4. DEVELOPMENT TREND AND POSSIBLE DEVELOPMENT SCENARIOS ALONG THE STUDY ROUTE CORRIDOR

4.1 Land Use Plan

The basic feature of land use in the Mamminasata Metropolitan Area is a mixture of 3 components: natural, agricultural and urban land uses as shown in **Table 4.1**, which more or less reflect the land use in the areas along the FS and pre-FS roads. Predominant categories of land use (with the share of more than 10 % of land) are agriculture (irrigated mixed crop, mixed crop, rice field), forest and dry land.

Table 4.1 Existing Land Use

Categories		**Areas** (sq.km)	**Share** (%)
Urban area	Residential, commercial, business and industrial	149.3	6.0
Agriculture area	Irrigated mixed crop, Irrigated rice field (11.4%), Mixed crop (10.0%), Rice field (15.8%), plantation	1,063.2	42.6
Green area	Grassland, Bushed, forest (26.1%)	717.9	28.7
Water	River, Wetland, Reservoir	205.5	8.2
Others	Dry land (13.9%), open space	364.4	14.6
Total		2,500.2	100

Source: Mamminasata Study

Urbanization has been expanding outward from the center of Makassar, especially along the main arterial roads. Urbanization stretches up to the 15 km point from the center of Makassar to the north along the national road of Jl. Perintis- Kemerdekaan, and to the 10 km point to the south along the national road of Makassar- Sungguminasa - Takalar. The other direction of urbanization is toward the east from the center of Makassar up to the planned Outer Ring Road.

4.2 Urban Structure and Land Use Plan

(1) Mamminasata Metropolitan Areas Development Strategy and Policies

The Mamminasata Study elaborated the spatial development strategy that Mamminasata Metropolitan Area should serve as a "Logistic and Trade Hub in Eastern Indonesia" in the future, expecting Mamminasata and South Sulawesi to develop into clusters, promoting vertical and horizontal integration of the industrial activities. In order to materialize this strategy, the economic development plan included proposals in agriculture (shifting cropping pattern toward cultivation of crops of higher value such as vegetables, fruit and fish products based on advanced technology), manufacturing (supporting and logistic industries), tourism industry (domestic tourist spots) and others.

(2) Proposed Urban Structure

In order to accommodate the projected size of population and economic activities in such a manner as preventing the prevailing urban sprawls toward the suburban areas of Makassar as well as concentration of population and economic activities causing traffic congestion and environmental deterioration in the Makassar urban area, a new urban structure, e.g. "Fun Structure" was proposed. This proposed structure along which housing areas and industrial areas should be distributed to the regencies other than Makassar City. It is also incorporated in the "Multi-core development" program, as an objective envisioned in the Mamminasata Metropolitan Area spatial plan.

(3) Development Direction

In the pursuit of Multi-core development, development directions were more specifically defined as follows:

Housing and Urban Development

To decentralize population from Makassar City to the other regencies and to create large scale residential areas with efficient infrastructure.

Industrial Development

To expand industrial development in Makassar City and to induce industrial development into Maros, Gowa and Takalar Regencies.

(4) Land Use Plan

Along with the proposed urban structure and development directions, a land use plan (land use zoning) will be proposed. The land use plan should be associated with the distribution of socio-economic indicators (population and GRDP). Based on this development system, the Development Zoning Plan were proposed in the Mamminasata Study as shown in **Figure 4.1**.

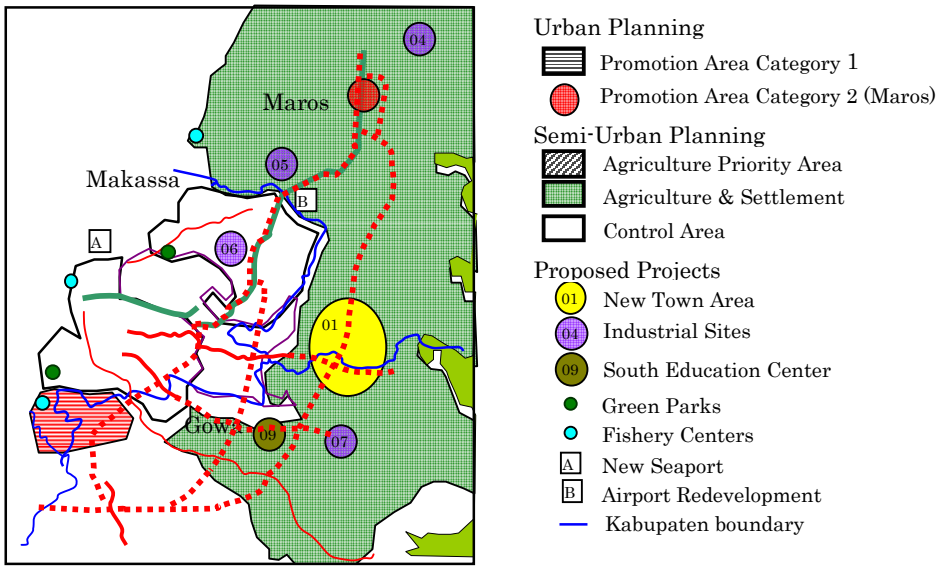


Figure 4.1 Proposed Development Zoning Plan

The basic policy of land use in this development system is to disperse the population, industries and urban activities in the new built-up areas. A new settlement area (New Town) is proposed at the east of Makkassar City in order to accommodate the increasing population in the Mamminasata Metropolitan Area.

4.3 Socio-economic Framework and Distribution

(1) Basic Concept in setting Socio-economic Framework

The socio-economic framework of the Study area during the period of 2005-2020 was established at the time of the "Study on Implementation of Integrated Spatial Plan for the Mamminasata Metropolitan Area, July 2006" (hereafter called the Mamminasata Study).

The Mamminasata Study forecast rapid urbanization of the suburban area and population decease in the center of Makassar. For example, the framework assumed that new development of large-scale residential estates in the suburbs of Makassar City (such as Pattallassang in Gowa, Pattallassang in Takalar, Tanralili and Mandai in Maros) will absorb about 430,500 local people by 2020. The Study Team judges that such scenario will progress not rapidly as the existing scenario. Given such condition, although the Study Team decided to use the same growth ratio of GRDP and population in the target year (2020) for the Study area as a whole, distribution of population and GRDP within the Study area was revised based on the following concept.

i) More moderate development of suburban residential estate; and

ii) Not rapid but gradual decrease in the population in the existing urban area of Makassar

(2) Revised Population Forecast

Figures 4.2 and 4.3 indicate shows the reviewed population density between 2005 and 2023. As these figures show, population density in the periphery of Makassar City. Particularly, population density of Tamalanrea sub- district of Makassar (48.96 /km2 in 2005 -> 62.07 /km2 in 2023), Patallasang sub-district of Gowa (2.92 /km^2 -> 10.51 /km^2), Mandai sub- district of Maros (5.81 /km^2 -> 13.55 /km^2), Moncongloe sub-district of Maros (2.56 /km^2 -> 13.31 /km^2), and Pattalassang sub-district of Takalar (11.22 /km^2 -> 20.66 /km^2) were forecasted to grow rapidly.

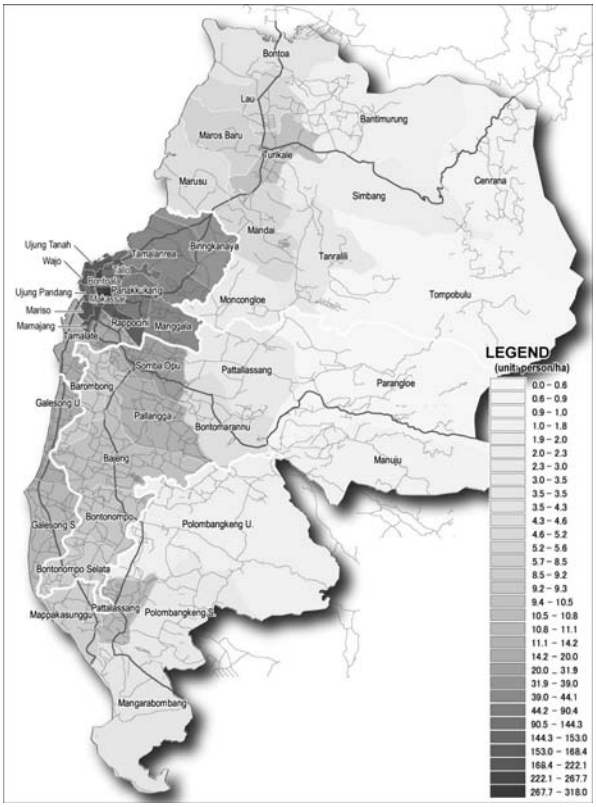


Figure 4.3.1 Population Density (2005)

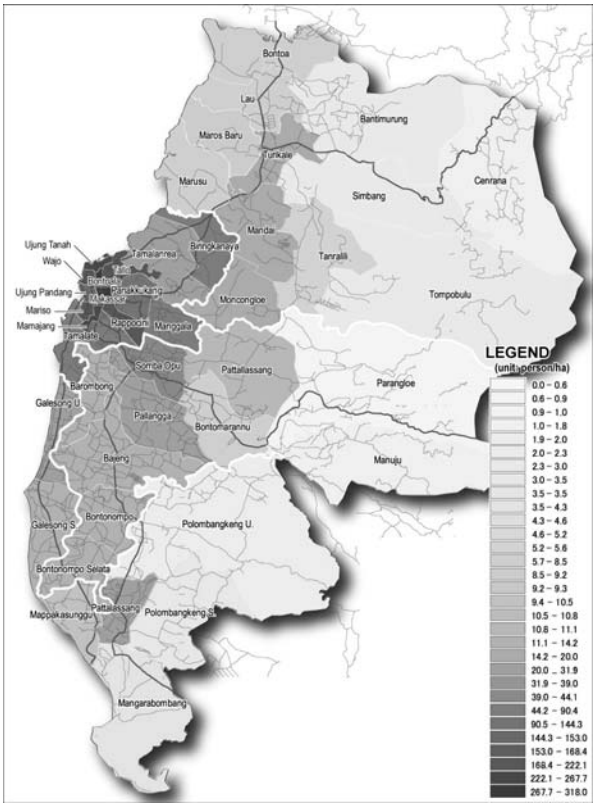


Figure 4.3 Population Density (2023)

(3) Revised GRDP Forecast

As same as population forecast, the Study Team assumed that the average growth rate of GRDP in the Study area remains unchanged. On the other hand, sub-district-wise distribution of GRDP, however, was revised in accordance with the change in the population forecast.

The revised forecast assumed that GRDP will particularly increase in the sub-districts which have plans to develop industrial/commercial areas (including the proposed industrial area of Tamalanrea in Makassar City), then the remaining GRDP growth was attributed to the number of labor force in each sub-district.

Figure 4.4 shows change in the GRDP in 1993 constant price. While the growth

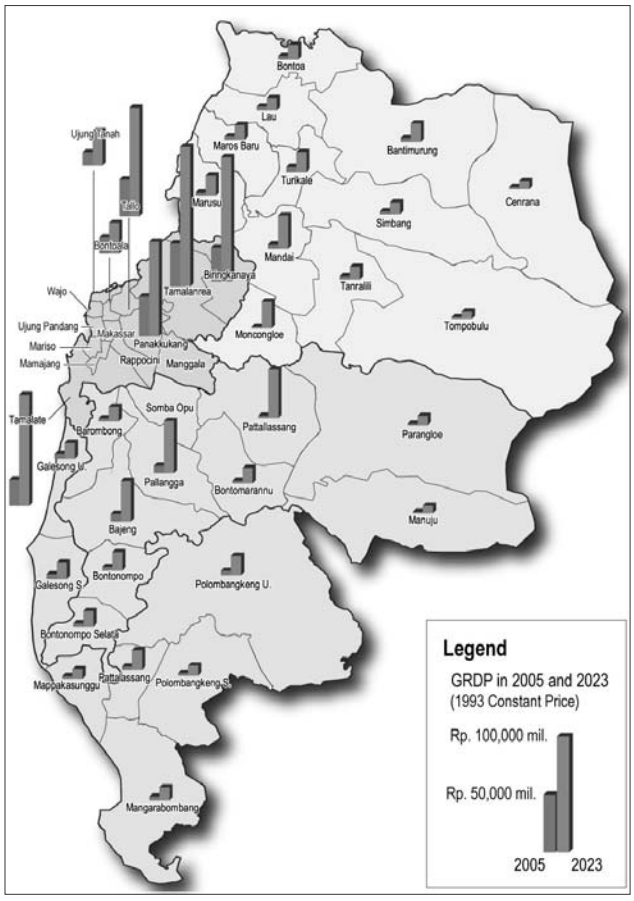


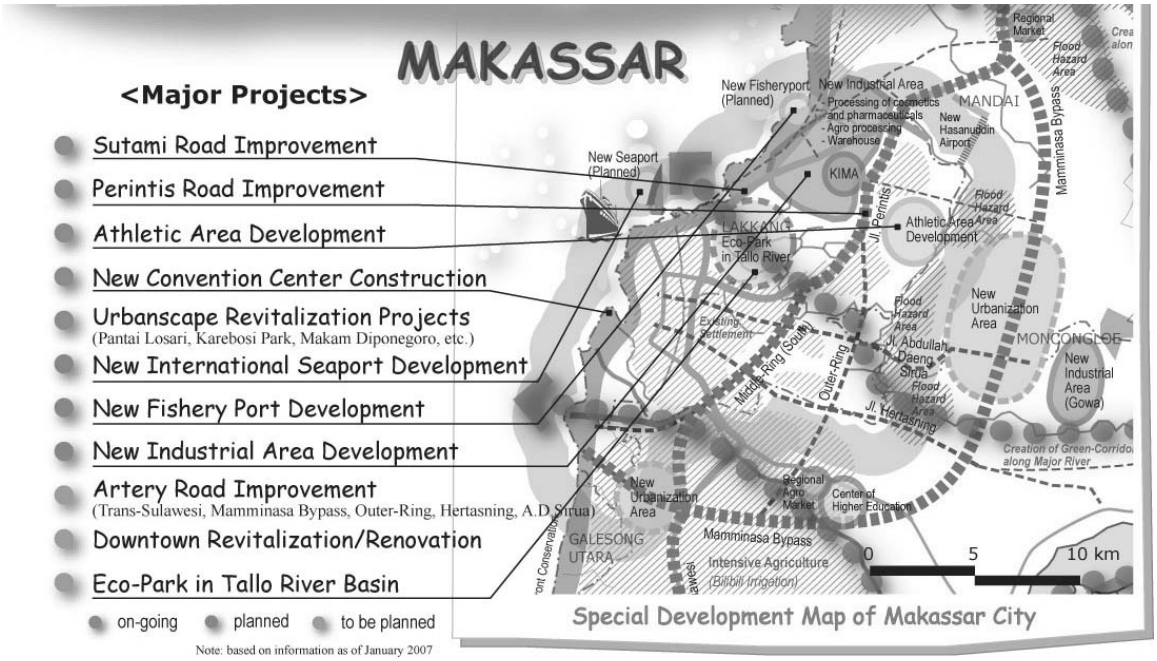
Figure 4.4 Change in the GRDP (2005 - 2023)

rate of Makassar City was forecasted lower than the other regencies, amount of incremental GRDP in Makassar was forecasted bigger than the other regencies.

4.4 On-going and Proposed Development Plans Related to the F/S Roads

(1) Updated Mamminasata Spatial Development Plan

There are many development projects currently undertaken or planned as shown in the following **Figure 4.5**.



Source: BKSPMM, February 2007

Figure 4.5 Ongoing/Planned Development Projects in Mamminasata Metropolitan Area

In addition to the above, several new development projects at Tanjung Bunga, Tanjung Merdeka and Tanjung Bayang are in progress or under planning, including integrated business district, housing, sports facilities, leisure facilities and culture center.

(2) New Industrial Area Development along Jl.Tol.Ir.Sutami and Middle Ring Connection

An industrial area (KIMA) was developed between the Hasanuddin airport and the Makassar seaport with a JBIC loan based on a JICA development study in 1980s. The initially developed area was 200 ha. It was later planned to expanded to 700 ha and the current plan is approximately 1,200 – 1,600 ha along Jl.Tol.Ir.Sutami according to the 2004 spatial plan of the South Sulawesi Province. This is an integrated plan including warehouses for port cargoes, new industrial areas, housing, shopping facilities and parks.

(3) Development Plans at the South of Jeneberang River and Related Road Links

As illustrated in **Figure 4.6,** an integrated development project is in progress at the mouth of Jeneberang River since this area is free from flooding after completion of the Bili-Bili dam.

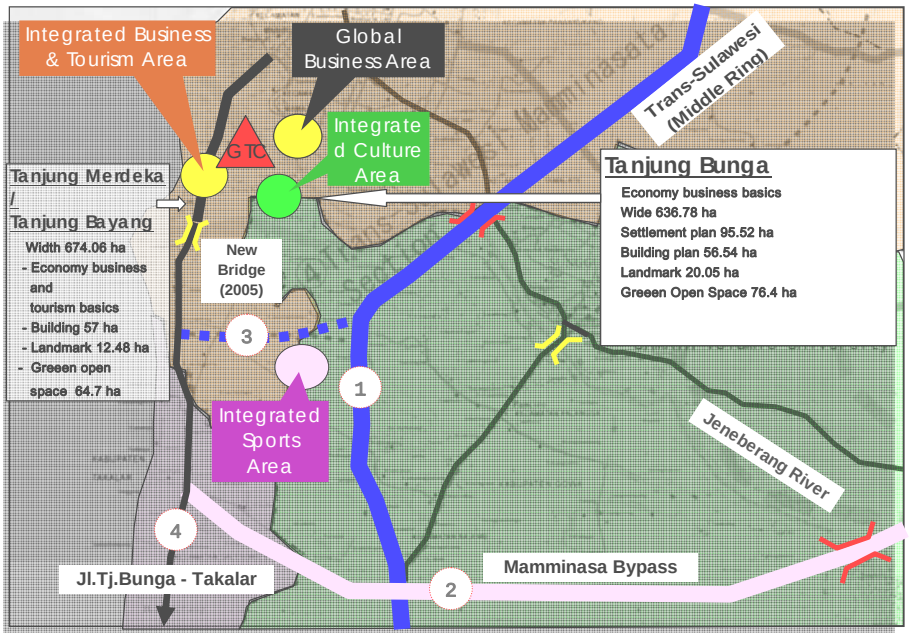


Figure 4.6 Appropriate Topography for Satellite Towns

The JICA 1989 Study recommended construction of the south radial road (Jl.Metoro Tj.Bunga - Takalar) along the coast line. As the 300m-long bridge was constructed over the Jeneberang River in 2005, development has expanded to the south. The following four road links should be introduced for this area to control urbanization in order:

① Trans-Sulawesi Middle Ring Road access
② Mamminasa Bypass (South Section)
③ Middle Ring Road Access (Tj.Bunga Access)
④ Jl.Metro Tj.Bunga – Talkalar (Lintas Barat Makassar).

4.5 Preliminary Study for a Satellite Town Development along Mamminasa Bypass

(1) Satellite Town Development for Mamminasata Metropolitan Area

In the Integrated Spatial Plan for the Mamminasata Metropolitan Area, new town development outside the boundary of Makassar City was proposed with the aims of dispersing population and urban activities to the east of Makassar City so as to alleviate the present and future traffic and population congestions and consequently to increase

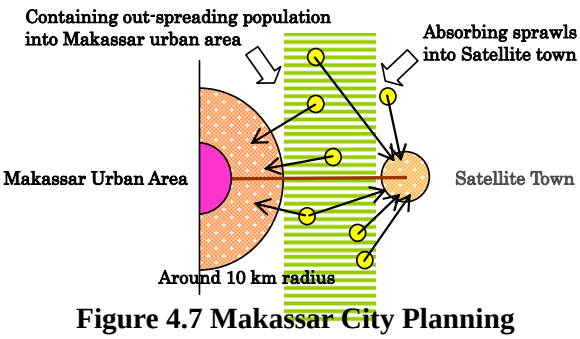


Figure 4.7 Makassar City Planning

urban green areas, and of reducing urban sprawls on the outskirts of the city. Urbanization or built-up areas has been spreading broadly throughout and beyond the administrative boundary of Makassar City. Measures to combat this urban problem in city planning are to absorb the increasing population in the urban area within the limited distance from the Makassar City center, redevelopment of the city center (old towns), and development of new towns for the out-going population at the optimal distance.

(2) Proposed Location of Satellite City

Development potential lands for new towns are identified taking into account the topography (elevation over 10 m sea level), land availability for large scale development, land prices, location/accessibility, existing landuse and others.

i) Land under elevation of 10 m sea level in the Tallo River basin covers mostly wet/flood-prone area and paddy fields, in which urban development without river improvement and flood control measures should be avoided.

ii) Flat lands in large scale over the elevation of 10 m sea level (free from flood) can be found only in Kecamatan Biringkanaya in Makassar City, Moncongloe in Maros Regency and Pattallassang in Gowa Regency. In contrast to Biringkanaya, Moncongloe is vastly undeveloped/less populated and best located at 15-20 km from the Makassar City center to attract/ accommodate spilling-over population/ households.

iii) Opening of the radial urban arterial road (Abdullah Daeng Sirua Road) directly connecting Makassar central districts and Moncongloe will accelerate the land development in Moncongloe. In addition the Mamminasa Bypass is due to greatly increase south-north accessibility from both Gowa and Maros Regencies.

iv) "Neither too far nor too close to the existing urban center" is a vital criterion for selecting the location of the Satellite city, especially self-contained city. If it is too close, the new town will become a part of the existing urban center, and if it is too far, economic linkage with the existing urban center, which is of significant importance for the new town' viability, will be lost.

(3) Potential Population Size of Satellite City

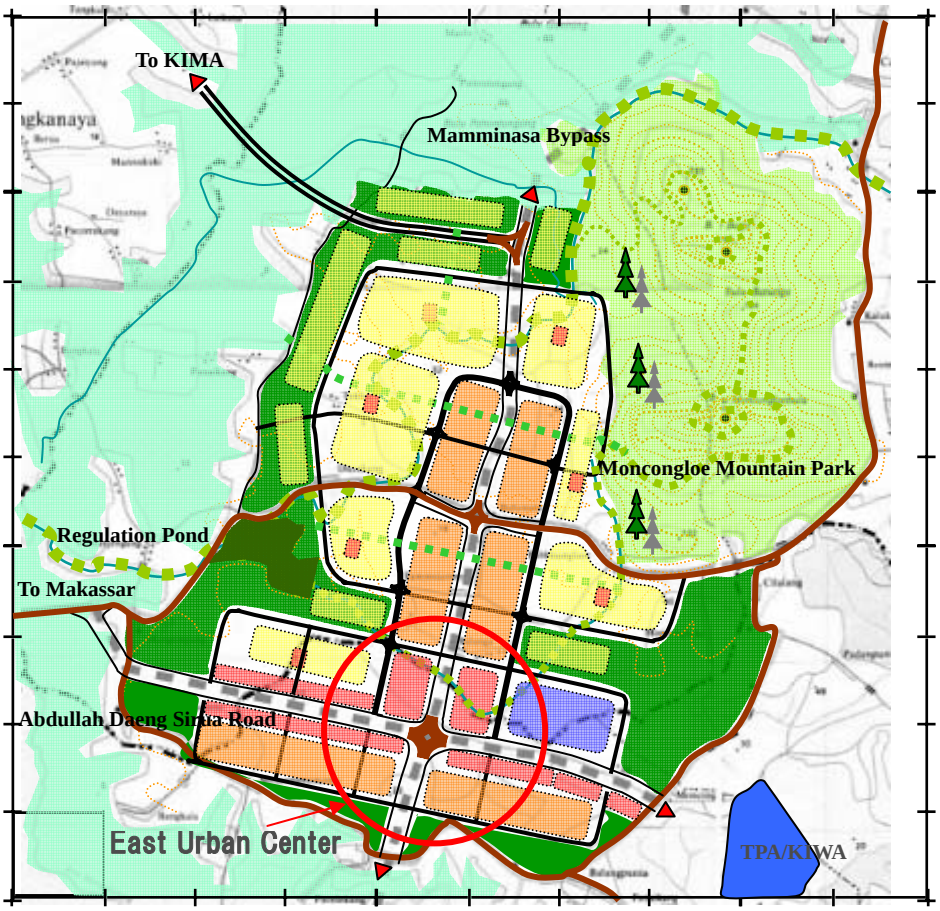
The Mamminasata Study proposed to develop a Satellite town in Tanralili in Maros Regency and in Pattallassang in Gowa Regency with a population of about 200,000. The planned satellite town was moved to Moncongloe and Pattallassang with that planned population of 100,000 in total by year 2023.

(4) Development Concept of Satellite City

The new urban service center (satellite town) should be planned to promote and boost the industrial development in the eastern part of the Mamminasata Metropolitan Area as envisioned in the

Mamminasata Study. As the territory of Makassar City ends at around 10 km east from its center, adjoining Kecamaten belong to Maros or Gowa Regencies would be appropriate location as indicated in **Figure 4.8**.

The new town study area is enclosed mostly by the paddy fields in the valley (under 10 m sea level) along the Tallo River and its tributary at the west, and the mountains (Mt. Moncongloe 317 m and Mt. Bogo 265 m) at the east. The planned site is located on the terrace-type terrain between a mountain (Moncongloe Mountain) and a river (Tallo River), being connected with the Tallo River through a water system, and with the Moncongloe Mountain through a land/soil system. Town and land development must be designed to embrace the water and land systems in and around the Moncongloe area.



	Land use	Remarks
	Commercial area	Retail, trade, finance, service, hotel,
	High amenity urban area with multi land uses	Flat houses, Office building, , Culture, Social services, Administration
	Low/medium density housing area	Detached house, Town house
	Urban service industry	
	Reserved and conservation area	Detached houses, parks and greens

Figure 4.8 Diagrammatized Development Concept of East Makassar Satellite Town

(5) Implementation System (Challenge of Local Governments)

The purposes of the East Makassar Satellite Town are not merely to promote private land and urban

development investment/ business, but also to cater for such public interests as provision of affordable houses, stabilization of land price, prevention of urban sprawl, facilitation of regional development, etc. However, it is certain that the latter cannot be achieved without the former. Accordingly this new town scheme must be implemented by the private sector under the government initiative or guidance.

In Indonesia there are three (3) legal systems for implementing urban development as listed below:

i) Development permit system under spatial plan regulation
ii) Land Consolidation (Konsolidasi Tanah)
iii) KASIBA (Ready to build: Kawasan Siap Bangun)

Most urban housing development projects (or land subdivision projects), except those of the National Urban Development Corporation (Perum Perumnas), have been implemented by private investors/developers with development/location and planning permits granted by the government.

5. TRAFFIC SURVEY AND TRAFFIC DEMAND FORECAST

5.1 Supplemental Traffic Survey and Review of Mamminasata Traffic Study

(1) Objectives of Supplemental Traffic Survey

A comprehensive traffic survey was conducted in the Study on Integrated Spatial Plan for the Mamminasata Metropolitan Area ("the Mamminasata Study") for the following objectives:

- To obtain latest information/data on transport situation;
- To identify transport characteristics;
- To quantify existing transport movements in Mamminasata Metropolitan Area; and
- To provide baseline data for traffic demand forecast.

The JICA Study Team conducted a supplemental traffic survey at 9 points selected from the 29 Mamminasata traffic study points, to calibrate and review the traffic survey and analysis conducted by the Mamminasata Study as more accuracy is required for the F/S roads. The supplemental survey also covered three additional points.

(2) Scope of Traffic Survey

The items of supplemental survey under the F/S are as follows:

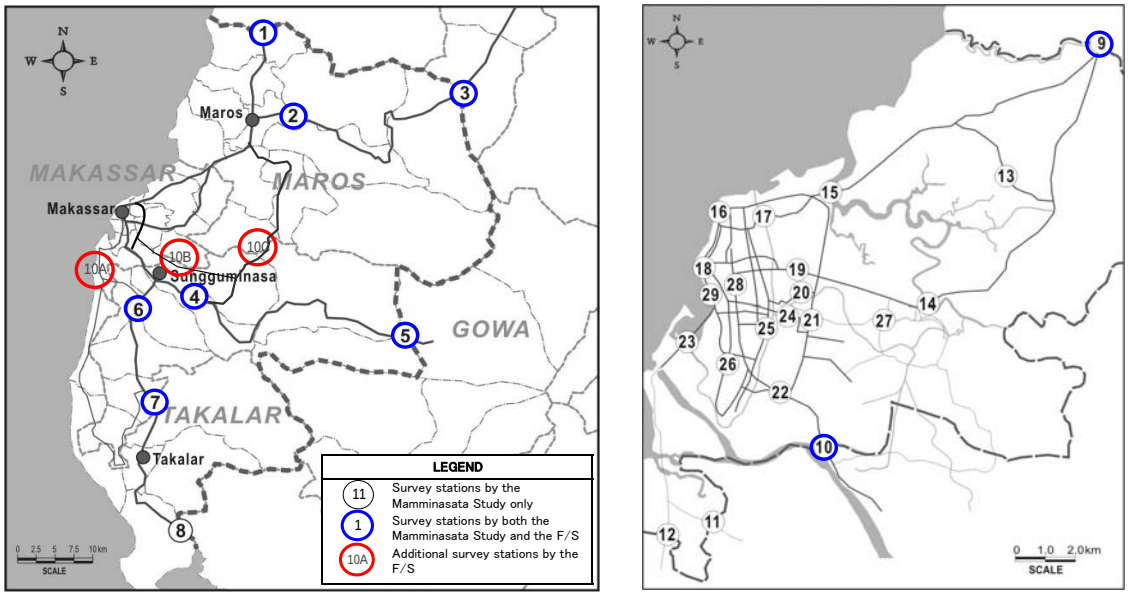
i) Traffic Count Survey
ii) Roadside OD Interview Survey
iii) Intersection Traffic Count Survey
iv) Travel Speed Survey
v) Axle Load Survey
vi) Distribution System Survey

The traffic survey in the Mamminasata Study was conducted in May - June 2005 in the dry season and these for the F/S was executed in February - March 2007 in the rainy season.

(3) Survey Locations

1) Traffic Count and Origin/Destination (OD) Interview Survey

In the Mamminasata Study, traffic surveys were conducted at 29 stations at Kabupaten and/or Kecamatan (district) borders in the Mamminasata Metropolitan Area. The F/S conducted the traffic survey at 12 stations (refer to **Figure 5.1**).



Source: JICA Study Team

Figure 5.1 Traffic Survey Stations in Mamminasata Metropolitan Area

2) Intersection Traffic Count Survey

The intersection traffic survey in the Mamminasata Study aimed at identifying traffic movements in CBD of Makassar city during peak periods and assessing operational efficiency of intersections. The intersection traffic count survey was conducted to obtain the hourly traffic volume by vehicle type and direction at eight (8) stations. These can be used as baseline data for planning intersection improvement.

(4) Present Traffic Condition

1) Traffic Volume

The existing traffic volumes are shown in **Table 5.1.** Traffic counts were conducted at 29 stations (Stations 1 - 29) in the Mamminasata Study and at three additional stations (Stations 10A, 10B and 10C) in the F/S. The traffic volumes obtained from 16-hour counts were expanded to 24-hour traffic by using the expansion factors obtained from 24-hour count stations.

The heaviest volume was 136,802 vehicles (69,556 pcu) at Jl.Andi Pangerang Pettarani (Station 21), which is a main road of the Makassar City Center running from the north to the south. Jl.Perintis Kemerdekaan (Station 14) and Jl.Urip Sumoharjo (Station 19) have the second heaviest volume of 124,522 - 97,230. Jl.Veteran Utara (Station 25) and Jl.Sultan Alauddin (Station 10) follow with 84,500 and 77,530, respectively.

Table 5.1 Current Traffic Volumes in Mamminasata Metropolitan Area

Survey Station	Bicycle	Becak	MC	Car/Taxi /Jeep	Minibus (Inc.Pete Pete)	Large Bus	Pickup	Small Truck (2-Axle)	Large Truck (3-Axle or more)	**Motorized Vehicle Total**	Non-Motorized Vehicle Total	**PCU Total (exclduing Bicycle & Becak)**
Station 1	156	134	3,762	3,832	1,749	450	974	1,767	447	**12,981**	290	**11,362**
Station 2	311	869	5,770	1,476	1,976	59	524	602	28	**10,435**	1,180	**6,346**
Station 3	33	4	1,441	86	1,239	46	229	303	34	**3,378**	37	**2,445**
Station 4	379	18	7,717	1,080	1,767	82	414	1,823	665	**13,548**	397	**9,013**
Station 5	0	0	578	77	339	6	86	146	0	**1,232**	0	**845**
Station 6	3,497	227	20,296	3,524	3,381	87	718	1,996	158	**30,160**	3,724	**15,738**
Station 7	217	91	11,803	1,926	2,480	81	666	1,094	73	**18,123**	308	**9,712**
Station 8	95	39	2,218	304	2,183	108	251	505	46	**5,615**	134	**4,203**
Station 9	165	102	19,274	12,639	6,142	692	1,927	3,532	698	**44,904**	267	**32,552**
Station 10	8,084	475	51,693	11,918	7,232	343	1,495	3,642	1,207	**77,530**	8,559	**41,231**
Station 11	381	20	2,324	195	449	7	85	145	1	**3,206**	401	**1,511**
Station 12	1,042	24	3,833	177	466	8	214	102	3	**4,803**	1,066	**1,966**
Station 13	201	53	18,098	2,991	1,114	580	1,263	1,410	307	**25,763**	254	**13,210**
Station 14	515	193	79,650	20,268	20,272	318	1,785	2,136	93	**124,522**	708	**65,677**
Station 15	578	11	18,332	10,653	3,253	262	2,744	5,032	1,640	**41,916**	589	**31,448**
Station 16	0	0	0	2,560	3,681	76	983	1,538	1,165	**10,003**	0	**11,667**
Station 17	4,487	7,560	16,463	1,622	5,600	117	1,062	1,322	302	**26,488**	12,047	**14,898**
Station 18	1,240	1,966	20,255	11,449	4,072	42	853	713	107	**37,491**	3,206	**22,642**
Station 19	1,331	405	54,741	18,374	21,129	291	1,657	1,028	10	**97,230**	1,736	**56,638**
Station 20	1,221	2,756	16,599	1,097	1,241	39	894	605	15	**20,490**	3,977	**8,257**
Station 21	2,186	1,799	91,750	28,739	8,657	250	3,840	3,035	531	**136,802**	3,985	**69,556**
Station 22	2,912	4,365	43,924	7,297	19,755	150	966	681	14	**72,787**	7,277	**40,137**
Station 23	887	0	14,039	8,084	314	42	646	222	11	**23,358**	887	**12,927**
Station 24	1,358	2,514	34,561	20,554	96	26	1,839	527	47	**57,650**	3,872	**31,947**
Station 25	2,568	4,764	57,609	17,096	6,115	147	2,093	1,303	137	**84,500**	7,332	**41,895**
Station 26	1,118	3,650	25,135	5,597	6,574	22	838	378	67	**38,611**	4,768	**19,951**
Station 27	983	286	22,528	5,582	5,518	97	745	712	28	**35,210**	1,269	**18,604**
Station 28	686	216	28,261	15,847	11,680	82	1,394	140	1	**57,405**	902	**36,293**
Station 29	1,371	2,260	24,559	13,515	2,061	50	1,015	754	87	**42,041**	3,631	**23,960**
Station 10A*			7,959	395	741	0	257	158	2	**9,512**		**3,592**
Station 10B*			2,620	53	109	0	98	107	15	**3,001**		**1,083**
Station 10C*			2,337	15	142	0	62	55	0	**2,611**		**875**

Note: Traffic survey conducted by the F/S.
Source: JICA Study Team

2) PCU Conversion Factor

The Passenger Car Unit (PCU) conversion factors used in "The Study on Integrated Transportation Master Plan for Jabotabek (SITRAMP)", "Indonesian Highway Capacity Manual (IHCM) 1997", and "Mamminasata Study" and adopted in the F/S are indicated in **Table 5.2**.

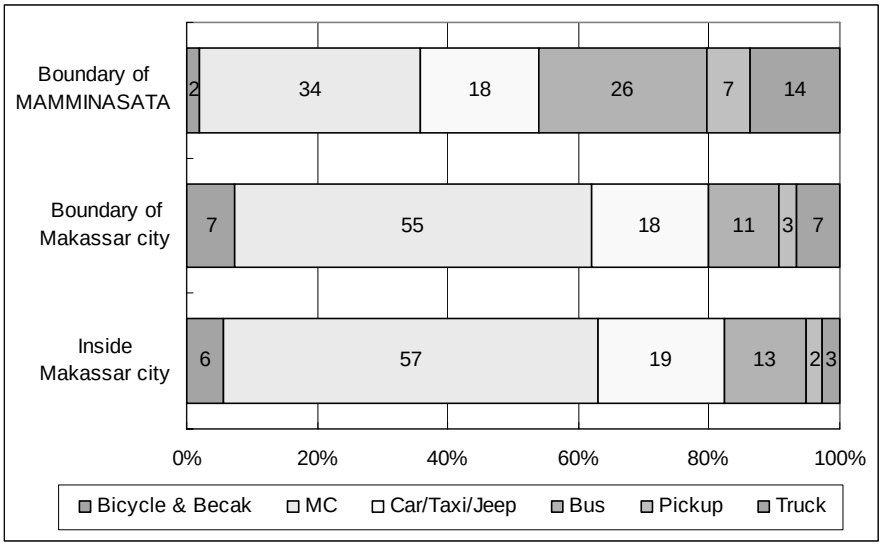
Table 5.2 PCU Conversion Factors

Vehicle Type	SITRAMP*	Mamminasata Study**	IHCM***						Used for the FS**
			Inter-urban Roads (Flat)			Urban Roads			
			2/2 UD W=6-8m	4/2 D	6/2 D	2/2 UD W>6m	4/2 D	6/2 D	2/2 UDD
									4/2 D, 6/2 D
Bicycle	-	0.2	-	-	-	-	-	-	-
Becak	-	0.5	-	-	-	-	-	-	-
Motorcycle	0.33	0.33	0.5	0.5	0.5	0.25	0.25	0.25	0.25
Car/Taxi/Jeep	1	1	1	1	1	1	1	1	1.0
Mini-bus	1.2	1.2	1	1	1	1	1	1	1.0
Medium Bus	1.5	-	1.3	1.3	1.3	1.2	1.2	1.2	-
Large Bus	2	2	1.5	1.5	1.5	1.2	1.2	1.2	1.5
Pickup	1	1	1	1	1	1	1	1	1.0
Small Truck (2-Axle)	1.5	1.5	1.3	1.3	1.3	1.2	1.2	1.2	1.3
Large Truck (3 or more axle)	2	2	2.5	2	2	1.2	1.2	1.2	2.0

Sources: * SITRAMP (Phase 1), 2004
** Mamminasata Spatial Plan Study in 2005-2006
*** Indonesian Highway Capacity Manual, 1997

3) Traffic Characteristics (Vehicle Composition)

Motorcycle has the substantial share of all traffic at 56.6%, followed by car/taxi/jeep at 18.6% and bus (mostly minibus) at 12.6%. Truck and pickup account for only 2.65% and 3.7%, respectively. **Figure 5.2** illustrates the vehicle composition by area. Motorcycle has the substantial share of traffic in and around Makassar City, while bus and truck increase their shares on national and provincial roads at the boundaries of the Mamminasata Metropolitan Area.

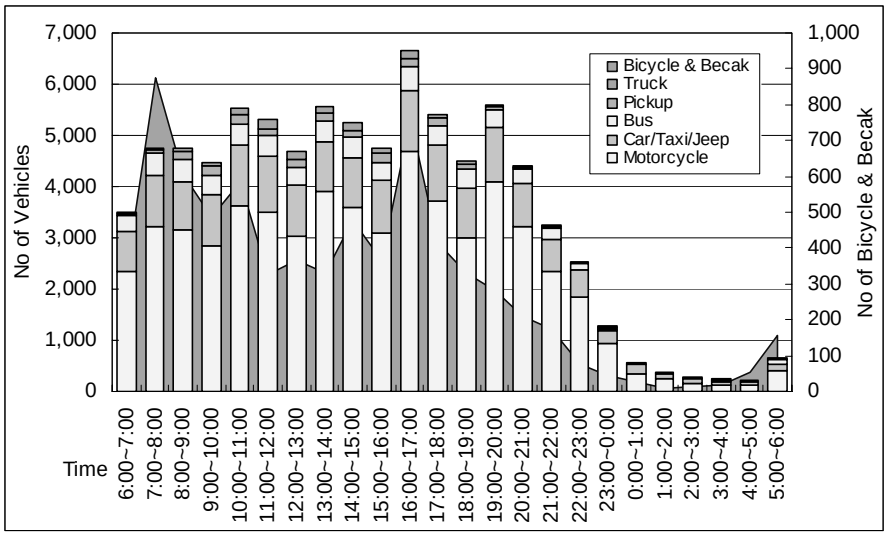


Source: Mamminasata Study

Figure 5.2 Vehicle Composition by Area

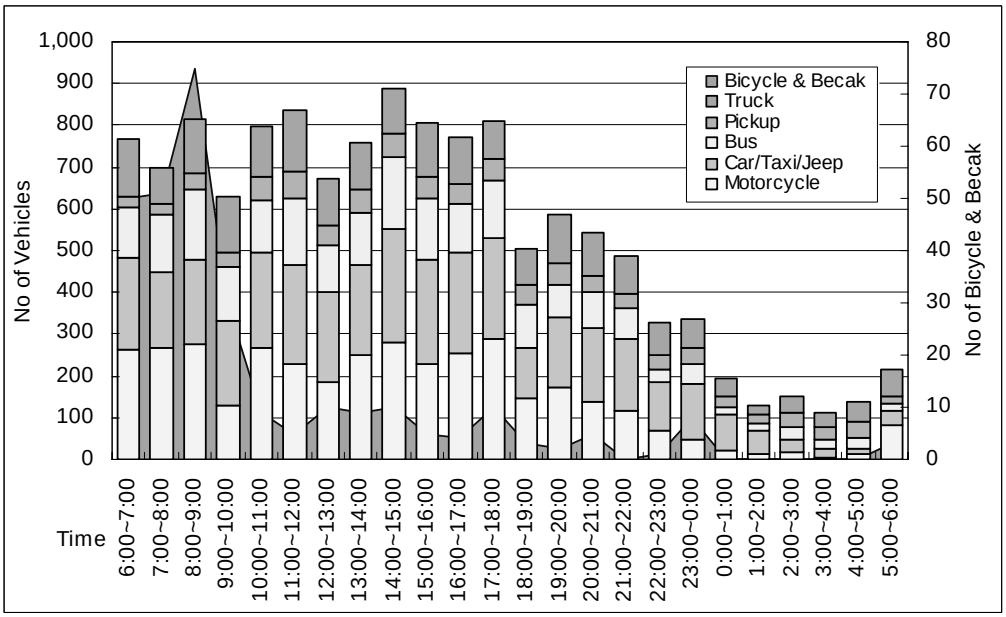
4) Hourly Variation

Figures 5.3 - 5.4 show the hourly traffic variation at 24-hour survey stations. At Jl.Veteran Utara (Station 25), which is one of the north-south main roads in the Makassar City center, the highest traffic volume was observed between 16:00 and 17:00 as an evening peak. In contrast to this, constant traffic volumes were recorded from 06:00 to 18:00 at Station 1, the border between Kab. Maros and Kab. Pangkep (Mamminasata border) except midnight.



Source: Mamminasata Study

Figure 5.3 Hourly Fluctuation of Traffic on Jl.Veteran Utara (Station 25)



Source: JICA Study Team

Figure 5.4 Hourly Fluctuation of Traffic on National Road at Kab.Maros/Kab.Pangkep Boarder (Station 1)

(5) Results of Origin and Destination Survey

A desired line was drawn based on the OD matrices to represent the transport demand characteristics (**Figure 5.5**). The desired line indicated that most of the traffic from/to outside of the Mamminasata Metropolitan Area has origin or destination in the Makassar City, while there is little traffic from the north to the south passing through this city.

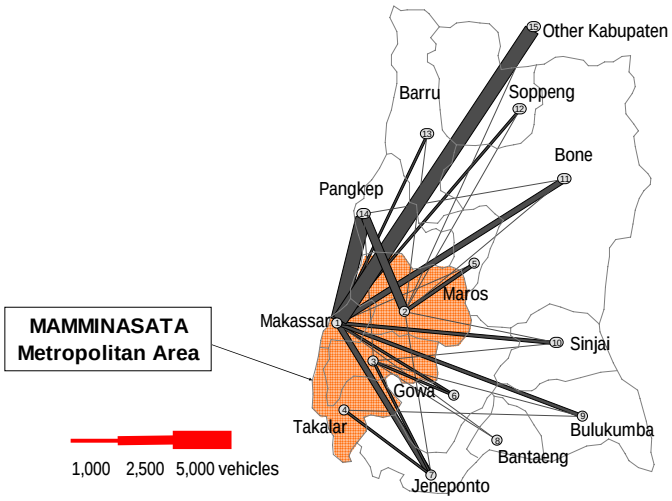


Figure 5.5 Desired Lines Across Mamminasata (2005)

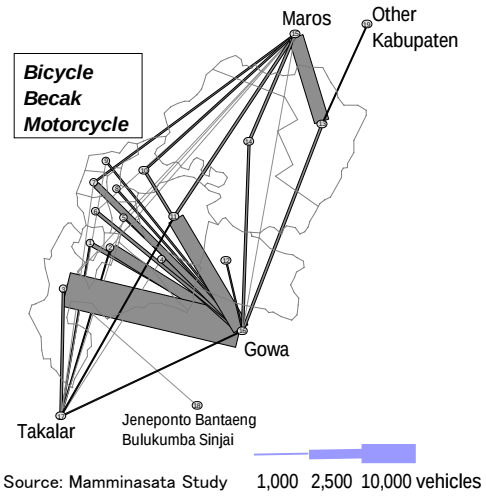


Figure 5.6 Desired Lines Across Mamminasata (2005) for Bicycle and Motorcycle

Note: Excluding Bicycle and Becak.

It is noteworthy that motorcycles and bicycles are very active in the traffic between Gowa and Kecamatan Tamalate in the Makassar City (right figure). This traffic goes to two major markets in Kecamatan Tamalate for supply of vegetables and fruit from Kabpaten Gowa. GMTDC also attracts the traffic from Gowa (Sungguminasa).

(6) Travel Speed Survey

The travel speed survey aimed at measuring the average travel speed and evaluating transport efficiency on the selected routes in the study area. The results of the survey were essential for identifying the congested road sections in the study area as well as for the setting of Q/V formulae of network links for traffic assignment in the traffic demand forecast.

The results of the travel speed survey conducted for the Trans-Sulawesi Mamminasata Section by tare as shown in **Figure 5.7**.

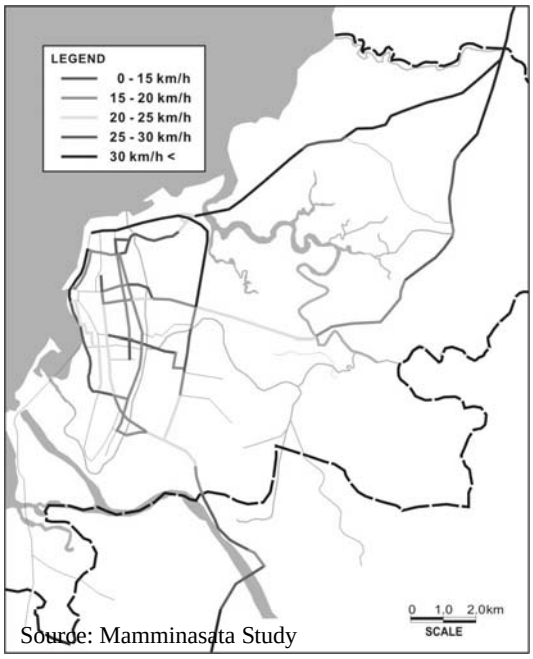
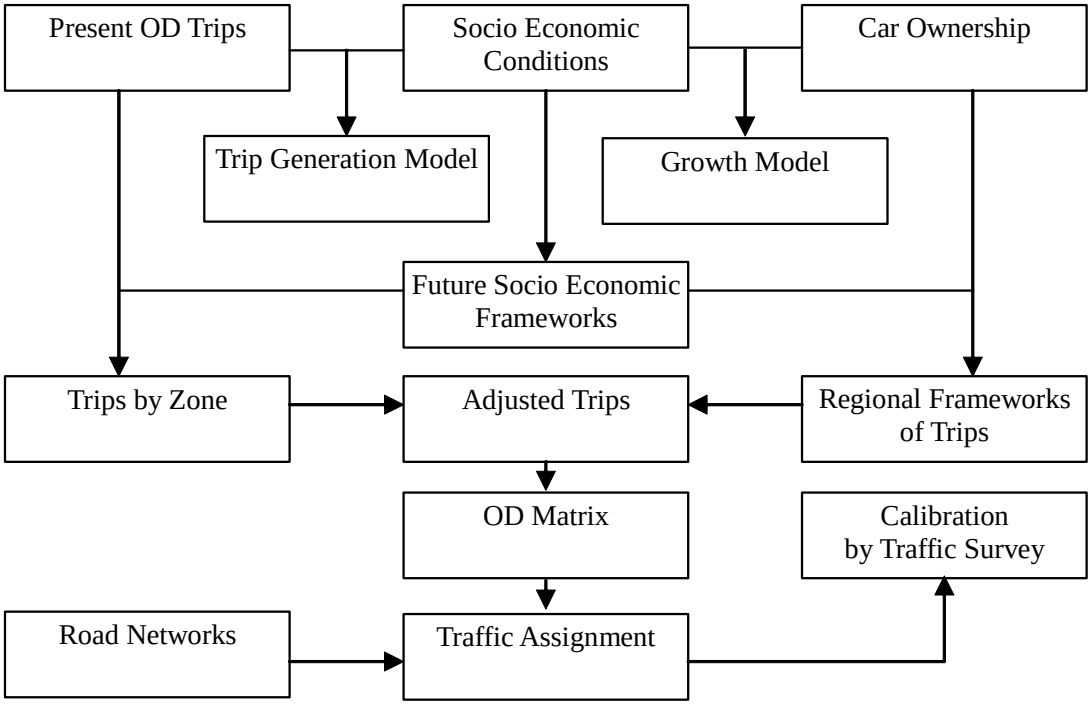


Figure 5.7 Travel Speed Profile (PM Peak) in Makassar

5.2 Method of Traffic Demand Forecast

Traffic demand depends on socio economic conditions. Therefore the method of traffic demand forecast should be constructed by the analysis of the relation between traffic demand and socio economic conditions.

As shown in **Figure 5.8** the main forecast process takes into consideration stepwise the present socio economic indices, future socio economic plan, traffic assignment by OD tables, and traffic network.

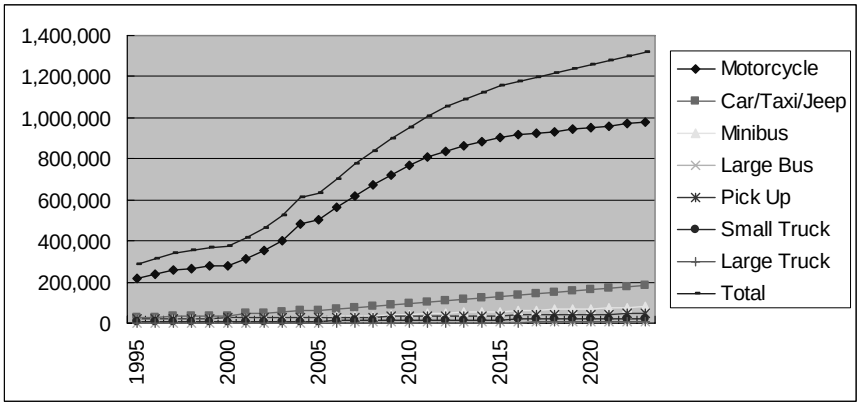


Source: JICA Study Team

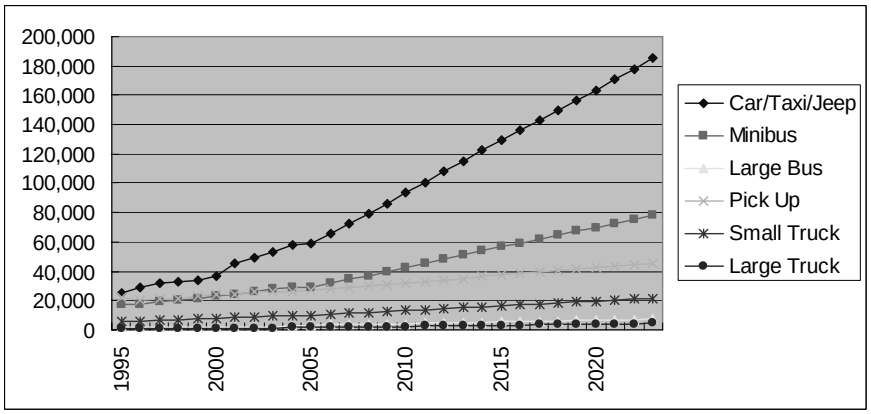
Figure 5.8 Traffic Demand Forecast Flow

In South Sulawesi car ownership is increasing gradually year by year. The framework of traffic demand is forecast by the growth of car ownership. Even though the growth rate of traffic volume might be higher than that of car ownership because trips per person per day increase in line with economic activities, the data on car ownership is the most reliable one to explain the growth of trips.

In line with the GRDP per capita growth, car ownership increases. The results of forecast of car ownership by the above model are shown in **Figure 5.9** for all kinds of vehicles except motorcycles.



Note: All types of vehicles



Note: Excluding motorcycles
Source: Statistics of South Sulawesi and JICA Study Team

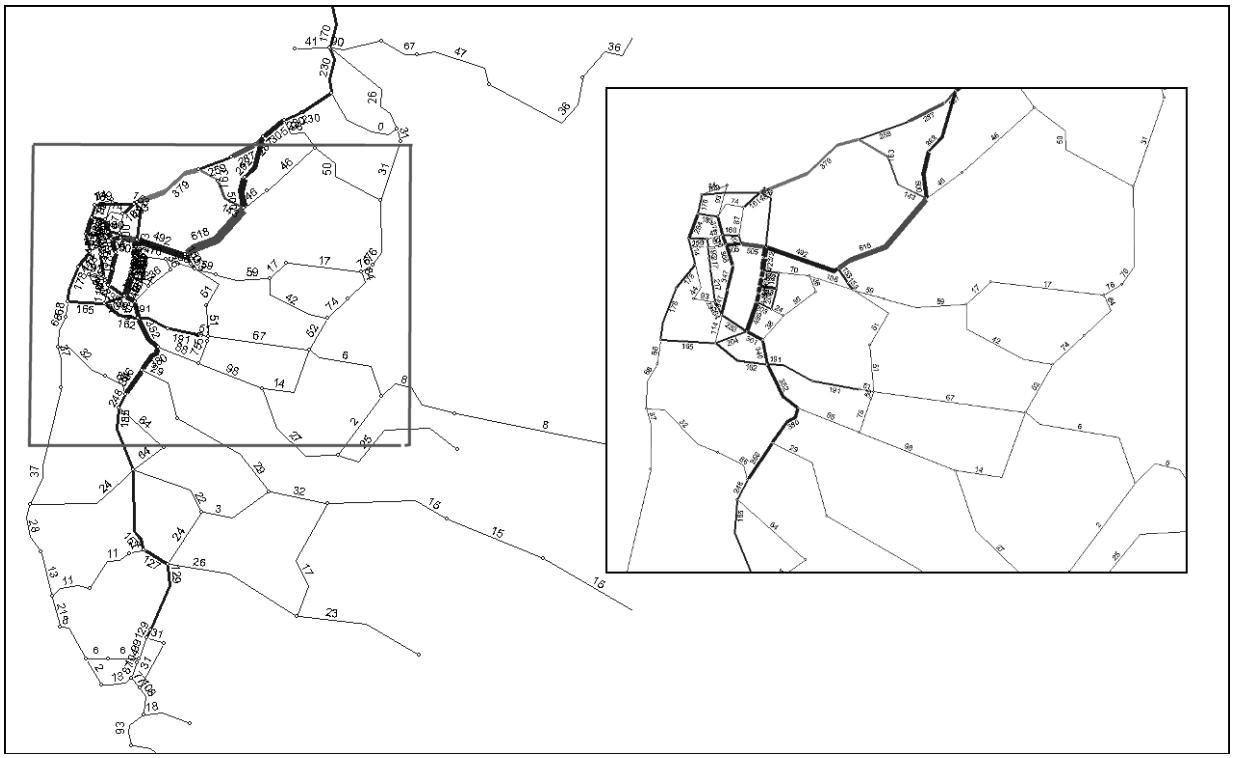
Figure 5.9 Growth of Car Ownership

5.3 Examination of Future Traffic Demand

(1) Calibration of Forecast

Traffic demand should be calibrated by a comparison between the traffic count survey result and the traffic assignment simulation at present.

The present pattern by traffic assignment determined through some revisions of network conditions and OD matrices is shown in **Figure 5.10**. The revisions included QV conditions according to the Indonesian standards and AADT conversion. For traffic assignment, the multi-stage assignment method was used because this method is more useful than the equilibrium method to analyze cross section traffics. Although the zone size defined in the JICA Integrated Spatial Plan, July 2006 is not small enough to analyze short trips in the center of Makassar, most traffic volumes recorded on the network reflect real traffics since the traffic surveys in this study were carried out in the dry season. Therefore this network and OD matrices in year 2006 were referred to as basic conditions to forecast future traffics.



Source: JICA Study Team

Figure 5.10 Present Traffic Assignment (unit:100 pcu)

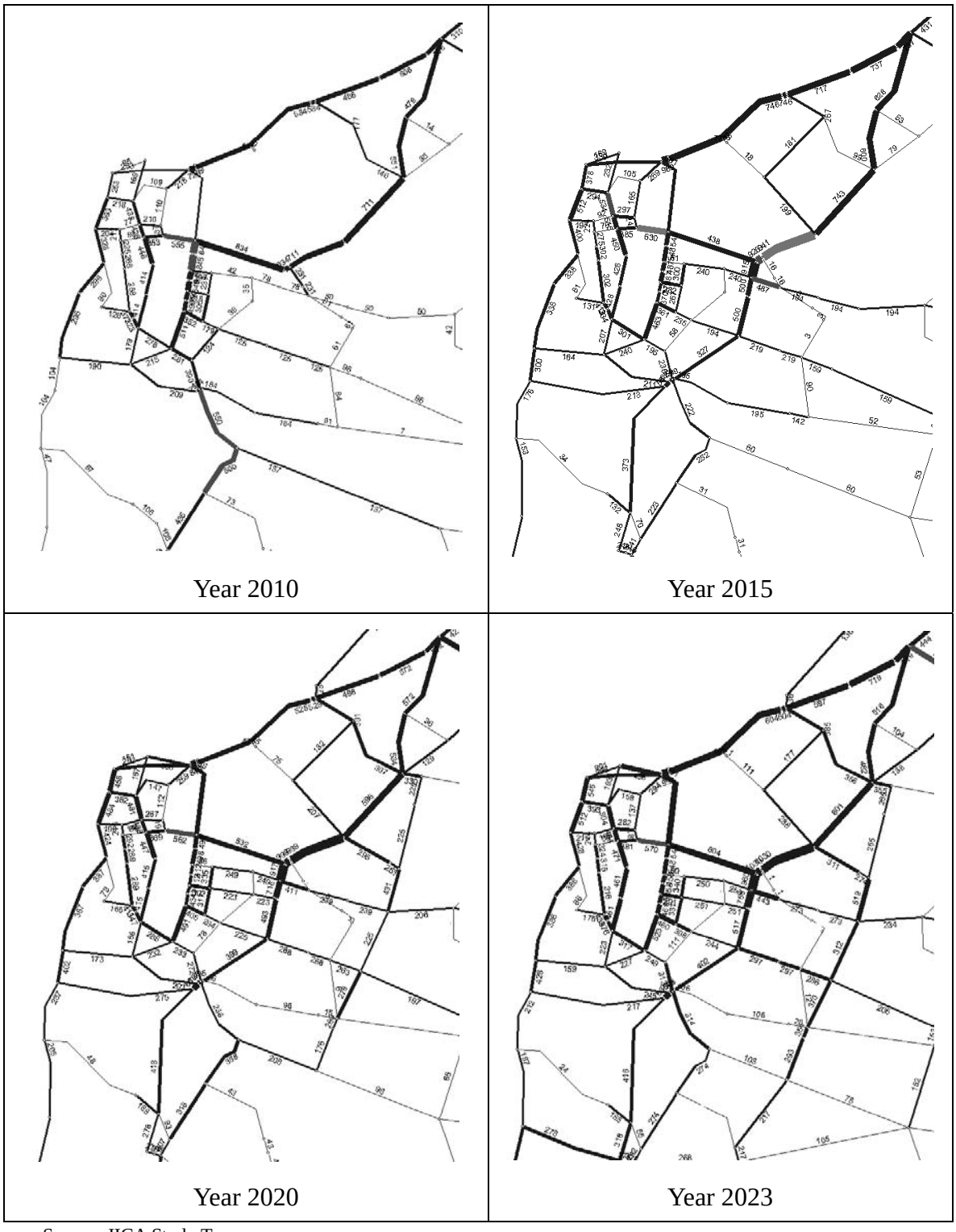
(2) Future Traffic Flow

1) Future Traffic Flow

Future traffics on the road network were simulated by multi-stage traffic assignment. This is an "all-with" case in year 2023. Although there are no congested links owing to the completion of future networks, traffic volumes larger than capacities are seen on roads in the intermediate years.

The forecast traffic volumes in areas surrounding the center of Makassar in the intermediate years are shown in **Figure 5.11**. New roads and widened roads will play an important role as a result of the increase of traffic demands in the future.

The traffic volume on most sections of the Trans Sulawesi will increase about 2 times in year 2023 from the present. On the section near Maros, it will reach 45,000 PCU, therefore the Maros bypass section and the New Port-Jl.Ir.Sutami-Tambua road will also become important roads.



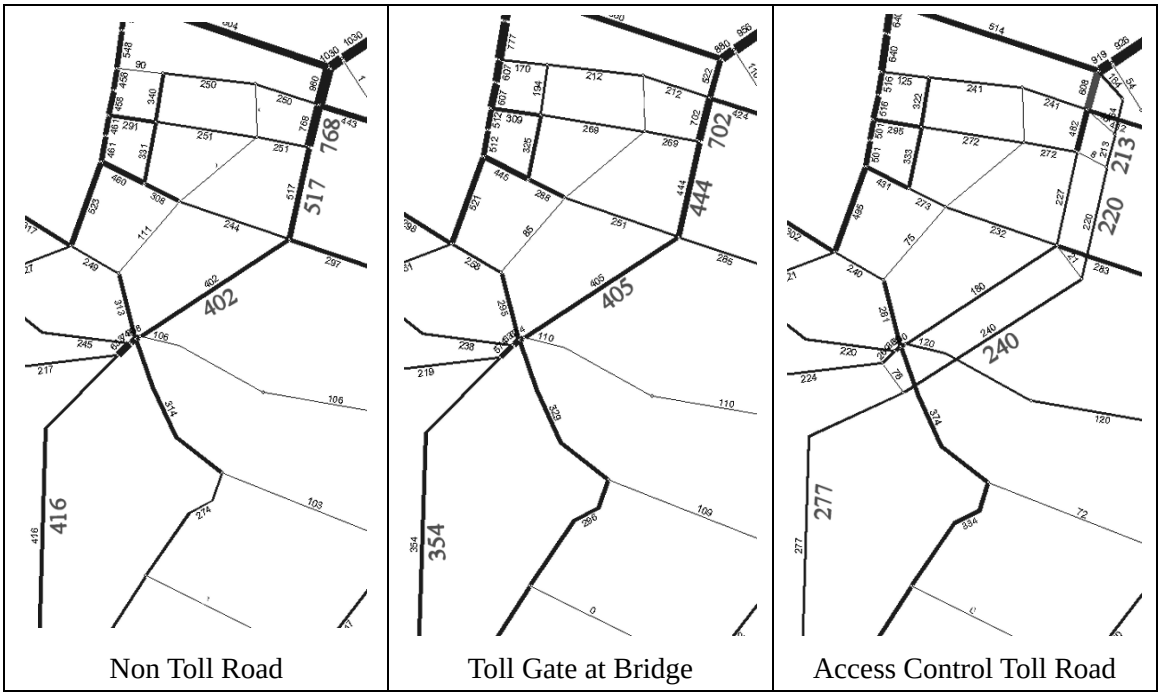
Source: JICA Study Team

Figure 5.11 Forecast of Traffic in Makassar (unit:100 pcu)

2) Future Traffic Flow for Toll Cases

In the traffic forecast for an alternative road development plan, two types of toll road systems were simulated for the middle section (Section C and D of Trans-Sulawesi Mamminasata Road. One is

the toll gate system installed at the two bridges across the Tallo River and the Jeneberang River for. User charges will be collected at each gate for the road maintenance fund at an assumed rate equivalent to a third of the present tariff on JJl.Tol.Ir.Sutami. The other is a full access-controlled toll road system. The section between the Tallo River and the Jeneberang River will be a 2-lane x 2-way toll road at the center and a 2-lane frontage road at the both sides. The south section from the Jeneberang River will be a 2-lane x 2 way access-controlled toll road. The toll rate was assumed to be the same as present (March 2007) rate on Jl.Tol.Ir.Sutami. The following figure shows comparison of these 3 cases, including non-toll case.



Non Toll Road | Toll Gate at Bridge | Access Control Toll Road

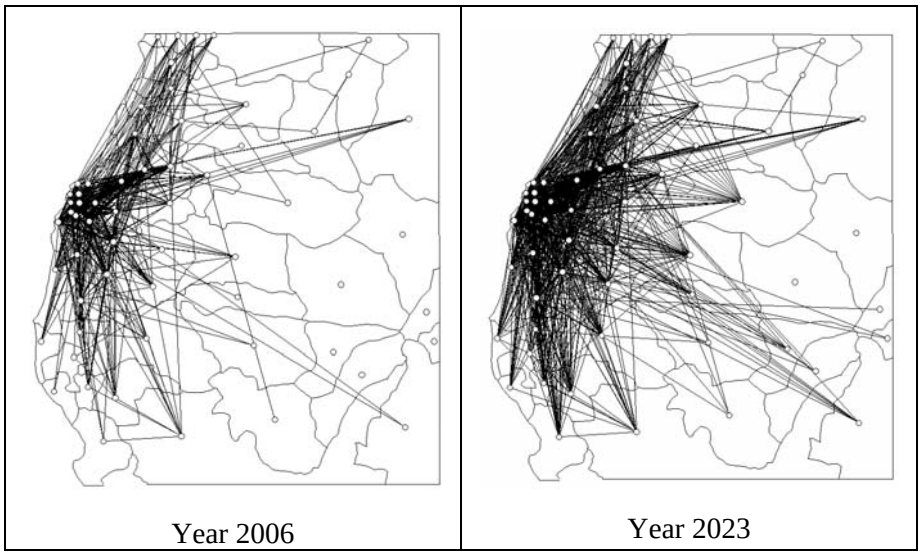
Source: JICA Study Team

Figure 5.12 Case Study for Toll Roads in 2023 Traffic (unit: 100 pcu)

(3) Characteristics of Traffic Flow

The traffic share of motorcycle is highest all over Mamminasata, especially in the urbanized area. The second largest traffic share is passenger car and mini bus. In the future the road network might face traffic jam and safety problems by the increase of motorcycle trips.

Most traffic flow consists of intra-Mamminasata trips. Through traffics are small. Although the ratio of through traffics might increase in the future, for example in the case where new industries generate new traffic flows between the north and the south, the characteristics of high share of intra-traffics will still remain. Under the similar traffic characteristics, the density of traffics increases and the sphere of traffic flows extend as in the following desire lines among new town and new industrial areas.



Source: JICA Study Team

Figure 5.13 Desire Line in the Future

5.4 Axle Load Survey and Analysis

(1) Axle Load Survey

The weigh bridges of the transport department of South Sulawesi Province are located at the following three major inlets /outlets of the traffic from/to Makassar City (**Figure 5.14**):

- Maccopa / Mandai (Kab.Maros) on the national road for the north traffic
- Somba Opu (Kab.Gowa) on the provincial road for the east traffic
- Pallanga (Kab.Gowa) on the national road for the south traffic

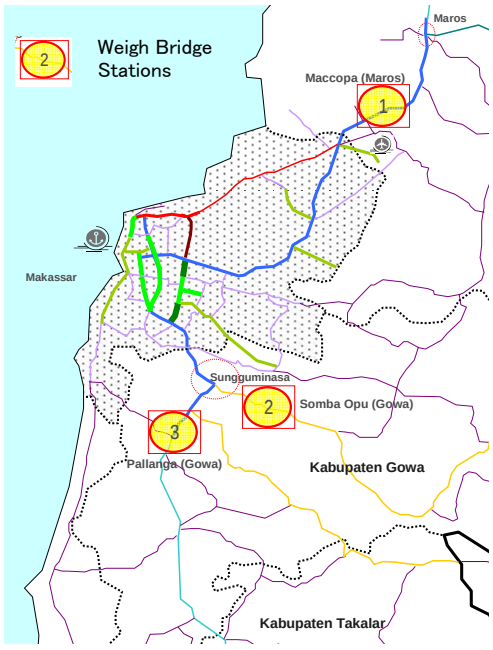


Figure 5.14 Axle Load Survey Stations

The average axle load for the front and rear axles of 2-axle trucks at Maccopa Station is 3.9 tons and 9.0 tons, respectively. Those for 3-axle trucks are 6.3 tons and 25.2 tons. The average axle load for the front and rear axles of 2-alxe trucks at Somba Opu Station is 4.4 tons and 7.1 tons, respectively. Those for 3-axle trucks are 6.5 tons and 28.7 tons.

(2) Axle Load Analysis

Many trucks sampled for weighing were overloaded. Especially, overloading of 3-axle trucks carrying construction materials (sand, gravel and soil), agricultural products and cement was

significant. The trucks carrying gravel and sand passing Somba Opu station come from Bili-Bili, which is major construction material supply source, and this is the major cause of pavement damages.

Overloading causes negative effects on pavement, road safety and traffic capacity. Of these, the effect on pavement is measured by vehicle damage factor (VD) / Equivalent Standard Axle. The average VDF is 3.0 for 2-axle trucks which should be less than 1.0 on the MST (Axle Load) 8.0-ton roads. The average VDF is 12.0 for 3-axle trucks which should be less than 2.0.

(3) Axle Load Regulation and Overloading Control

In accordance with the Government's Regulation No.43, Year 1993, the maximum axle load in Indonesia is as follows:

- Class I: MST >= 10 tons
- Class II: MST = 10 tons
- Classes IIIA, IIIB, IIIC: MST 8 tons.

All roads in Sulawesi were categorized into Class IIIA, IIIB and IIIC by the Degree of MOC KM No.13 Year 2001 and, therefore, 8 tons are axle load limit. The vehicle damage factors increase in 4^{th}-5^{th} power to the axle load. Therefore, overloading control is extremely important to keep the pavement life.

There are some points to be considered, including:

- Improve transparency in MST control method at weighing stations, introducing computer systems
- Increase the number of weighing stations to prevent overloaded trucks escaping to alternative routes that are out of control
- Establish weigh bridge stations on routes of construction material transportation
- Strengthen education for vehicle owners and drivers
- Exercise 24-hour operations of weigh bridge stations.

Besides application of the MST 10 ton on strategic routes, more strict regulation enforcement should be imposed against overloading to curtail investments on road facilities. Participation of private sector in the weigh bridge operation would be one of the measures increasing efficiency and effectiveness.