be located not only in Mamminasata but in Palu/Pantoloan area in Central Sulawesi. The potential export market of the cacao-based cluster would be China where the demands are predicted to increase in the future.

2) Consolidated Food Processing Cluster combined with Residual Recycling

Although processing of local agricultural products has been put into operation at different locations in Sulawesi, it is desirable that such processing industries would be collectively located to form a food processing industrial complex in the medium and long terms. The complex would integrate processing of such products as cacao, coconut, rice, livestock and marine products. The complex might be located in the Mamminasata in South Sulawesi and the BUMIDI in North Sulawesi.

In combination with the consolidated food processing complex, a complex for recycling of the process residuals is proposed. The recycling complex would integrate a residual processing plant, organic fertilizer and animal feed maker, bio-mass generation plant, common distribution facilities, and/or liquid/solid waste treatment facilities. The significant function of the complex would be the function of food processing and the utilization of by-products are combined to mitigate the environment load in Sulawesi. Application of the complex or cluster to the Clean Development Mechanism (CDM) could also be envisaged.



Source: JICA Study Team

Figure 4.4.4 Cluster Concept of Food Processing Complex and Residual Recycling

3) Bio-Diesel Fuel Cluster

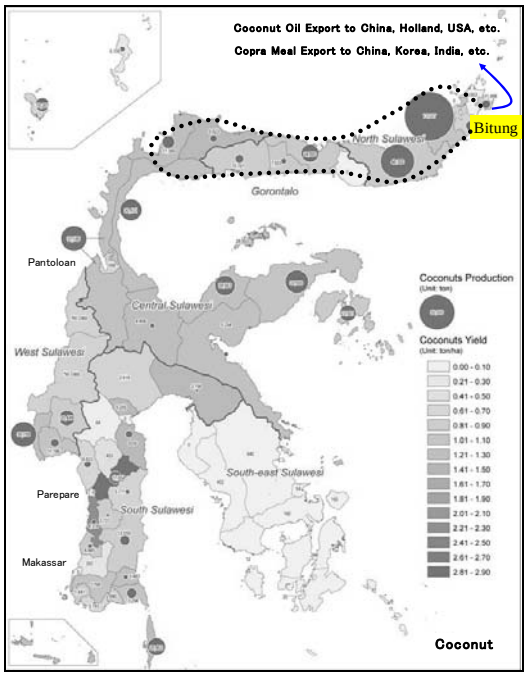
Several Asian countries have already taken measures to introduce bio-diesel fuel (BDF) made from raw vegetable oils available locally. In Indonesia, experimental production and distribution of bio-diesel is currently being conducted but the raw material used is palm oil. Parallel with the development of the palm oil-based bio-diesel, the use of Jatropha has likewise progressed especially in areas where there is limited precipitation since Jatropha farming does not require much water.

Sulawesi has traditionally been known as a coconut island. It has around 700,000 hectares planted by coconuts, accounting for 20% of the total coconut cultivation area in Indonesia. The northern part of Sulawesi, such as Sulawesi Utara and Gorontalo, are the areas where intensive cultivation of coconut has been practiced for quite a long time.

Table 4.4.1 Distribution of Coconut Cultivated Areas in Sulawesi

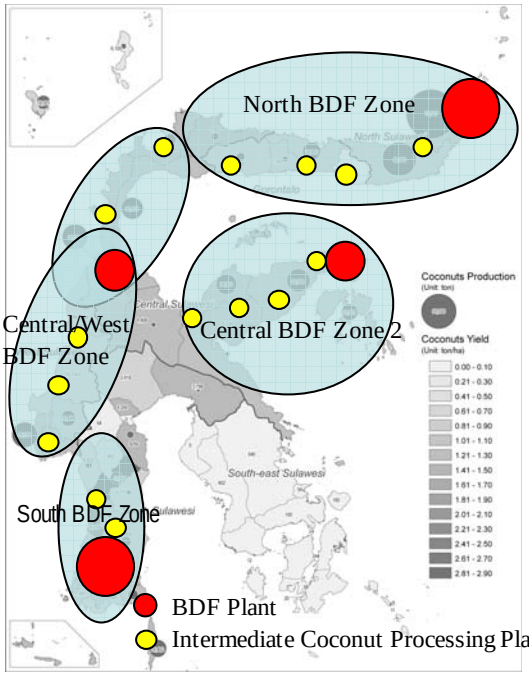
	North	Central	South	Southeast	Gorontalo	West	Total
Area (ha)	250,923	172,581	119,498	50,375	53,967	67,013	**714,357**
Share	35%	24%	17%	7%	8%	9%	100%

With coconut's predominance in the island, it is proposed that BDF development zones be established, as shown in the following.



Source: JICA Study Team

Figure 4.4.5 CNO Export from Bitung Port



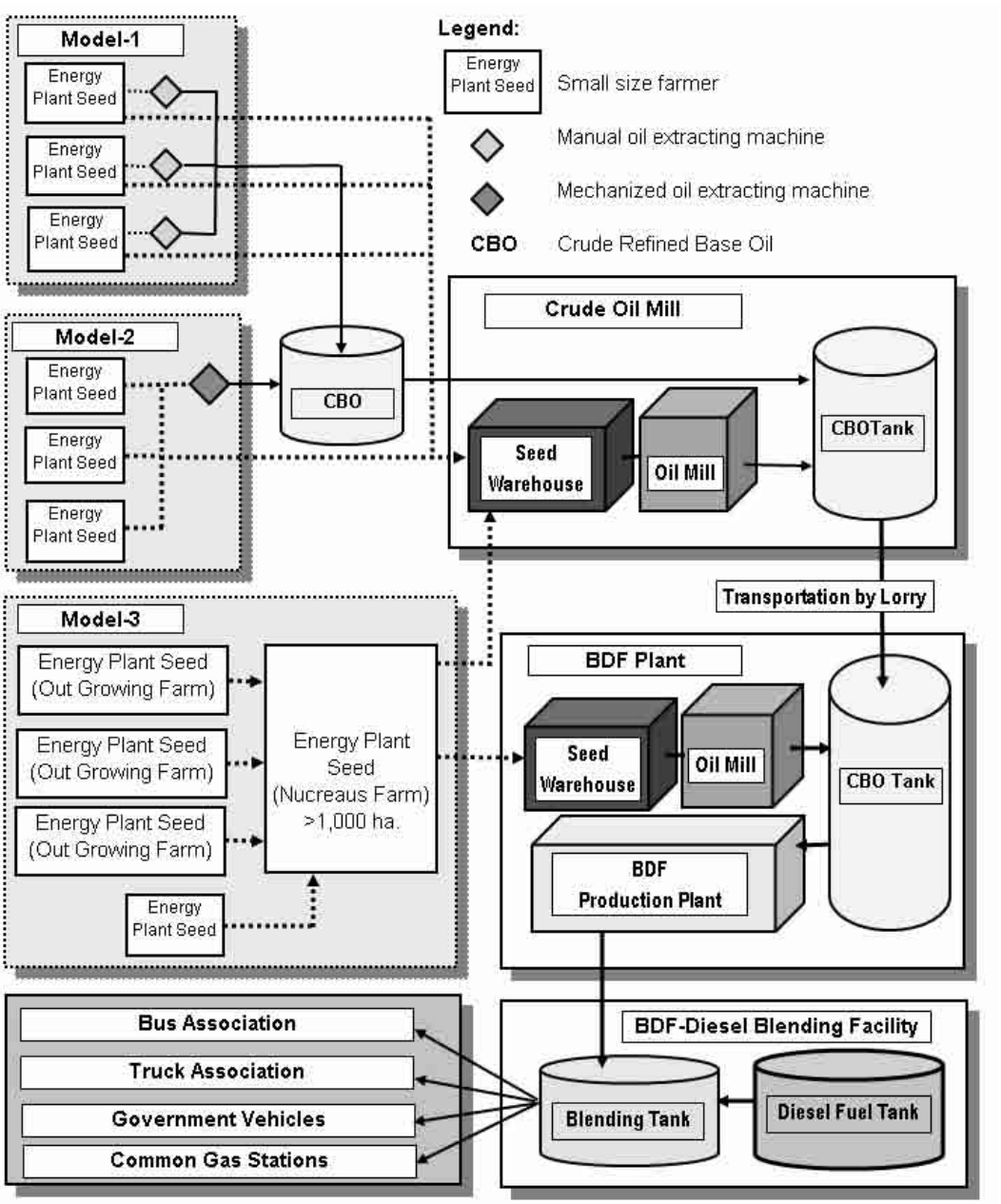
Source: JICA Study Team

Figure 4.4.6 Coconut-based Bio-diesel Development Zones in Sulawesi

In the long-term, each zone shown in the figure above is planned to have at least one unit of bio-diesel production plant with a capacity of 300 tons of BDF per day, or 110,000 kl per year. This plant requires around 165,000 hectares of coconut cultivated land for the supply of raw materials for producing bio-diesel. If four BDF plants will be put into operation, the total BDF production volume will reach 440,000 kl per year.

The total diesel consumption of Sulawesi in 2006 was around 1.4 million kl which is expected to increase to 2.0 million kl in 10 years starting 2007. Since the maximum blending ratio of bio-diesel and petroleum diesel is 20%, it is expected that BDF demands for Sulawesi will reach 400,000 kl, which correspond to the production output of the four BDF plants. Theoretically, if the pump price of diesel would remain as it is today at, say US$0.55 per liter, the annual sales from 400,000 kl of bio-diesel will be US$ 220 million for Sulawesi alone.

A conceptual diagram of the BDF supply Chain is illustrated in following.



Source: JICA Study Team

Figure 4.4.7 BDF Supply Chain Conceptual Diagram

Due to the lack of virgin land for coconut plantation, several measures that would help in attaining high productivity should be taken. This includes the replanting of existing coconut plantations with more productive species and the use of effective harvesting cycles of around 45 days. The SWOT analysis below will show that BDF has a large potential for Sulawesi.

Table 4.4.2 SWOT Analysis of BDF

Area	Profile	Internal Factor	
		Strength	**Weakness**
Production	Total coconut cultivation area of Sulawesi is around 710,000 ha. It accounts for around 22% of the total coconut cultivation area of Indonesia which is almost 3.2 million hectares.	Sulawesi has traditionally grown coconuts and the population is familiar with it.	Most coconut trees are old and their productivity has declined substantially.
	The production of coconut in Sulawesi is around 600,000 tons per year in terms of copra weight and it is processed into CNO at around 290,000 tons per year or 35% of the total CNO production of Indonesia.	Sulawesi has been a leading exporter of CNO, so it is famous in the international market.	
	Indonesia is ranked second after the Philippines in terms of CNO export volume and ranked first in coconut cultivation area.	Sulawesi has a number of fairly large operative CNO production plants. However, since the market demand for CNO has declined despite a considerable increase in palm oil demand in the world, CNO plants are operating below capacity.	
	Shifting of market from coconut oil to palm oil.	The market for vegetable oil has been shifting from coconut oil to palm oil, causing a continuous decline of market demand for coconut oil.	
Area	**Profile**	**External Factors**	
		Opportunities	**Threats**
Market	The potential of introducing bio-diesel production and distribution is quite high in Sulawesi because of the intensive cultivation of coconut trees in the area.	Bio-diesel production using coconut oil may be realized. If it is realized, farmers will be assured of steady incomes, thereby enhancing rural economies.	Unless copra can be purchased by bio-diesel producers at fixed prices, the bio-diesel business will not be feasible. Thus coconut farmers will not have an access to this new income source.
	All parts of the coconut can be utilized for commercial purposes so it is called tree of life.	If by-products are fully exploited through the bio-diesel production, farmers' incomes will increase.	Unless a steady purchase of copra is realized by bio-diesel producers, this will not happen.

Source: JICA Study Team

4.5 Environmental Protection

(1) Overview of Biodiversity in Sulawesi

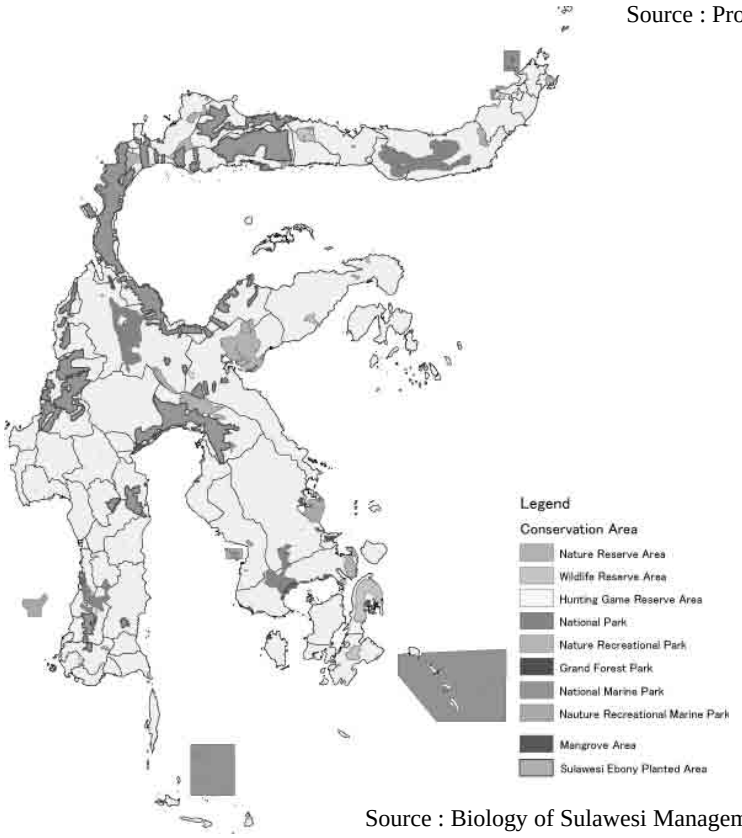
As noted in Section 1.2, Sulawesi is full of biodiversity with plants of about 10,000 species, birds of 650 species, mammals of 220 species, repitiles of 220 species and freshwater fishes of about 250 species. They are overviewed in the following.

Plants

Although the flora of Sulawesi has not been totally disclosed, 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 (about 5%) in Sulawesi.

The mangrove and ebony are protected. The mangrove is distributed almost on the coastal area of Gorontaro, South Sulawesi and Southeast Sulawesi Province. The Sulawesi ebony trees are scattered mainly in the mountainous areas of Central Sulawesi, West Sulawesi and South Sulawesi. Central Sulawesi is a famous source and ebony trees are prohibited to be exported without permission for processing.

Source : Provincial Tourist Board



Source : Biology of Sulawesi Management of Ebony

Figure 4.5.1 Location of Main Conservation Area in Sulawesi

Birds

There are about 650 regularly occurring bird species in Wallacea, and about 262 (40 %) 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 identified by BirdLife International. It is reported that some 50 bird species are threatened with extinction.

Maleo (Celebes Mound Builder)

Among them the maleo (Macrocephalon maleo, EN) is famous for their behavior. This chicken-like bird builds some mounds (including imitation) in which they bury their eggs. Three months later, the young birds explode out of the mound already feathered in adult plumage and possible to fly.

Table 4.5.1 Main Endemic Birds of Sulawesi

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)

Blyth's Hornbill

Lilac-cheeked Kingfisher

Sulawesi golden owl

Source : Provincial Tourist Board

Mammals

More than 125 of Wallacea's 220 mammal species are found is Sulawesi, showing the highest level of mammal endemism in the world.

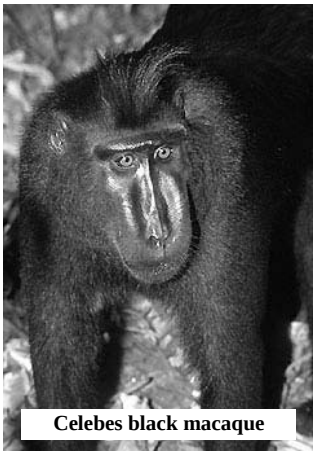
One of the most unusual mammals in Sulawesi is the babirusa (Babyrousa babyrussa, VU) that is protected. Babirusas (literally "pig-deer") are pig-like animals characterized by the male's long recurved tusks that penetrate the upper lip.

Source : Provincial Tourist Board

Source : Provincial Tourist Board

Another famous protected mammal is anoa, or dwarf buffalo. The lowland anoa (Bubalus depressicornis, EN) and the mountain anoa (Bubalus quarlesi, EN) inhabit the conservation areas, national parks and forests.

A number of endemic primates inhabit Sulawesi; at least seven species of endemic macaques and at least five species of endemic tarsiers. The Celebes Black Macaque is seriously threatened to become extinct among endemic macaques. Spectral tarsiers are tiny, goggle-eyed creatures that resemble mammalian tree frogs more than monkeys. They are widely found in many conservation areas and national parks. Sulawesi palm civet (Macrogalidia musschenbroekii, VU) is found only in Sulawesi and around 25 species of rodents are ranging. Unfortunately, about one-third of endemic mammals in this hotspot are threatened with extinction.



Source : Provincial Tourist Board

Table 4.5.2 Mammals of Sulawesi

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)

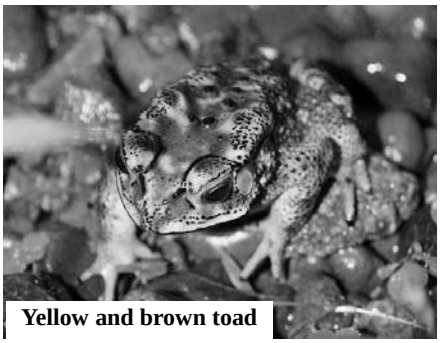
Amphibian

The amphibian specy in Sulawesi is less disclosed. The confirmed species of amphibian in Sulawesi at present are shown in the following.

Table 4.5.3 Amphibian 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

Reptile

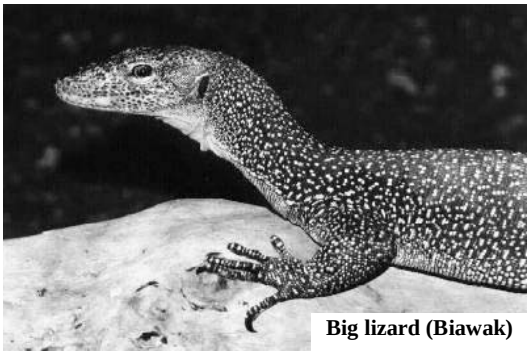
The confirmed species of snakes in Sulawesi are shown in the following table. 64 snakes including the poisonous snakes (e.g., cobras) are confirmed to exist in Sulawesi.

Table 4.5.4 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 are listed in the following table. Resident people say that the crocodiles inhabit the northern part of Central Sulawesi. The big lizards of over 1m in length are even found in and around Makassar. This lizard is popular with a timid nature and ferocious appearance.



Big lizard (Biawak)

Source : Provincial Tourist Board

Table 4.5.5 Reptiles of Sulawesi

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 species of turtles are listed in the following table. The locations where turtle lay eggs in and around Sulawesi are also indicated in the figure.

Table 4.5.6 Turtles of Sulawesi

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

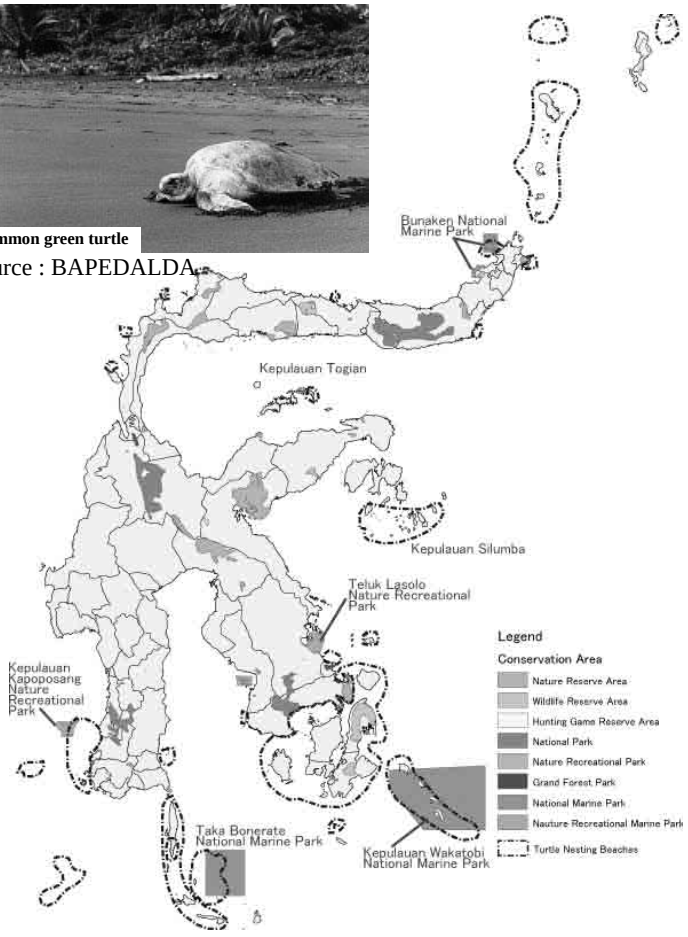


Figure 4.5.2 Location of Turtles laying eggs area around Sulawesi

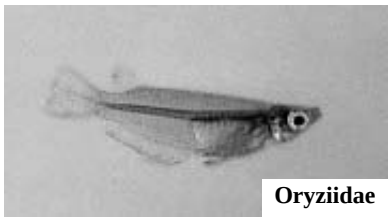
Freshwater Fishes

More than 300 freshwater fish species are found in Wallacea and about 75 of these species are endemic. In Sulawesi alone, there are nearly 70 fish species, about three-quarters of which are endemic. 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.

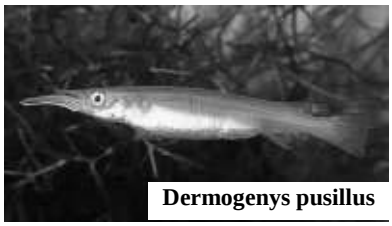
Table 4.5.7 Freshwater Fishes of Sulawesi Rivers

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



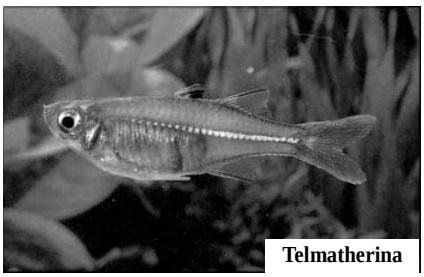
Dermogenys pusillus

Source : Provincial Tourist Board

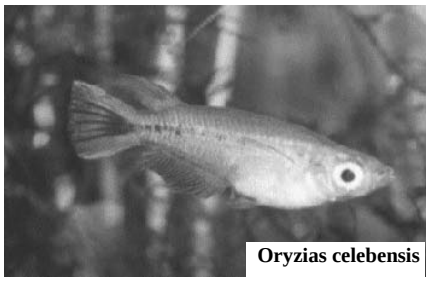
Table 4.5.8 Freshwater Fishes of Sulawesi Island Lakes

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

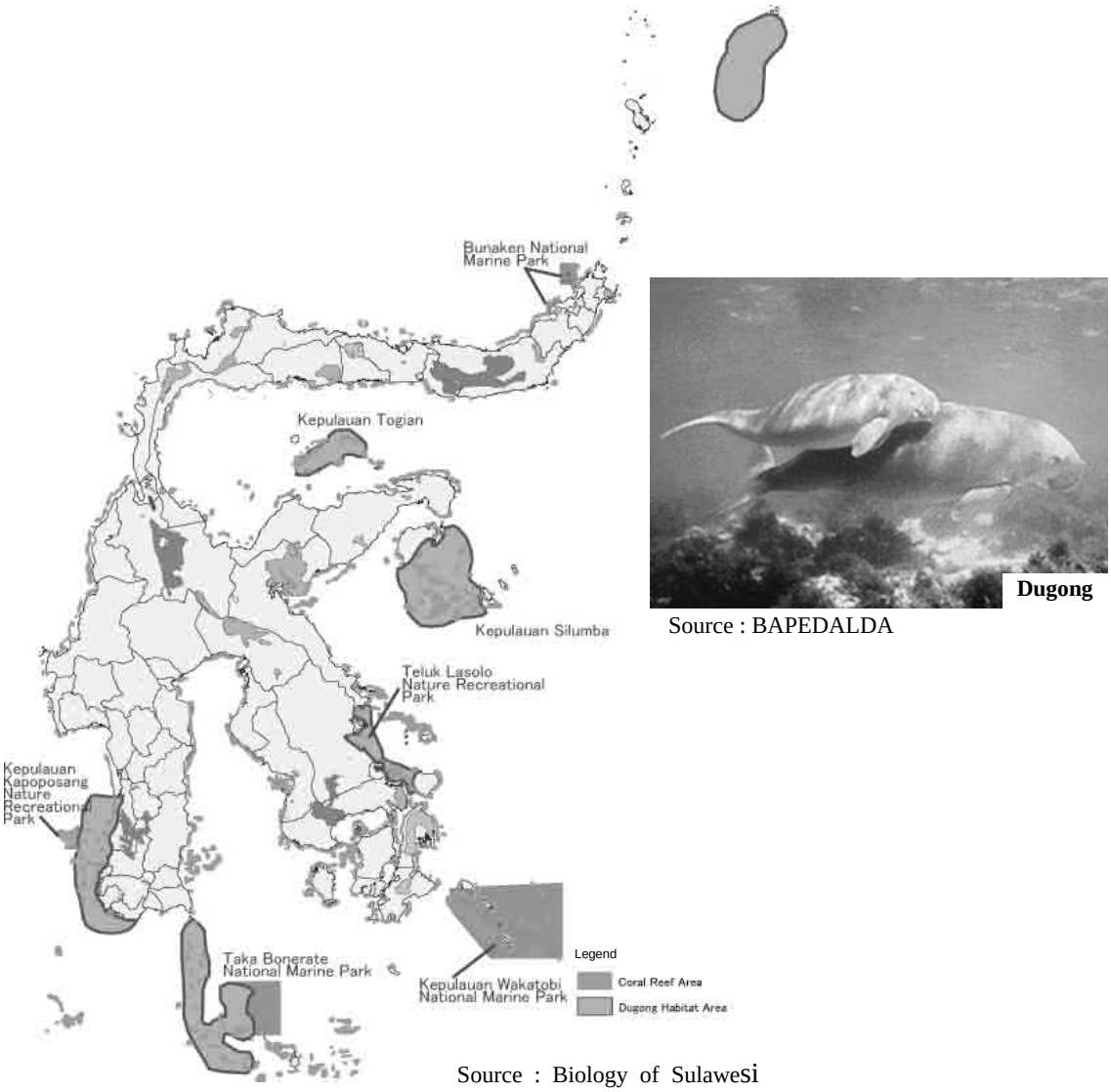
Source : Provincial Tourist Board

Coral Reef and Dugong Habitat

The coral reef extends around Sulawesi as shown in the following figure. The coral reef is useful for preservation of the biodiversity and fishery production. In addition, it is also favorable as tourist attractions. Three National Marine Parks are designated around Sulawesi, together with Nature Recreational Marine Parks.

The Dugong habitat areas overlap with some National Marine Parks and coral reef areas. The IUCN (International Union for Conservation of Nature and Natural Resources) lists the dugong as

a species vulnerable to becoming extinct, while the Convention on International Trade in Endangered Species bans the trade of derived products.



Source : Biology of Sulawesi

Dugong

Source : BAPEDALDA

Figure 4.5.3 Location of Coral Reef and Dugong habitat Area

(2) Strategies for Environmental Protection

For the protection of the natural environment in Sulawesi, it is of prime significance that any development projects/programs take utmost attention to follow the laws and regulations for environmental protection. Some strategies to be adopted for the protection and enrichment of the environment are proposed in the following.

1) Indicator Species for Protection of Biodiversity

Any development projects/programs should be planned and designed to protect the biodiversity abundant in Sulawesi. Several indicator species could be identified to draw specific attention and care. For instance, under the arterial road improvement project, the indicator species have been

identified and proposed in the following manner.

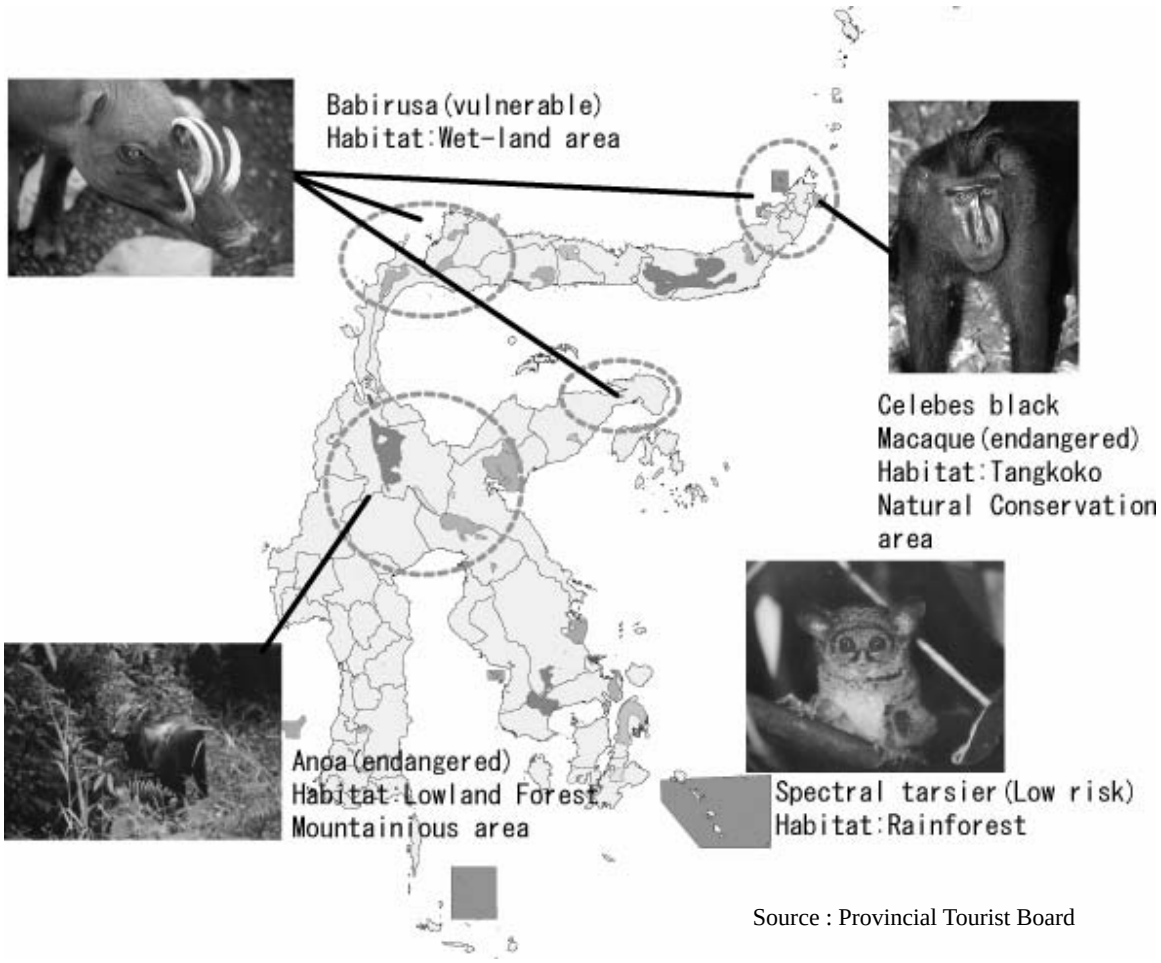


Figure 4.5.4 Selected Indicator Species (Mammals)

Anoa is an endangered species inhabiting the lowland forest and mountainous area over the island, particularly in Central Sulawesi. It is reported that the number of anoas has been rapidly decreasing in recent years. Celebes black macaque is also an endangered species with its habitat particularly in the Tangkoko Natural Conservation area. Babirus is a vulnerable species with its habitat in the wet land area in North and Central Sulawesi. Spectral tarsier widely inhabit the mountains and conservation areas; e.g., in the Tangkoko Natural Conservation area and Morowali Nature Reserve area.

On the other hand, several bird species are identified as indicator species. The Maleo is an endangered species with its habitat over the island, except for South Sulawesi. The Maleo in the Tangkoko Natural Conservation area, Bogami Nani Wartabone National Park are observed along the seashore and plain land. The Matinan flycatcher in Minahassa peninsula and white-tipped monarch in South Sulawesi are also endangered species. The Sulawesi red-knobbed hornbill is a vulnerable species widely observed in the island.

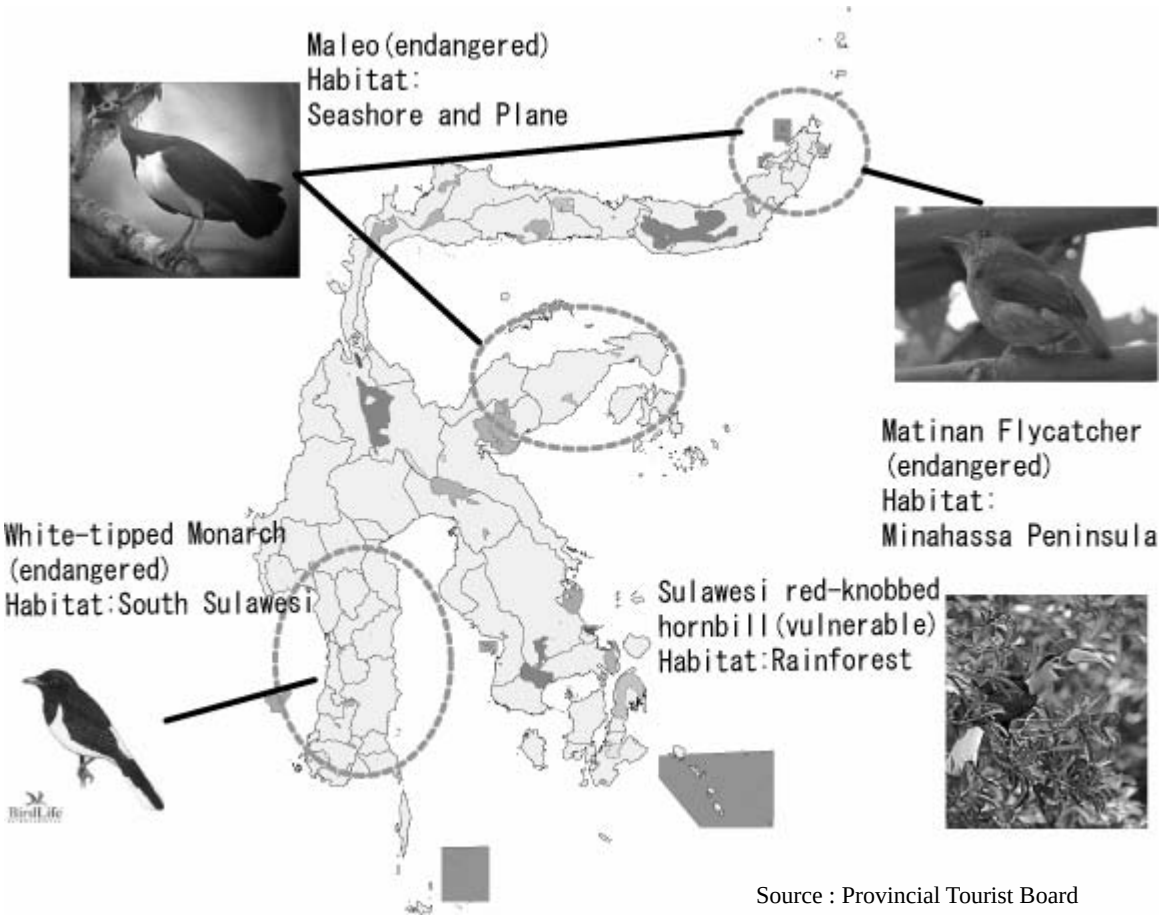


Figure 4.5.5 Selected Indicator Species (Birds)

2) Protection of Forest Area full of Biodiversity

The forest coverage in Sulawesi (53.4% as noted in Section 1.2) has been decreasing in recent years with the exploitation of valuable trees and encroachment of cultivated lands. Further degradation of the forest area should be avoided by all means.

As noted in the foregoing section, most endangered and vulnerable biodiversity are habitats in the forest areas. Although the Natural Conservation Areas have been designated in Sulawesi to cover relatively wide areas (or about 35,000 km^2), the habitat areas of mammals, birds, reptiles and amphibians are not always limited to such conservation areas. It is also observed that the conservation areas are scattered in a rather isolated manner, and a number of corridors for their integration would be required for better protection of biodiversity. Conservation of the forest area is therefore of prime importance for the protection of the biodiversity and environments in Sulawesi.

Attention is also drawn to the conservation of the mangrove forests in the coastal area. Some mangrove forests have been cleared for fish/shrimp ponds and the land use of the mangrove area should be managed in more appropriate manners. Deforestation along the coastal land for plantation of oil palm, particularly to the north of the Bone bay and along the coast in West Sulawesi, should also be managed to protect the biodiversity and environment.

In addition to the protection of the forest area, afforestation should be promoted in every province.

For instance, the development plan for the Mamminasata Metropolitan area in South Sulawesi has put a target of afforestation by 25,000 ha in 15 years, with the forest area expanding from 29% (2005) to 38% (2020) in Mamminasata. Such a target should be strategically made by the people of respective province and all stakeholders should do their best to attain the target. It is also noted that afforestation is particularly important for watershed management, as the river basins in Sulawesi are relatively steep in slopes and the volume of sedimentation is relatively large.

3) Management of Water Pollution

With the progress in urbanization, BODs, COD and total suspended solid (TSS) have increased in rivers and sea water, particularly in Makassar and other densely populated urban centers. Although contamination by heavy metals is reported to be low in grade, water pollution would become a serious constraint for enjoying a healthy life in Sulawesi.

Even in Makassar, there is no sewerage treatment system and waste water is drained to river/creek channels and to the ocean without treatments. As planned for the Mamminasata Metropolitan area, water pollution should be managed by treatments at the household and municipal levels. Sewerage treatment facilities would be required in Makassar, Manado and other major centers in the medium term.

Water contamination is often caused by solid wastes thrown into rivers/creek channels as observed not only in Makassar but in other major centers that have been developed in the river estuaries. It is therefore required that a sound solid waste management system be introduced by the people, communities, regencies and provinces. Disorderly disposal of solid waste is not only harmful for the people but also for mammals, birds and other biodiversities in Sulawesi.

Losari beach polluted by wastes

Polluted water in drainage canal

4) Management of Air Pollution

Impact of air pollution has been aggravating in Jakarta, Surabaya and other major urban centers in Indonesia. Major sources of NOx in Indonesia are energy consumption in industries, electric power generation and transportation. As shown in the foregoing Figure 3.3.3, volume of NOx emission has been sharply increasing year by year. The emission from industries and power generation has increased by 270% during the period from 1990 to 2003, while the emission from transportation has increased by 203% (nearly double in 13 years).

The increase in NOx emission is also notable in Sulawesi. The emission from power generation has increased by 198% during the period from 2000 to 2005, while the increase in power generation has remained at 132%. The emission should be minimized by development of cleaner energy sources by all means. Likewise, industrialization in Sulawesi should be promoted in parallel with the protection measures for excessive emission of NOx and other pollutants.

Management of air pollution should also be promoted in transportation, particularly in road transport as traffic volume has been increasing remarkably. In the arterial road network improvement in Sulawesi, a mathematical model is to be used for management of NOx and CO_2 volume, which is estimated in the following formula.

Volume of NOx or CO_2 = (A1 x p1 + A2 x p2) x Q

Where: A1 is volume of small vehicle (vehicles/day)
p1 is exhaust coefficient of small vehicle
A2 is volume of large vehicle (vehicles/day)
p2 is exhaust coefficient of large vehicle
Q is traffic volume (vehicles/day)

The NOx and CO_2 exhaust coefficient of small vehicles and large vehicles is estimated as shown in the following.

Table 4.5.9 Exhaust Coefficient by Vehicle Type

average speed (km/h)	Nox		CO_2	
	p1	p2	p1	p2
10	0.34	3.79	99	237
20	0.29	3.33	67	182
30	0.24	2.87	54	155
40	0.20	2.41	46	137
50	0.21	2.16	42	127
60	0.23	1.90	40	122
70	0.25	2.10	39	123
80	0.27	2.29	40	129

In the event that the average driving speed is improved by 10 km/h from 25.4 km/h at present to 35.4 km/h in 2024, the volume of NOx emission is estimated to decrease by 14%. Likewise, it is estimated that the volume of CO_2 emission will decrease by 21%.

Furthermore, as discussed in Section 4.4, cluster development of bio-diesel fuel using coconut cultivation in Sulawesi has been proposed from the viewpoint of environmental protection, too. By making use of bio-diesel fuel, volume of NOx emission from diesel engines would be decreased by the same ratio as the mixture ratio. For reference, the merit and demerit of bio-diesel fuel and bio-ethanol fuel are summarized in the following

Table 4.5.10 Comparison of Bio-diesel and Bio-ethanol

	Bio-diesel	Bio-ethanol
Merit	• Reduction of SO2, NO2, SPM, Pb • High safety and simple for usage • Possible for mixing normal diesel fuel	• Nothing of CO2 • Recyclable energy from vegetable • High efficiency of thermal energy • Possible for mixing normal gasoline
Demerit	• Higher price than normal diesel fuel (about 1.5~2 times) • Tough to get because limited distribution route	• Normal price compared gasoline but production is limited • Tough to get because limited distribution route

In addition, a certain decrease in the emission is expected by shifting from vehicle transport to ferry transport along the nautical highway to be proposed in transportation development for Sulawesi.

5) Management of Noise Level

In the major urban centers in Sulawesi, the noise level has been elevated due mainly to the increase in road traffic and congestions. The noise level can be estimated in the following manner.

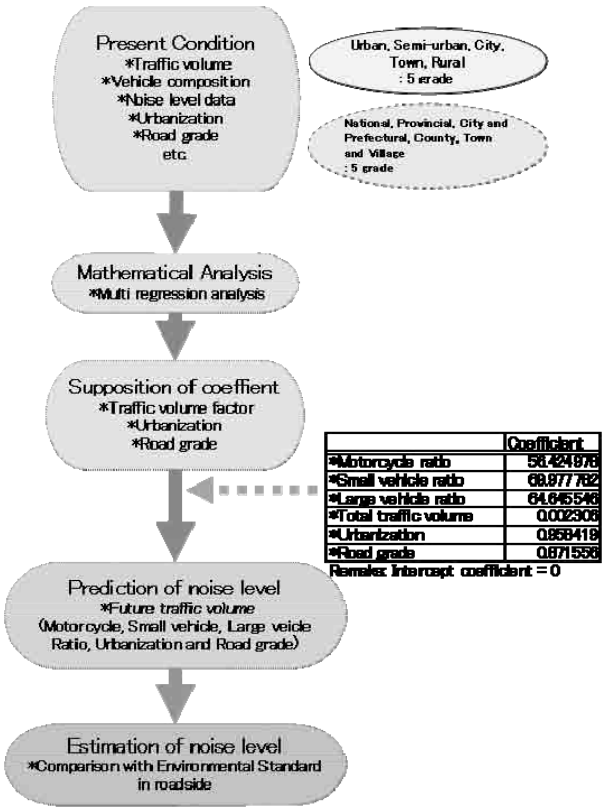


Figure 4.5.6 Prediction Flow of Noise Level

The noise level with the increased traffic in major urban centers is predicted to exceed in some cases the Environmental Standard (70 dB(A). For instance, the noise level in and around the Makassar area is estimated in the following.

Table 4.5.11 Predicted Peak Noise Level in 2024 (around Makassar area)

unit veh/dec/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	**69.9**
Makassar-3	9	614	1,612	1,968	454	380	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	3,342	6,204	292	67,498	**79.0**
Makassar-6	**153**	20,988	19,042	16,106	1,224	3,342	6,204	292	67,498	**79.0**
Makassar-7	**155**	20,988	19,042	16,106	1,224	3,342	6,204	292	67,498	**79.0**
Makassar-8	**184**	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**

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

Consequently, countermeasures should be taken against the excessive noise level near hospitals, schools and other specific areas to minimize the noise level.

6) Introduction of Strategic Environmental Assessment (SEA)

The application of the strategic environmental assessment (SEA) has been initiated in Indonesia as recommended by the World Bank and other international donors. SEA intends to collectively evaluate the environmental impacts for any development projects. Generally, it will follow the following steps and all information is kept open to the public, not only on the impacts on natural conditions but also on the social impacts.

i) Collection of baseline data and information
ii) Identification of evaluation items
iii) Impact assessment
iv) Multi-criteria analysis (MCA)
v) Selection and structuring of evaluation items
vi) Fixing evaluation indices and rating evaluation scores
vii) Weighting and totaling evaluation score
viii) Formulation of MCA matrix
ix) Recommendation of mitigation measures

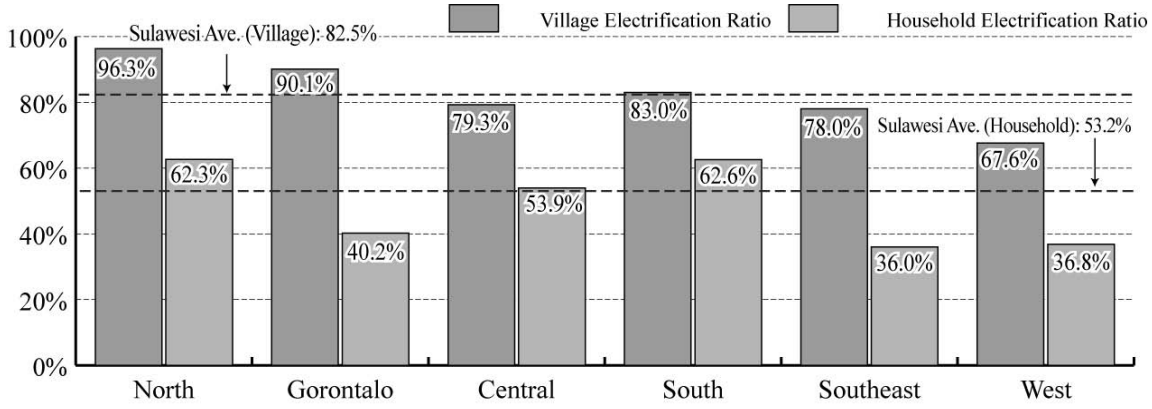
The alternative case of without project or “zero option” should be duly evaluated under the SEA. The environmental impacts of other related projects are collectively evaluated for comprehensive assessment of the impacts.

4.6 Electric Power Development

(1) Overview of Electric Power Situation in Sulawesi

Development of electric power in Sulawesi has been lagged due partly to the dispersed demand centers and partly to the delay in meeting the growing power demand in every corner of the island. The electrification ratio still remains relatively low and the consumers have been suffering from shortage in power supply.

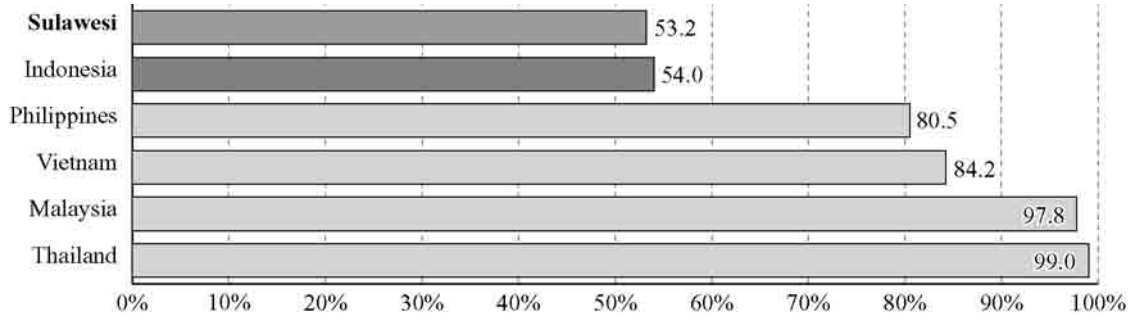
The village electrification ratio in Sulawesi was 82.5% in 2006 (5,353 villages electrified out of 6,490 villages), or much lower than the ratio in Java-Bali (90.1%). The household electrification ratio was 53.2%, with the implication that nearly half of the households in Sulawesi had not enjoyed electric power supply. The household electrification ratio varies by province; while it is relatively high in South Sulawesi (62.6%), it remains low in Southeast, West and Gorontalo provinces as illustrated in the following.



Source: PLN Statistics 2006

Figure 4.6.1 Electrification Ratios in Sulawesi

The household electrification ratio of Sulawesi, as well as the ratio of Indonesia, is substantially low if compared with the ratios of other ASEAN countries, as shown in the following figure.

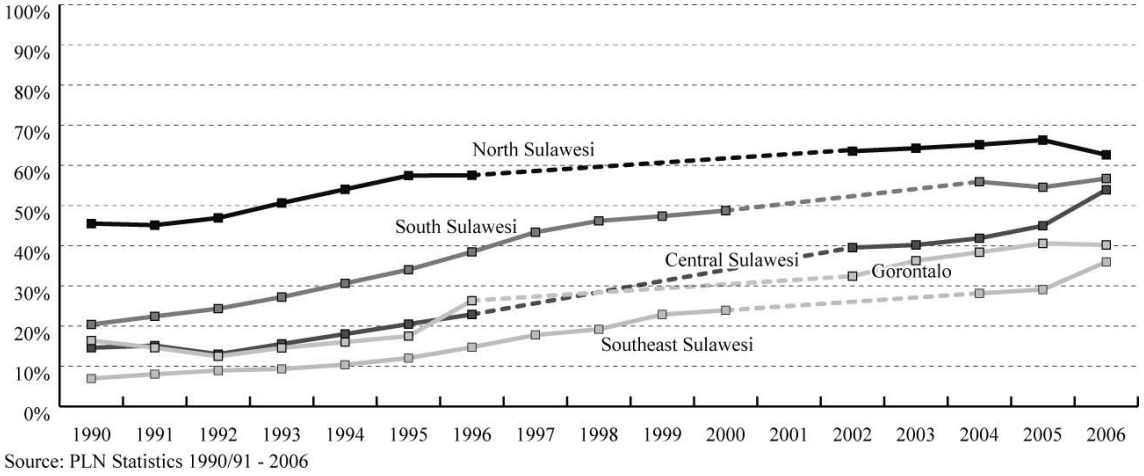


Source: World Energy Outlook 2006, and PLN Statistics 2006

Figure 4.6.2 Household Electrification Ratio in Sulawesi and ASEAN

The electrification ratios have substantially improved in Sulawesi since the late 1990s. PLN has electrified nearly 47,600 households per year on an average during the period from 1990 to 2006. It might be attributable to the strenuous efforts of PLN in extending 115kV/70kV transmission lines,

as well as to the completion of the Bakaru hydro-power and Sengkarng combined-cycle power stations. The PLN data and information on the historical trends of the household electrification ratios are shown in the following.



Source: PLN Statistics 1990/91 - 2006

Figure 4.6.3 Change in Household Electrification Ratio

In addition to the PLN records, some households have been electrified branching distribution lines to some relatives nearby from the PLN contracted house and some others have been equipped with their own generators or electrified by solar and micro-hydro power. It is therefore estimated that the electricity penetration ratio would slightly increased up to around 69.3% as illustrated in the following figure.

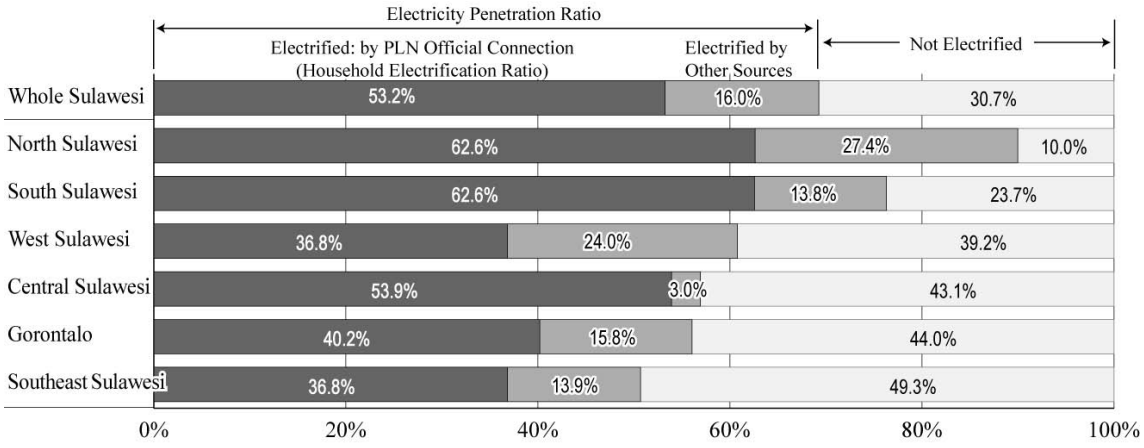
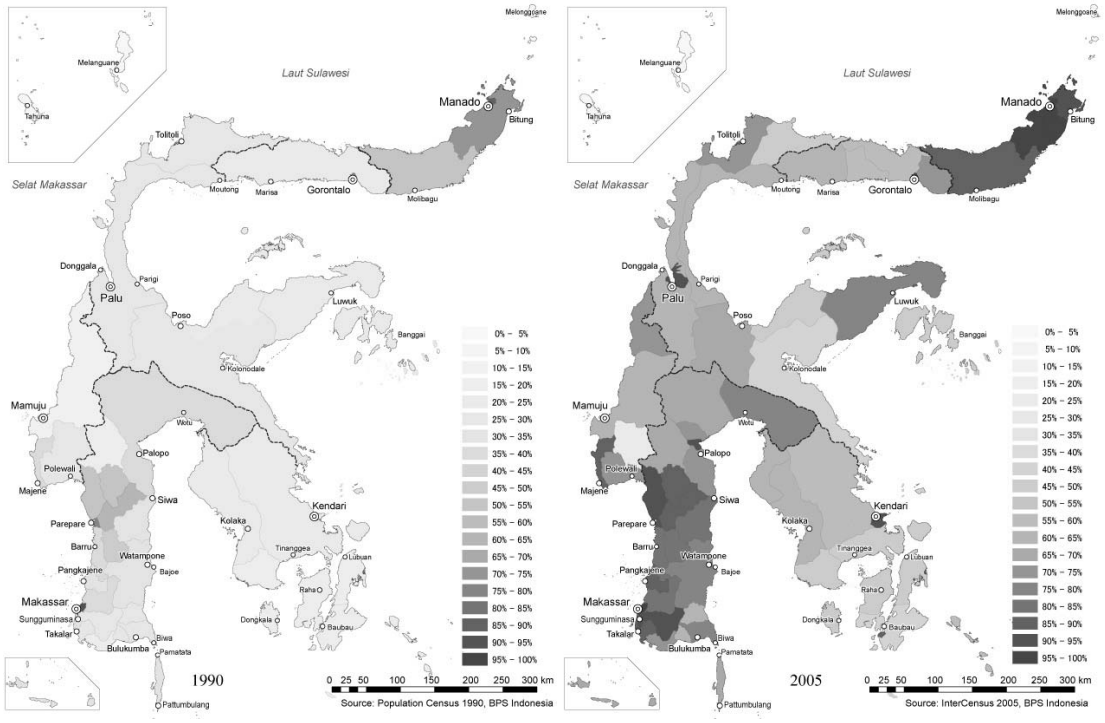


Figure 4.6.4 Electrification Ratio and Electricity Penetration Ratio

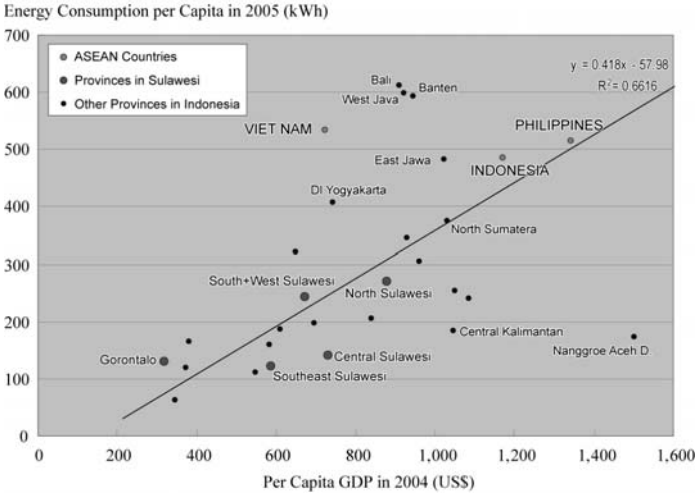
Despite the improved electrification, particularly in the urban centers, a number of Kabpatens still remain at a low level of electricity penetration ratio (e.g., 23% in Mamasa in West Sulawesi, 43% in Buton in Southeast Sulawesi and Morewali in Central Sulawesi), as illustrated in the following.



Source: JICA Study Team on Optimum Power Development Plan in Sulawesi Island, Population CENSUS 1990 and 2005, BPS

Figure 4.6.5 Electricity Penetration Ratio of Sulawesi in 1990 and 2005

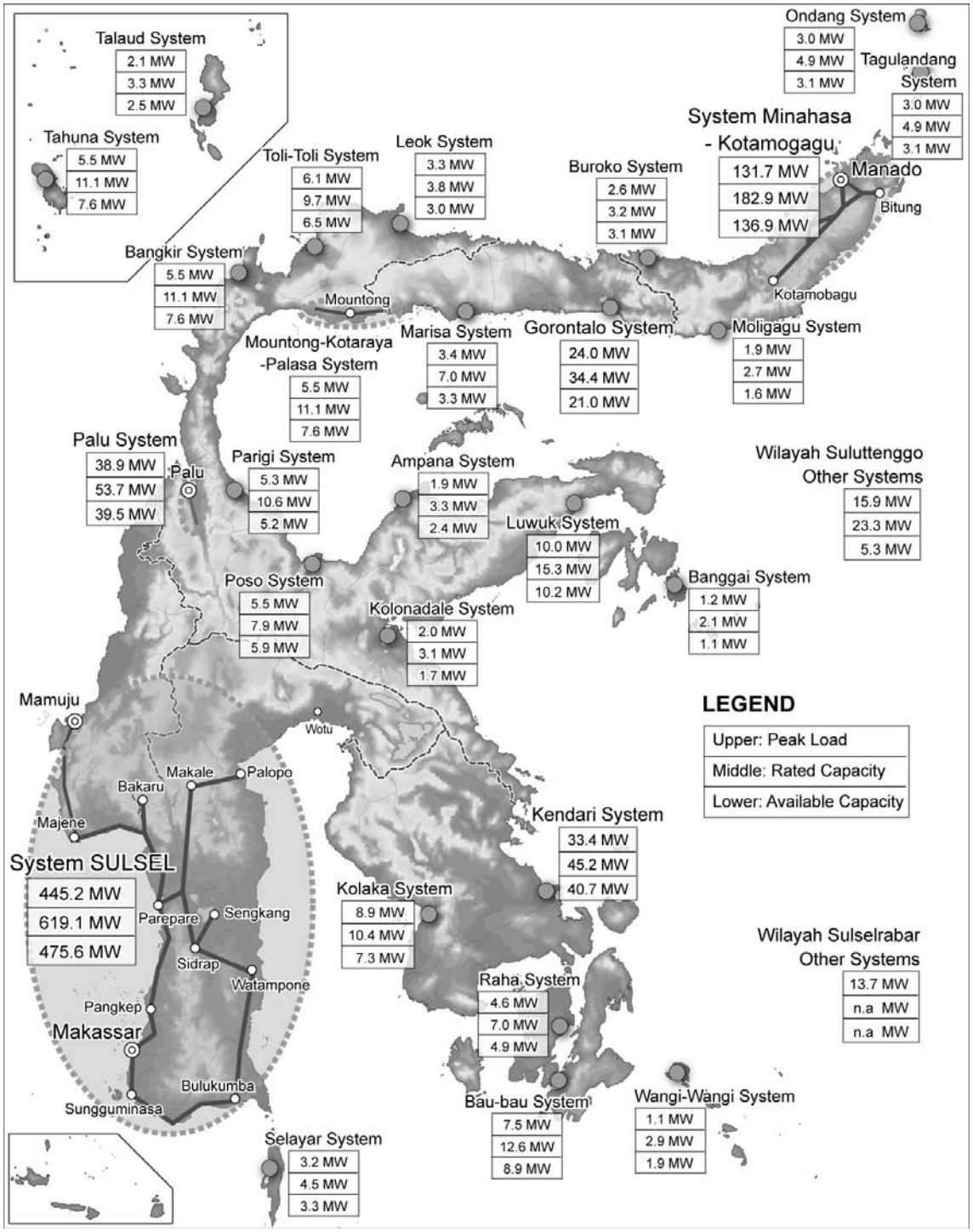
The per capita electricity consumption also remains at a relatively low level. It ranges from 269 kWh/year in North Sulawesi to 121 kWh/year in Southeast Sulawesi. In some power grid areas, power supply is still limited to hours during night time (e.g, 4 hours in Buroko in Gorontalo, 7 hours in Bangkir and 12 hours in Leok in Central Sulawesi).



Source: PLN Statistics 2005, CIA World Fact Book 2007, and World Economic Outlook Database, April 2007

Figure 4.6.6 Per Capita Energy Consumption and Per Capita GDP

On the electricity supply side, the power grids over Sulawesi are quite dispersed into small and isolated grids, except for Sulsel (South Sulawesi) grid and Minahasa-Kotamobagu (North Sulawesi) grid, as summarized in the following.



Source: RUPTL 2008 – 2017 PLN Wilayah Suluttenggo and Sulselrabar

Figure 4.6.7 Electric Power Grids in Sulawesi

The power supply system in Sulawesi and in major PLN power grids (Sulsel and Minahasa-Kotamobagu grids) are composed of the following power generation schemes.

Table 4.6.1 Power Generation in Sulawesi (2006)

		Generation Capacity (MW)	Energy Production (GWh)	Plant Load Factor (%)
PLN Wilayah Suluttenggo (North, Gorontalo, and Central Sulawesi)	PLN	356.5	986.8	31.6%
	Private	0.0	0.0	-
	Rental	53.0	295.9	63.7%
	Sub-total	409.5	1,282.7	35.8%
PLN Wilayah Sulselrabar (South, Southeast, and West Sulawesi)	PLN	484.9	1,246.9	29.4%
	Private	200.0	1,433.0	81.8%
	Rental	44.2	201.7	52.1%
	Sub-total	729.1	2,881.7	45.1%
Sulawesi Total		1,138.6	4,164.4	42.8%

Source: PLN Statistics Wilayah Suluttenggo and Sulselrabar 2006

Table 4.6.2 Power Generation in 27 Major Grids (2006)

		No. of Power Stations	Number of Generating Units	Generation Capacity (MW)	Available Capacity (MW)
PLN Wilayah Suluttenggo (North, Gorontalo, and Central Sulawesi)	Hydro	10	17	64.37	59.25
	Diesel	62	314	285.44	175.18
	Geothermal	1	1	20.00	20.00
	Sub-totl	332	332	369.81	254.43
PLN Wilayah Sulselrabar (South, Southeast, and West Sulawesi)	Hydro	4	9	149.32	148.18
	Diesel	22	144	266.31	187.25
	Steam	1	2	25.0	10.50
	Gas Turbine	1	4	122.72	110.30
	Combined Cycle	1	3	135.0	108.30
	Sub-total	163	163	698.35	564.53
Sulawesi Total		102	495	1,068.15	818.96

Source: PLN Statistics Wilayah Suluttenggo and Sulselrabar
Note: Power Stations within isolated mini systems are not included

The situation of power supply in most grids has been unstable, due mainly to the shortage in the installed capacity and fuel, as well as to the inadequate transmission and distribution facilities. The current situation of the PLN grids has been evaluated as summarized in the following table.

Table 4.6.3 Power Supply Situation in Sulawesi

Province	System	(1) Peak Load	(2) Available Capacity	(3)= (2)-(1) Reserve Capacity		Reserve (> 0)	(4) Max. Unit	(3) - (4) (> 0)	Capacity Addition Plan within 2 yrs.	Judgment
North Sulawesi	Minahasa-Kotamobagu	131.7 MW	136.9 MW	5.2 MW	3.9%	O.K.	20.0 MW		Yes	O.K.
	Tahuna	5.5 MW	7.6 MW	2.1 MW	38.2%	O.K.	1.1 MW	O.K.	No	O.K.
	Ondang	3.0 MW	3.1 MW	0.1 MW	3.3%	O.K.	0.7 MW		No	Critical
	Molibagu	1.9 MW	1.6 MW	-0.3 MW	-15.8%		0.7 MW		No	Critical
	Talaud	2.1 MW	2.5 MW	0.4 MW	19.0%	O.K.	0.5 MW		No	Critical
	Tagulandang	1.2 MW	1.6 MW	0.4 MW	33.3%	O.K.	0.5 MW		No	Critical
Gorontalo	Gorontalo	24.0 MW	21.0 MW	-3.0 MW	-12.5%		2.9 MW		No	Critical
	Marisa	3.4 MW	3.3 MW	-0.1 MW	-2.9%		0.7 MW		No	Critical

Province	System	(1) Peak Load	(2) Available Capacity	(3)= (2)-(1) Reserve Capacity		Reserve (> 0)	(4) Max. Unit	(3) - (4) (> 0)	Capacity Addition Plan within 2 yrs.	Judgment
Central Sulawesi	Buroko	2.6 MW	3.1 MW	0.5 MW	19.2%	O.K.	0.9 MW		No	Critical
	Palu	38.9 MW	39.5 MW	0.6 MW	1.5%	O.K.	13.5 MW		No	Critical
	Poso	5.5 MW	5.9 MW	0.4 MW	7.3%	O.K.	1.3 MW		No	Critical
	Toli-toli	6.1 MW	6.5 MW	0.4 MW	6.6%	O.K.	1.3 MW		No	Critical
	Parigi	5.3 MW	5.2 MW	-0.1 MW	-1.9%		1.1 MW		No	Critical
	Moutong-Kotaraya-Palasa	5.5 MW	7.6 MW	2.1 MW	38.2%	O.K.	1.0 MW	O.K.	No	O.K.
	Leok	3.3 MW	3.0 MW	-0.3 MW	-9.1%		1.0 MW		No	Critical
	Kolonadale	2.0 MW	1.7 MW	-0.3 MW	-15.0%		0.7 MW		No	Critical
	Bangkir	5.5 MW	7.6 MW	2.1 MW	38.2%	O.K.	0.7 MW	O.K.	No	O.K.
	Luwuk	10.0 MW	10.2 MW	0.2 MW	2.0%	O.K.	1.6 MW		No	Critical
	Ampara	1.9 MW	2.4 MW	0.5 MW	26.3%	O.K.	0.8 MW		No	Critical
	Banggai	1.2 MW	1.1 MW	-0.1 MW	-8.3%		0.5 MW		No	Critical
South+West Sulawesi	Sulsel	445.2 MW	475.6 MW	30.4 MW	6.8%	O.K.	67.5 MW		Yes	O.K.
	Selayar	3.2 MW	3.3 MW	0.1 MW	3.1%	O.K.	0.6 MW		Yes	O.K.
Southeast Sulawesi	Kendari	33.4 MW	40.7 MW	7.3 MW	21.9%	O.K.	2.4 MW	O.K.	No	O.K.
	Kolaka	8.9 MW	7.3 MW	-1.6 MW	-18.0%		2.2 MW		No	Critical
	Raha	4.6 MW	4.9 MW	0.3 MW	6.5%	O.K.	2.0 MW		Yes	O.K.
	Bau-bau	7.5 MW	8.9 MW	1.4 MW	18.7%	O.K.	1.7 MW		No	Critical
	Wangi-wangi	1.1 MW	1.9 MW	0.8 MW	72.7%	O.K.	0.5 MW	O.K.	No	O.K.

Source: JICA Study Team on Optimum Power Development Plan in Sulawesi Island

In conclusion, there still remains much to be improved in the electric power supply in Sulawesi, with relatively low electrification ratios and per capita consumption, as well as under the critical power supply conditions. The networks of isolated power grids should also be improved in order to secure stable power supply not only for household consumption but also for industrial development envisaged in respective provinces.

(2) Strategies for Electric Power Development

Although the optimum power development plan in Sulawesi is to be formulated through the Ministry of Energy and Mineral Resources and PLN with the technical assistance by JICA, some strategies are proposed below from the regional development point of view.

1) Utilization of Local Energy Resources

Sulawesi has various energy resources, inclusive of coal, natural gas, geothermal, hydropower, and such renewable energy as solar and wind energy. The coal deposits are reported to be as low as 60,000 tons in Central and South Sulawesi (e.g., Maros, Pangkajene, Enrekang, and Mamuju) and they would not be suitable for sizable power generation. Peat in Malangke is reported to be as low as 4,940 kcal/kg of dried peat and deposit is limited in quantity (estimated to be 1.25 million tons). For development of coal-fired power plants, fuel has to be imported from Kalimantan or foreign sources.

Natural gas deposit in Sulawesi has not been disclosed totally. Although the information available from the Ministry of Energy and Mineral Resources shows limited deposit in Central Sulawesi (3.92 Tcf) and South Sulawesi (0.79 Tcf), it is reported that the deposit in Sinora in Central

Sulawesi is to be developed by foreign investors for LNG export.

Geothermal power potential has been identified to be around 735 MW in exploitable energy, located in North Sulawesi, Gorontalo and Central Sulawesi, as shown in the following. On the other hand, hydropower potential in Sulawesi is estimated to reach 12,600 MW, or quite sizable if compared with the currently developed hydropower with the installed capacity of around 210 MW. Distribution of hydropower potential is also illustrated in the following figure.

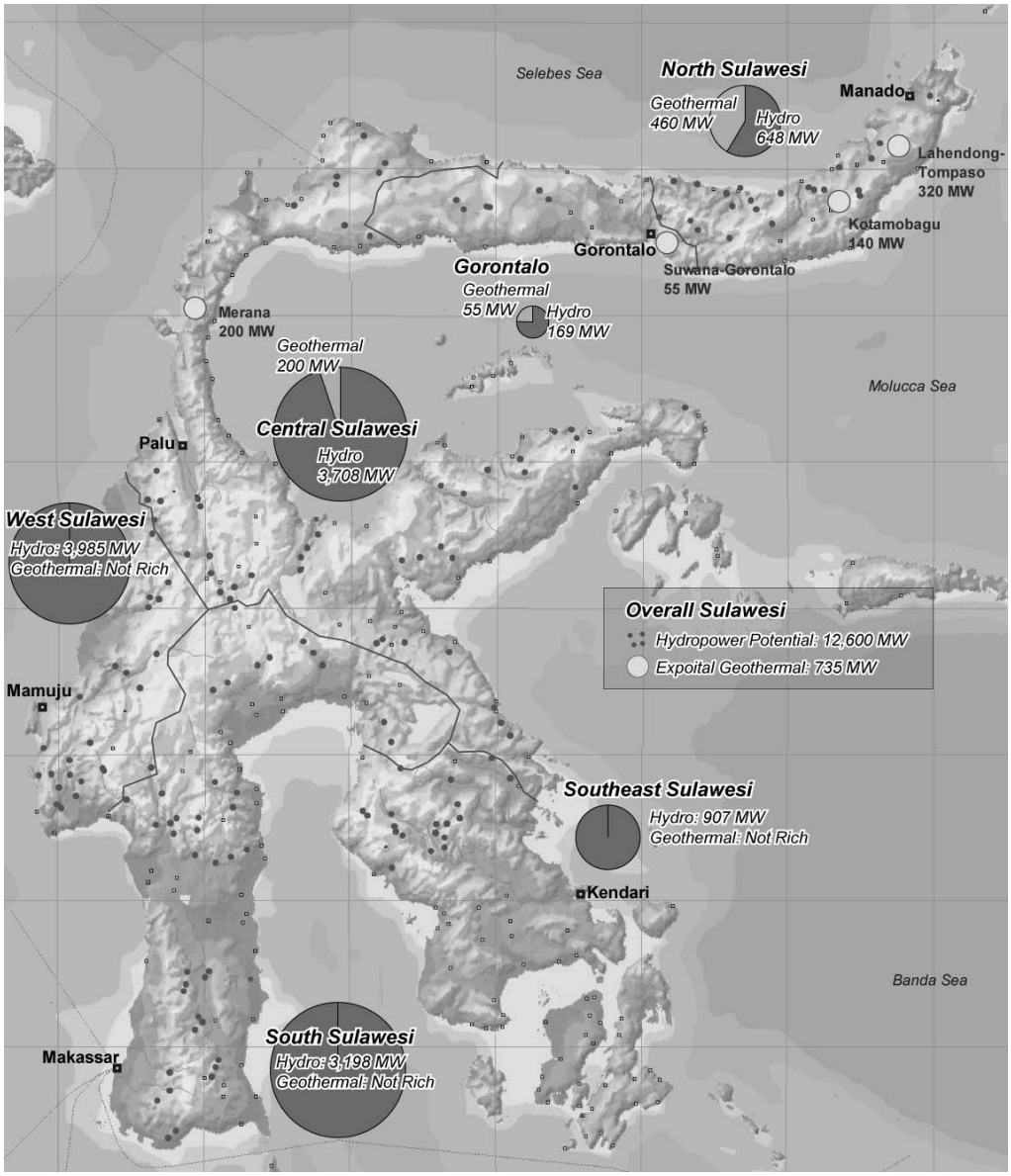


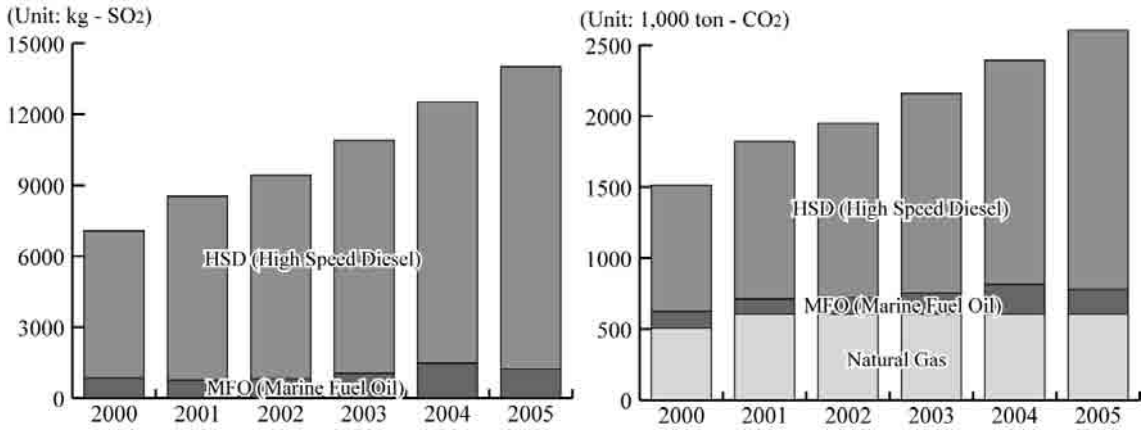
Figure 4.6.8 Hydropower and Geothermal Potential

From the viewpoint of availability of energy resources, geothermal and hydropower should be developed as far as they are economically viable compared with coal-fired power generation. In evaluating the least cost in power generation, attention should be paid to the projection of international fuel prices, as well as to the environmental impacts (both natural and social impacts).

2) Minimization of the Environmental Load in Power Generation and Transmission

The development vision of Sulawesi Island envisages that the protection of the environment is one of the supreme targets to create an environment-friendly island. Utmost attention, therefore, is to be paid to the protection and minimization of the environmental load in power generation.

The following figures illustrate the emission of CO_2 and SO_2 in Sulawesi by type of fuel used for generation. It is understood that nearly 90% of the SO_2 emission and about 70% of CO_2 emission are caused by diesel power generation which accounts for around 30-40% of total energy production in Sulawesi.



Source: PLN Statistics

Figure 4.6.9 Emission of SO_2 (left) and CO_2 (right) from Generation in Sulawesi

Besides, the emission of effluents from diesel power station is sizable or estimated to be 150,000 liters in slope oil and 100,000 liters in lubricants. At a number of diesel power stations, they are disposed of without proper treatments. The improvement in the power generation system in Sulawesi should therefore pay utmost attention to the protection and minimization of the environmental load.

3) Integration and Networking of Isolated Power Grids

The electric power grids in Sulawesi are widely dispersed and independent, except for the Sulsel system in South and West Sulawesi and the Mihahassa-Kotamobagu system in North Sulawesi where various energy sources are combined (hydro, natural gas, geothermal and diesel). The remaining 25 small grids are heavily dependent on diesel generators, and they are seriously suffering from the fuel supply due to the sharply increasing fuel prices, with the resultant shortage and instability in electricity supply.

In order to attain stable and reliable electricity supply and to improve the household electrification ratios in every province, interconnection among power grids should be thoroughly studied, preferably by making use of local energy resources as noted previously. It is expected that the on-going Study on Optimal Electric Power Development in Sulawesi would show the direction towards the interconnection and integration of electric power supply systems in Sulawesi.

4) Promotion of Innovative Hybrid-type PPP Scheme

It is understood that PLN has difficulty in financial positions and large investments in power development would have to depend on the IPP schemes. This is true in Sulawesi, too. However, investors in IPP would prefer to develop thermal power stations in order to secure incomes in a shorter period. In view of the availability of cleaner energy resources in Sulawesi, it is expected that hydropower would be developed in a more strategical manner.

In this context, it is proposed that a Public-Private-Partnership (PPP) scheme would be strategically applied in hydropower development, making use of the available local energy resources and protecting the environment in Sulawesi. Such a hybrid-type PPP scheme would minimize the fiscal burdens and bring benefits to both public and private sectors. Application of this innovative financial scheme should be studied on specific priority hydropower projects in a concrete form.

5) Improvement and Rehabilitation of Existing Transmission and Distribution System

In line with the expansion of transmission and distribution lines to meet the demand growing by electrification and industrialization, the existing facilities for transmission and distribution should be rehabilitated and/or renovated. As experienced in Makassar, the existing transformers are often obsolete causing shutdown due to the over-capacity. In addition to the proper maintenance of such facilities, their capacity should be expanded to cope with the growing demand and to minimize the transmission and distribution losses.

6) Dissemination of Demand-side Management

In parallel with the improvements in power generation and transmission systems, it is suggested to promote energy saving on the consumers' side. In Sulawesi, particularly in major energy consumption centers like Makassar and Manado, demand-side management has not been disseminated yet to the appropriate level. Waste of energy is often observed at relatively large consumers and in the use of air-conditioners.

Public agencies and offices should lead the save-the-energy campaign all the year round, designating persons responsible for the campaign and demand-side management. Such a campaign would be more effective if and when the energy saving is explained in terms of monetary value how much the savers can contribute to the protection of the Sulawesi environments.

4.7 Transportation Development

(1) Overview of Transportation in Sulawesi

The transportation sector development has been governed at the national level by the "National Transport System" (SISTRANS, 2005), "National Long-term Development Plan 2005-2025" (BAPPENAS, 2007), and "National Mid-term Development Plan 2005-2009" (BAPPENAS, 2004). The National Transport System is a government guideline to improve operational efficiency and effectiveness of the transportation sector over the country. The National Long-term Development Plan specifies basic policy for economic development and the role of private initiative has been emphasized in all sectors. The Mid-term Development Plan, on the other hand, determines various targets for development, among which the road network master plan in Sulawesi has been taken up.

From the viewpoint of the spatial development plan at the national and regional levels, the National Spatial Plan (RTRWN, 2006) specifies the principles and strategies of land use, as well as improvements in transportation by roads, ports and airports. In Sulawesi, the "Sulawesi Island Spatial Plan" (BKPRS, 2005) has been formulated to promote balanced and efficient regional development over the island. The improvement in the transportation sector under the island spatial plan includes the following.

Table 4.7.1 Transport Improvements under Sulawesi Spatial Plan

Sub-sector	High Priority	Medium Priority	Low Priority or Not Specified
Road	* Trans Sulawesi East	* Trans Sulawesi West * Trans Sulawesi Central * Feeder and peninsula-crossing roads	* Circular roads for remote islands
Water (shipping, ferry,etc.)			* Major lakes in Sulawesi * Inter-provincial and inter-island ferries within Sulawesi * Inter-island shipping lines between Sulawesi and external areas
Port	* International ports (4)	* National ports (27) * Local ports (17)	
Air	* Primary airports (2) * Secondary airports (3)	* Tertiary airports (2) * Other airports (15)	
Railway	* Urban and suburban lines around Makassar and Manado	* Medium-distance lines near regional centers along Trans Sulawesi	* Medium to long distance lines connecting major cities along Trans Sulawesi

Road transport is the most significant sub-sector in Sulawesi. The Sulawesi road network is composed of national, provincial, regency and other roads. By functional classification it is categorized into the arterial, collector, local and district roads. The total length of the national roads was about 7,100 km while the provincial roads extend for nearly 5,000 km, as shown in the table.

Table 4.7.2 Lengths of National and Provincial Roads by Province, 2005

(unit: km)

Province	National	Provincial	Total
North Sulawesi	1,267	741	2,008
Gorontalo	616	284	900
Central Sulawesi	1,806	1,977	3,783
South/West Sulawesi	2,108	1,487	3,595
Southeast Sulawesi	1,294	489	1,783
Sulawesi Total	7,091	4,977	12,069

Source: Penetapan Ruas-Ruas Jalan Menurut Statusnya Sebagai Jalan Nasional 2004 and Road Inventory Balai VI

Most inter-city roads in Sulawesi have two lanes with less than seven meters in road width. Some national roads that had been classified into provincial roads before 2004 have narrower width. Most national roads are covered by asphalt concrete (AC) or hot rolled sheet (HRS), though LASBUTAG/BUTAS and gravel faced roads extend in some sections.

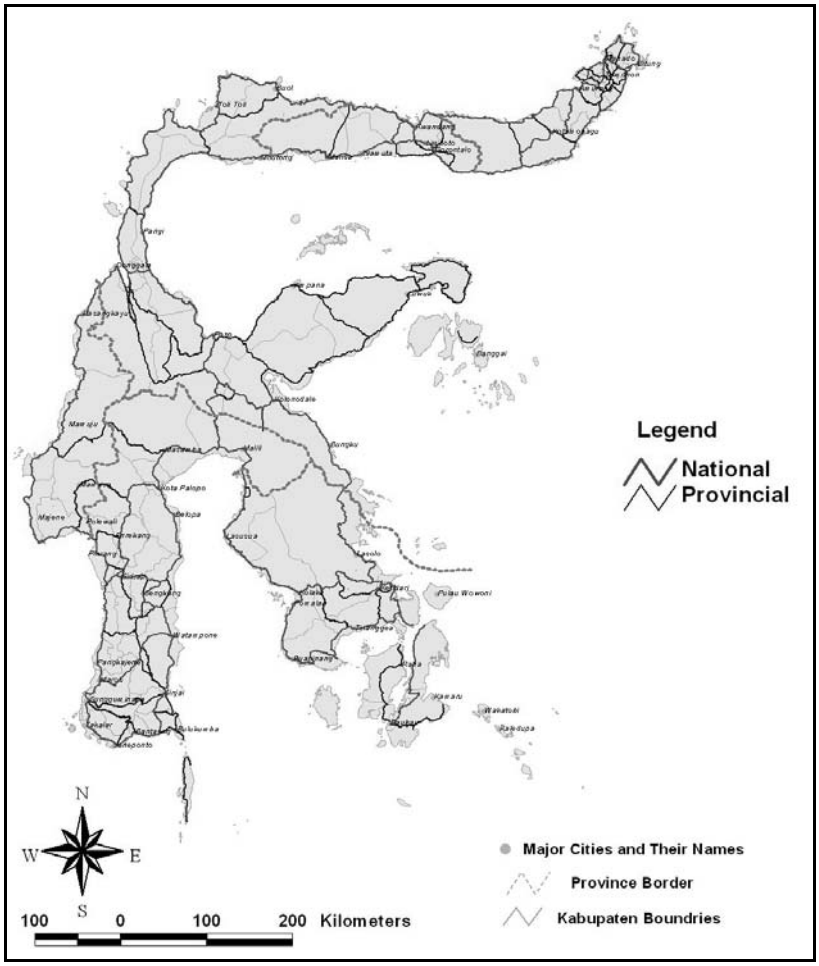


Figure 4.7.1 National and Provincial Road Network, 2006

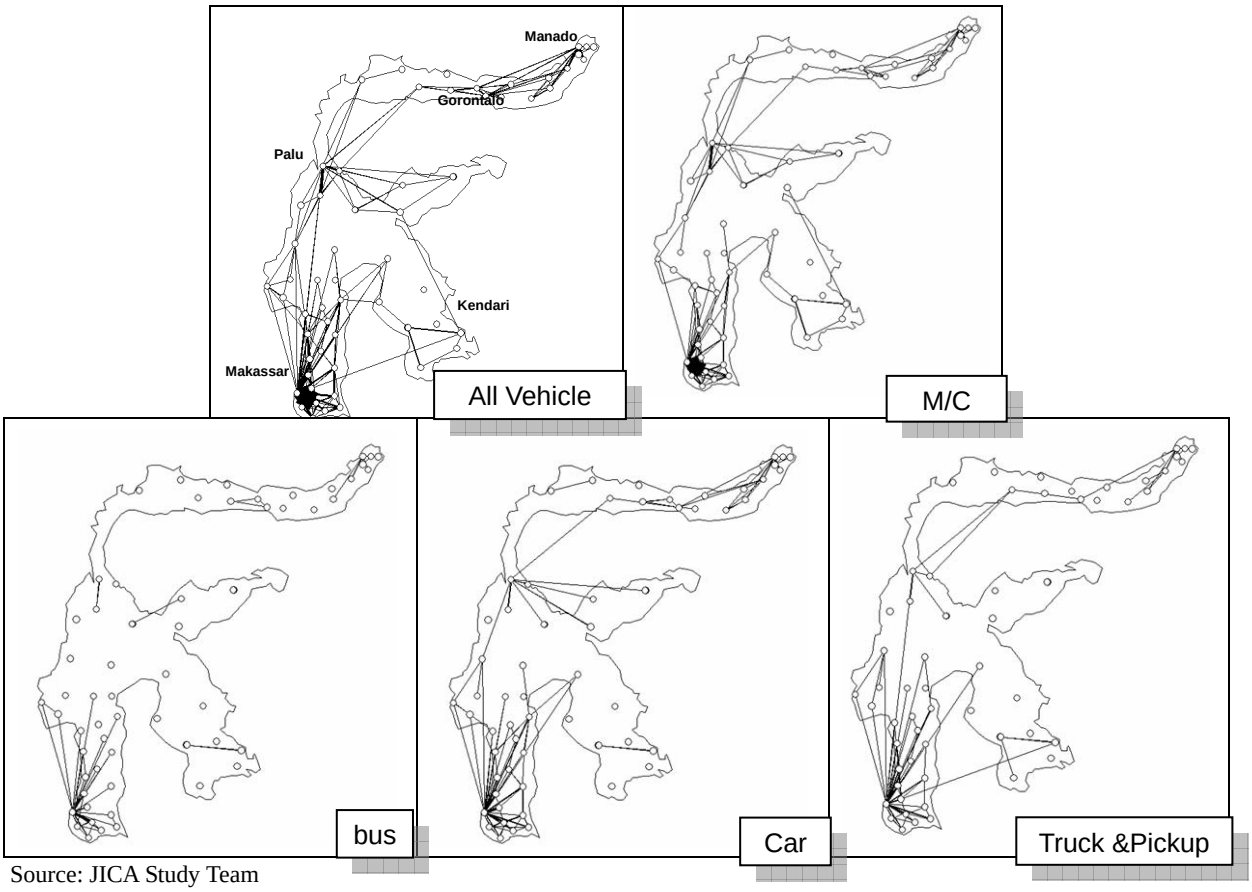
The road network in Sulawesi has a great number of bridges. There are about 3,300 bridges on the national roads and 2,500 bridges on the provincial roads as summarized in the following table. About 90 bridges on the national and provincial roads are more than 100 m in length. According to the assessment, about 64% of the bridges on national roads and 71% on provincial roads are in good condition, while 26% of the national road bridges and 13% of the provincial road bridges are in poor conditions.

Table 4.7.3 Number of Bridges on National and Provincial Roads by Province, 2006

Province	National	Provincial	Total
North Sulawesi	591	382	973
Gorontalo	284	54	338
Central Sulawesi	925	782	1707
West Sulawesi	277	88	365
South Sulawesi	694	684	1378
Southeast Sulawesi	573	533	1106
Total	3,344	2,523	5,867

Source: IBMS

Road traffic at present has been assessed by the origin-destination (OD) survey as shown in the following figure. Most trips concentrate to the urban areas, e.g., Makassar, Manado, Palu, Gorontalo and Kendari. The long-distance inter-provincial trips (e.g., from Makassar to Manado) are relatively small.



Source: JICA Study Team

Figure 4.7.2 Trip Distribution in Sulawesi Island

One of the characteristics in land transport in Sulawesi is a forced detour in traveling between provincial capital cities due mainly to the long rugged coast lines and topographic conditions. The following table shows the ratio between the actual road distances and crow-fly distances between provincial capitals.

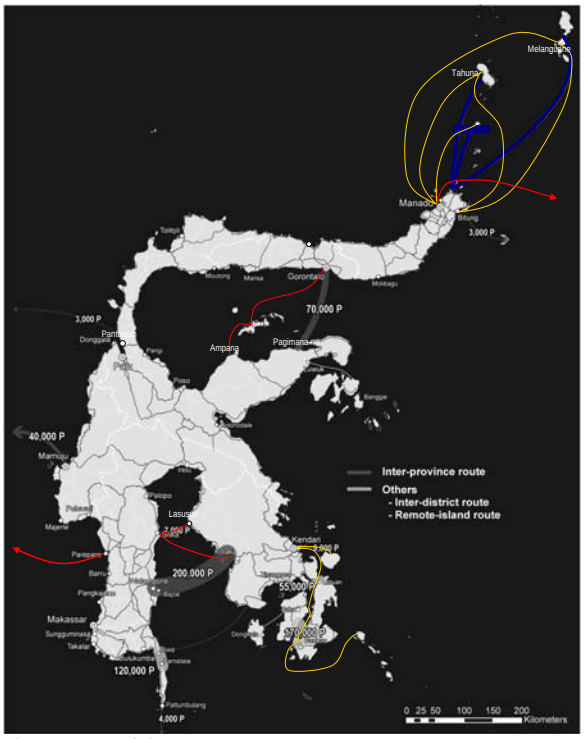
Table 4.7.4 Actual Road Distances and Crow-Fly Distances between Provincial Capital Cities

	Actual Distance (km) - A	Crow-fly Distance (km) - B	Ratio A/B
Manado - Gorontalo	416	226	1.84
Manado - Palu	963	619	1.56
Manado - Mamuju	1356	801	1.69
Manado - Makassar	1800	949	1.90
Manado - Kendari	1872	685	2.73
Gorontalo - Palu	617	395	1.56
Gorontalo - Mamuju	1010	582	1.74
Gorontalo - Makassar	1454	746	1.95
Gorontalo - Kendari	1421	504	2.82
Palu - Mamuju	393	218	1.80
Palu - Makassar	837	468	1.79
Palu - Kendari	1007	445	2.26
Mamuju - Makassar	444	276	1.61
Mamuju - kendari	1009	419	2.41
Makassar - Kendari	1057	361	2.93

Source: JICA Study Team's estimate based on IRMS.

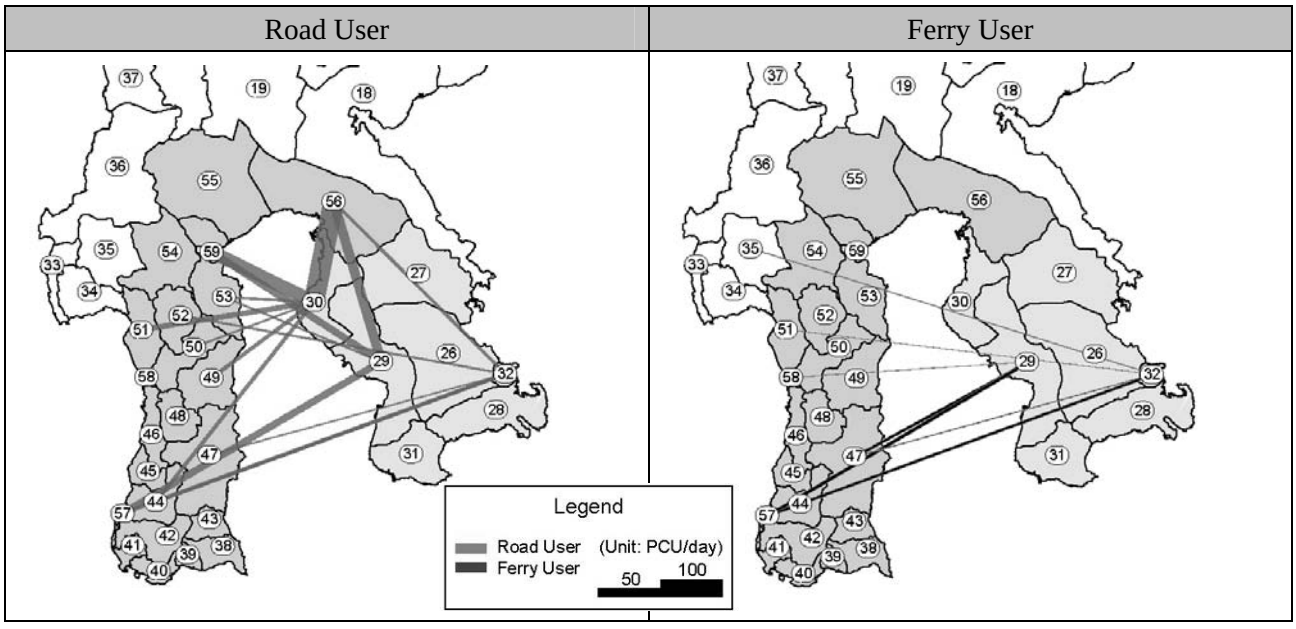
Maritime transport is quite important for Sulawesi Island as it is separated by gulf, straits and rivers. At present, there are 28 ferry ports of which 12 are inter-provincial and 16 are inter-regional. The passengers traveling by ferry were reported to be 1.5 million in 2005, though the number had been decreasing due mainly to the shift to domestic air transport.

The roles of existing ferry services, assessed by interview survey, are significant particularly for transport between large cities (e.g, between Makasar and Kendari) and for vehicles having more cost-shouldering power. The ferry tariff at the moment is relatively high or equivalent to the vehicle operating cost for 400-1,000 km in distance. The distribution of inter-provincial trips by road and ferry between South and southeast Sulawesi is illustrated for reference in the following figure.



Source: PT. ASDP

Figure 4.7.3 Ferry Operation in Sulawesi, 2006



Source: JICA Study Team

Figure 4.7.4 Distribution of Inter-provincial Trips by Road and by Ferry between South and Southeast Sulawesi

There are about 150 ports in Sulawesi, including three international ports (Makassar, Bitung and Pantoloan) and four national ports. Total cargo throughput of major seaports was around 12.8 million tons in 2006, i.e., international cargo of 2.8 million tons (22%) and domestic cargo of 10.0 million tons (78%). Export cargo volume accounted for 36% and domestic cargo for 64%. About 22% of cargo was for inter-island destinations while 78% was for inter-regional destinations. The cargo volume by province is summarized in the following.

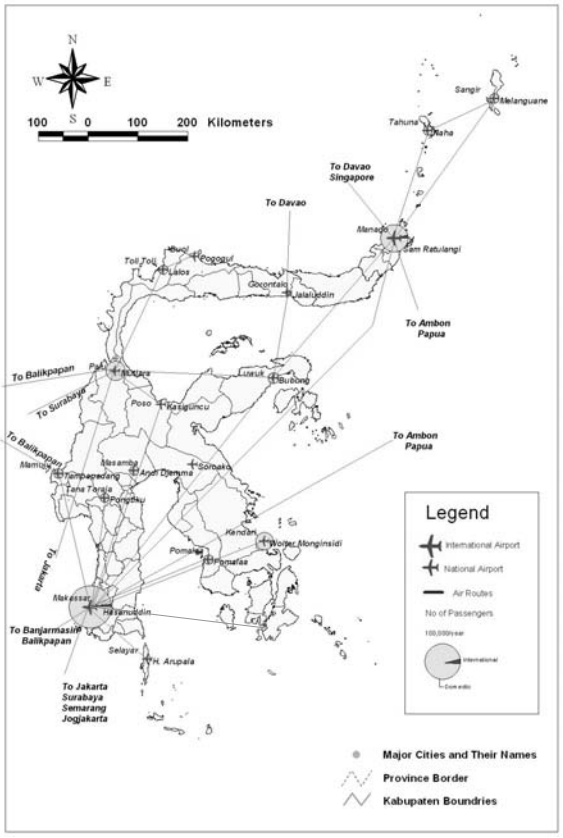
Table 4.7.5 Share of Cargo Throughput in Major Ports by Province

(%)

	International Cargo Volume	Domestic Cargo Volume	Total
South Sulawesi	57	49	51
Southeast Sulawesi	23	7	9
Central Sulawesi	5	26	26
Gorontalo	1	5	3
North Sulawesi	14	13	17
Total	100	100	100

Containerization has been lagged, and the ports in Makassar and Bitung have container terminals. The volume of container cargo in Makassar port was limited to 135,000 tons in 2006. Generally, 20-feet containers are predominant due mainly to the road traffic conditions in Sulawesi.

Air transport in Sulawesi assumes the increasingly important roles as distance among major cities are relatively long and traffic between the islands has been growing in recent years. The current air routes are illustrated in the following figure. In 2005, Hasanuddin airport in Makassar handled about 2.6 million domestic passengers accounting for nearly 60% of air traffic in Sulawesi. Sam Ratulangi airport in Manado is the second largest in passenger traffic, amounting to 0.9 million or about 20% of air traffic. There are about 20 airstrips in Sulawesi though their contribution is relatively limited.



Source: JICA Study Team

Figure 4.7.5 Air Routes in Sulawesi, 2007

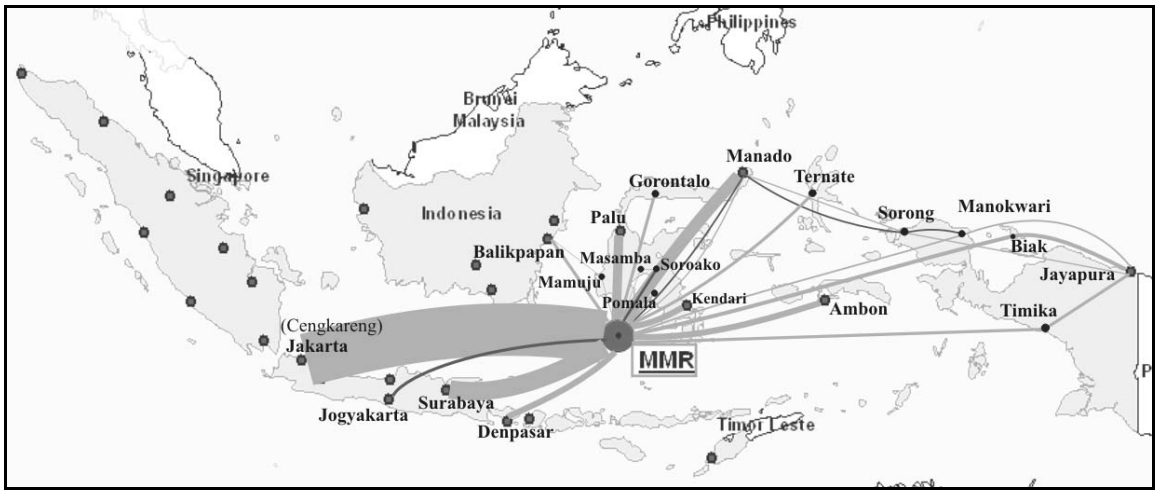


Figure 4.7.6 Aviation Network of Makassar Airport

Expansion and improvement of Hasanuddin airport in Makassar is underway and it is expected that the taxiway (2,155 x 23 m), apron (62,80 m^2) and passenger terminal (48,500 m^2) would be expanded and/or renewed by 2015 and the runway (3,100 x 45 m) and taxiway would be further improved by 2020.

The spatial development plan for Sulawesi indicated that railway transport would be envisaged for mass transport. The current traffic by land, sea and air as noted above in a summarized form will lead to the implication that the traffic volume would not be so large to economically and financially justify the costly railway construction. The right railway transport in such a major city as Makassar has also been evaluated to be less viable judging from the current and future traffic volumes. Consequently, the railway system would not be considered as a new transport system in Sulawesi for the time being.

(2) Strategies and Plans for Arterial Road Network Development in Sulawesi

The improvements of arterial roads in Sulawesi have been implemented by Bina Marga with the financial supports of the World Bank (Eastern Indonesia Region Transport Project: EIRTP), ADB (Road Rehabilitation Sector Project: RRSP) and AusAID (Eastern Indonesia National Road Improvement Project: EINRIP). The ADB sponsored RRSP has shifted its focus to Sumatra and Kalimantan since 2007.

JICA has been studying on Arterial Road Network Development Plan for Sulawesi Island, and the report has been compiled separately. At the same time, JICA has worked out the feasibility study on priority arterial road development in South Sulawesi as a follow-up study on integrated regional development of the Mamminasata Metropolitan area (Makassar, Maros, Gowa and Takalar). The strategies and plans proposed for the arterial road network development are summarized as cited in the following.

1) <u>Road Development in line with the Regional Development Strategy</u>

The road development policy is set to cope with the regional development strategies set out in this report. Eight policies are adopted as shown in the following.

Table 4.7.6 Road Development Policy to be applied for Road Master Plan

Development Goal	Regional Development Strategy	Road Developemnt Policy
[Goal 1] Development of Sulawesi as the Leading Island in East Indonesia and as the Gateway to other Asian Countires	**[Strategy 1]** Effective Economic Growth by Strengthening Inter-regional Linkages not only in Sulawesi but also with other Asian Countries	**[Policy 1]** Strengthening inter-regional transport network of six provinces in Sulawesi
		[Policy 2] Accommodation of increasing large traffic volume and heavy vehicle
	[Strategy 2] Economic Growth through Development of Processing Industry on the Basis of Potential Resources of Sulawesi	**[Policy 3]** Improvement of accessibility to the potential resources areas
[Goal 2] Development of Sulawesi as an Environmentally Friendly Island with Poverty Reduction	**[Strategy 3]** Alleviation of Social and Economic Disparities in Rural Area by Strengthening Public Administration Services through Integration of Prioirty Regional Center and Cities	**[Policy 4]** Strengthening the road network in rural area and isolated island
	[Strategy 4] Development of Sulawesi with due Consideration on Environment, Safety and Human Resources	**[Policy 5]** Reduction of environmental load in transport sector
		[Policy 6] Enhancement of Traffic Safety and Capacity of Suburban Arterial Roads
		[Policy 7] Development of road network paying due consideration on environment
		[Policy 8] Strengthening the road management including maintenance system

Source: JICA Study Team

2) Identification of Roads for Improvements

In line with the development policy for road improvement and the current road conditions, major roads for improvement in Sulawesi have been identified under the Arterial Road Network Development Plan as summarized in the following list.

Table 4.7.7 Proposed Road Development Plan

Proposed Road Development Plan		ssible Major Projects identified by the Study team (Excluding on-going projec	Province
[Policy 1] Inter-regional transport network of six provinces in Sulawesi in Sulawesi	(1-1) Strengthening the Trans Sulawesi Road (West, Central and East Corridors) as a backbone of transport network in Sulawesi	① West Corridor of TS between Mamuju – Palu including proposed re-alignment section of Mamuju – Tappalang	Central & West
		② Central Corridor of TS from Parepare – Palu Section	South & Central
		③ Central Corridor of TS from Gorontalo – Molibagu – Bitung	Gorontalo and North
		④ East Corridor of TS in the Poso – Ampana – Biak – Luwuk – Baturube – Kolonodale – Border of South East Sulawesi – Kendari	Central & Southeast
	(1-2) Strengthening peninsula crossing road connecting each Trans Sulawesi Corridor to complete the road network	① Capacity Expansion of Maros – Watampone	South
		② New construction of Mountong – Buol Road	Central
		③ Improvement and Upgrading of Kaluku – Sabbang Road	West
		④ Capacity Expansion of Tawaeli – Toboli Road by Tunnel	Central
		⑤ North Mountain Area Crossing Road	Southeast
[Policy 2] Accommodation to the Heavy Vehicle	(2) Reinforcement of access to/from port facilities to accommodate increasing large-sized container and over-loaded heavy truck.	① Makassar – Maros – Watampone/Bajoe Route and Kolaka – Kendari Route	South & Southeast
		② Mamuju – Parepare – Siwa Route and Palopo – Siwa Route	South
		③ Gorontalo – Isimu – Kwandang/Anggrek Port – Manado – Bitung Route	Gorontalo & North
[Policy 3] Improvemen of accessibility to potential resource areas	(3) Strengthening the road to be in all weather conditions which connected with high potential resource areas to enhance regional development in rural area	① Lakahang – Tumongan Road : 85km (requesting upgrade to national road)	West
		② Kalukku – Tabang Road:168km (requesting upgrade to national road)	West
		③ Wonomulyo – Keppe: 95km	West
		④ Beteleme – Border of South Suwawesi – Nuha (requesting upgrade to national road) = Soroako (Lake Matano Crossing Ferry should be provided)	Central
		⑤ New development of north crossing road (Tatewatu – Routa – Porehu: 200km)	Southeast

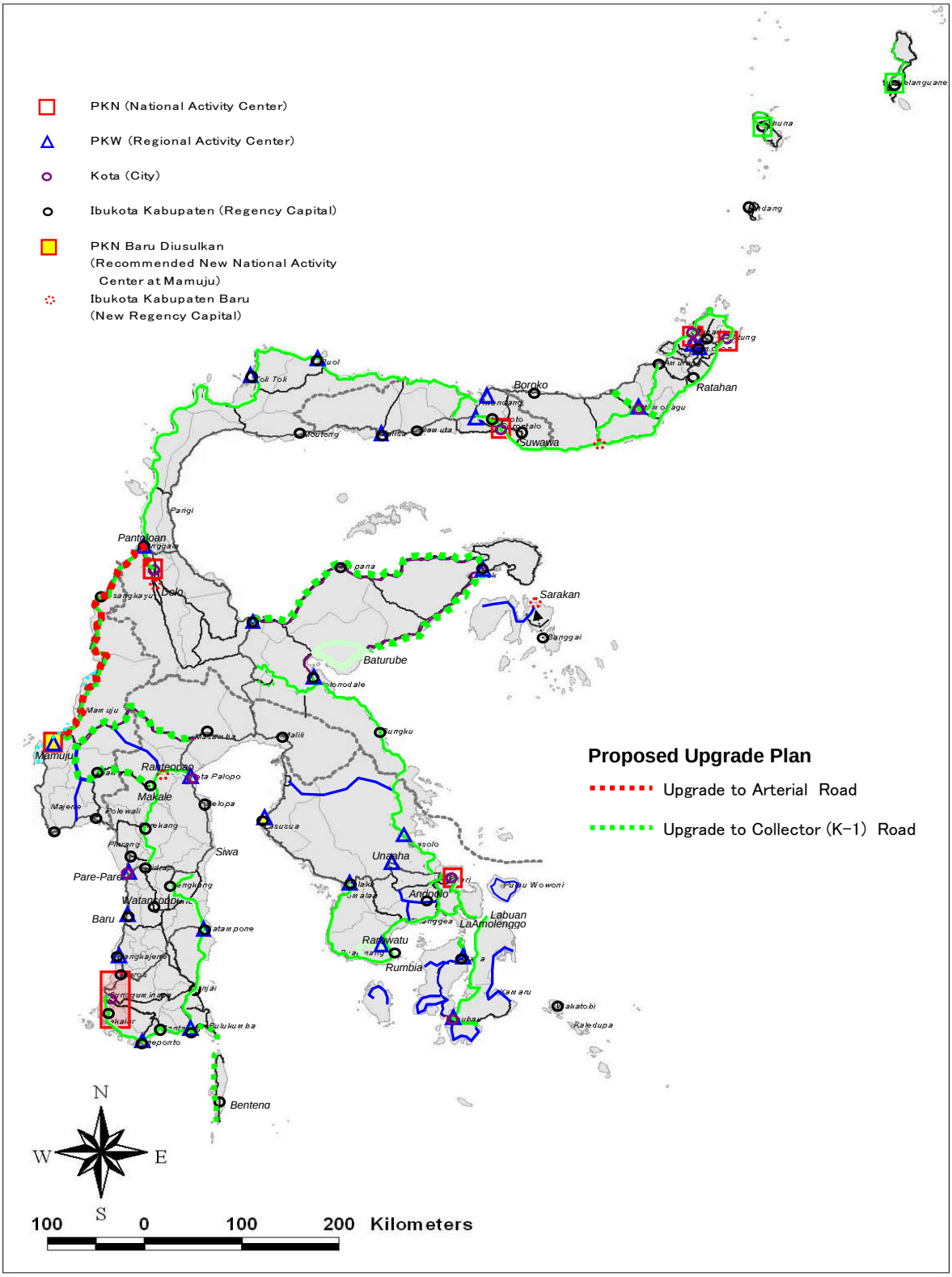
Proposed Road Development Plan		ossible Major Projects identified by the Study team (Excluding on-going project	Province
[Policy 4] Strengthening the road network in rural areas and isolated islands	(4-1) Upgrading the road function to be higher classification which linked with major cities or new regency capitals and improvement of the road in accordance with the road classification	① Upgrading West Corridor of Trans Sulawesi Road from Mamuju to Palu to be arterial national road from collector national road	West & Central
		② Upgrading East Corridor of Trans Sulawesi Road (Poso – Luwuk – Baturube – Kolonodale) to be collector national road from collector provincial road	Central & Southeast
		③ Upgrading East Coast Buton Road (Pasar Wajo – Lasalimu –Bubu – Ronta;174km and Malingano – Ronta – Ereke:73km) and Road in Wakatobi Islands	Southeast
		④ Upgrading Lapoa – Poli pololia – Kolaka (90 km)	Southeast
		⑤ Upgrading ferry routes from Manado – Bitung – Melanguane and Tahuna	North
	(4-2) Improvement of access to the underdeveloped areas to be in trafficable condition by proper maintenance.	① Access roads to underdevelopment areas should be trafficable in all seasons under the road maintenance program	Six Provinces
[Policy 5] Reduction of environment load in tranport sector	(5) Incorporation of energy-saving ferry transport in the road network system as a Nautical Highway to reduce the environmental load	① Watampone/Bajoe = Kolaka route	South & Southeast
		② Siwa = Kolaka route	South& Southeast
		③ Kolonodale = Baturube/Tokala Route across Tomori Bay (Need of New Ferry Service)	Central
		④ Kendari = Luwuk = Gorontalo	Central & Southeast
		⑤ Manado/Bitung = Tahuna = Melongguane = (Davao in Philippine)	North
		⑥ Kendari = Labuan = Baubau	Southeast
		⑦ Sinjai = Kambara – Raha	South & Southeast
[Policy 6] Improvement of traffic safety and and expansion of road capacity	(6) Widening of congested suburban roads or construction of bypass/toll roads to cope up with increasing traffic demand and to improve the natural/living environment along the congested major roads	① Trans Sulawesi Mamminasata Road /Mamminasata Bypass	South
		② Manado Bypass and Manado Ring Road	North
		③ Palu Bypass	Central
		④ Kendari Bay Crossing Bridge	Southeast
		⑤ Gorontalo – Jalaluddin – Anggrek Port Bypass	Gorontalo
[Policy 7] Control of road development with due consideration to environment	(7-1) Reinforcement of disasters prevention measurers for a flood and a landslide disasters	① East corridor of Trans Sulawesi (Luwuk – Toili – Baturube)	Central
		② Crossing roads from Mamuju to Toraja in West Sulawesi	West & South
	(7-2) Restriction of road development to maintain environmental preservation on natural resources and to protect isolated culture community	① Baturube – Kolonodale road should not be developed because of natural preservation of Morowali and appropriate ferry transport be provided instead of new road.	Central
[Policy 8] Road Management and Maintenance	(8) Strengthening road maintenance system and its management including traffic safety, capacity development and privatization, etc	① Improvement of road maintenance system including its organization, administration, capacity, fund, etc	Six Provinces
		② Enhancement of traffic management including traffic safety and control to cope up with increasing motorcycle and large sized vehicles	
		③ Road management (Reinforcement of land acquisitions and land use control, etc)	
		④ Capacity Development of regional government	
		⑤ Shifting to a private sector for implementation of toll road (Manado – Bitung Toll Road, Sutami Toll Road in Makassar)	
		⑥ Asset Management on Road and Bridge Facilities	

Source: JICA Study Team

The proposed improvements will be classified into; (i) new road construction (bypass and re-alignment), (ii) betterment (pavement and widening), and (iii) maintenance.

3) Upgrading of Arterial and Collector Roads

In view of the traffic volume, as well as the roles of international/inter-regional centers and inter-regional centers identified under the spatial structure and the recent administrative changes, it is proposed that some roads be upgraded from the collector road to arterial road and from the provincial/Kabupaten road to national/provincial roads. Such an upgrading plan is proposed as shown in the following.



Source: JICA Study Team

Figure 4.7.7 Proposed Upgrade Plan of Arterial and Collector Roads

Furthermore, the application of the new regulation on roadway and travel-way width is to be taken into account, because the new regulation was specified under the "Government Road Regulation No.34, 2006. It is proposed that the primary arterial roads would be widened to the

7.0m-standard in travel-way by 2024 and the primary collector roads would be widened to the 7.0m-standard in line with the growth in traffic.

4) Proposed Capacity Improvements

Based on the assessment of the existing condition and traffic volume, the requirements for expansion of road capacity have been identified by classification with the target year set for 2024. The following table and figure summarize the requirements for capacity expansion of the arterial and collector roads. Furthermore, the capacity expansion plan in each province is shown in subsequent figures.

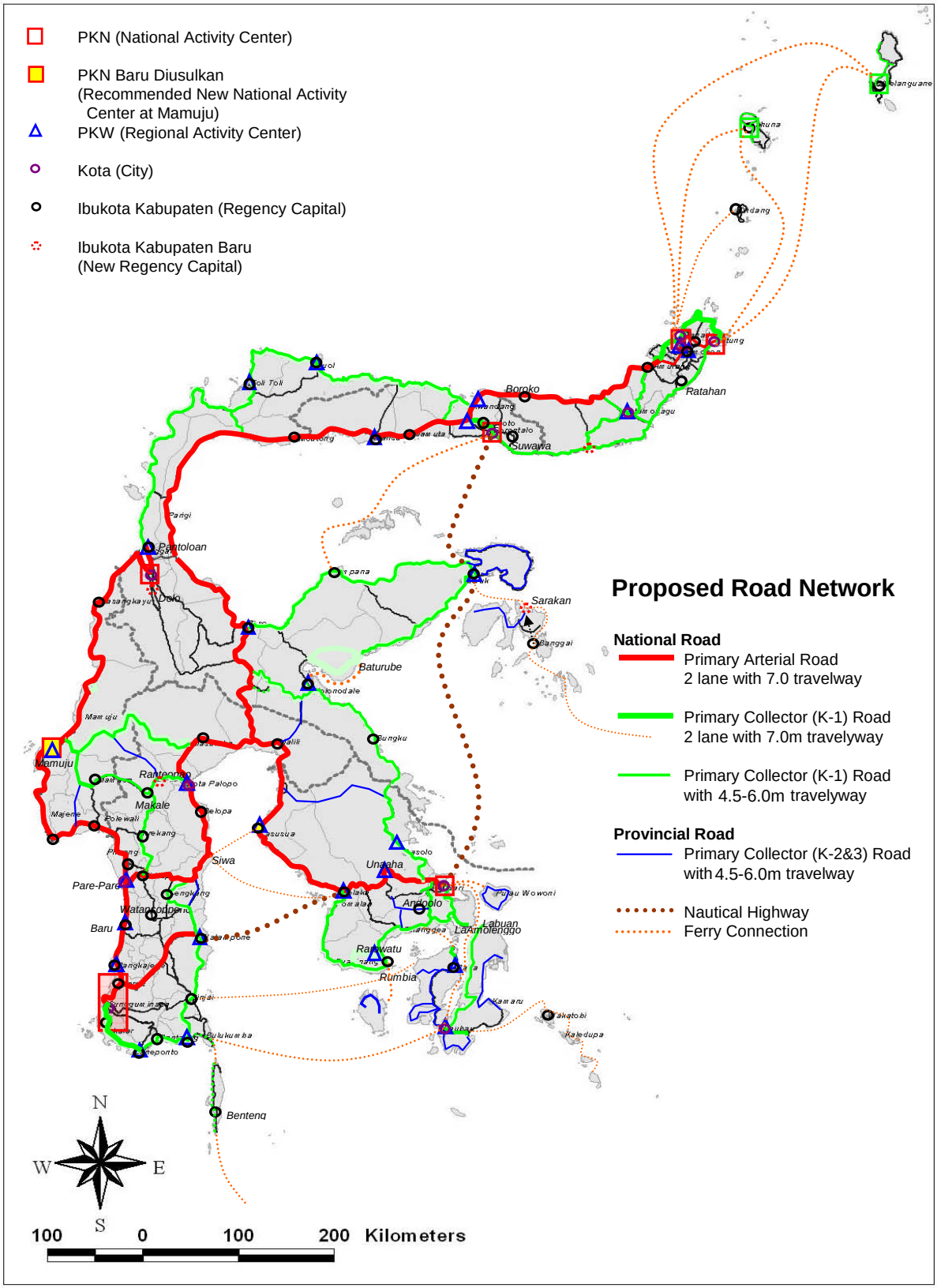
Table 4.7.8 Needs for Capacity Expansion of Arterial and Collector Roads by 2024

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**

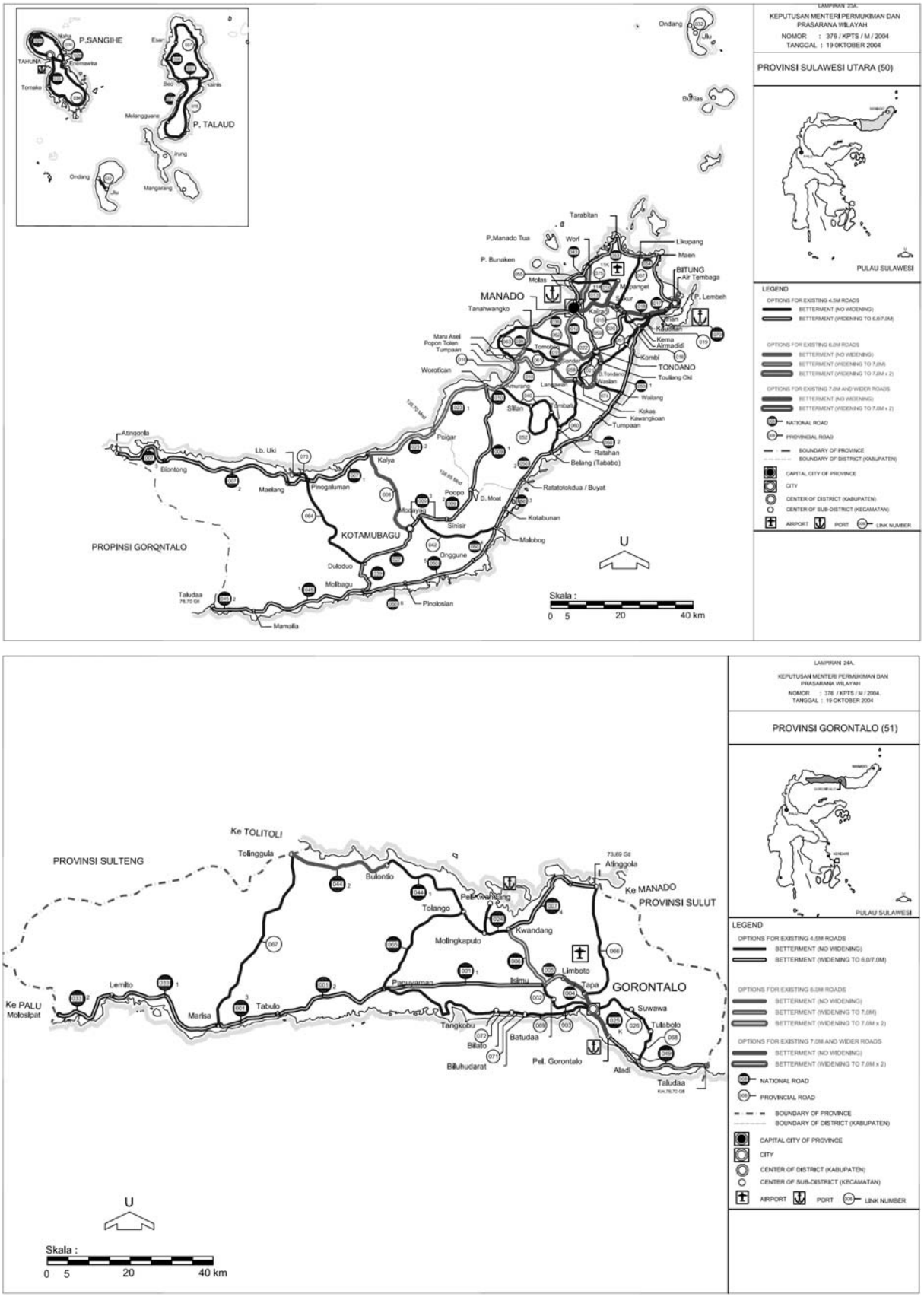
Note: Betterment I: Pavement improvement without widening
Betterment II: Widening of travel-way from 3.5-5.5m to 6.0m
Betterment III: Widening of travel-way from 6.0m to 7.0m
Betterment IV: Widening of travel-way from 6.0m to more than 7.0m or increase in additional traffic lanes

Source: JICA Study Team



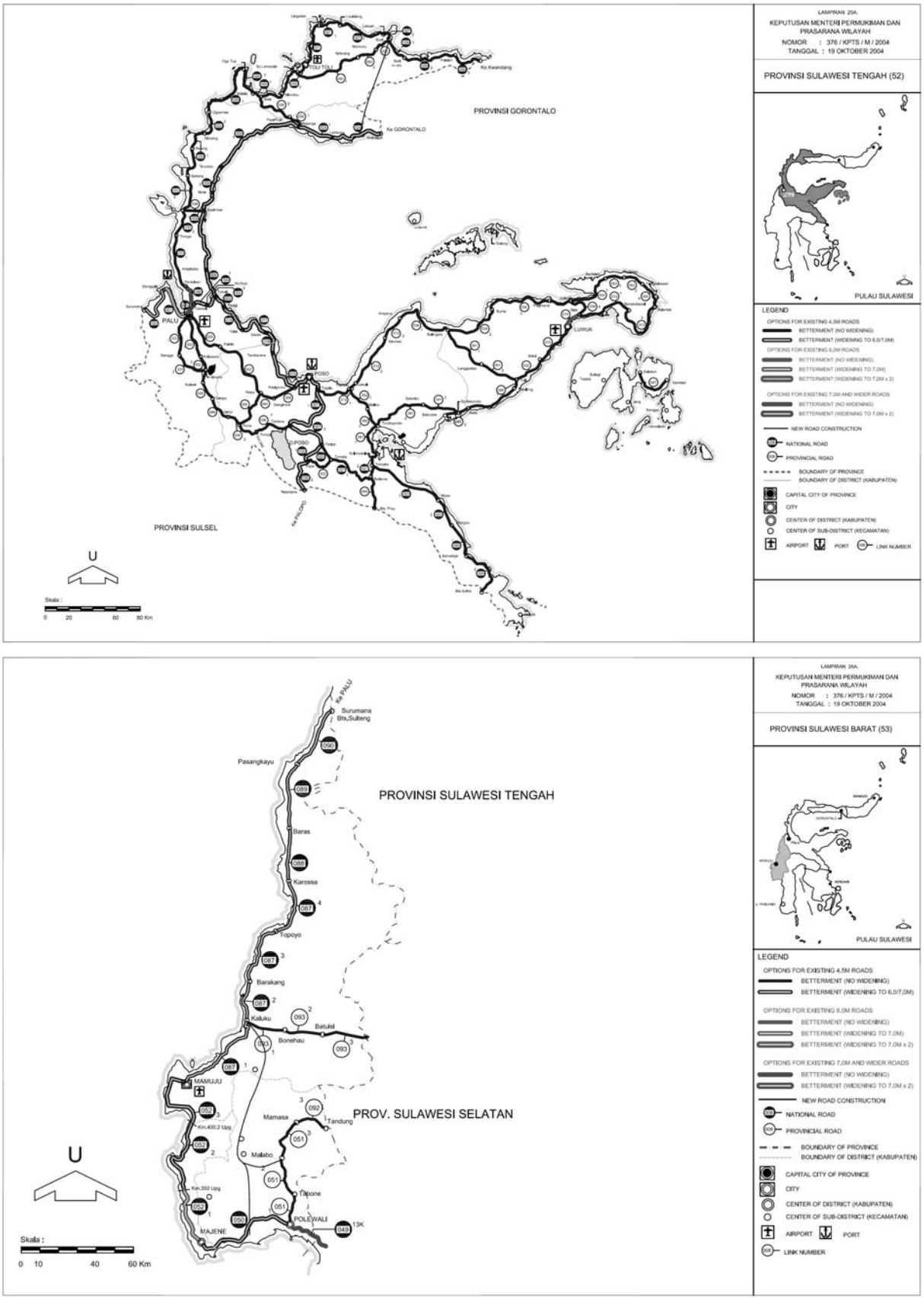
Source: JICA Study Team

Figure 4.7.8 Sulawesi Road Master Plan in 2024



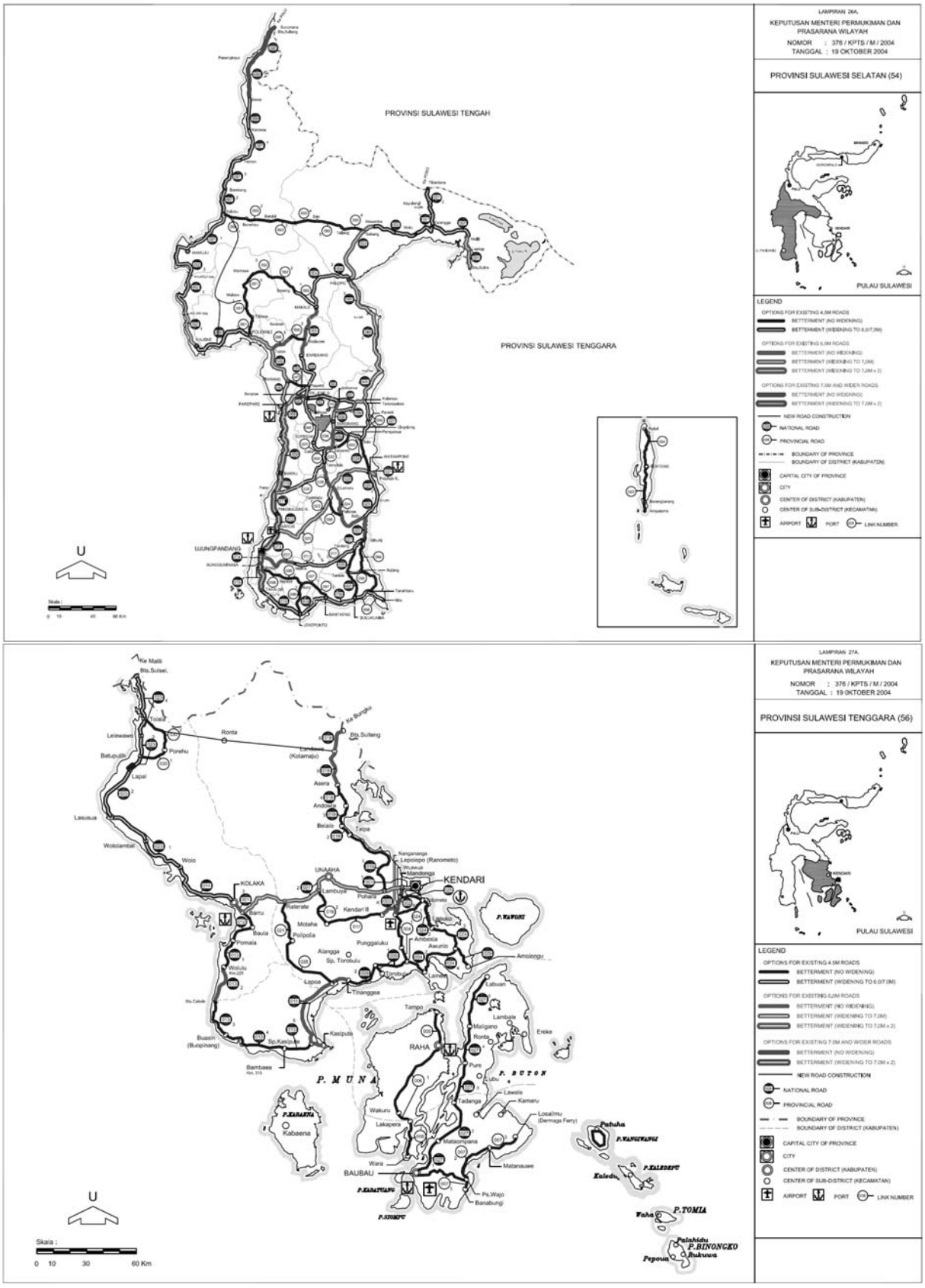
Source: JICA Study Team

Figure 4.7.9 (1) Needs for Capacity Expansion of Existing Roads (North & Gorontalo)



Source: JICA Study Team

Figure 4.7.9 (2) Needs for Capacity Expansion of Existing Roads (Central & West)



Source: JICA Study Team

Figure 4.7.9 (3) Needs for Capacity Expansion of Existing Roads (South & Southeast)

5) Proposed Pavement Improvements

The existing pavement conditions have been assessed and classified into: good (Class I), fair (Class II), poor (Class III) and bad (Class IV). The pavement improvement should be carried out in line with the widening works in principle. However, the poor and bad pavement (Classes III and IV) should be implemented as early as possible under the short-term improvement plan. It is therefore proposed that the pavement improvement of the existing road network would cover the following.

Table 4.7.9 Needs for Pavement Improvement of Existing Road Network

Prog. No	Project	Section	Total	Areterial	Collector	Need for Pavement Improvement				
						Periodic Maintenance		Urgent (Short-term)		Total
						Class I	Class II	Class III	Clas IV	
TS-1	West Corridor (South section)	Jeneponto – Makassar – Parepare – Mamuju – Palu	846	418	428	276	304	73	193	846
TS-2	West Corridor (North section)	Palu – Kwandang – Manado – Bitung	1,390	337	1,053	741	475	61	113	1,390
TS-3	Central Corridor (South section)	Jenoponto – Watampone – Tarregne – Poso – Tobori	951	648	303	507	405	38	1	951
TS-4	Central Corridor (North section)	Tobori – Gorontalo – Bitung	1,012	529	483	445	319	184	64	1,012
TS-5	East Corridor	Tarrenge – Kolaka – Knedari – Tompira –Luwul – Poso	2,197	495	1,702	378	1113	402	304	2,197
Total (1)			**6,396**	**2,427**	**3,969**	**2,347**	**2,616**	**758**	**675**	**6,396**
PR-1	North Sulawesi Province		1,359	74	1,285	492	455	260	152	1,359
PR-2	Gorontalo Province		476	31	445	151	102	219	4	476
PR-3	Central Sulawesi Province		1,195	56	1,139	92	633	293	177	1,195
PR-4	West Sulawesi Province		307	0	307	6	45	0	256	307
PR-5	South Sulawesi Province		1,646	220	1,426	401	839	241	165	1,646
PR-6	Souteast Sulawesi Province		697	45	652	276	174	20	227	697
Total (2)			**5,680**	**426**	**5,254**	**1,418**	**2,248**	**1,033**	**981**	**5,680**
Total (1)+(2)			**12,076**	**2,853**	**9,223**	**3,765**	**4,864**	**1,791**	**1,656**	**12,076**

Source: JICA Study Team

As discussed in Section 4.2, utilization of asphalt locally produced in Bauban on Buton Island in Southeast Sulawesi is suggested for further study for the improvement of provincial and/or Kabupaten roads in Sulawesi. Such a plan would stimulate not only improvement of road pavement but also local industrial development in Sulawesi.

6) Bridge Improvements

The existing conditions of bridges on the national roads have been assessed and classified into: good (Grade 1, accounting for 37% of 3,109 bridges on national road), fair (Grade 2, or 39%), poor (Grade 3, or 13%), bad (Grade 4, or 6%) and impassable (Grade 5, or 5%). It is now proposed that the bridges classified into Grades 4 and 5 would be improved at the earliest in order to prevent traffic accidents and collapse with the resultant negative impacts. The number and total length of bridge improvements would reach 77 bad bridges (1,732 m in total), 113 impassable bridges (2,992 m) and 136 wooden bridges (788 m) as tabulated in the following.

Table 4.7.10 Summary of Bridge Conditions on National Road

Province	No Damage /Good (Grade 1)	Fair/Poor (Grade 2 & 3)	Bad/Very Bad (Grade 4 & 5)	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		

Source: JICA Study Team

Table 4.7.11 Summary of Bridge Conditions on Provincial Road

Province	No Damage /Good (Grade 1)	Fair/Poor (Grade 2 & 3)	Bad/Very Bad (Grade 4 & 5)	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		

Source: JICA Study Team

7) National and Provincial Roads in 2024

By 2024, the national and provincial roads in Sulawesi would be improved stage-wise under the unified standards as summarized in the following.

Table 4.7.12 Proposed Improvements under the Master Plan

Road Classification			Road Structure		Development Concept of Sulawesi Road Master Plan
			Nos. of Lane	Pavement Width	
I	Nationa Road	Arterial Road	2 lanes	7.0 m	All arterial national road become 7.0m road regardless of traffic volume and will be improved to be all weather condition with sufficient capacity and standard
		Collector Road (K-1)	2 lanes	6.0m - 7.0 m	The road carrying the traffic more than 3,000 p.c.u/day - 8,000 p.c.u/day become 6.0 m road and the road more than 8,000 p.c.u/day become 7.0m road
			1.5 lanes	4.5m (3.5m-5.4m)	The road carrying the traffic less than 3,000 p.c.u/day will be the l.5 lanes road but improved to be all weather condition road with asphaltic concrete
II	Provincial Road	Collector Road (K-2&3)	2 lanes	6.0m - 7.0 m	Same as Collector K-1 Road
			1.5 lanes	4.5m (3.5m-5.4m)	Same as Collector K-1 Road

Source: JICA Study Team

With the proposed improvements, the national and provincial roads in Sulawesi would reach 3,256 km of national/arterial roads, 4,884 km of national collector roads, and 4,786 km of provincial collector roads, as tabulated in the following,.

Table 4.7.13 National and Provincial Roads in Sulawesi under the Master Plan

Unit: Km

Province	National Road			Provincal Road	Total
	Arterial Road	Collector K-1	Total	Collector K-2&3	
North Sulawesi Province	351	981	1,332	890	2,222
Gorontalo Province	306	299	604	385	989
Central Sulawesi Province	743	1,578	2,322	1,426	3,748
West Sulawesi Province	514	319	833	288	1,121
South Sulawesi Province	879	800	1,679	1,108	2,787
Souteast Sulawesi Province	464	908	1,371	689	2,060
Total	3,256	4,884	8,141	4,786	12,926

Source: JICA Study Team

With the road improvements proposed under the master plan for 2024, it is expected that:

(i) Social and economic integration would be promoted in a regionally harmonized manner, and linkages or clusters could be actively promoted among six provinces, particularly through the completion of the Trans-Sulawesi Road;

(ii) Improvements in basic human needs and poverty reduction would be promoted in rural areas, as well as in isolated islands, by means of the improved road network system over the island;

(iii) Development of processing industries would be accelerated with the improved accessibility and logistic facilities/services;

(iv) Natural and social environment would be properly protected by road improvements without disorderly invasions into the environmentally sensitive areas; and

(v) Increase in the environmental loads in Sulawesi would be minimized by means of improved driving conditions, as well as by the energy-saving transport with road/ferry combinations (e.g., the nautical highway network).

The master plan for Arterial Road Network Development Plan for Sulawesi Island shows details of the development plans and the economic evaluation, as well as the initial environmental evaluation. Additionally, the feasibility study on Priority Arterial Roads in South Sulawesi, particularly in the Mamminasata Metropolitan Area, will provide further details towards the implementation of the proposed road improvements.