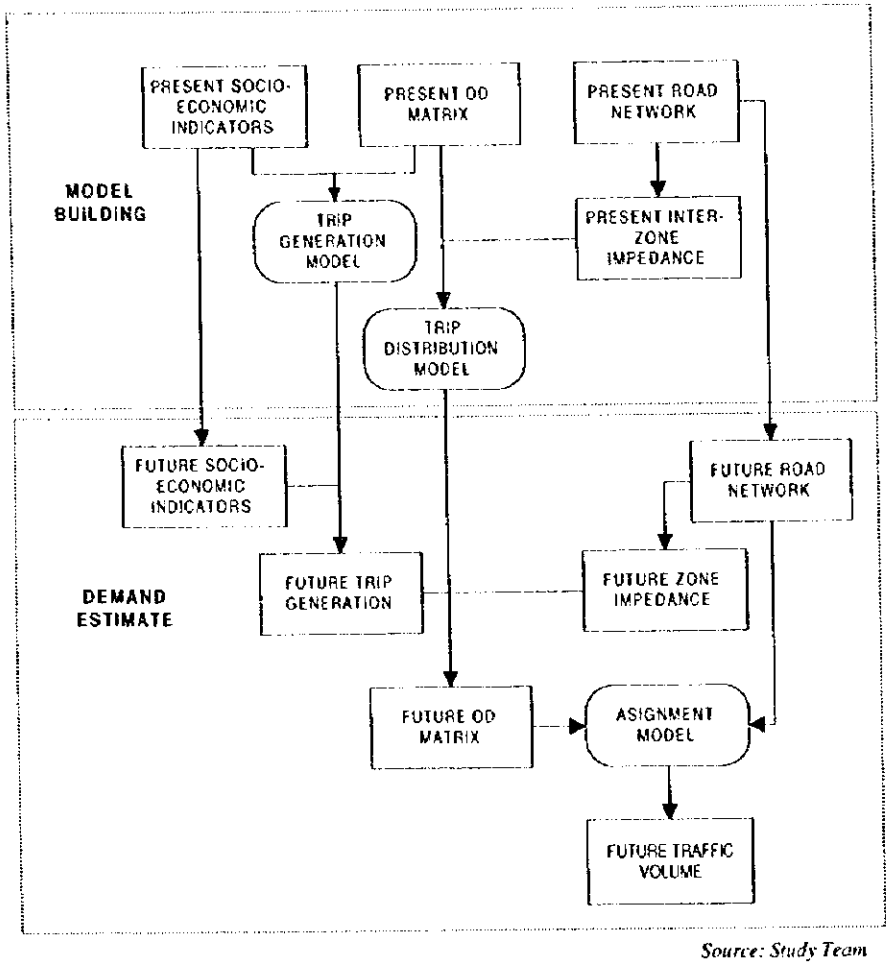
4.5 Future Demand Forecast

4.5.1 Demand Forecast Process

Figure 4-5-1 shows the demand forecast process. The process is divided into two parts: model building and demand forecast. In model building, vehicle trip generation/ attraction and trip distribution model by vehicle classification is developed based on the present vehicle OD and inter-zone impedance.

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



Source: Study Team

Figure 4-5-1 Demand Estimate Process

4.5.2 Trip Generation/Attraction Model

The trip generation/attraction model was developed based on the present generating/ attracting traffic, and the population and per-capita GRDP in terms of 1993 constant price as the socio-economic indicators. Tables 4-5-1 and 4-5-2 show the population and per-capita GRDP, aggregated into zone based Figure.

Table 4-5-1 Population by Zone and by Year

Unit: persons

Zone	1998	2003	2008	2013	2018
1	184,415	194,943	204,952	214,440	223,404
2	33,711	35,614	37,389	39,035	40,551
3	44,278	51,201	58,385	65,744	73,196
4	92,756	99,659	107,678	116,974	124,443
5	36,893	38,866	40,698	42,387	43,937
6	75,829	83,200	90,542	97,790	104,893
7	79,835	87,849	95,912	103,955	111,917
8	20,649	21,758	22,772	23,694	24,528
9	107,443	115,504	124,345	133,896	141,846
10	43,695	47,592	51,482	55,320	59,066
11	78,820	80,977	82,954	84,738	86,293
12	29,188	30,166	31,042	31,824	32,520
13	165,218	178,737	191,923	204,692	216,978
14	126,713	137,998	148,994	159,642	169,880
15	51,205	55,030	58,504	61,706	64,472
16	93,956	99,784	105,275	110,441	115,274
17	51,521	55,240	58,785	62,143	65,306
18	42,776	45,036	47,093	48,982	50,705
19	124,935	145,149	166,368	188,357	210,878
20	61,823	65,633	69,261	72,700	75,944
21	121,608	135,454	149,418	162,961	171,757
22	43,864	46,322	48,626	50,778	52,778
23	46,811	48,701	50,448	52,061	53,545
24	232,524	251,424	274,726	295,201	315,225
25	75,888	79,296	81,941	83,951	85,300
26	34,644	39,439	43,945	48,122	51,950
27	108,686	112,855	115,485	117,597	119,194
28	53,187	57,639	61,497	64,818	67,663
29	62,143	64,806	67,073	68,990	70,581
30	29,073	28,952	28,813	28,671	28,531
31	65,332	67,867	70,262	72,436	74,677
32	94,394	97,095	98,845	99,842	100,260
33	98,003	100,403	99,781	102,474	102,254
34	64,722	76,896	89,297	101,591	113,508
35	63,496	72,650	82,773	90,022	96,566
36	68,508	79,437	91,515	100,508	108,763
37	24,989	29,284	34,048	37,693	41,071
38	195,182	231,691	263,632	294,600	326,470
39	76,942	93,919	113,972	131,724	149,695
40	95,383	106,932	119,453	127,695	134,928
41	35,874	43,260	51,767	58,986	66,090
42	73,249	81,905	90,960	99,287	107,338
43	49,843	61,534	73,569	85,694	97,649
44	153,415	177,985	201,550	223,924	244,407

Source: Study Team

Table 4-5-2 GRDP by zone and by Year

Unit: 1,000 RP. in 1993 constant price

Zone	1998	2003	2008	2013	2018
1	7318129	9460171	12481189	16345966	23409071
2	2186432	2858585	3831752	5206240	7620105
3	1145474	1501237	2019620	2779683	4068206
4	3710110	4963462	6726056	9237080	13142852
5	1112101	1461001	1971452	2717891	4013731
6	2979204	3963319	5383972	7336956	10777753
7	3954132	5256748	7133396	9694384	14221756
8	2036907	2731124	3753780	5250010	7853679
9	4461395	6098602	8457433	11876429	17291363
10	2100782	2837790	3943096	5648443	8574349
11	5076111	6806823	9357925	13092681	19623428
12	1340538	1731737	2291172	3053886	4313890
13	4021614	5195211	6873516	9161658	12941670
14	2705373	3503293	4647911	6236199	8842099
15	1604440	2175443	3041270	4560862	6897367
16	5503639	7159516	9549048	12971079	18520947
17	1340538	1731737	2291172	3053886	4313890
18	1432656	1889826	2562887	3607452	5271740
19	2681076	3463474	4582344	6107772	8627780
20	3200787	4224147	5528535	7116879	9995202
21	3674758	4786387	6420599	8789720	12824796
22	2133858	2816098	3685690	4744586	6663468
23	3200787	4224147	5528535	7116879	9995202
24	8608569	11276826	14747687	19542988	28089240
25	4394016	5856138	8450084	12616830	20027682
26	2107968	2635790	3662164	5256788	7882390
27	6543490	10008544	14566103	21424599	33336247
28	2107968	2635790	3662164	5256788	7882390
29	3293372	4364671	6251019	9244692	14449569
30	2107968	2635790	3662164	5256788	7882390
31	3323755	4525659	6669766	10224945	16365783
32	5196350	6355655	8576655	12032055	18040410
33	3513479	5005233	7202283	10154861	15376488
34	4157080	5084524	6861324	9625644	14432328
35	2343767	2581390	3190733	4219295	5969709
36	3436569	3658719	4458306	5805687	8040786
37	2291046	2439146	2972204	3870458	5360524
38	6854870	8753601	11155367	14814968	20890706
39	3436569	3658719	4458306	5805687	8040786
40	4698235	5195752	6440376	8544227	12142468
41	2344088	2585413	3201917	4244249	6024331
42	5400594	7408628	9746353	13130770	18812173
43	3317074	4211733	5591310	7732420	11457015
44	6534157	8175412	10853738	15048832	22410628

Source: Study Team

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

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

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

a1-a4: Parameters (See Table 4-5-3)

Table 4-5-3 Parameters of Generation/Attraction Models

Vehicle Classification	a1	a2	a3	a4	r^2
Motor Cycle	0.00041	245.358	206.355	-269.42	0.794
Passenger Car	0.00007	116.126	68.9247	-118.07	0.866
Bus	-0.00018	180.530	185.634	-161.85	0.860
Truck	0.00004	215.891	77.8859	-208.95	0.747

Note, r^2 Correlation Coefficient

Source: Study team

The dummy variables are 0 for the most of zones and 1 for the zones as shown in Table 4-5-4.

Table 4-5-4 Zones with Dummy Variables of 1

Vehicle Classification	Zones
Motor Cycle	7,9,14,20,35,38,40,43
Passenger Car	7,9,14,15,35,36,40,43
Bus	14,35,40,42,43
Truck	4,7,9,31,35,36,43,44

Source: Study Team

Reflecting the present population distribution in the study area, the parameters of population are small, and the inter-zone vehicle trip generation is almost completely decided by the per-capita GRDP, which shows the income level.

Table 4-5-5 shows the calculated future trip generation by the trip generation models and the future socio-economic indicators. The vehicle trips in the study area in 2018 will grow by 3.7 times in buses to 4.8 times in trucks.

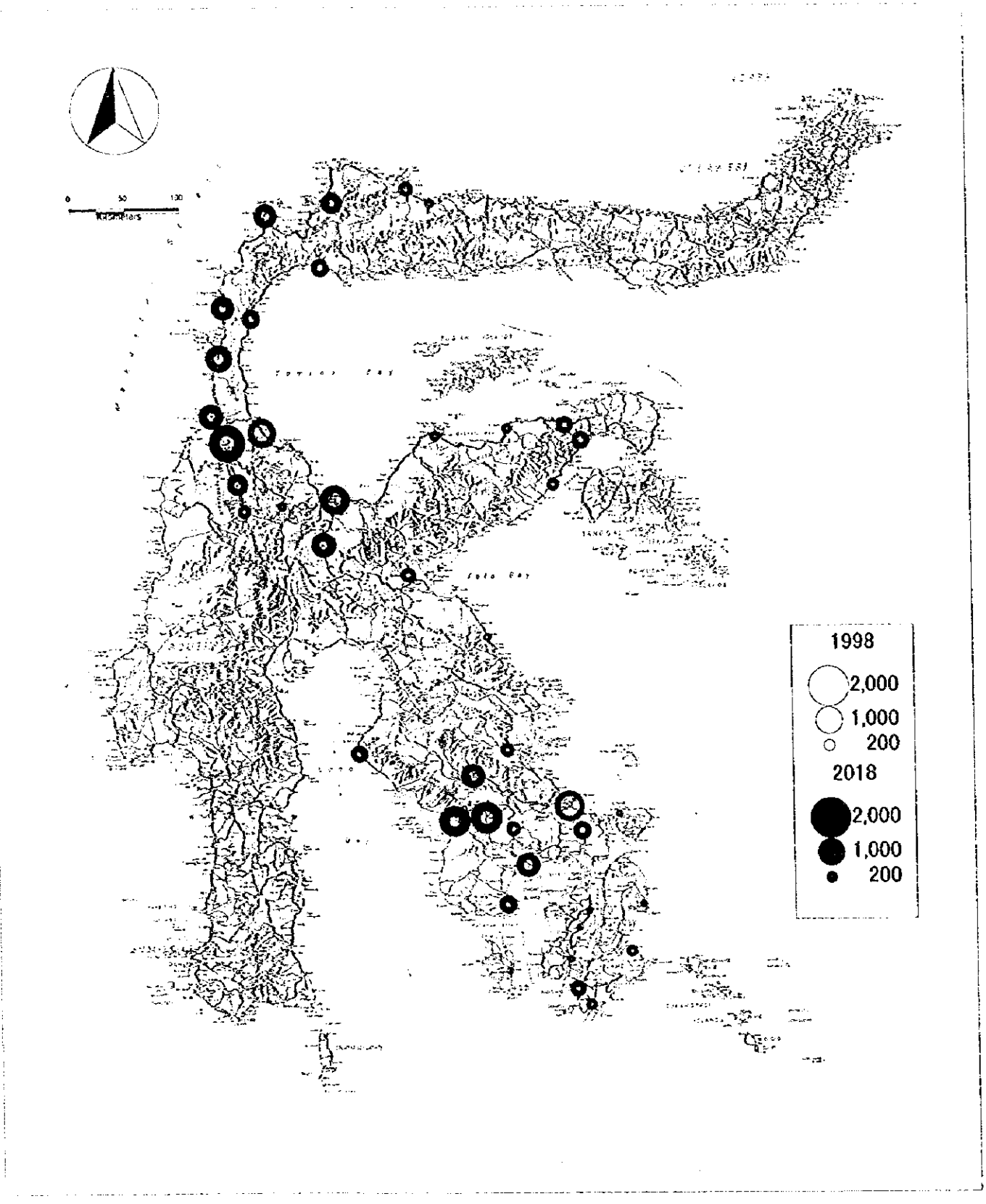
Table 4-5-5 Trips Generation

Unit: vehicles/day

Year	M.Cycle	P.Car	Bus	Truck
Trips				
1998	4,664	1,998	3,845	3,629
2003	6,452	2,652	4,308	4,795
2008	9,941	4,115	6,556	7,656
2013	14,853	6,170	9,706	11,745
2018	21,718	9,047	14,274	17,571
Growth Factor				
1998	1.000	1.000	1.000	1.000
2003	1.383	1.327	1.120	1.321
2008	2.131	2.060	1.705	2.110
2013	3.185	3.088	2.524	3.236
2018	4.657	4.528	3.712	4.842
Annual Growth Rate(%)				
1998-2003	6.71	5.83	2.30	5.73
2003-2008	9.03	9.18	8.76	9.81
2008-2013	8.36	8.44	8.16	8.94
2013-2018	7.89	7.96	8.02	8.39

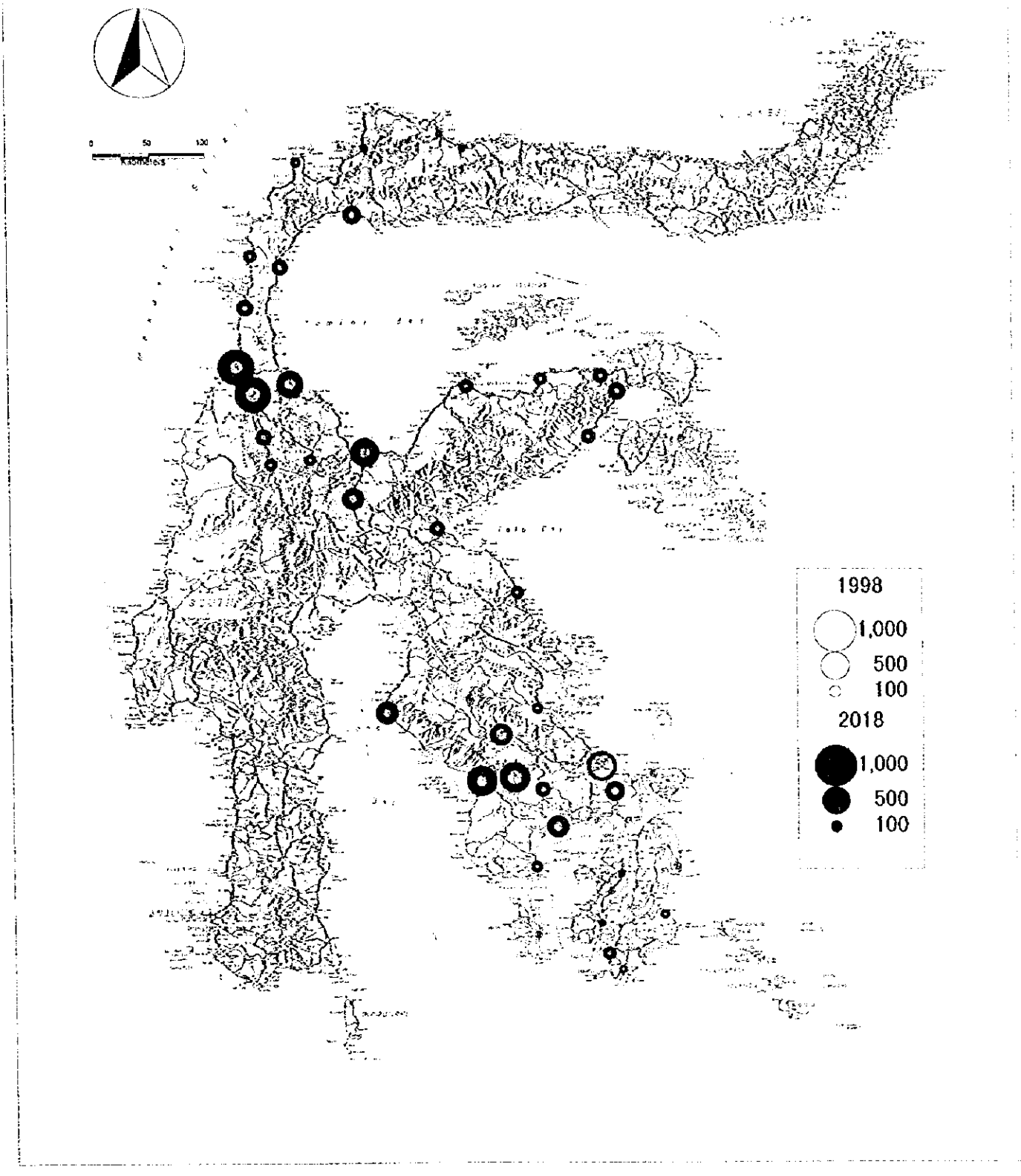
Source: Study Team

The comparison of 1998 and 2018 vehicle trip generation is shown in Figures 4-5-2 through 4-5-5. Most of the vehicle traffic will increase at Palu-Poso-Tentena area in Central Sulawesi, and Kendari-Kolaka area in Southeast Sulawesi. At the west coast of Central Sulawesi, increase of motor cycle use is notable comparing the other areas.



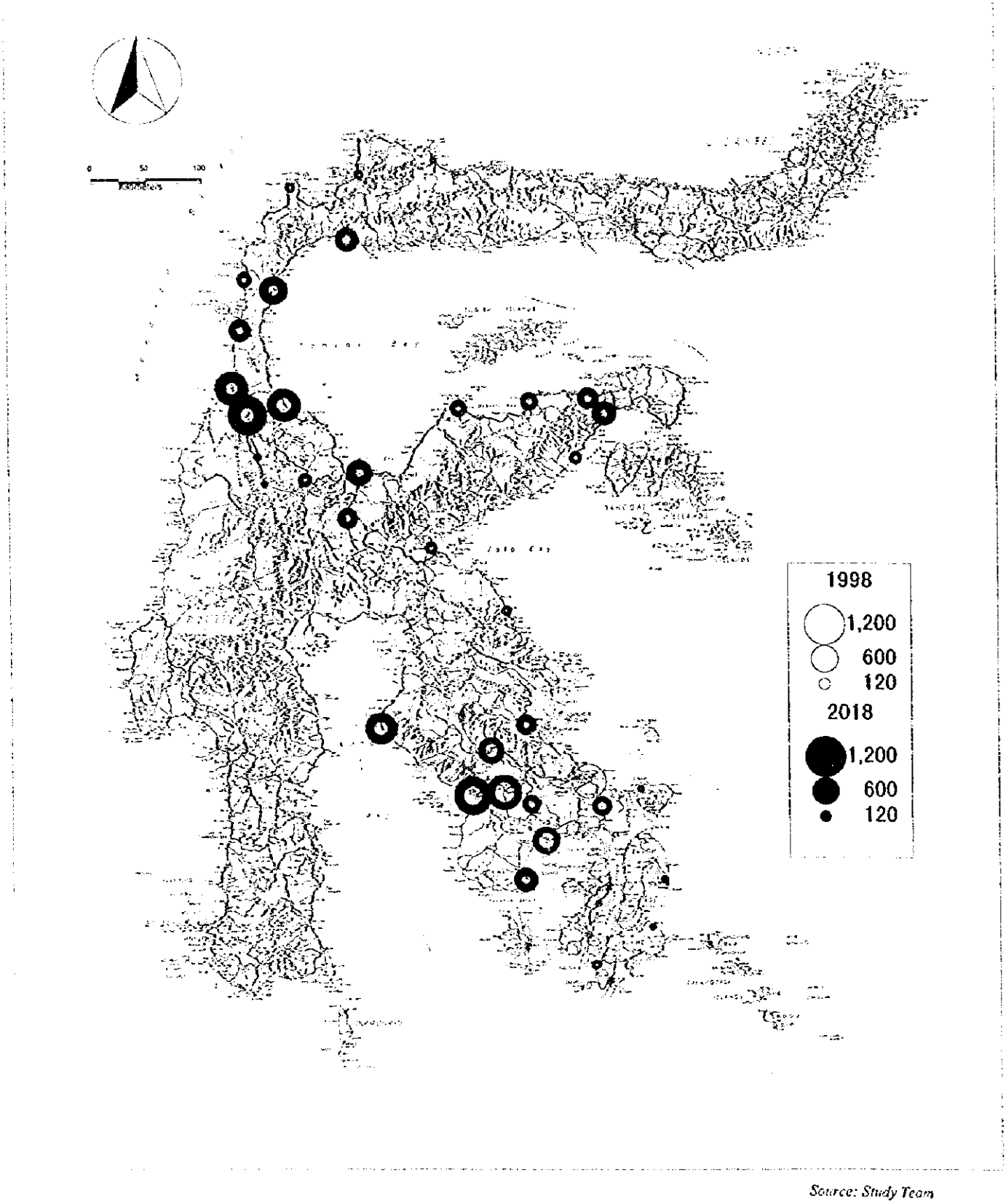
Source: Study Team

Figure 4-5-2 Motorcycle Trip Generation



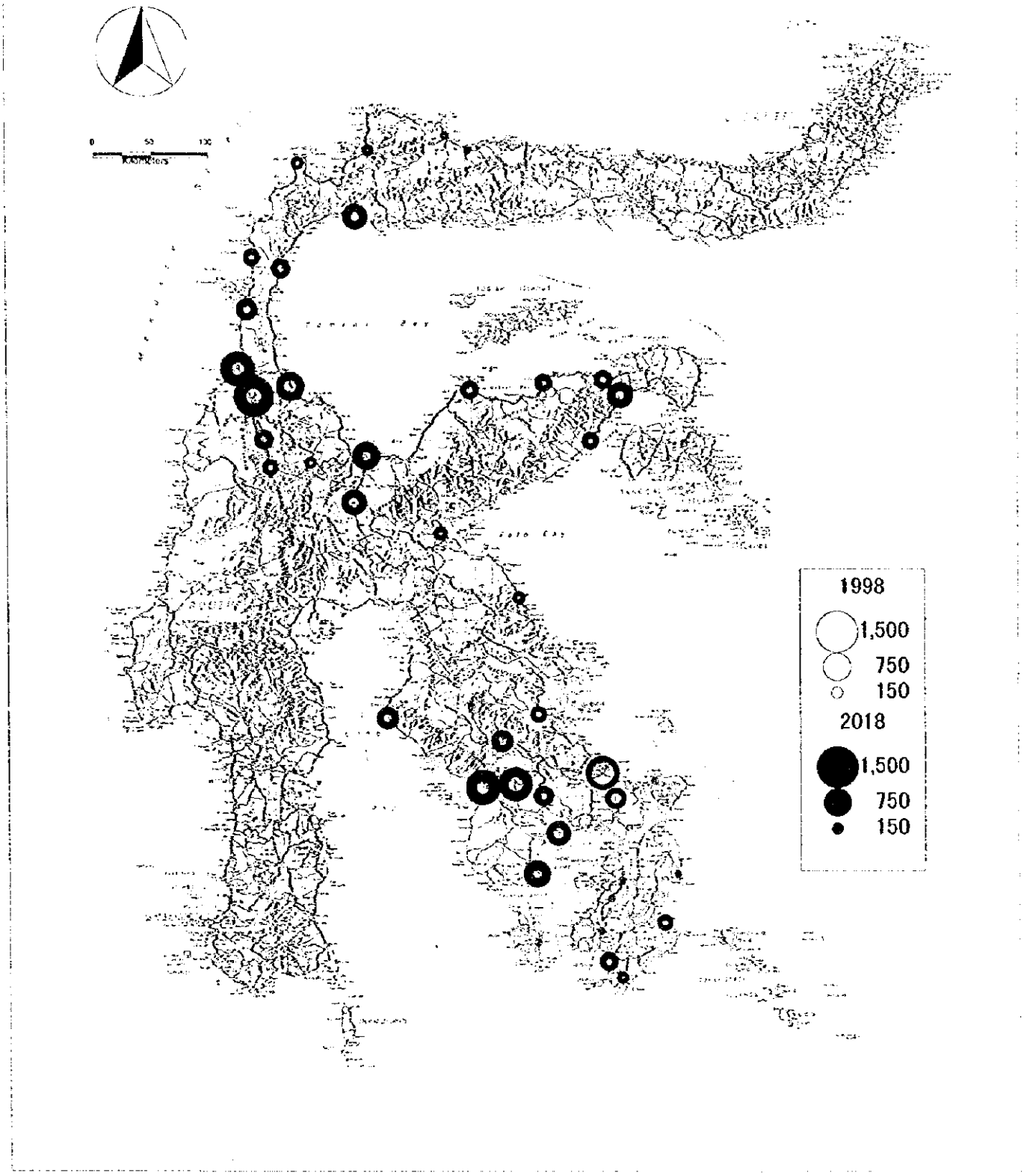
Source: Study Team

Figure 4-5-3 Passenger Car Trip Generation



Source: Study Team

Figure 4-5-4 Bus Trip Generation



Source: Study Team

Figure 4-5-5 Truck Trip Generation

4.5.3 Trip Distribution Model

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

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

where, Tij :Trip between zone i and j
K :Parameter (See Table 4-5-1)
Gi :Generated trips from zone i
Aj :Attracted trips to zone j
Dij :Impedance between zone i and j (Travel time in min.)
a :Parameter (See Table 4-5-5)

Table 4-5-6 Parameters of Trip Distribution Model

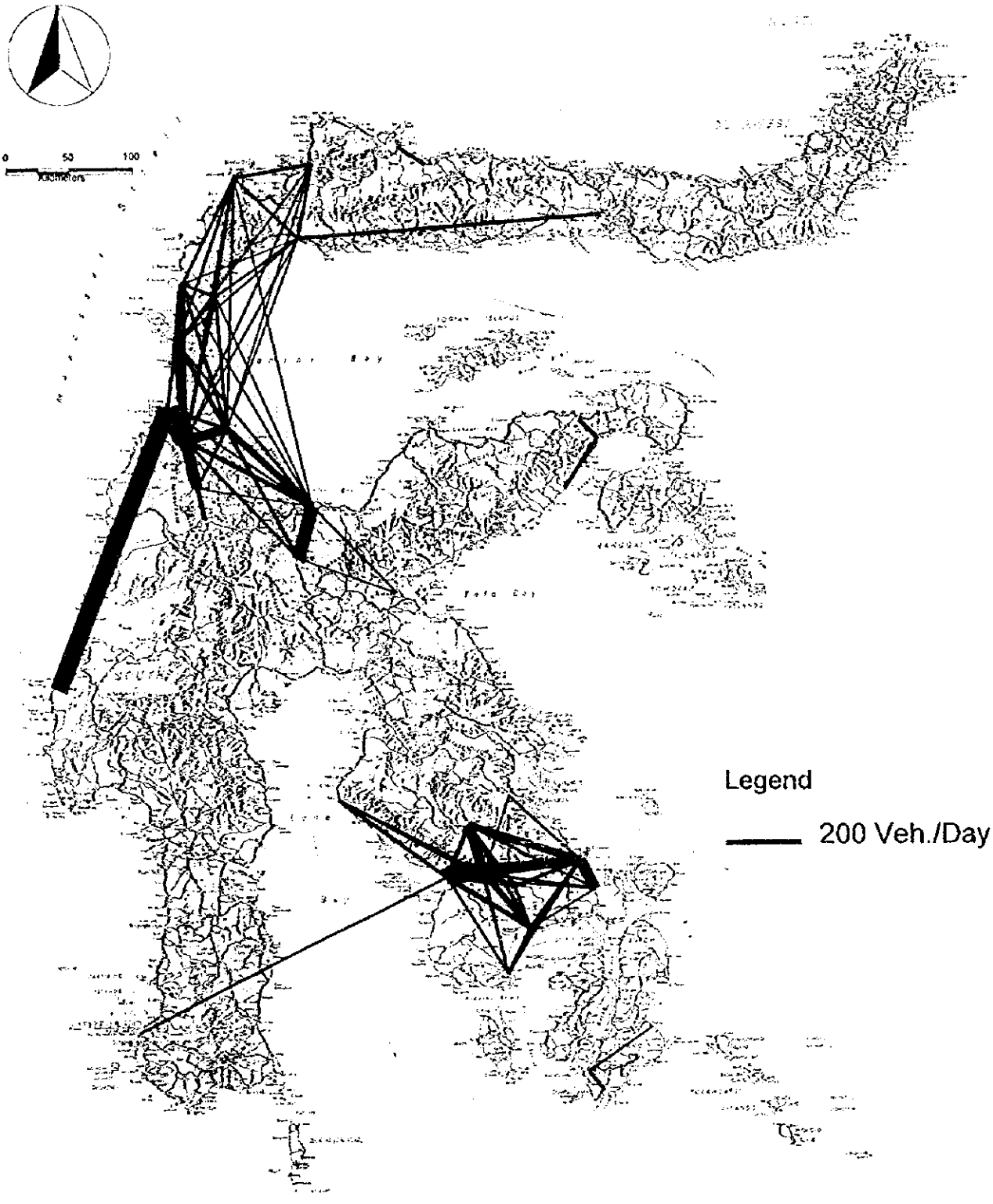
Vehicle Classification	a	K
Motor Cycle	-1.1792	0.8366
Passenger Car	-0.9108	0.7313
Bus	-0.9447	0.7005
Truck	-0.6197	0.6905

Source: Study Team

After calculating *Tij* applying the trip distribution model, the total of *Tij*s are adjusted to the generated/attracted trips by Frator method.

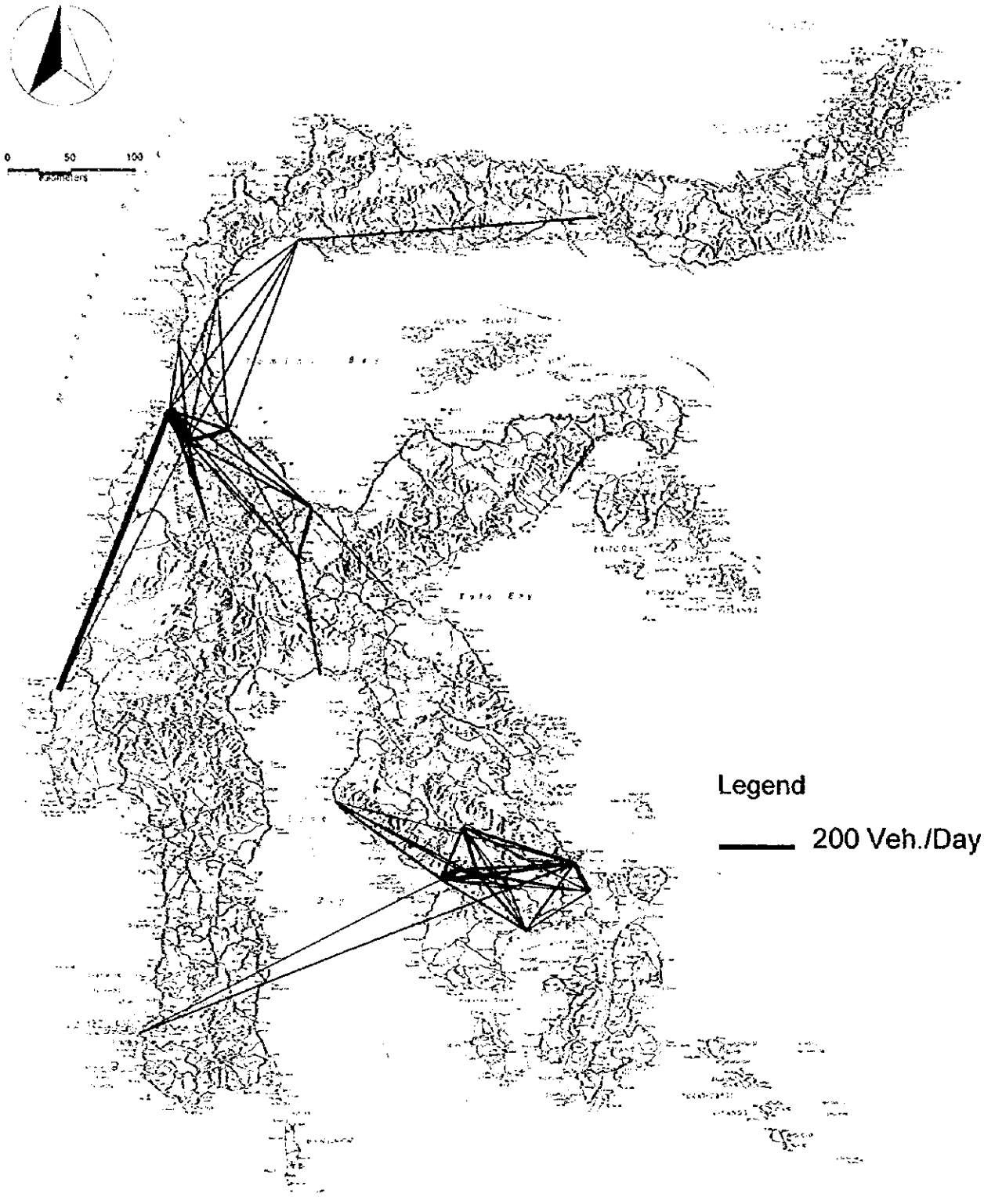
The future OD matrices were developed applying the future vehicle trip generation to the trip distribution models. The cordon trips were estimated applying the average trip growth factors in Table 4-5-6 and the present patterns.

Figures 4-5-6 through 4-5-9 show the calculated results of the 2018 future vehicle trip distribution in desire lines. Motorcycles and passenger cars show relatively short-distance trips, while buses and trucks show more long-distance trip. Trips between Central and Southeast Sulawesi, which are very few at present, will increase by the development of road network in the future.



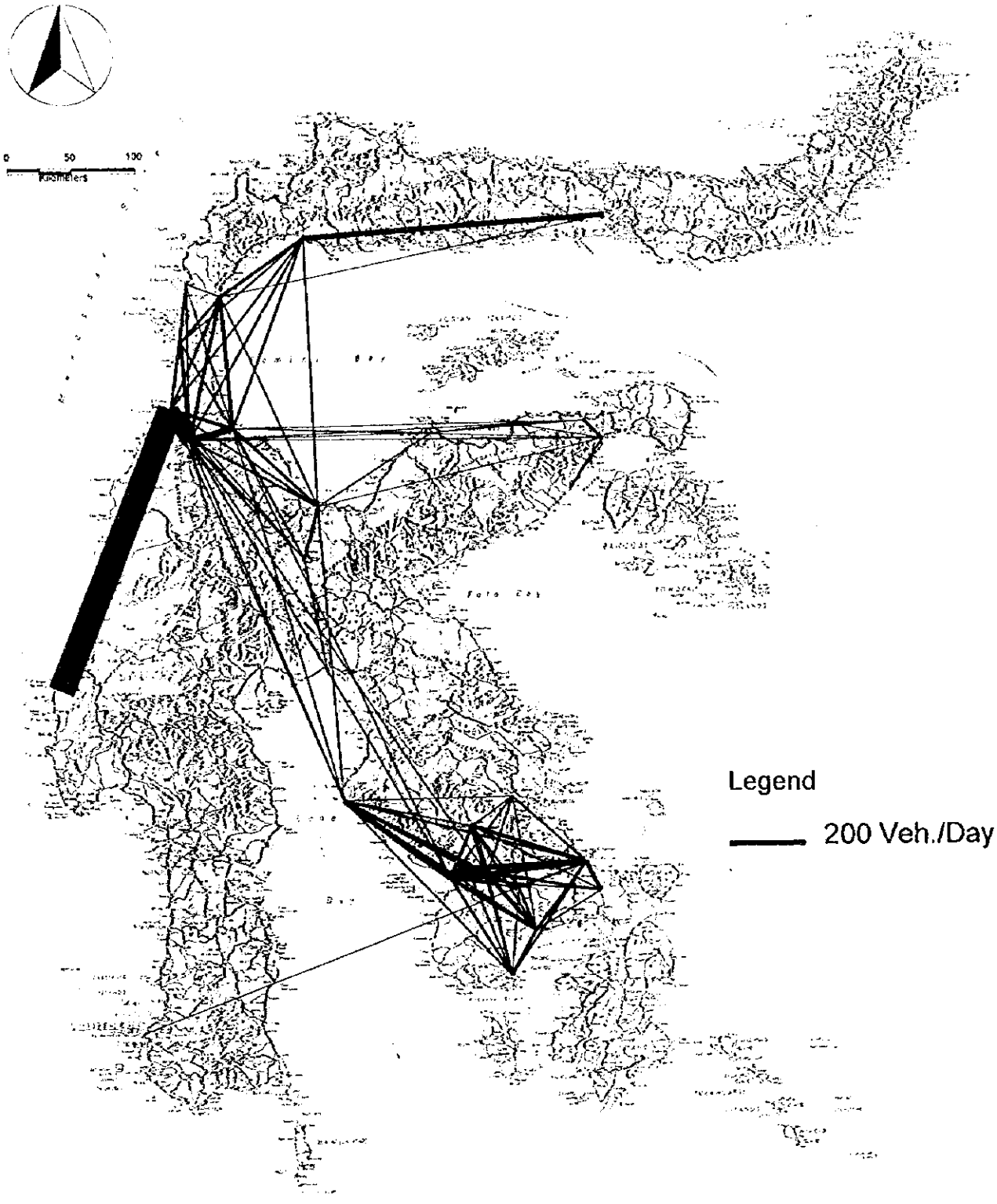
Source: Study Team

Figure 4-5-6 2018 Desire Line for Motorcycles



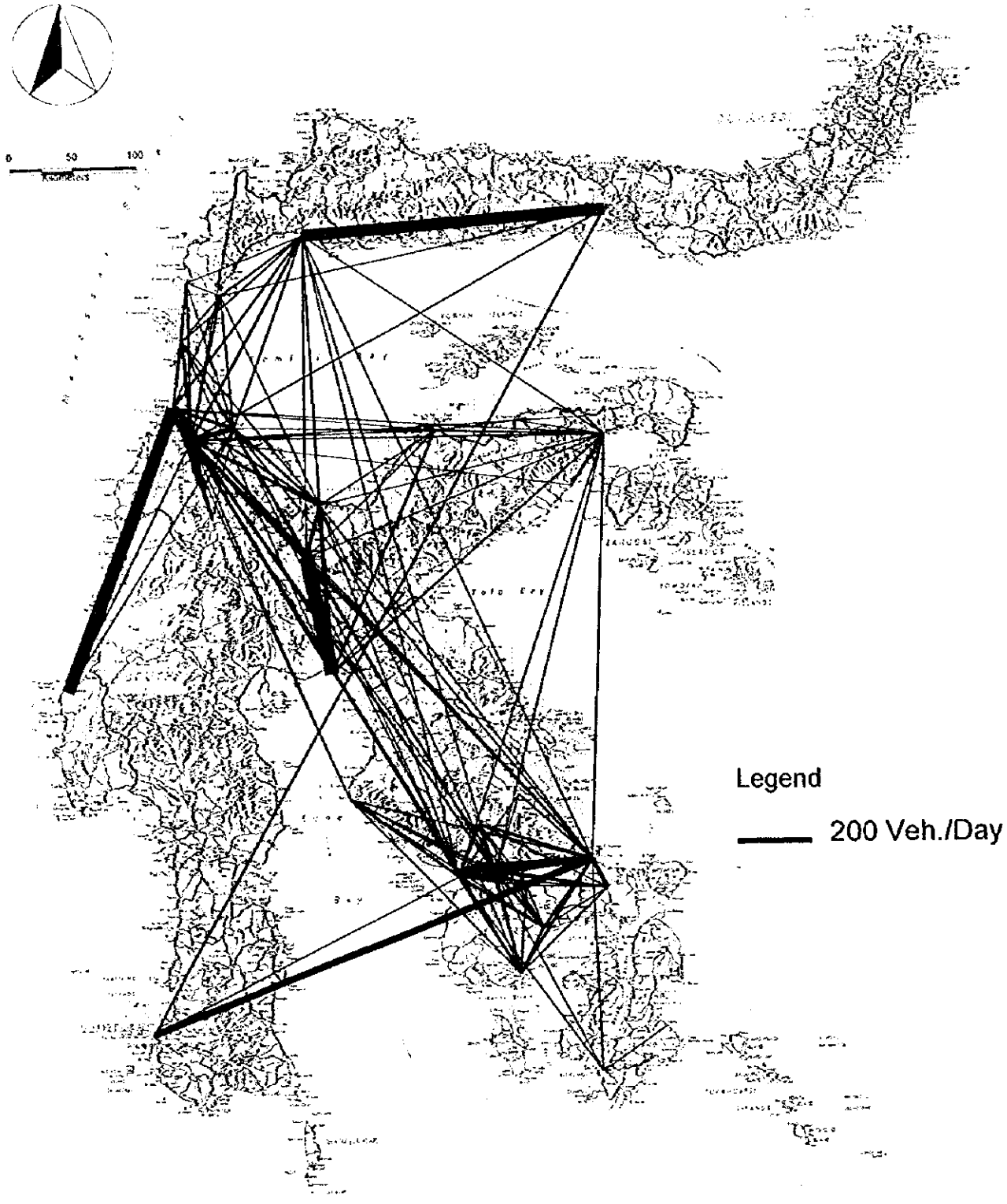
Source: Study Team

Figure 4-5-7 2018 Desire Line for Passenger Cars



Source: Study Team

Figure 4-5-8 2018 Desire Line for Buses



Source: Study Team

Figure 4-5-9 2018 Desire Line for Trucks

4.5.4 Assignment Model

(1) Network Development

The road network in the study area was developed based on the road inventory data in Bina Marga in Jakarta, Palu and Kendari. The roads, which are classified into national, provincial and kabupaten roads, are divided in links, and they are subdivided into sub-links and sections according to road conditions such as carriageway width, surface type, and shoulder type and width. All sections of national and provincial roads were compiled in Bina Marga Jakarta with information on the present traffic volume and International Roughness Index (IRI). The sections are coded by province code (2 digits), sequence number of links (3 digits), sub-link number (1 digits) and section sequence number (2 digits). For the kabupaten roads, kabupaten codes such as "PO" for Kabupaten Poso, for example, were attached in the study instead of the province codes. The sections were further sub-divided into flat and mountainous area by topographic features. The total section number in the network was 1723.

(2) Free Flow Speed

The free flow speed was calculated following the Transport and Road Reserch Laboratory (TRRL) Kenya speed equations for utility cars as the representative vehicle, described as an alternative model in Highway Design and Maintenance Standard Model III of World Bank (HDM-III) manual;

$$S = \frac{2}{\frac{1}{Su} + \frac{1}{Sd}}$$

$$Su,d = a1 - a2 \times RF - a3 \times C - a4 \times BI - a5 \times A - a6 \times Max((5 - W),0)$$

Where, S :Round trip journey speed (Km/h)
Su :Up-hill segment speed (Km/h)
Sd :Down-hill segment speed (Km/h)
RF :Average Rise+Fall (m/Km)
C :Average horizontal curvature (Degree/Km)
BI :Roughness (m/Km)
A :Altitude (m)
W :Carriageway width (m)
a1-a6 :Parameters (See Table 4-5-6)

Table 4-5-7 Parameters in Speed Formula (1)

	a1	a2	a3	a4	a5	a6
Unpaved Road						
Su	80.3	0.317	0.0966	0.001	0.0028	4.32
Sd	80.3	0.059	0.0966	0.001	0.0028	4.32
Paved Road						
Su	89.7	0.418	0.0738	0.001	0.0028	7.31
Sd	89.7	0.0496	0.0738	0.001	0.0028	7.31

Source: Study Team

The equation can be simplified, assuming the standard RF and C for the links in flat and mountainous areas based on the measurements in Tawaeli-Toboli Road and others in the study area, as follows;

$$Su,d = A - B \times BI - C \times Max((5 - W),0)$$

where, *Sud* :Free flow speed (Km/h)
A :Parameter (See Table 4-5-8)
B :Parameter (See Table 4-5-8)
C :Parameter (See Table 4-5-8)
W :Road width (m)
BI :Roughness (mm/Km)

For the links where BIs are not described in the Bina Marga road inventory, the standard values were assumed as in Table 4-5-8. Most of these links are kecamatan roads.

Table 4-5-8 Standard Alignment Values

	RF(m/Km)	C(Degree/Km)	BI(mm/Km)
Flat Area			
Paved Road	30	100	6,000
Gravel Road	30	150	10,000
Earth Road	30	150	14,000
Mountainous Area			
Paved Road	60	250	6,000
Gravel Road	60	350	10,000
Earth Road	60	350	14,000

Source: Study Team

For the links having the carriageway width of less than 2.5m, the free flow speed was assumed to be zero, as four wheel vehicles cannot pass. The present carriageway width and the surface conditions (paved/gravel/earth) of the national, provincial and kabupaten roads were derived from the road inventory data of Bina Marga in Jakarta, Palu and Kendari.

Table 4-5-9 Parameters in Speed Formula (2)

	Su			Sd		
	A	B	C	A	B	C
Flat Area						
Paved Road	69.78	0.001	7.31	80.83	0.001	7.31
Unpaved Road	56.30	0.001	4.32	64.04	0.001	4.32
Mountainous Area						
Paved Road	44.78	0.001	7.31	66.88	0.001	7.31
Unpaved Road	26.08	0.001	4.32	41.56	0.001	4.32

Source: Study Team

(3) Final Speed

The final speed was calculated by the following BPR (Bureau of Public Road, USA) formula after assigning the link flow.

$$Tc = To \times (1.0 + k \times (V/C)^{4.0})$$

where, *Tc*: final travel time
To: travel time by free flow speed
V/C: volume capacity ratio
k: parameter(0.15)

(4) Assignment Method

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

(5) 2018 Master Plan Network Configuration

The links in the 2018 Master Plan network was assumed to be improved as the following conditions;

Minimum carriageway width:	4.5m
Surface:	Asphalt paved
BI:	6.0 m/Km

The total network length to be improved in the two provinces is 4,966 Km, of which 1,745 Km or 35.1% is subject to overlay.

(6) Master Plan Flow

Traffic assignment of motorcycle and four-wheel vehicle for year 2003 and 2018 was conducted for the master plan network. Table 4-5-10 indicates the growth factors at present and in the future by road links.

Table 4-5-11 Growth Factors of Link flows

1997=1.00

Project Package	2003				2018			
	M.C	P.C	Bus	Truck	M.C	P.C	Bus	Truck
1	1.69	1.54	1.76	1.59	6.20	6.20	6.58	5.96
2	2.01	1.00	1.58	1.57	5.76	4.47	4.50	5.81
3	2.40	0.71	1.92	1.64	7.74	3.29	8.42	8.18
4	1.75	0.86	1.13	1.00	0.61	3.17	0.79	1.08
5	1.22	1.33	1.12	1.32	4.78	4.53	3.71	4.84
6	0.96	1.15	1.00	1.25	5.00	4.85	3.62	4.92
7	2.78	1.31	1.67	2.10	11.46	7.27	6.05	9.14
8	1.76	1.87	3.54	3.29	5.03	6.53	12.40	11.95
9	1.38	1.81	1.70	1.87	3.28	6.14	4.28	5.21
10	1.80	1.84	2.65	2.00	11.58	12.16	13.20	11.44
11	4.25	2.82	3.85	3.94	14.53	10.80	12.77	13.74
12	3.31	2.32	2.31	2.68	14.65	10.39	8.52	10.06
13	1.27	1.36	1.08	1.54	5.09	5.36	5.15	6.29
14	0.78	1.05	0.64	1.54	0.82	1.86	0.67	1.48
15	10.33	16.50	22.57	28.78	22.85	42.50	44.79	62.61
16	13.53	5.90	13.03	13.57	19.29	8.88	14.37	18.40
17	1.68	1.93	1.90	1.96	4.92	6.59	4.70	5.73
21	1.10	0.93	1.19	1.08	5.50	5.47	3.69	5.19
26	1.38	1.33	1.12	1.32	4.66	4.53	3.71	4.84
29	1.67	1.61	1.71	2.11	11.57	7.91	4.82	14.41
30	1.80	1.46	1.61	1.67	3.05	1.98	1.55	2.75
31	0.99	0.87	0.97	1.02	4.40	7.20	2.47	3.33
32	6.71	8.85	4.88	9.02	9.10	12.00	4.91	11.64
34	4.09	3.40	3.74	3.67	6.41	5.13	3.89	4.96
35	1.49	2.94	2.06	1.43	2.88	5.56	2.91	2.18
36	2.32	2.08	1.60	1.76	7.68	4.92	2.50	3.97
37	1.50	1.26	1.19	1.81	2.73	1.92	0.73	3.21
39	2.14	1.67	12.00	4.45	22.63	26.67	97.60	33.55
40	1.17	1.09	1.13	1.45	1.25	0.87	0.49	1.07
41	6.84	4.14	18.00	21.50	35.95	26.86	122.0	127.3
42	1.38	1.33	1.12	1.32	4.66	4.53	3.71	4.84
43	0.51	0.30	1.08	0.46	1.38	0.80	1.54	1.05
44	2.37	3.25	2.25	3.75	7.16	6.00	5.25	9.67
46	1.67	1.69	1.64	1.61	3.58	2.42	2.38	2.80

Project Packages with no link flow in 1997 are excluded

Source: Study Team

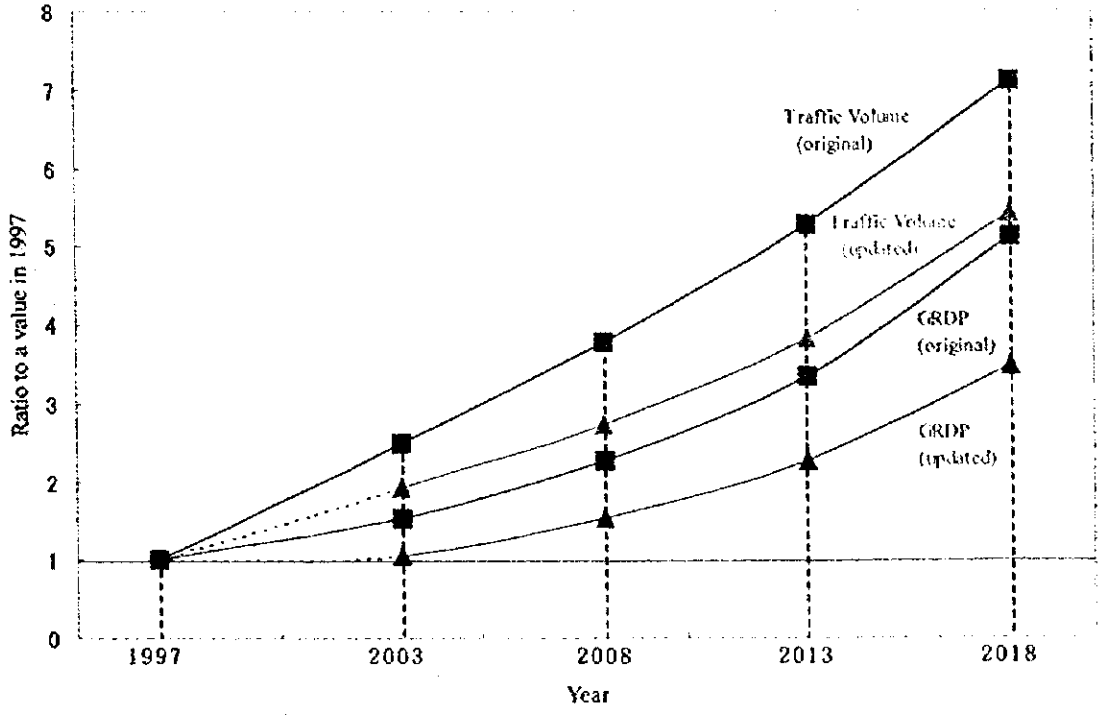
4.6 Review of Future Demand and Forecast

As Indonesia economic growth has been decreased sharply since August 1997, a review of future demand and forecast was conducted based on Section 3.3 of Chapter 3.

There is a close relationship between socio-economic growth and traffic volume increase. The relationship was obtained from the GRDP, population and traffic volume for the years 2003 and 2018 as shown in Figure 4-6-1.

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

Figure 4-6-2 through 4-6-5 shows the 2003 and 2018 traffic volumes of motorcycles and four-wheel vehicles assigned to 2003 and 2018 master plan network. Table 4-6-1 shows traffic volume for each link in year 1997, 2003 and 2018.



Source: Study Team

Figure 4-6-1 Relationship between GRDP and Traffic Volume

Table 4-6-1 Traffic Volume for Each Road Link

unit: Veh./day

Link No.	1997				2003				2018			
	M.C	P.C	Bus	Truck	M.C	P.C	Bus	Truck	M.C	P.C	Bus	Truck
1	303	112	159	231	391	132	214	281	1437	531	801	1053
2	136	15	24	37	210	11	29	44	599	51	83	164
3	112	14	12	28	206	8	18	35	663	35	77	175
4	79	7	16	18	106	5	14	14	37	17	10	15
5	9	7	7	3	8	7	6	3	33	22	19	10
6	53	34	79	151	39	30	60	145	203	126	219	568
7	143	62	144	145	304	63	184	233	1254	345	666	1014
8	692	223	168	305	934	318	454	768	2664	1115	1593	2788
9	716	177	319	390	746	268	438	658	1778	907	1102	1841
10	139	64	82	233	191	90	166	356	1232	595	928	2039
11	89	60	86	140	284	129	253	422	989	496	840	1472
12	62	41	95	130	157	73	168	266	695	326	619	1001
13	22	14	13	28	21	15	11	33	86	57	51	135
14	96	21	42	46	57	17	21	54	60	30	21	52
15	33	10	14	18	261	126	242	396	577	352	480	862
16	34	42	35	58	352	190	349	602	502	285	385	816
17	121	27	10	67	155	40	15	100	455	136	36	294
18	0	0	0	0	0	0	0	0	35	20	0	83
19	0	0	0	0	0	0	0	0	352	96	26	204
20	0	0	0	0	0	0	0	0	23	17	12	21
21	20	15	26	26	17	11	24	21	84	63	73	103
22	0	0	0	0	335	162	333	569	441	224	347	750
23	0	0	0	0	0	0	0	0	32	37	28	105
24	0	0	0	0	0	0	0	0	271	9	23	73
25	0	0	0	0	0	0	0	0	8	9	14	19
26	2	6	6	5	2	6	5	5	8	20	18	21
27	0	0	0	0	0	0	0	0	11	21	19	13
28	0	0	0	0	74	41	111	127	1073	571	904	1698
29	144	111	330	161	184	137	432	259	1274	672	1216	1775
30	582	381	823	559	802	426	1011	715	1359	576	974	1175
31	93	15	148	182	70	10	110	142	313	83	280	464
32	78	26	111	87	400	176	415	601	543	239	417	775
33	0	0	0	0	335	162	333	569	450	230	352	769
34	69	30	87	69	216	78	249	194	338	118	259	262
35	77	16	47	82	88	36	74	90	170	68	105	137
36	19	13	30	29	34	21	37	39	112	49	57	88
37	173	78	244	144	199	75	223	200	361	115	135	353
38	0	0	0	0	0	0	0	0	1267	583	929	1246
39	35	9	5	22	57	11	46	75	606	184	373	565
40	310	140	478	267	278	117	415	296	295	93	179	220
41	19	7	1	6	99	22	14	99	522	144	93	584
42	6	6	5	6	7	7	4	6	23	22	13	21
43	39	10	13	41	15	2	11	16	41	6	15	33
44	19	4	4	12	34	10	7	34	104	18	16	89
45	0	0	0	0	0	0	0	0	15	10	10	35
46	412	215	381	264	526	278	478	324	1129	398	694	565
47	0	0	0	0	74	41	111	127	1086	579	912	1726

For the Link locations, see Chapter 6.

Source: Study Team

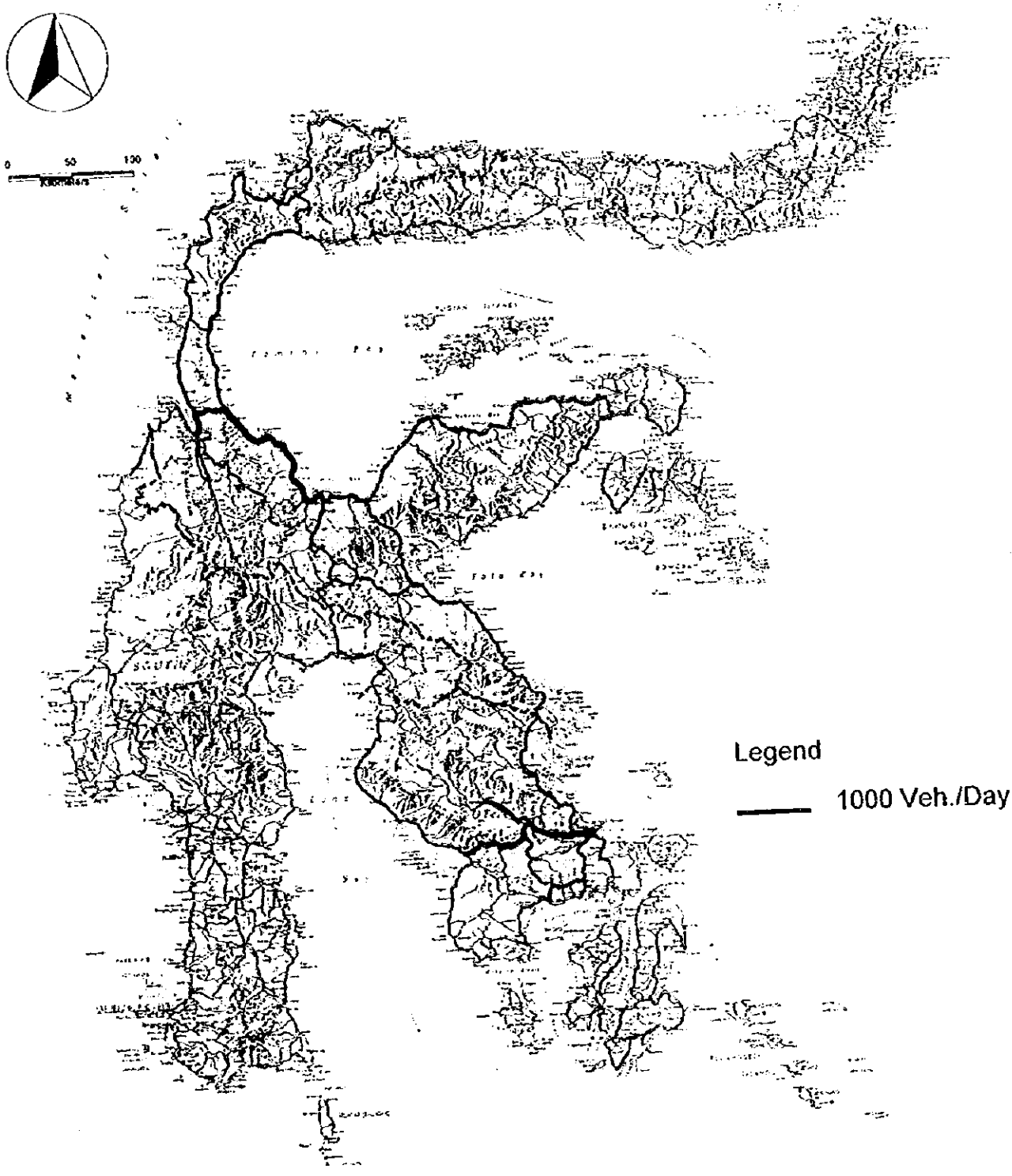


Figure 4-6-2 2003 Motorcycle Flow Assigned to 2003 Master Plan Network

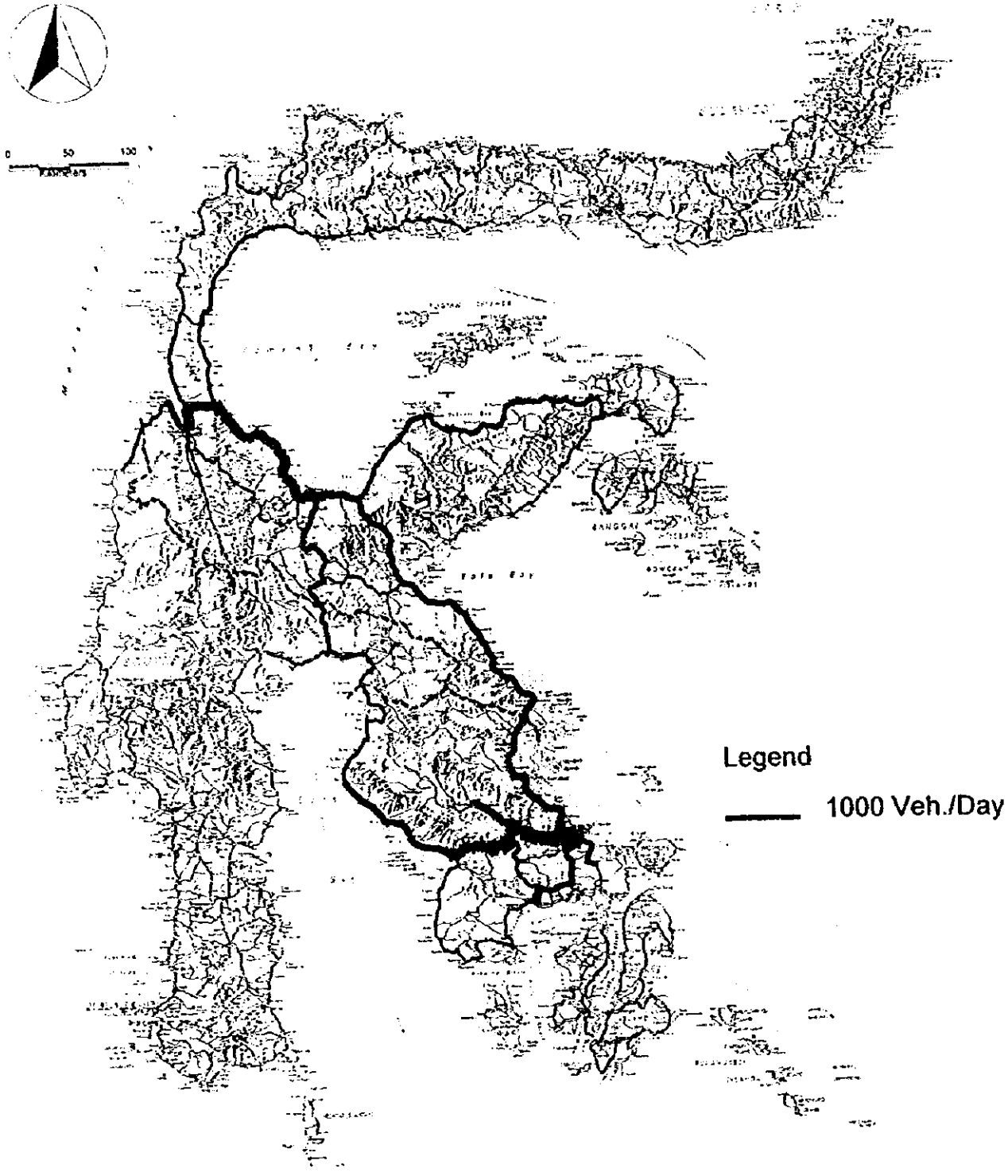


Figure 4-6-3 2003 Vehicle Flow Assigned to 2003 Master Plan Network

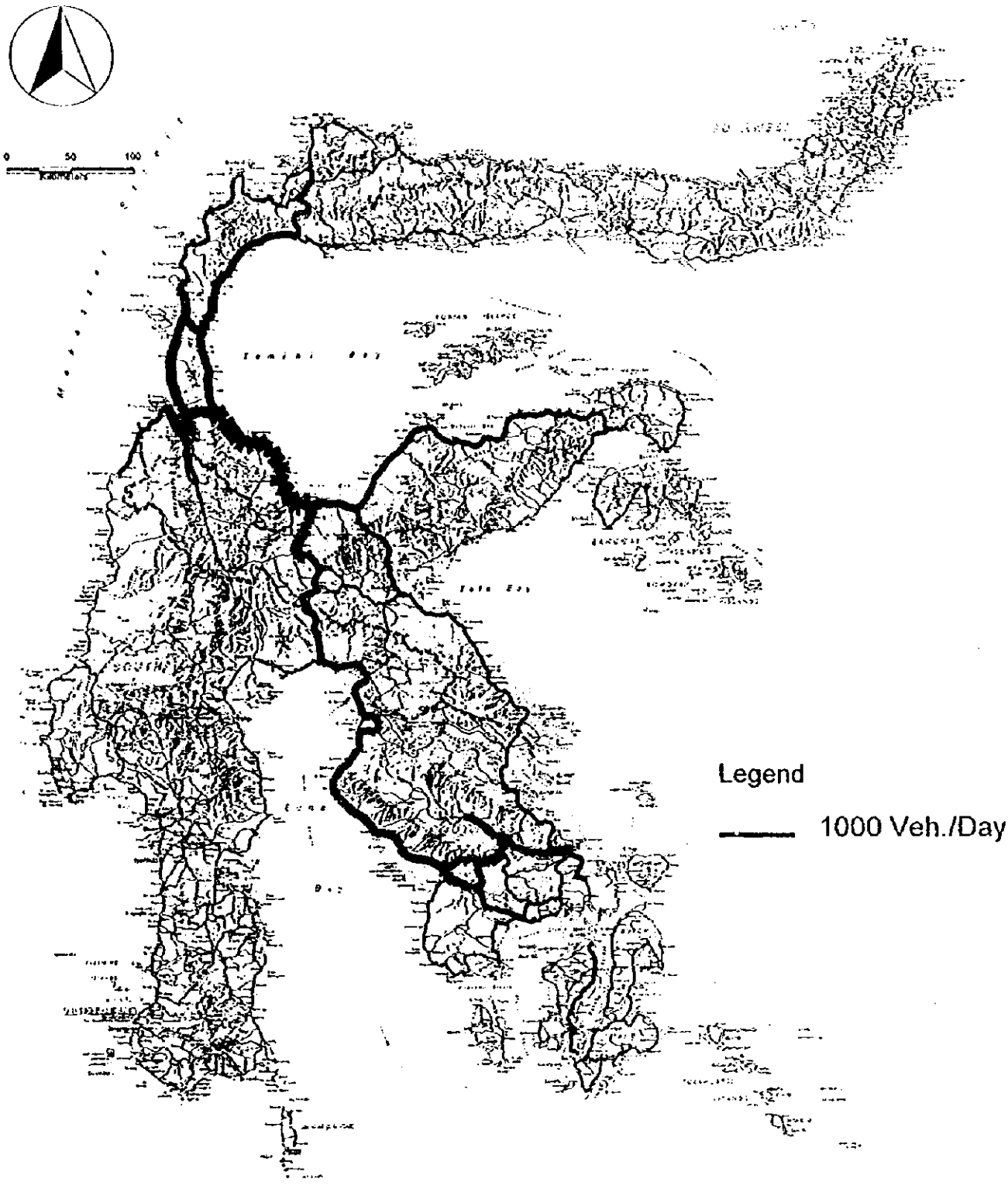


Figure 4-6-4 2018 Motorcycle Flow Assigned to 2018 Master Plan Network

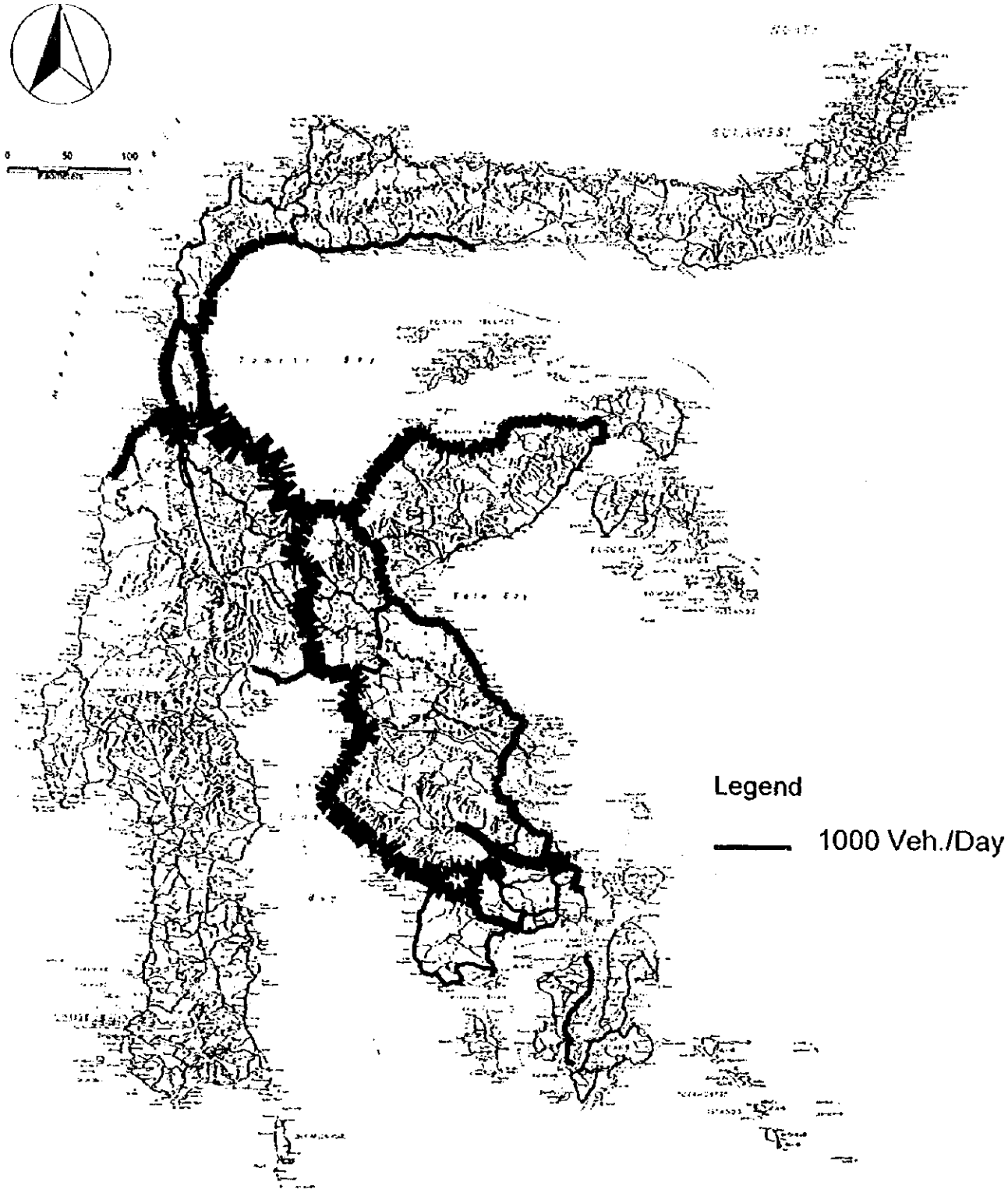


Figure 4-6-5 2018 Vehicle Flow Assigned to 2018 Master Plan Network

Chapter 5
Environmental Consideration for Master Plan

Chapter 5 ENVIRONMENTAL CONSIDERATION FOR MASTER PLAN

5.1 Environmental Management

5.1.1 Environmental Legislation

(1) Government Policy on the Environment

In the Republic of Indonesia, the basic law concerning the environment is Act No.4 of 1982 regarding Basic Provisions for the Management of the Living Environment. As stated in the introduction of the Act, the Basic Environmental Law makes a appeal for protection of the environment while making effective use of natural resources, as stated in the Constitution of 1945. This is in accordance with the increasing worldwide awareness of the environment and the responsibility of each country to carry out environmental management based upon an integrated and comprehensive national policy. The act consists of 9 sections : i. General provisions, ii. Principles and objectives, iii. Rights, obligations and authorities, iv. Protection of the living environment, v. Institutions, vi. Compensation and restoration, vii. Penalties, viii. Transitional provisions and ix. Concluding provisions.

Act No.4 of 1982 takes 'sustainable development' as a basic policy for environmental management. 'Sustainable development' can be defined as development which provides economic, social, and environmental benefits in the long term and for future generations. Establishment of an environmental impact assessment system has therefore been stressed in the act as one of the actions for the protection of environment.

International conventions on environmental conservation which the Government of Indonesia has participated in and/or ratified are listed below;

- Washington Convention, CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora) : Regulated in Presidential Decree No.43 of 1978
- Global Treaty on Cultural Heritage : Participated in 1992
- Ramsar Convention (Convention on Wetlands of International Importance Especially as Waterfowl Habitat) : Regulated in Presidential Decree No.48 of 1991 (Rawa Aopa National Park in Southeast Sulawesi has been proposed as designated wetland in 1996)
- United Nations Law of the Sea Conference : Participated in 1992
- Bio-diversity Treaty : Participated in 1992
- United Nations Framework Convention on Climate Change

(2) Environmental Regulations Related to the Study

Based on the Act No. 4 of 1982, the government has put forward various regulations and decrees on environment management. Table 5-1-1 shows the regulations and decrees related to road engineering and its environment. These will be used as guides for the study.

Table 5-1-1 Environmental Regulations Related to the Study

Number	Content/Description
(1) Government Act	
No. 13 of 1980	concerning roads
No. 4 of 1982	Principles of the Management of Living Environment
No. 5 of 1990	Principles of the Conservation of Ecosystem and Natural Resources
No. 4 of 1992	Housing and Settlement
No. 14 of 1992	Traffic and Transportation
No. 24 of 1992	Land Spacing
(2) Government Regulation	
No. 26 of 1985	Road
No. 51 of 1993	Environment Impact Analysis (AMDAL)
(3) Presidential Decree	
No. 32 of 1990	Conservation Area Management
No. 55 of 1993	Acquisition of Land for the Development of Public Interest
(4) State Minister of Environment Decree	
No. KEP-49/MENKLH/1/1987	Guidelines for the Determination of Significant Quality
No. KEP-50/MENKLH/1/1987	Guidelines for the Analysis of Environmental Impacts of Proposed Projects
No. KEP-02/MENKLH/1/1988	Manual on Determining Standard Environmental Quality
No. KEP-39/MENLH/8/1988	Types of Businesses or Activities Required for AMDAL
No. KEP-11/MENLH/3/1994	General Guideline on Environmental Impact Analysis
No. KEP-14/MENLH/3/1994	General Guidelines for AMDAL
No. KEP-14/MENLH/8/1996	AMDAL Screening
(5) Head of the Environmental Impact Management Agency Decree	
No. KEP-056/1994	Guidelines for the Determination of Significant Impact
(6) Ministry of Public Works Regulation	
No. 46/PRT/1990	Technical Manual on Environmental Impact Assessment
No. 69/PRT/1995	Technical Guidelines of AMDAL of Public Works Projects
(7) Ministry of Public Works Decree	
No. 126/KPTS/1990	Determination of Projects in Public Work Department which need AMDAL
No. 779/KPTS/1990	Technical Manual of Road and Bridge Projects
No. 506/KPTS/1992	Guideline of AMDAL, Department of Public Works (DPU)
No. 211/KPTS/1994	Organization and Working Procedures of DPU
No. 04/KPTS/1995	Formation of AMDAL Central Committee in DPU
No. 58/KPTS/1995	AMDAL Approval Guidelines
No. 147/KPTS/1995	Technical Guidelines of KA-ANDAL of Public Works Projects
No. 148/KPTS/1995	Technical Guidelines of RKL and RPL
No. 296/KPTS/1996	Technical Guidelines of UKL and UPL
No. 40/KPTS/1997	Technical Guidelines of AMDAL (for Road Project)
(8) Minister of Agriculture / Head of National Land Agency Regulation	
No. 1 of 1994	Land Acquisition
(9) Environmental Management Agency Decree	
No. KEP-56 of 1994	Guideline for Determination of Important Impact

Source : JICA Study Team

5.1.2 Environmental Impact Assessment

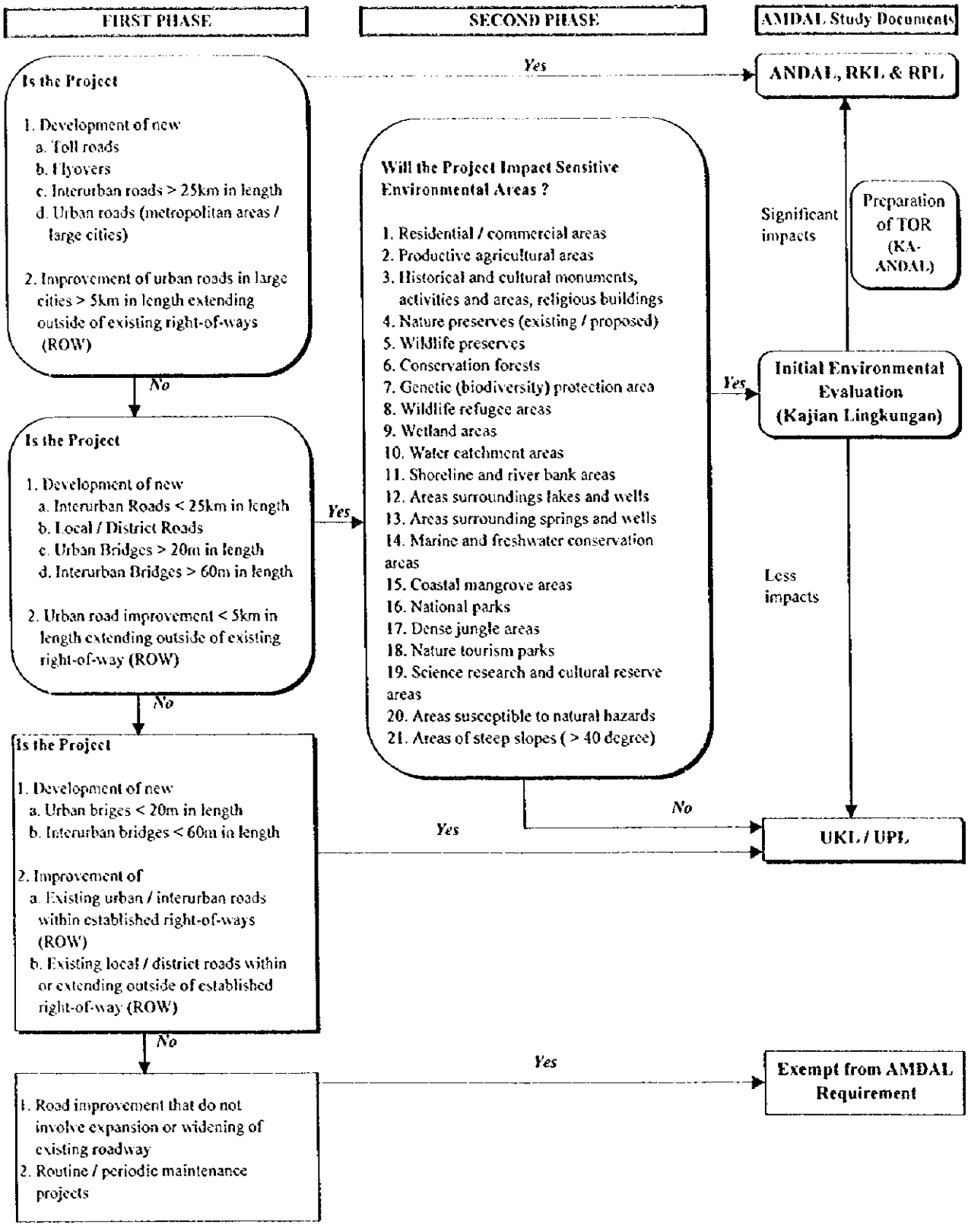
(1) Procedures of Environmental Impact Assessment

Article 3.13 of Act No. 4 of 1982 prescribes that every plan which is considered likely to have a significant impact on the environment must be accompanied with an environmental impact assessment (AMDAL). An environmental impact assessment system has been established accordingly to meet this requirement. Figure 5-1-1 shows a cycle of environmental impact control measures, including flow chart of AMDAL process. The type of businesses and activities for which AMDAL is required are specified in the Decree of the State Minister of Environment No. KEP-39/MENLH/8/1996 according to the scale of the project. Meanwhile, in recent years, the respective AMDAL Sections of BIPRAN and BINKOT were created by Bina Marga to facilitate the environmental reviews and management of their relevance to inter-urban and urban road projects. AMDAL process is specified in Government Regulation No. 51 of 1993 and surmised in the report "Overview of the Approach to Environmental Management at Bina Marga" prepared by Louis Berger International, Inc. AMDAL screening process and its procedure are shown in Figure 5-1-2 and 5-1-3.

For projects which need the AMDAL, a Terms of Reference of Environmental Impact Assessment (KA-ANDAL) must be submitted for approval before the AMDAL study. The output of the AMDAL includes an Environmental Impact Statement (ANDAL), Environmental Management Plan (RKL) and Environmental Monitoring Plan (RPL).

At the national level, the Ministry of State for the Environment is responsible for environmental management along with the Ministry of Public Works for public works projects. The Central Commission of AMDAL is organized within the Ministry of Public Works with its chairman appointed by the Minister. At the provincial level, this task is taken by the Regional AMDAL Commission which is organized within the provincial government with its chairman appointed by the governor.

Regarding the projects which do not need AMDAL, an Effort of Environmental Management (UKL) and Environmental Monitoring (UPL) may still be required according to the project contents and its scale.

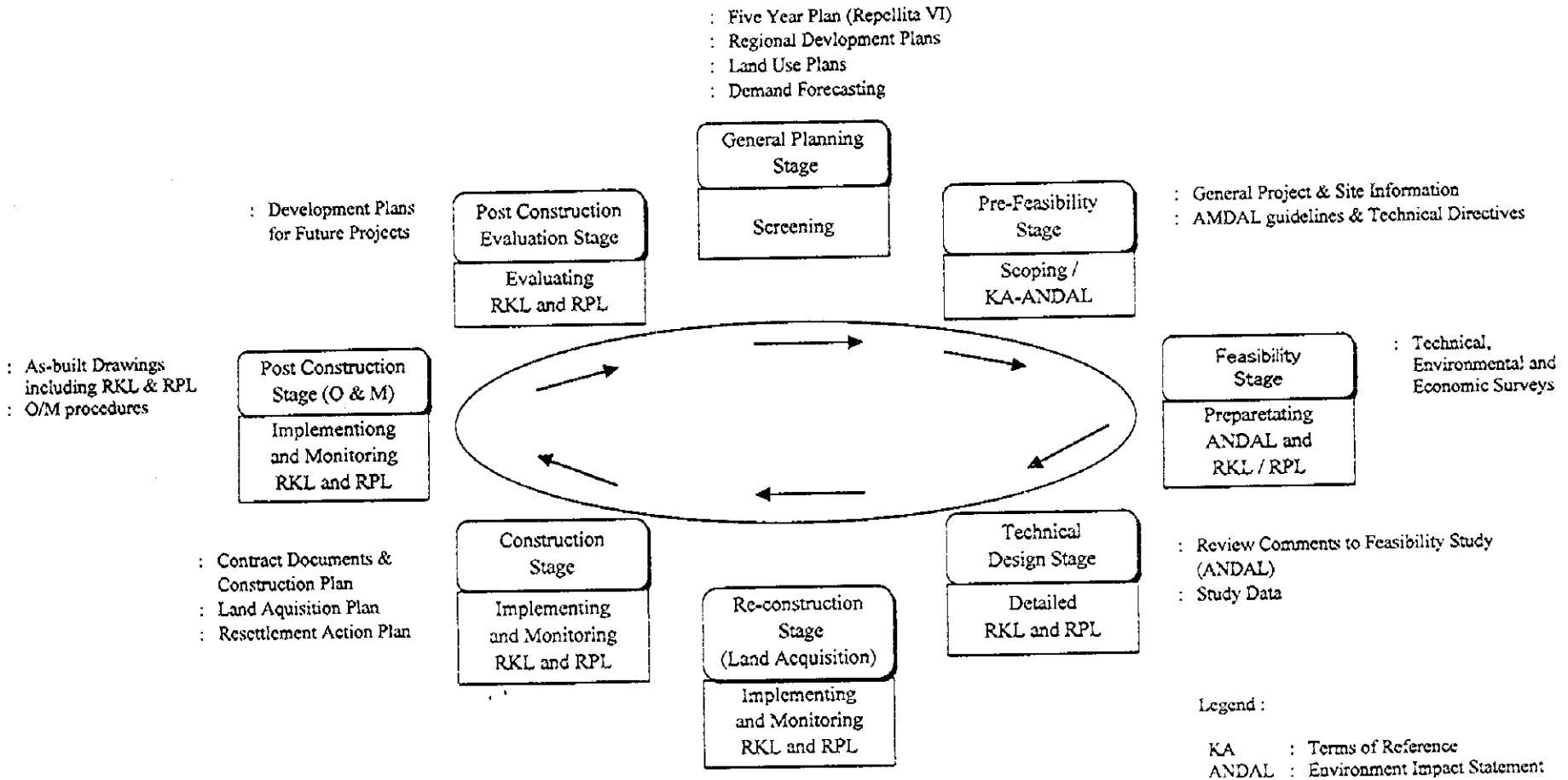


Legends :
KA : Terms of Reference
ANDAL : Environmental Impact Statement
AMDAL: Environmental Impact Analysis
RKL/UKL : Environmental Management Plan
RPL/UPL : Environmental Monitoring Plan

(Source : Binkot Section AMDAL, Consultant Translation, SURIP #2/Screen)

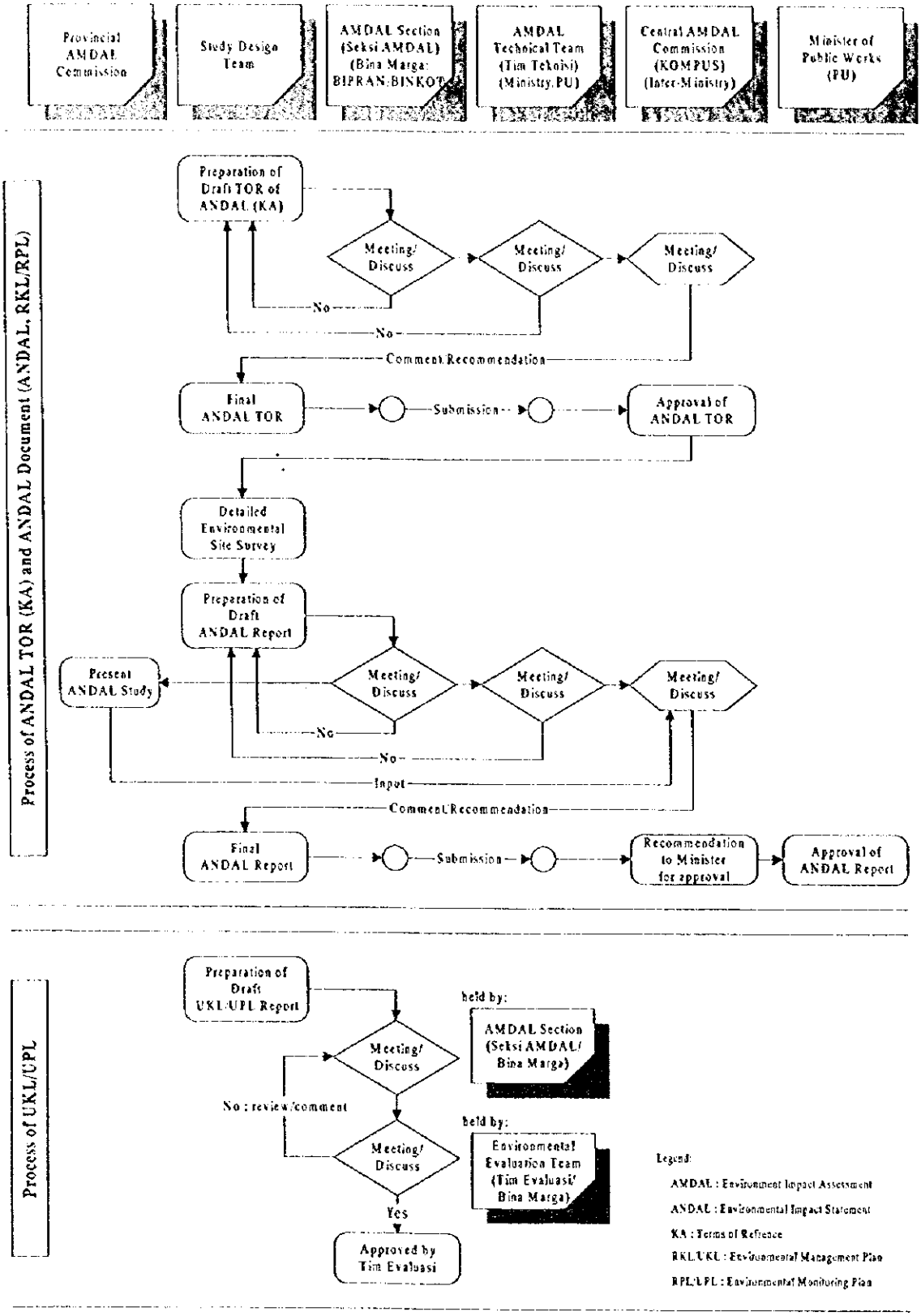
Source: Study Team

Figure 5-1-1 Cycle of Environmental Impact Control Measures



Source: Study Team

Figure 5-1-2 AMDAL Screening Process for Road and Bridge Projects



Source: Study Team

Figure 5-1-3 Procedure of Environmental Management

5.2 Present Environmental Conditions

5.2.1 General Description

(1) Central Sulawesi Province

Central Sulawesi is the most forested and least populated province in Sulawesi, with a land area of nearly 6.4 million hectares. Even with a population of approx. 1.3 million and a growth rate of 3.5 % (including transmigrates), population density of the province is only 22 persons per km^2. Forests cover 64 % of the land and over 95 % of the province's income is derived from timber exports, mainly ebony.

The province consists of high, steep mountains, broad lakes (Danau Poso, Lindu), rivers and valleys, a varied coastline and many offshore islands (Kep. Togian, Banggai). Mt. Sonjol, the highest point, is 3,225 m above sea-level. The mountainous areas are infertile and poor for agriculture, being mostly granite in the west and ultra-basic and/or limestone in the east. The human population is concentrated around the coast and/or large lakes and few people inhabit the mountainous areas.

Central Sulawesi remains one of most culturally diverse provinces in Indonesia. Government publication list 12 different ethnic groups and 24 distinct languages for the province.

The provincial capital, the coastal town of Palu, lies in the driest place in Indonesia with only 300-800 mm rain per year. The province is divided into four Kabupatens - Banggai, Buaol Toli Toli, Donggala and Poso.

(2)Southeast Sulawesi Province

Southeast Sulawesi is a low-lying province of many wetlands, with a land area of nearly 3.8 million hectares including the offshore islands of Buton, Muna, etc. Its population is 1.22 million. The province is still the remotest and least developed area among four provinces in Sulawesi.

The northern part of the peninsula of Southeast Sulawesi province is mountainous. Mt. Mekongga, the highest place, is 2,790 m above sea-level. The southern plains are covered in the west with forest, and in the east with grass fields, including *Savannah*, while low lying area around Aopa is mostly wet/swamp-land.

The provincial capital, Kendari is located on the eastern edge of the province. The province is divided into four kabupatens - Buton, Kendari, Kolaka and Muna. Ethnically, the inhabitants of the province can be divided into two main groups - the mainland Tokali and the offshore islanders of Muna and Buton islands. Bugis and Makassarese immigrants from South Sulawesi province have settled along the coasts, and more recent arrivals include transmigrates from Java, Bali and Lombok.

5.2.2 Natural Environment

(1) Topography and Geology

The details of geological features of Central and Southeast Sulawesi have already been described in Chapter 2, Section 2.5 of this report, and its topographic features are briefly described in Article 5.2.1.

(2) Fauna and Flora

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

Topographically, Sulawesi is very mountainous. Most of the island lies above 500 meters, and one-fifth lies 1000 meters above sea-level. Forest types on the island reflect the geological diversity. Tropical rain-forest is found on volcanic soil. The limestone and basic grounds are poor, though, and their trees do not attain such heights as in the rain-forest. Both limestone and basic mountain areas have their own characteristic flora.

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

1) Fauna

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

A list of protected fauna in Sulawesi is shown in Table 5.2-1.

Table 5-2-1 Protected Fauna in Sulawesi

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

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

2) Flora

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

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

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

(3) Conservation Areas

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

The conservation area system is managed by PHPA. Two Directorates of PHPA are concerned specifically with conservation areas: (i) the Directorate of Nature Conservation is responsible for overall planning of the protected area system, drafting conservation legislation, and proposing, establishing and managing individual protected areas; and (ii) the Directorate of National Parks and Recreation Forests is responsible specifically for the national parks program.

Existing and proposed conservation areas of different categories in Central and Southeast Sulawesi, which have defined by PHPA, are shown in Table 5-2-2 and Table 5-2-3. Their locations are shown in Figure 5-2-1 and Figure 5-2-2, respectively.

Table 5-2-2 Existing and Proposed Conservation Areas in Central Sulawesi

PHPA Number	Status	Name	Area (Ha)	NCP 1982 No.	Marine Atlas 1984 No.
Existing Conservation Areas					
1	SM	Pati Pati	3,500	1	
2	CA	Paboya	8,100	2	
3	TN	Lore Lindu	231,000	3, 6, 12	
4	SM	Lombuyan	3,665	4	
5	CA	Tanjung Api	4,246	5	153
6	CA	Morowali	200,000	7	156
7	TW	Air Terjun Wera	250	-	
8	SM	Pulau Dolongan	462	11	150
9	SM	Pinjam/Tanjung Matop	1,612	10	149
Proposed Conservation Areas (as shown in PHPA records)					
1	SM	Peg. Buol Toli-Toli	720,000	13, 14, 16	
2	SM	Komp. Peg. Palu	600,000	17	
3	CA	Morowali extension	1,625,000	7, 18	
4	HW	Bancea	5,000	-	
5	CA	Pangi Binanga	6,000	17	
6	CA	Pamona	35,000	-	
7	TB	Lodusa Tamata	3,500	-	
Significant Conservation Area Proposals in 1982 NCP (not shown in PHPA records)					
8	SM	Bakiriang	1,000	19	
9	Marine Reserve	Perairan Pulau Peleng	42,000	15	157
10	Marine Reserve	Kepulauan Togian	100,000	20	154

Source: National Conservation Plan for Indonesia (1995)

Remarks ; CA : Nature Reserves
TN : National Parks
SM : Game Reserves
TW : Recreation Parks
TB : Hunting Reserves
HW : Grand Forest Parks
NCP : National Conservation Plan

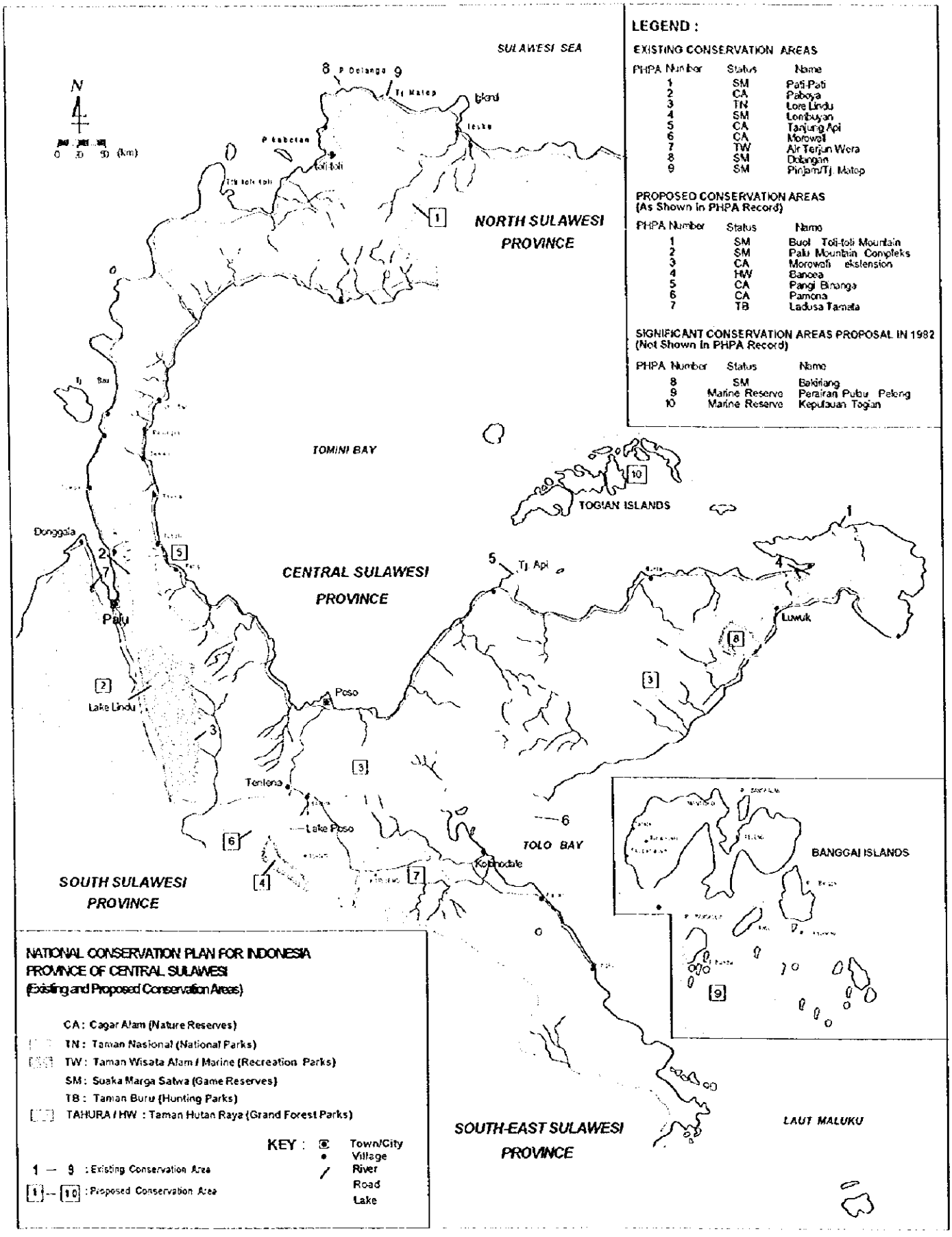


Figure 5-2-1 Location of Conservation Areas in Central Sulawesi

Table 5-2-3 Existing and Proposed Conservation Areas in Southeast Sulawesi

PHPA Number	Status	Name	Area (Ha)	NCP 1982 No.	Marine Atlas 1984 No.
Existing Conservation Areas					
1	SM	Buton Utara	82,000	6	166
2	SM	Tanjung Batikolo	5,500	10	164
3	SM	Tanjung Amolenggo	850	3	162
4	TN	Rawa Opa Watumohari	96,800	4, 8	165
5	CA	Napabalano	9	1	
6	SM	Tanjung Peropa	38,937	11	161
7	CA	Lamedae	500	2	
Proposed Conservation Areas (as shown in PHPA records)					
1	SM	Lambusango	25,000	13	
2	TW	Wakanti	1,000	14	
3	SM	Kakinawe	5,000	12	
4	SM	Pulau Moromahu	33,564	-	
5	TW	Mangolo	5,200	-	
6	CA	Napa Melano		-	
Significant Conservation Area Proposals in 1982 NCP (not shown in PHPA records)					
7	TWL	Selat Muna	20,000	17	168
8	CA	Lasolo-Sampara	45,000	19	
9	SML	Kepulauan Tukang Besi	306,590	20	167

Source: National Conservation Plan for Indonesia (1995)

Remarks ; CA : Nature Reserves
TN : National Parks
SM : Game Reserves
SML : Marine Game Reserves
TW : Recreation Parks
TWL : Marine Recreation Parks
TB : Hunting Reserves
NCP : National Conservation Plan

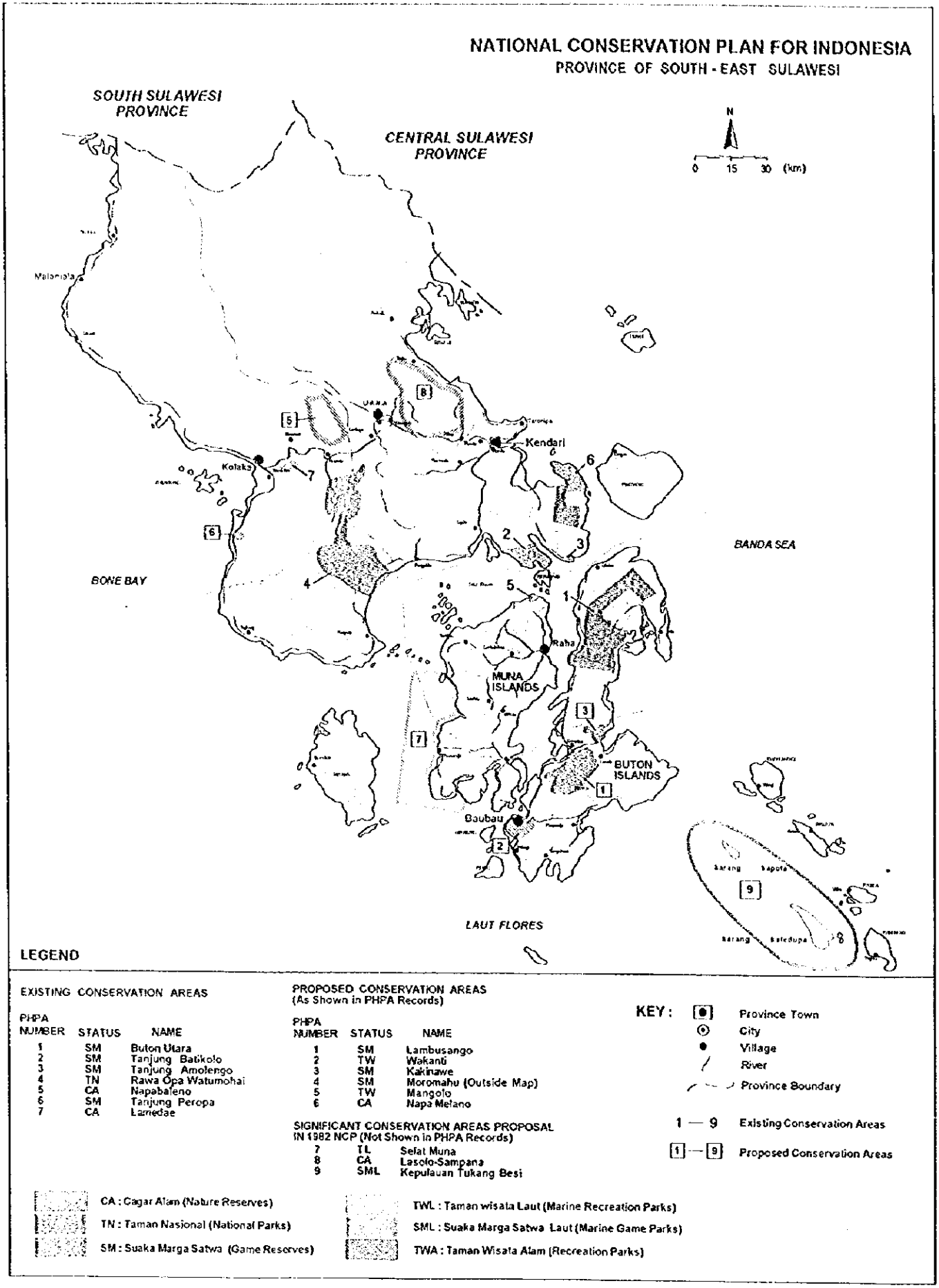


Figure 5-2-2 Location of Conservation Areas in Southeast Sulawesi

Two national parks, Lore Lindu and Rawa Aopa Watumohari National Park, which are located in Central and Southeast Sulawesi, respectively, are briefly described as follows.

1) Lore Lindu National Park (Central Sulawesi)

Lore Lindu National Park comprises an area of 231,000 hectares in Central Sulawesi. Its the largest national park in Sulawesi. Most of Sulawesi's endemic mammals and 83% of its endemic fauna have been recorded in or are closely associated with the park. Danau Lindu (Lindu lake) -a large ancient lake- is located in the center of the park.

The greater part of Lore Lindu National Park lies at an altitude of more than 1,000 m with Gunung Nokilalaki (2,356 m) as the highest mountain. The mountain forests at these heights consist of tree species of more moderate climates as oaks, chestnuts and laurels. At lower altitudes, lowland rainforest is observed, while above 2,000 m altitude the flora is sub-alpine.

Endemic wild fauna and flora, listed in Table 5-2-4, can be observed at the park.

Table 5-2-4 Endemic Fauna and Flora in Lore Lindu National Park

	Items	Species/Wildlife
Fauna	Birds	Maleo, Blue-faced rail (*Gymnocorex rosenbergii*), Sulawesi Woodcock (*Scolopax celebensis*), Brahminy kite, White-bellied sea-eagle, Lesserfish-eagle (*Ichthyophaga humilis*), Golden-mantled racquet-tail (*Prioniturus platurus*), Blue-backed parrot (*Tanygnathus sumatranus*), Ornate lorikeet, Snoring rail (*Aramidopsis plateni*), Minahassa masked-owl (*Tyto inexpectata*), Geomalia (*Geomalia heinrichi*), Dusky scrubfowl (*Megapodius freycinet*)
	Mammals	Mountain anoa, Anoa, Babirusa, Sulawesi Palm civet, Tonkean macaque (*Macaca tonkeana*), Celebes black macaque, Celebes warty pig, Bear cuscus, Celebes grey cuscus (*Strigocuscus celebensis*), Sulawesi tarsier, Dian's tarsier (*Trasius dianae*), Maxomys hellwaldii
	Reptiles	King cobra (*Ophiophagus hannah*), Reticluated python (*Python reticulatus*), Elaphe erythrura, Elaphe janseni
	Amphibians	Bufo celebensis
Flora	Oak spp., Chestnut spp., Laurel spp., Rattan (*Calamus spp.*), Diospyros celebica	

(Source: The Nature Reserves of Indonesia, URL: http://www1.tip.nl/users/t008530/)

Meanwhile, Gimpu-Gintu road, planned to be pass through the southwestern part of Lore Lindu National Park, had not had implementation permitted by the government, referring to the letter no.620/1793/Ro.BIPPRAM and no.363/Menhut-VI/1997, because of nature preservation measures.

2) Rawa Aopa Watumohai National Park (Southeast Sulawesi)

Rawa Aopa Watumohai Park comprises an area of 105,000 hectares in Southeast Sulawesi. Geographically, the park is located on the eastern coast of Sulawesi where the southeast monsoon affects the area. The park is named after the swampy area Aopa and the mountain Gunung Watumohai.

Large parts of Rawa Aopa Watumohai National Park consist of savanna with palm trees and tropical rain-forest. The coastal area is relatively flat and covered with mangrove forest. The swampland Rawa Aopa forms an important habitat for water-birds. Gunung Watumohai

(550m) and Gunung Mendoke (980m), the highest points in the area, are located in the south.

Unique species of wild fauna and flora, listed in Table 5-2-5, can be observed at the park.

Table 5-2-5 Endemic Fauna and Flora in Rawa Aopa Watumohai National Park

	Items	Species/Wildlife
Fauna	Birds	Milky stork (*Mycteria cinerea*), Blue-faced Rail, Maleo, Small sparrow-hawk (*Accipiter nanus*), Brahminy kite, Osprey, Sulawesi goshawk (*Accipiter griseiceps*), Chinese goshawk (*Accipiter soloensis*), Grey-faced buzzard (*Butastur indus*), Black-winged kite, Spotted kestrel (*Falco moluccensis*), Oriental hobby (*Falco severus*), Black eagle (*Ictinaetus malayensis*), Red-billed hanging-parrot (*Loriculus exilis*), Sulawesi hanging-parrot (*Loriculus stigmatus*), Sulawesi scopsowl, Sulawesi serpent-eagle, Blue-backed parrot (*Tanygnathus sumatranus*), Yellow and green lorikeet (*Trichoglossus flavoviridis*), Ornate lorikeet, Owl (*Tyto rosenbergii*)
	Mammals	Anoa, Water buffalo (*Bubalus bubalis*), Babirusa, Celebes warty pig, Wild boar (*Sus scrofa*), Pangolin (*Manis javanica*), Celebes black macaque (*Macaca ochreata*), Rusa deer, House rat (*Rattus rattus*), Stein's cuscus (*Phalanger vestitus*), Celebes Grey cuscus, Sulawesi tarsier
	Reptiles	Estuarine crocodile, Retuculated python, Water monitor (*Varanus salvator*), Varanus togianus, Common sun skink (*Mabuya multifasciate*), Four-clawed gecko (*Gelyra mutilata*), House gecko (*Gekko gekko*)
Flora	Bruguiera gymnorrhiza, Sonneratia alba, Ceriops tagal, Rhizophors stylosa, Avicennia marina, Sonneratia acida, Rhizophora apiculate, Rhizophora mucronata, Alang-alang	

(Source: The Nature Reserves of Indonesia, URL: http://www1.tip.nl/users/t008530/)

(4) Coastal and Wetland Environment

With its several long and narrow peninsulas, Sulawesi has more coastline relative to its land area than any other Indonesian island. No point on the mainland is more than 90 km away from the sea, and most are within 50 km. Coral reefs occur around most of Sulawesi's shores and all the major reef environments -fringing, barrier and atoll- can be found around their shores. As for fauna and flora: nesting turtles, dugongs, mangroves, coconut crabs and giant clams can be observed in some of the coastal area of the study area.

Conservation of mangrove forests has been given the highest priority by the Indonesian Government. 20% of the total mangrove areas, over 700,000 hectares of mangrove forest all over Indonesia have been designated as conservation forests. The Department of Forestry is responsible for the management of mangrove forest land, including all activities related to its utilization, protection and conservation of mangrove ecosystem and mangrove forest land.

Mangrove lands are tidally-influenced areas stretching along a coastal line on a flat coastal plain. The front parts of mangrove lands may be suitable for fishery pond, whereas the hinterlands, with certain treatment, may be sufficiently suitable for agriculture. For these reasons, mangrove lands are continuously under pressure of being converted for fishpond, agriculture and for other uses such as human settlements, industrial estates, etc.

Wetlands are part of Indonesia's diversity, both in terms of ecosystems as well as species, therefore, wetland conservation is of great importance in Indonesia. Wetland International, non-profit organization (NGO) which is in charge of wetland conservation in Indonesia, has supported PHPA, Ministry of Forest, in a program of survey, conservation and management of

wetlands, and evaluated the bio-diversity, ecological importance, habitat status and conservation potential of a number of areas.

A summary of coastal and wetland habitats in Central and Southeast Sulawesi are shown in Table 5-2-6.

Table 5-2-6 Habitat in Coastal and Wetland in Central and Southeast Sulawesi

	Original Area (ha)	Remaining Area (ha)	Area Within Reserves (ha)
Central Sulawesi			
a. Freshwater swamp	5,000	3,000	--
b. Freshwater lakes	5,000	5,000	4,250
c. Beach vegetation	25,000	10,000	1,000
Southeast Sulawesi			
a. Mangrove forest	40,000	25,000	4,000
b. Peat swamp	44,000	34,000	--
c. Freshwater swamp	19,000	11,000	--
b. Beach vegetation	4,000	3,000	600

Source: National Conservation Plan for Indonesia (1995)

(5) Soil Erosion (Natural Hazard)

The details of geological conditions in the study area have already been described in Chapter 2, Section 2.6 of this report and are not included in this section. No data is available with regard to natural hazards and traffic problems/accident record related to natural hazard in the study area.

5.2.3 Social Environment

Regarding social environment, since some fundamental factors such as population and its growth, economic situation and activity, social conditions, development plan, etc., have already been described in Chapter 3 of this report, they are not included in this chapter.

(1) Transmigration

The transmigration policy was introduced by the government around 1976, with the aim of reducing the high population density of Java (approx. 90% Indonesian population inhabit only about 8% of the land) and, at the same time, to alleviate poverty in Java and promote the growth of regional development in other parts of the islands/provinces, such as Sumatra, Kalimantan, Sulawesi, etc.

During last 25 years, from the 1st to 5th Five-Year Plans of Indonesia, approx. 7,500,000 people (that is: 2,000 villages or 1,610,000 households) transmigrated. Meanwhile, according to the 6th Five Year Plan (1994-99), 6 million households are planning to do so.

Four provinces in Sulawesi, including Central and Southeast Sulawesi, together with Sumatra (8 provinces), Kalimantan (4 provinces) and eastern region/islands (4 provinces), are designated as "transmigrates-receiving provinces".

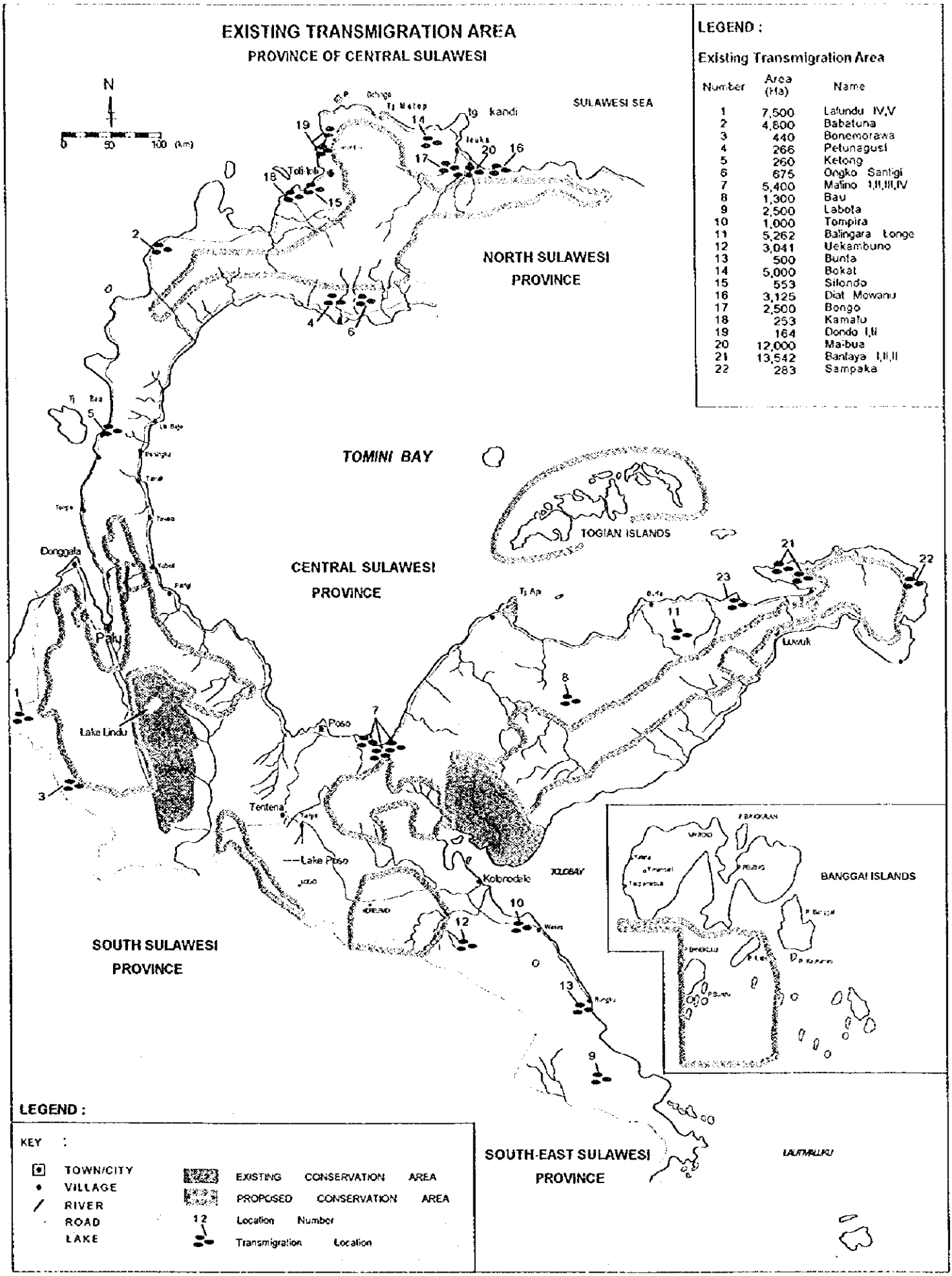
Table 5-2-7 shows the past history of transmigration over the 1st to 5th Five-year Plans, and the future plan described in 6th Five Year Plan. Figure 5-2-3 and Figure 5-2-4 shows the locations of transmigration and areas (in hectares), between year 1991 and 1997, in Central and Southeast Sulawesi, respectively,

Table 5-2-7 The History and Future Plan of Transmigration

(unit : hectare)

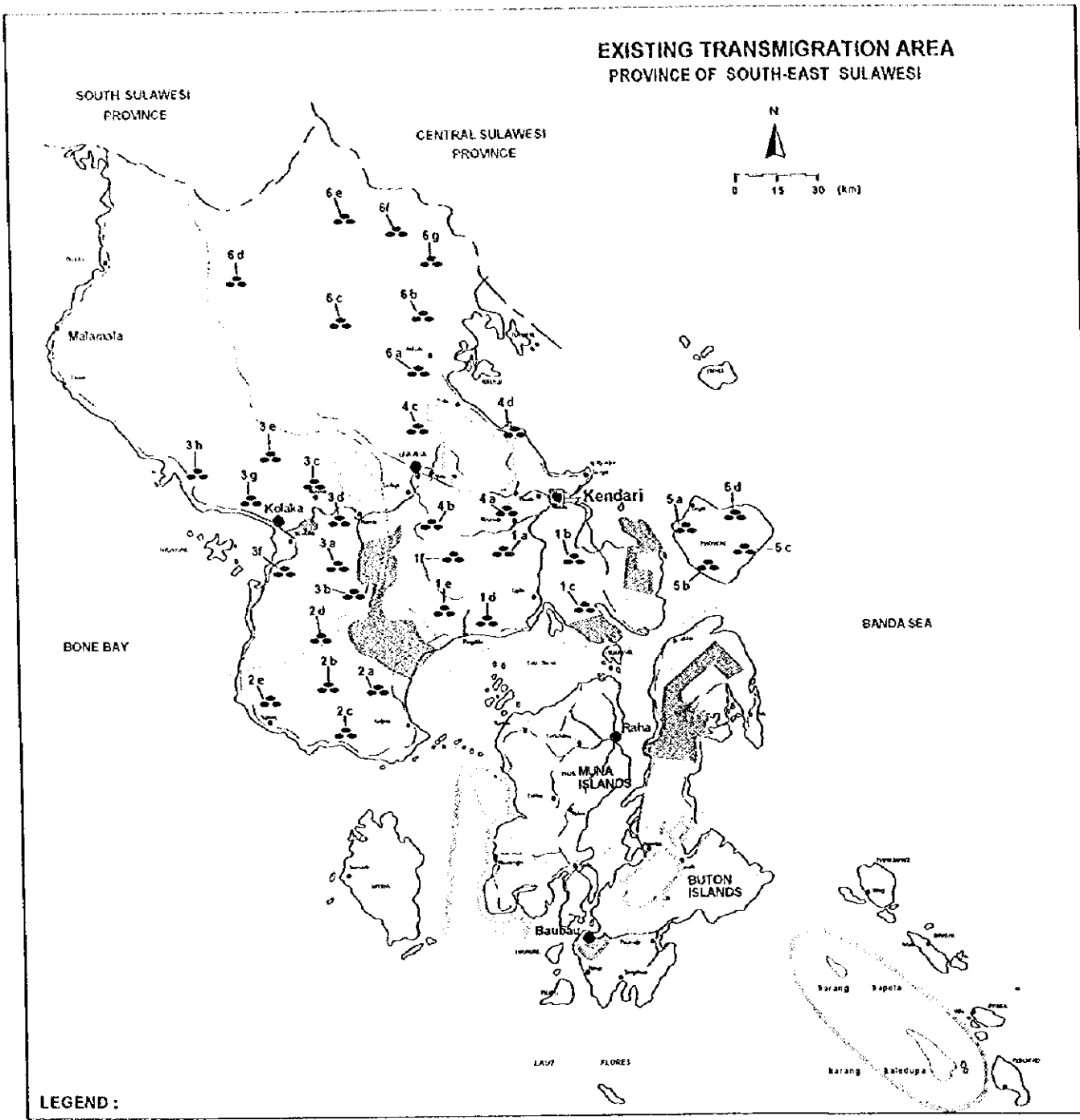
Region/Islands	Developed Agricultural Land (1st to 5th Five year Plan)			6th Five Year Plan (1994-1999)
	Rice Field	Vegetation Field	Total	
Java	--	--	--	--
Bali, others	--	--	--	--
Sumatra	185,000	851,050	1,036,050	233,180
Kalimantan	9,000	400,060	409,060	140,435
Sulawesi	--	191,340	191,340	58,367
Maluku, Irian Jaya	--	97,230	97,230	70,993
Total	194,000	1,539,670	1,733,670	502,975

(Source: Indonesia Handbook 1995/1996)



Source: Transmigration Office in Palu

Figure 5-2-4 Locations for Transmigration in Central Sulawesi



LEGEND :

KEY :
- PROVINCE TOWN
- CITY
- VILLAGE
- RIVER
- PROVINCE BOUNDARY
- EXISTING CONSERVATION AREA
- PROPOSED CONSERVATION AREA
- 3a Location Number
- Transmigration Location

EXISTING TRANSMIGRATION AREA

NUMBER	Area (Ha)	NAME	NUMBER	Area (Ha)	NAME
1a	25.960	Rumba SKPA			
1b	8980	SKPB	5a	9.180	Wawonii SKPA
1c	11.550	SKPC	5b	16.550	SKPB
1d	31.110	SKPD	5c	11.660	SKPC
2a	16.500	TinganggeaSKPA	5d	8.670	SKPD
2b	26.910	SKPB	6a	16.390	LasoloSKPA
2c	17.570	SKPC	6b	10.970	SKPB
2d	17.120	SKPD	6c	10.730	SKPC
2e	22.060	SKPE	6d	24.020	SKPD
3a	14.400	Wawotobi SKPA	6e	13.600	SKPE
3b	10.420	SKPB	6f	13.360	SKPF
3c	28.050	SKPC	6g	19.590	SKPG
3d	16.480	SKPD			
3e	11.340	SKPE			
3f	19.720	SKPF			
3g	19.505	SKPG			
3h	10.210	SKPH			
3n	13.970	Kendari SKPA			
4a	10.680	SKPB			
4b	15.906	SKPC			
4c	8.520	SKPD			
4d					

Source: Transmigration Office in Palu

Figure 5-2-5 Locations for Transmigration in Southeast Sulawesi

(2) Minority Races

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

Certain nomadic races are also found living in mountain areas. Their lifestyle is based on hunting and they tend to move from place to place in a group in order to catch game. The sukuwana tribe, nomads who live in bands of 60 or so people, live within the Morowari Reserve (Central Sulawesi). However, there is no sufficient data available regarding their total population. Some bands had been relocated to outside of the reserve by the government, as they destroy the reserved forest by open burning in a disorderly manner.

(3) Cultural Properties

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

(4) Transport

The detail of transport conditions in study area, that is transportation and road network system, have already been described in Chapter 2, Section 2.2 and 2.3 of this report.

5.2.4 Environmental Pollution

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

5.3 Initial Environmental Examination (IEE)

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

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

The results of screening and scoping processes, carried out by the JICA Study Team for the master-plan study area, are shown in Tables 5-3-1 and 5-3-2, respectively, and main points/items of the project which might cause environmental impact will be taken into account for the next step (environmental site survey, EIA Study, etc.) are surmised in Section 5.4.

Table 5-3-1 Screening Result for the Master Plan Study Area

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

Source : "JICA Environmental Guidelines"

Table 5-3-2 Scoping Result for the Master Plan Study Area

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

Source: "JICA Environmental Guidelines"

Note : Evaluation categories:

A: Serious impact is expected.

B: Some impact is expected.

C: Extent of impact is unknown (Examination is needed. Impact may become clear as study progresses).

D: No impact is expected.

5.4 Environmental Considerations for EIA Study

Based on the evaluation result of screening and scoping processes carried out by JICA Study Team and described in Section 5.3, environmental considerations for the project were carried out for the following environmental items, which are designated as A/B/C in Table 5-3-2. Itemized matters followed by sub-title, stated in Article 5.4.1 and 5.4.2, were clearly identified and necessary counter-measures taken into consideration, during the project's environmental site survey and EIA Study.

5.4.1 Social Environment

(1) Resettlement

- Conditions of the inhabitants and/or minority races surrounding the project sites
- Inventory for number of families/households and population required to be relocated from the project sites, quality of housing, religious status, occupation, income level, living standard, etc.
- Public facilities, if any, needed to be relocated from the project area. Evaluation of value and estimation of scale of influence on the related area
- Experience of resettlement and/or compensation in previous project
- Resettlement plan/idea to be carried out by authorities concerned

(2) Economic Activities

- Inventory of regional economic activities, such as agriculture, forest production, etc.
- Characteristics of the transmigration, in view of religion, tribe, origins of the migrants, their main jobs, their activities related to environmental conservation, etc.
- Inventory of major industry

(3) Transport and Public Facilities

- Major transportation network connected to the project, access road to the project sites and traffic volume by types of vehicles in each direction
- Distribution of major infrastructures and public facilities interfered with by the Project; such as schools, hospitals, public markets, solid waste disposal sites, urban/rural drainage facilities, sewage treatment facilities, high-voltage electric cables, waste distribution pipe lines, gas pipes, telephone cables, and so on
- Future land-use plans for the study area

(4) Water Rights and Rights of Common

- Domestic, agricultural and industrial uses of river/lake/spring/sea water.
- Existence of common land and its location (Special attention should be paid to old communities likely to have common forests or land.)
- Location/distribution of national parks, nature conservation areas, etc., in the study area

(5) Waste Disposal

- Estimate of amount of solid waste, especially surplus soil produced during slope-cutting works
- Plan of treatment and/or final disposal

(6) Hazards/Risk

- History of natural hazard/disaster and its location within the study area; such as landslides, high tidal waves, earthquakes, or floods
- Potentially hazardous area in the study area, especially concerning landslides
- Frequency and magnitude of earthquakes
- Countermeasures for natural hazard which have been planned by the project

5.4.2 Natural Environment

(1) Topography and Geology

- Topographic and geographic characteristics at the project site, related to natural hazards
- Meteorological data, especially rainfall

(2) Soil Erosion

- Investigation of soil texture of the project site
- Possible/predicted area of soil erosion
- Examination of the possibility of soil erosion by the project construction

(3) Groundwater

- Relationship between groundwater flow and tunnel construction

(4) Hydrological Situation

- The following hydrological conditions: hydrology in terms of flow pattern, capacity of volume; existing drainage system of surface water; river and channel use which may be used for drainage; and river system and river usage
- Impacts on the river flow in case the construction of pier, etc., in the river
- River flow in case of flood
- Possible/predicted area for the impacts on the river flow

(5) Coastal Zone

- Examination of impact on the coastal environment, especially the earth flow and soil sedimentation by the river water running off into the coast/sea area during the project construction stage
- Possible/predicted area for impact on the coastal zone
- Impact on the mangrove forest and coral reefs

(6) Flora and Fauna

- Inventory of protected/endemic flora and fauna (excluding domesticated animals) in the study area
- Distribution and/or location of nature conservation areas, national parks, etc.

(7) Landscape

- Examination of impact on the natural, historical and cultural landscape by the road structure

5.4.3 Environmental Pollution

(1) Noise and Vibration

- Noise and vibration caused by construction equipment, mainly during construction stage, shall be taken into considered.

(2) Other Environmental Pollution Elements

Regarding the other environmental pollution elements; i.e. air and water pollution, soil contamination, land subsidence and offensive odor, no significant negative impacts are anticipated from any of the project activities, taking into consideration of contents of the Project and its scale; i.e. lower traffic volume in the study area, no toxic substances produced, no groundwater pumping, etc. Therefore, these elements were not considered in the environmental impact assessment.

Chapter 6

Development Plan for Future Road System for Master Plan

Chapter 6 DEVELOPMENT PLAN FOR FUTURE ROAD SYSTEM

6.1 General

Development of the inter-regional road network may take its place as a vital means to achieve regional development of Central and Southeast Sulawesi. Concerning the current regional structure of Sulawesi, development of the inter-regional road network is relevant to following goals.

6.1.1 Mitigation of Regional Imbalance

Sulawesi has achieved development under a tie-up of four provinces; North, South, Southeast, and Central. However, due to geographical restrictions, development of sea and air routes has been given the priority over others as connecting networks to other regions, with development of the inter-regional road network lagging behind. While South Sulawesi is the industrial core of the island, it is separated by land from the distribution centers of Central and Southeast Sulawesi by rugged mountain terrain, thus remaining relatively undeveloped. As long as the current regional structure stands, South Sulawesi with Mamuju, Pare Pare, and Ujung Pandang, will have further enhanced superiority in terms of industrial location, possibly resulting in widening of regional difference. It is essential therefore to proceed with development of fundamental infrastructures such as development of the inter-region road network, etc., to strengthen the regional industrial structure through tie-ups and complementation between regional nucleus and industrial distributing centers.

6.1.2 Utilization and development of regional resources

Central and South-east Sulawesi are abundant in resources such as land, nature, tourism, mining, agriculture, and fishing which are not yet substantially developed. Development of the inter-regional road network is therefore important to promote development of these resources.

6.1.3 Appropriate relocation of the population and industries

Population and industries continue to concentrate in Java and Bali, causing more and more serious urban and rural problems. To reduce such concentration, the agricultural development of Central and Southeast Sulawesi through transmigration has been promoted as a national policy. The inter regional-road network is essential to support the appropriate regional allotment of industries and population to Central and Southeast Sulawesi according to the plan.

6.2 Road Network Development Strategy

In this study, the road network has been established with due consideration of the economic and administrative aspects (central cities, traffic nodes, bases for industries, agriculture, mining, and tourism) of the area concerned, area promoting development, support immigration, network configuration, measures to meet the traffic demand, balance of public services among regions, topography and geology, environmental preservation, etc. Due attention was paid specifically to the following points for road development.

6.2.1 Road development as a gross corridor for the whole of Sulawesi

It would be beneficial for the Sulawesi area that development be made in a compounded and integrated manner on the basis of inter-regional cooperation. The axis for such compounded and integrated development would entail the development of a gross corridor supported by various infrastructures. A gross corridor is a functional and spatial tie-up ; for example, of the capital cities of Ujung Pandang, Menado, Palu and Kendari ; along an axis. In the case of Sulawesi, the gross corridor uses mostly airports for passengers and port facilities for cargoes. Provincial and kabupaten capital cities are nodes of sea and air routes, each becoming a regional nucleus and distribution points in the industrial center (mostly for agriculture and fishing) of the region. To establish a complete corridor for the development of Sulawesi, the inter-regional road network for land transport must be fully developed.

6.2.2 Road development as a corridor for the region

Nucleus and industrial distribution cities in the region are also nodes for physical and passenger flows. National and provincial roads function as an overland means to connect and integrate these cities. Existing national and provincial roads can be characterized more as functions of access connecting core regional cities with places of production, and less as inter-regional trunk roads. These roads are extremely poorly maintained. It is evident that development of Central and Southeast Sulawesi follows a scenario for development based on its abundant natural resources of agriculture, forestry, fishing, mining and tourism. Existing regional nucleus cities are centers of various support services for development of natural resources as well as places where natural resource development is concentrated. It would be beneficial if these provincial capital cities or expected bases of natural resource developments tie up with regional distribution cities to complement each other to achieve integrated development. In this respect, development of the inter-regional road network is urgent.

6.2.3 Road development as a means of improvement of living standards

Core cities and distribution points offer medical, educational, and cultural services, etc, for bases of day-to-day life. One function of the inter-regional road is to enhance the living standards of residents in Central and Southeast Sulawesi where the current service level is low. Development of a safe inter-regional road network is essential to enable residents to benefit from such services.

6.3 Proposed Road Network System

6.3.1 Basic Development policy

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

- Connections of provincial capital cities to develop gross corridors (arterial roads) for the entire Sulawesi area.
- Connections of provincial capital cities with kabupaten capital cities to develop sub-gross corridor (collector roads) which complement and strengthen regional tie-ups.

- Connections of principal port facilities and places of production in order to guide and promote the regional industry.
- Connections to provide improvement of a quality of life through transportation.
- These connections form a future road network, providing alternative links between provincial cities.

The above basic policy is shown in Figure 6-3-1 as a road network concept considering the role of the gross corridor, sub-gross corridors, port and airport corridors and emergency services access corridors.

6.3.2 Hierarchy of Inter-Regional Roads

The inter-regional roads are classified into the following four categories based on road function according to the Bina Marga (see Section 2.3.4);

- Arterial Road
- Collector Road 1
- Collector Road 2
- Collector Road 3

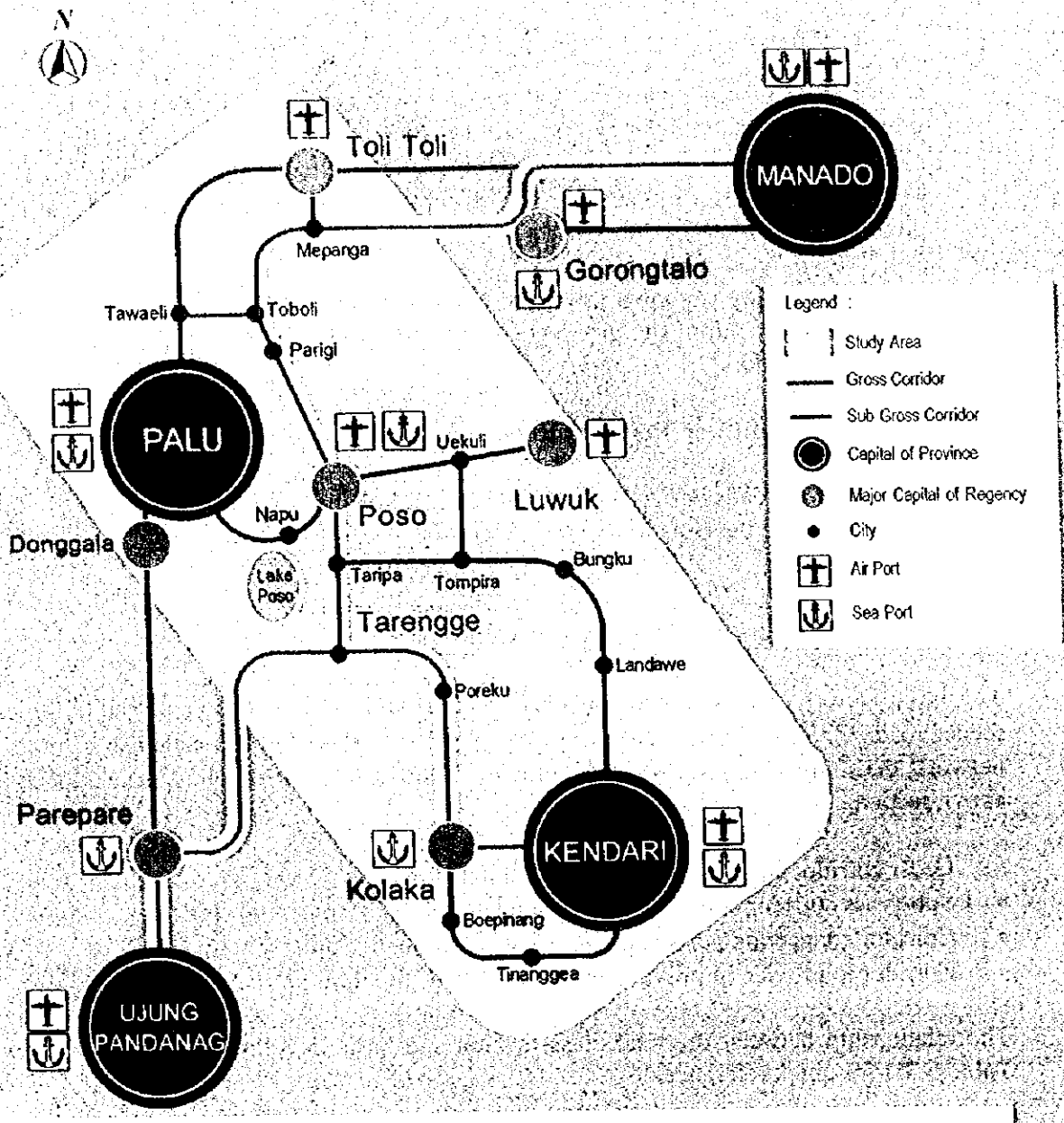
The basic factors of road functional classification are: ① connection of capital cities, ② feeder road, ③ route length and ④ travel speed. In this study to establish a future road network, the study team proposed the following basic development policy as mentioned in the above section;

- Gross corridor connecting provincial capital cities
- Sub-gross corridor connecting provincial and Kabupaten capital cities
- Corridor connecting ports and airports with productive areas
- Corridor to provide improvement of a quality of life through transportation

The relationship between the road classification and basic development policy is shown in Table 6-3-1 for quick reference.

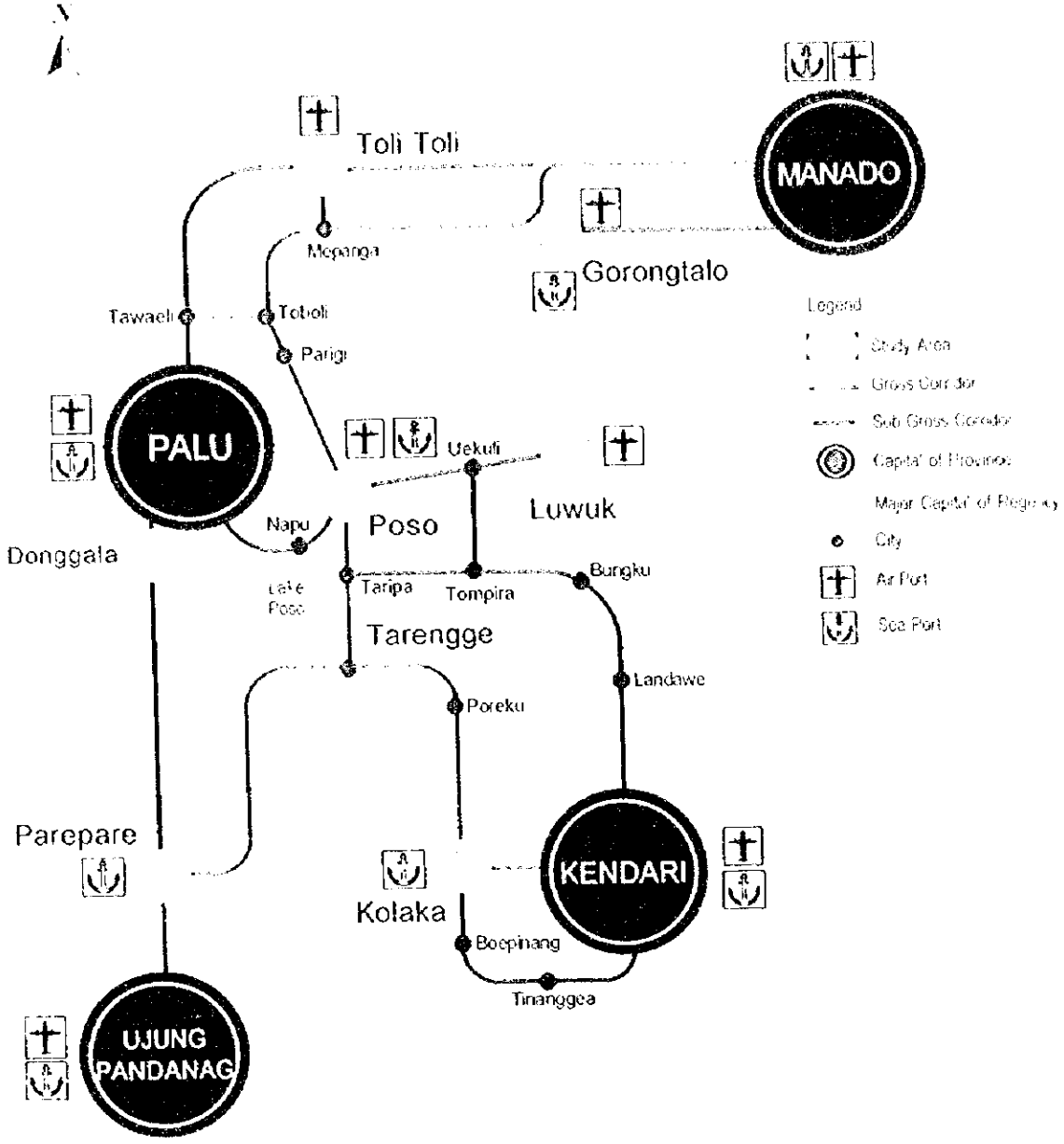
Table 6-3-1 Relationship between Proposed Development Policy and Road Classification

Development Policy	Road Functional Classification	Remarks
1. Gross Corridor 2. Sub-Gross Corridor 3. Corridor for Productive Area 4. Corridor for Improving Quality of Life 5. Road Network, Providing Alternative Links	Arterial Road (long distance, trunk road) Collector Road 1 (medium distance, feeder)	National Road
	Collector Road 2 (medium distance, feeder) Collector Road 3 (short distance, feeder)	Provincial Road



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

Figure 6-3-1 Concept of Inter Regional Road Network System in Study Area



ROLE OF CORRIDOR

CONNECTION OF CITIES

MANADO - PALU - POSO - KOLAKA - KENDARI
- UJUNG PANDANG

- PALU - TOLITOLI
PALU - GORONTALO - PAREPARE
POSO - UEKULI - LUWUK
TARIPA - BUNGKU
- KENDARI - TINANGGEA - BOEPINANG - KOLAKA

TOLITOLI - MEPANGA
PALU - NAPU - POSO
POSO - UEKULI - BUNGKU - LANDAWE - KENDARI

- ACCESS TO HOSPITAL, EDUCATION AND CULTURE FACILITIES

Figure 6-3-1 Concept of Inter Regional Road Network System in Study Area

6.3.3 Road Development Policies

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

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

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

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

- Improvement of drainage facilities and achievement of the road pavement width of 4.5 m
- Improvement of permanent-structure bridges
- Disaster prevention measures for roads
- Improvement of road alignment
- Creating new links; improving existing links

(3) Corridor for promotion of industry

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

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

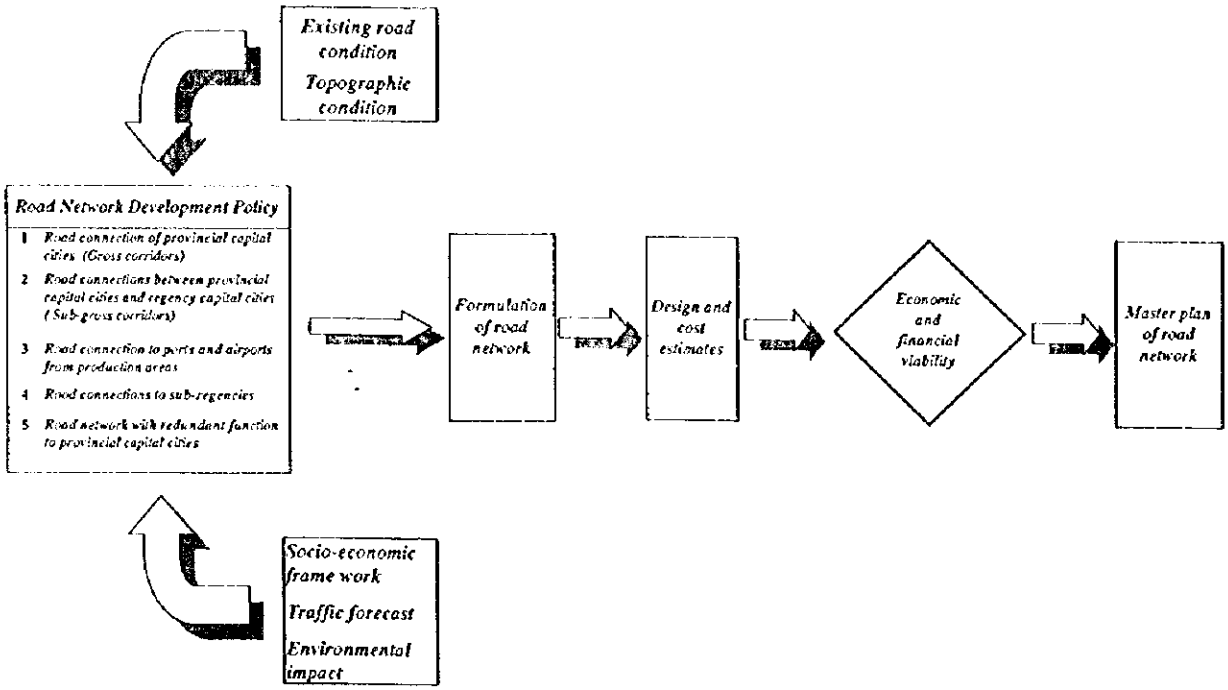
- Improvement of drainage facilities and achievement of road pavement width of 4.5 m
- Improvement of permanent-structure bridges
- Disaster prevention measures for roads
- Improvement of road alignment

6.3.4 Future Road Network

A future road network in the study area was formulated considering topographic conditions, present road and bridge conditions, environmental situation, future economic growth and traffic demand forecast together with the above road network development policy (see Figure 6-3-2)

The index of national and provincial road length per unit area for the future in the study area has been increased to about 0.07km/km^2 (6,500km) from 0.05 km/km^2 at present. That index of 0.05 km/km^2 is appropriate as the same index for Java island is 0.10 km/km^2 and that of Sumatra island is 0.05 km/km^2 at present. The higher index of more than 0.07 km/km^2 for the study area is excessive considering the other index mentioned in section 2.3.2 of this report (i.e. study area: 0.19, Java island: 0.10, Sumatra island: 0.16).

As a result, the total length of the future road network in Central and Southeast Sulawesi provinces becomes 6,503 Km (Central Sulawesi province: 3995 km, Southeast Sulawesi province: 2,508 km). The future road network is shown in Figure 6-3-3 and road link Nos. are packaged as shown in Figure 6-3-4



Source: Study Team

Figure 6-3-2 Flow Chart for Formulation and Master Plan of Road Network

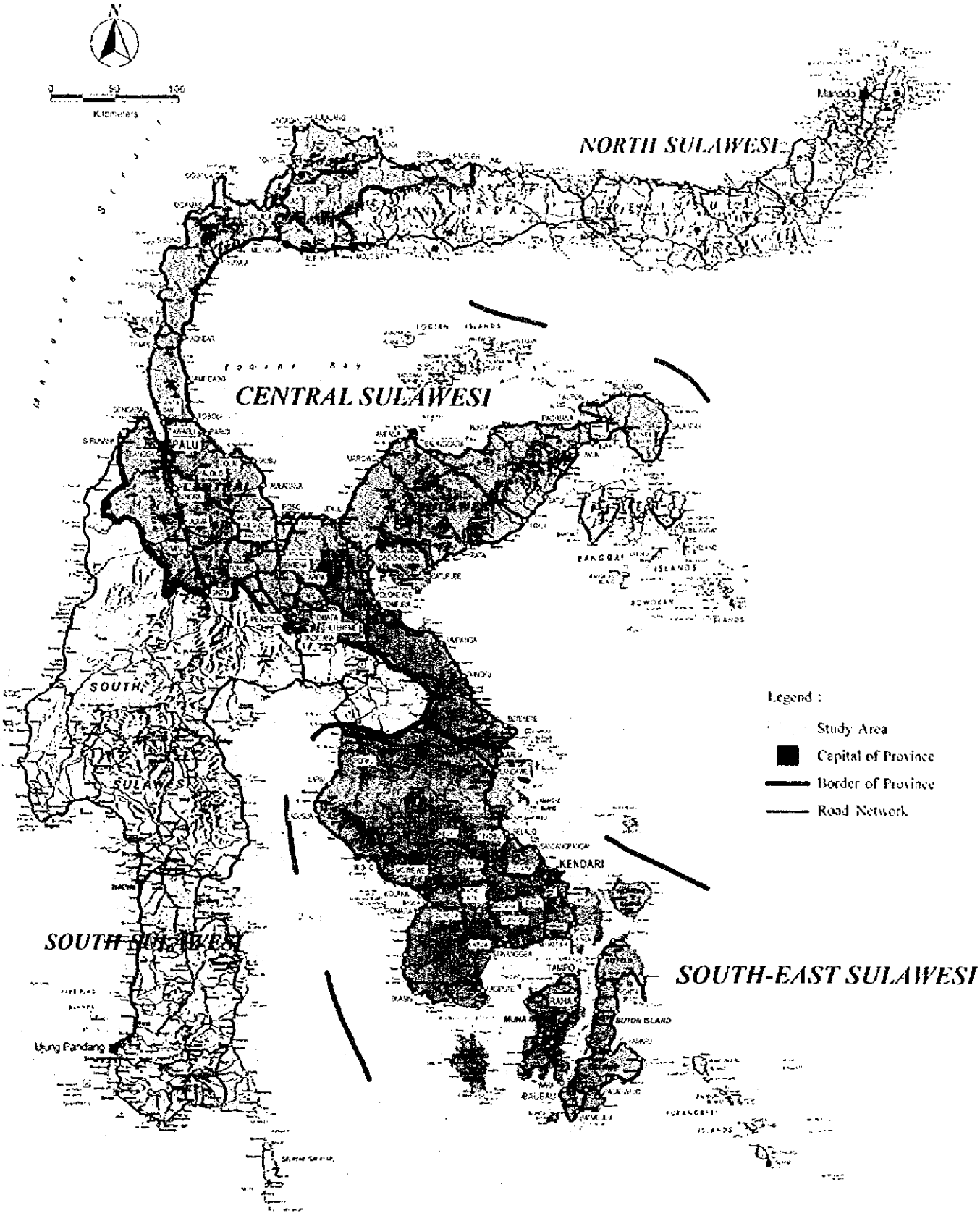


Figure 6-3-3 Master Plan Network

Source: Study Team

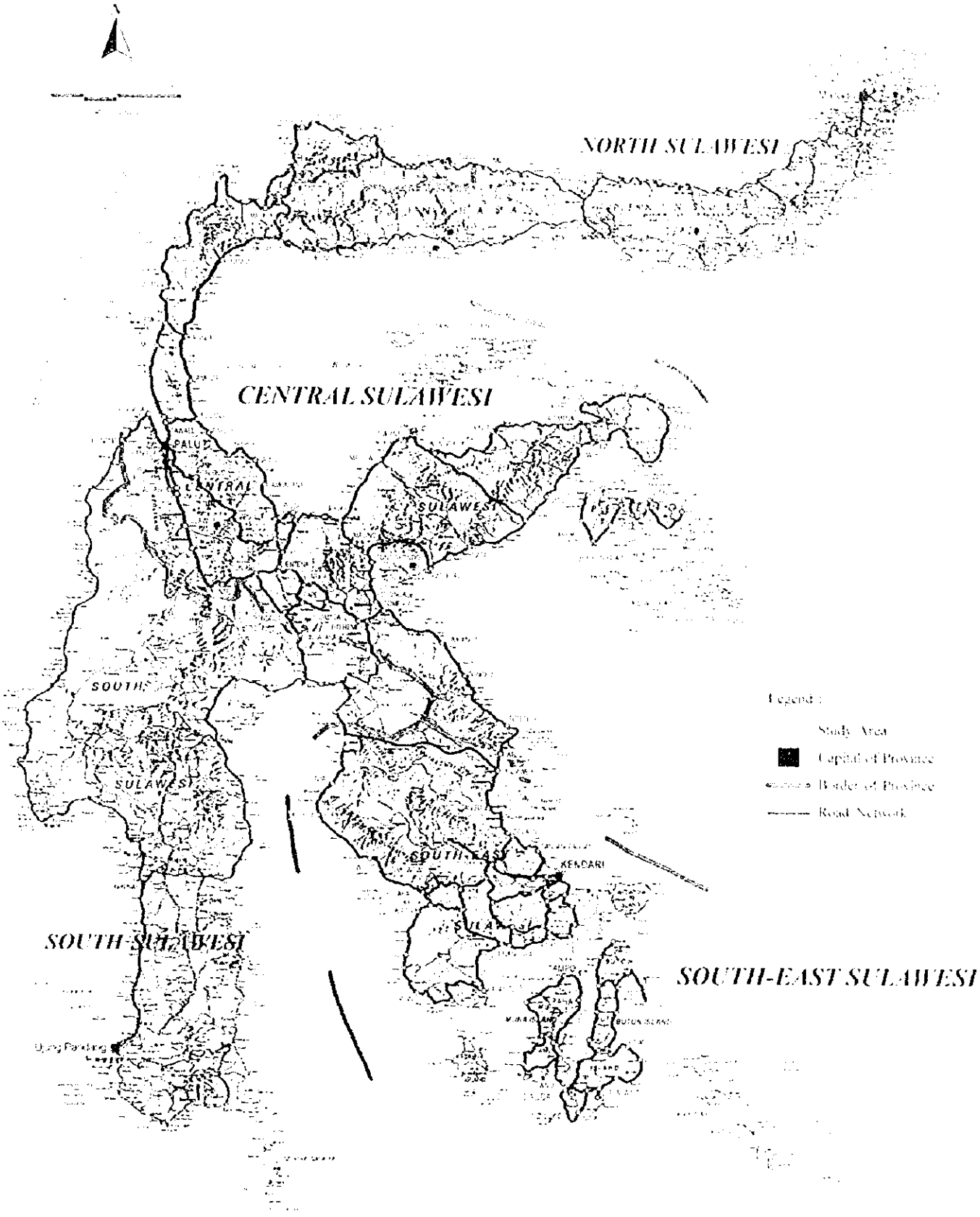


Figure 6-3-3 Master Plan Network

Source: Study Team

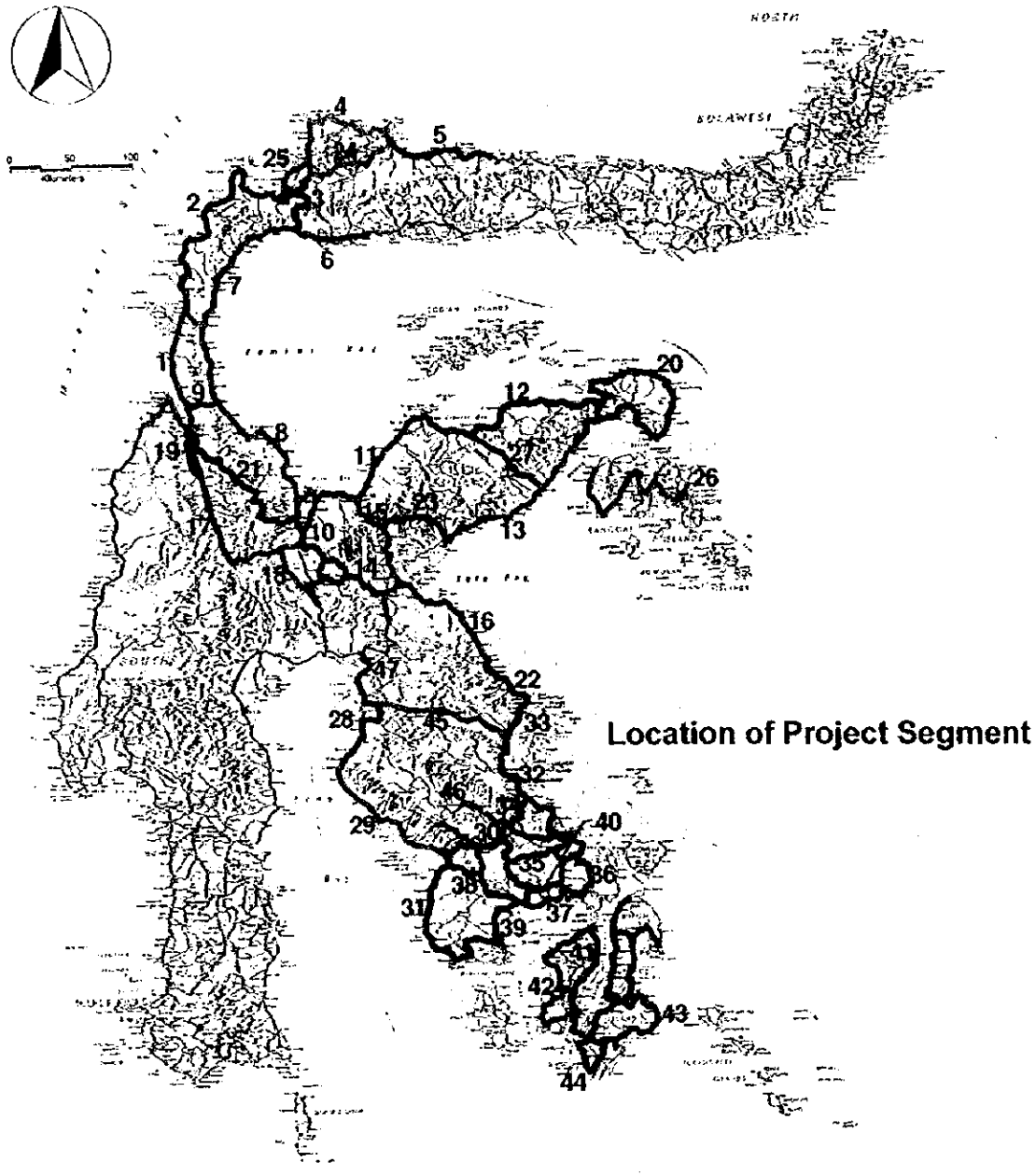


Figure 6-3-4 Location of Project Segment

Source: Study Team

6.3.5 Effect of Road Network Development on Industries

Development and improvements into road networks have various effects not only on roadside development and production as well as road users, but also on regional society as a whole. Such effects are diverse and are classified differently depending on the basic viewpoint. Effects presented by road development can be either direct or indirect, according to how the influence of road development flows.

Direct effects include those occurring directly without intervention of a third party. In this case, benefits can be enjoyed directly by the road users, roadside communities and regional societies. They are, for example, reduction of travel time, reduced total construction expenses, and added amenities for driving.

Indirect effects occur along with direct effects as time passes. These effects spread to road users, roadside communities and regional societies, and the public sectors. As regards the economic effects expected regionally, there are the flow effect or creation of demand through road construction projects, etc. and the stock effect or facility service effects generated when the road is completed or improved as the road service is improved. In this way, the point in time and period of enjoyment of benefits vary depending on effects.

Apart from effects which can be enjoyed daily, there are non-daily benefits, such as multiplier economic effects in line with demand creation in the course of investment in construction, redundancy or the effect that the road can function as an alternative route in case of emergency (natural disaster, etc.), and an option effect which enables selection of a road which is not used daily and which needs to be used for certain purposes.

It is quite natural to proceed with development and improvement of the road network in response to an increasing request for mobility. In particular, regional arterial roads are traffic facilities for regional exchange while playing an important role in development and settlement.

Indirect effects expected through road development and improvement for roadside communities and regional societies, and the public sector are described briefly below.

(1) Effects on roadside communities and regional societies

- Use of the road space:
  The road not only offers traffic functions, but also functions as a space to house lifelines for daily life (water supply, sewage systems, electric cable, etc.). Roads can therefore contribute to electrification and promotion of dissemination and development of water supply in a region).

- Securing of a lifeline in case of a natural disaster:
  The road network will prove highly beneficial for life and industrial activities in the region and inhabitants in the case of natural disasters, such as storms, earthquakes, and fires.

- Expansion of living and exchange opportunities:

Improvement in traffic provides enhanced accessibility to the region and facilities while expanding living and exchange opportunities because the people can visit the region and facilities anytime they like. This is expected to enhance further the employment opportunities and the development of new business (agro-industry). The road will prove highly beneficial to the region because it may used at anytime under various circumstances though not necessarily on a daily basis.

- Improvement of public services:

  Accessibility to public facilities (hospitals, schools, telegram, and telephone, as well as ports and airports) is improved, enabling the regional inhabitants to enjoy a wider range of public services. In addition, the road allows transport of regional products to outside areas, with expected growth in agricultural products in the roadside area.

- Improved productivity:

  Exchange of people and materials by the road will create new demand. In terms of production, such exchange is expected to enhance productivity efficiently. Reduction of transport time and costs through traffic improvements will expand the market for industrial activity in the region concerned, thereby increasing the production scale and productivity.

- Growth in opportunities to locate industries:

  Decreased traffic expenses, enhanced convenience, safety of users, and increased exchange opportunity will enhance regional industrial location opportunities. Enhanced accessibility to tourist resources is expected to induce tourism development and tourism-related industries.

- Demand creation effect from construction business:

  Construction will generate increased income and employment in related entities, which will grow through the multiplier effect.

- Effective land use:

  Increase in industrial locations due to road developments as well as in the planted acreage due to increase in agricultural markets and will promote effective utilization of the land.

(2) Public sector

- Saving of public facilities maintenance costs

  Road sites and road networks can be used to implement other public businesses or rational layouts of public facilities, possibly reducing the maintenance costs of public facilities.

- Increase in tax revenue

  Increase in income due to industrial location and production growth as well as increase in employment will generate increased tax revenue regionally and nationally.

As described above, the contribution of road network development on roadside communities and regional societies is not limited to direct effects, but includes substantial indirect effects. Therefore, road development and improvements are urgently needed to eliminate sections where the traffic is possible or use of large vehicles is unfeasible and sections where traffic is hampered during the rainy season or improvement of sections with lots of steep gradients and curves.

To redress the population concentration in larger cities and provide a balanced development of the national land, it is essential to expand employment opportunities and to enhance education and culture, health and medical services, living infrastructure, and disaster prevention in the region. Accordingly, development of road networks is a fundamental task to enable a highly sustainable, and stable development of the region. Construction of road networks will provide a backbone for social activity which is essential if each city or regional society is to function organically as a social entity while demonstrating unique characteristics.