CHAPTER A-8 TRAFFIC DEMAND FORECAST

8.1 Traffic Demand Forecast Methodology

Based on the current OD tables, containing the traffic count and OD interview survey data as well as the future socio-economic frame-work presented in previous chapter, future OD tables were forecasted through the use of a trip generation and attraction model for inter-zonal trips. Generated and attracted trips were then distributed on a zonal basis and intra-zonal trips were estimated for each zone for traffic assignment purposes. The magnitude of potential future traffic problems was identified in order to establish the transport improvement components for the master plan projects up to the target year of 2020.

8.1.1 Zoning system

The study area is divided into zone numbers 1 to 185 based on the Cambodian district zoning system, and the boundary of the study area is divided into zone numbers 186 to 197.

8.1.2 External zone transportation demand

The traffic categories in the study area can be defined as both domestic and international. Regional traffic is classified according to its origin and destination as; intra-regional traffic, inflow and outflow traffic, and through traffic. Intra-regional traffic includes journeys that are made entirely within the country of Cambodia, inflow and outflow traffic includes trips that are made between Cambodia and another country, and through traffic are those journeys that pass through the country on the way from one country to another.

Twelve border crossings linking Cambodia to Laos, Thailand and Vietnam, can be regarded as the inflow and outflow points of the intra-regional traffic, and the effects of the intra-regional and inter-regional traffic on the road network should be considered. In the future, the roads will have improved and international dealings will be more active, and therefore it is important to consider the volume of international traffic in the future. As this inflow traffic will originate in other countries, the volume of traffic will depend on the economic development of those countries and therefore the future traffic inflow from other countries is computed in a different way.

8.1.3 Modeling and forecasting tools

JICA STRADA and EXCEL spreadsheets were used for all steps of the model calibration and demand forecast. In order to undertake efficient and easy trial runs, the model calibrations and forecasts, in terms of trip generation and attraction, were programmed in Excel, and the trip distribution and traffic assignment stage was computed using JICA STRADA.

8.1.4 Traffic Demand Forecast Procedure

The procedure for calculating the future traffic demand forecast is shown in **Figure 8.1.1**. The procedure is divided into the following three major tasks.

Task 1: Preparation of the Present OD tables

In order to establish the present Origin-Destination (OD) tables, traffic surveys were conducted and zoning systems were adopted. The traffic survey methodology and an analysis of the results are presented in previous chapter.

Task 2: Preparation of the Traffic Demand Forecast

Various models were developed based on the present OD tables and the socio-economic indicators.

・Generation/Attraction Model to predict the volume of generated and attracted vehicles based on the socio-economic indicators for each zone

・Trip distribution: the process of distributing the generated/attracted trips in each zone into individual trips between each OD pair, and providing a full matrix of trips between all zones.

Task 3: Traffic Assignment Work

The OD traffic tables were assigned to the road network to obtain the volume of traffic on each link of the network.

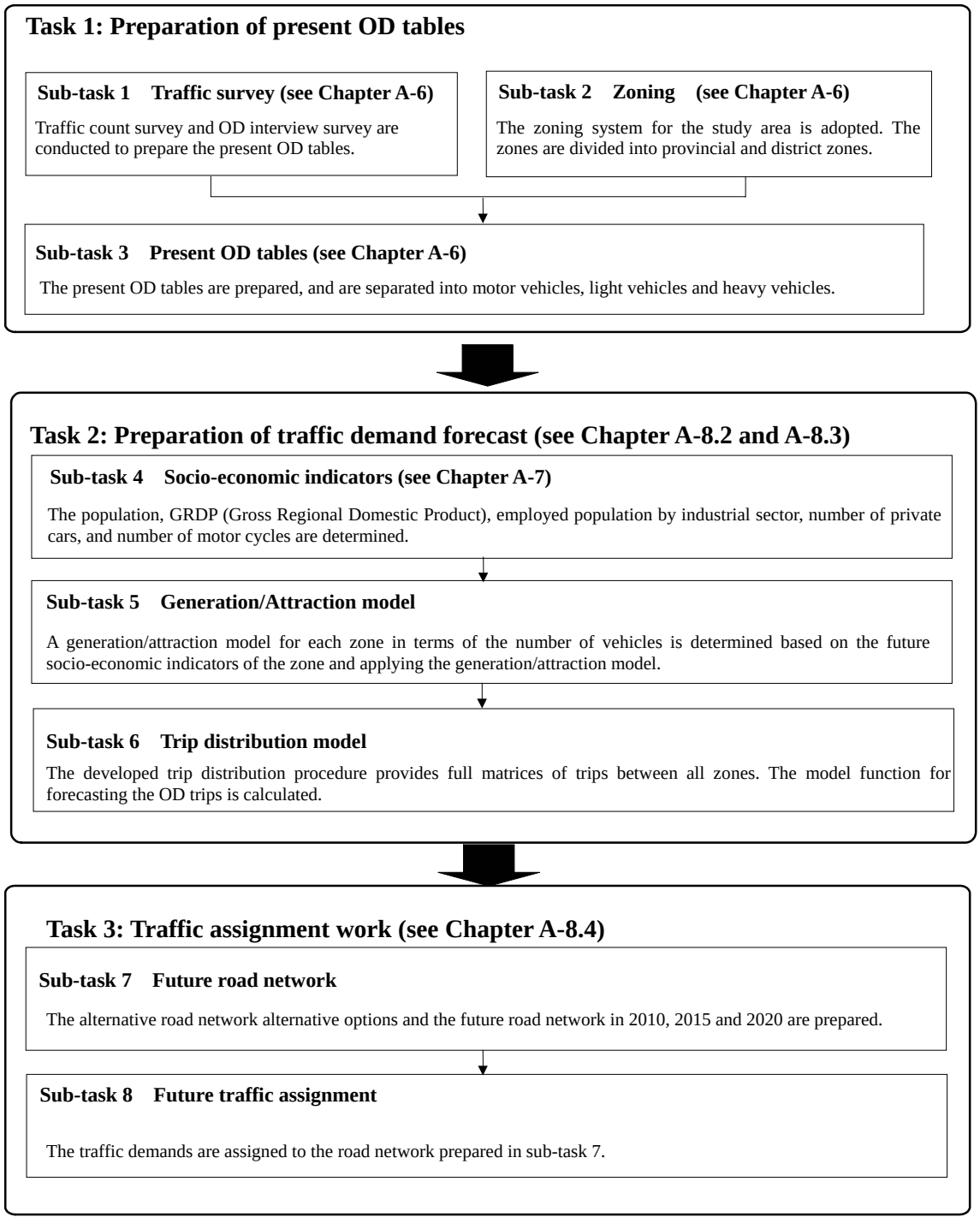


Figure 8.1.1 Procedure for Future Traffic Demand Forecast

Table 8.1.1 (1) Future Socio-economic Framework for Traffic Forecast "Population"

Year	2005	2010	2015	2020
Banteay Meanchey	718.9	819.9	941.0	1,068.5
Battambang	939.0	1,037.0	1,153.0	1,280.1
Kampong Cham	1,767.5	1,907.4	2,073.5	2,250.7
Kampong Chhnang	477.2	538.7	613.8	698.4
Kampong Speu	681.8	761.9	853.4	954.5
Kampong Thom	636.5	699.5	770.2	846.8
Kampot	573.2	616.1	669.4	726.2
Kandal	1,185.3	1,280.4	1,392.6	1,512.3
Koh Kong	182.0	217.8	255.6	299.6
Kracheh	305.1	344.6	388.2	436.7
Mondul Kiri	40.7	46.7	54.3	63.0
Phnom Penh	1,255.9	1,445.7	1,634.5	1,845.1
Preah Vihear	145.8	165.1	187.5	212.6
Prey Veng	1,005.1	1,055.6	1,119.0	1,184.4
Pursat	415.6	456.9	509.3	566.8
Ratanak Kiri	115.9	133.3	154.8	179.5
Siem Reap	804.1	903.3	1,016.3	1,141.6
Sihanoukville	201.0	235.3	272.6	315.3
Stung Treng	98.7	112.2	127.7	145.1
Svay Rieng	516.1	547.9	586.0	625.8
Takeo	855.7	917.1	993.5	1,074.7
Otdar Meanchey	94.2	106.8	121.6	138.2
Kep	38.0	44.3	51.3	59.2
Krong Pailin	31.7	37.6	44.1	51.6
Total	13,085.0	14,431.1	15,983.2	17,676.7

Table 8.1.1 (2) Future Socio-economic Framework for Traffic Forecast "Employment"

	2005				2010				2015				2020			
	Primary	Secondary	Tertiary	Total	Primary	Secondary	Tertiary	Total	Primary	Secondary	Tertiary	Total	Primary	Secondary	Tertiary	Total
Banteay Meanchey	230.8	32.9	132.9	396.7	252.0	38.4	142.3	252.0	274.4	36.9	163.1	474.4	298.5	33.5	184.8	516.8
Battambang	309.4	61.9	217.9	589.1	320.1	66.1	267.7	320.1	331.9	63.6	306.7	702.3	343.2	58.8	347.6	749.5
Kampong Cham	718.0	81.6	199.2	998.8	722.6	110.9	268.9	722.6	726.7	134.9	336.1	1,197.7	735.7	155.3	413.4	1,304.5
Kampong Chhnang	173.8	12.0	52.2	238.0	188.1	15.9	64.7	188.1	204.8	19.2	74.1	298.1	222.7	21.9	83.3	327.9
Kampong Speu	289.5	12.3	61.1	362.9	313.3	16.7	73.9	313.3	341.1	20.1	83.3	444.5	371.1	23.2	93.5	487.8
Kampong Thom	250.5	18.1	68.7	337.3	259.3	24.4	84.4	259.3	268.8	29.5	96.7	395.0	277.9	34.0	109.6	421.5
Kampot	236.8	15.9	58.2	310.9	258.6	17.5	72.0	258.6	281.5	16.7	82.5	380.7	306.2	15.3	93.5	415.0
Kandal	489.4	33.7	147.1	670.2	492.5	36.3	182.2	492.5	495.3	34.9	208.7	738.9	496.1	31.7	236.5	764.3
Koh Kong	31.6	15.2	47.0	93.8	28.2	16.4	49.8	28.2	25.4	19.5	66.5	111.5	22.2	22.0	85.7	129.9
Kratie	107.9	20.1	48.4	176.3	117.8	20.3	51.8	117.8	128.2	16.1	50.6	194.9	139.5	12.6	49.0	201.1
Mondul Kiri	14.2	3.3	7.4	24.9	15.8	7.9	9.1	15.8	17.2	8.4	10.8	36.4	18.5	8.2	12.5	39.3
Phnom Penh	40.7	316.2	560.4	917.3	36.7	322.2	600.0	36.7	32.7	356.2	721.5	1,110.4	29.6	373.9	852.4	1,255.9
Preah Vihear	51.7	2.1	19.0	72.8	54.0	2.6	19.2	54.0	56.0	2.8	18.2	76.9	57.9	2.7	17.6	78.2
Prey Veng	486.3	22.4	90.7	599.3	517.1	23.7	111.5	517.1	546.8	22.4	127.7	696.9	577.1	20.4	143.5	741.0
Pursat	122.0	50.6	70.7	243.2	133.2	107.2	87.5	133.2	145.0	200.3	100.3	445.6	157.7	357.8	113.6	629.1
Ratanak Kiri	42.1	2.3	10.0	54.4	43.6	1.9	10.6	43.6	59.6	1.5	10.1	71.2	81.6	1.2	9.7	92.5
Siemreap	272.2	210.0	44.0	526.2	294.6	259.9	54.1	294.6	317.6	316.2	71.2	705.1	342.1	361.6	92.4	796.1
Sihanoukville	40.0	30.8	59.9	130.8	41.4	41.7	74.2	41.4	42.9	50.7	92.7	186.3	44.8	58.8	114.9	218.5
Stung Treng	27.2	2.8	12.5	42.5	29.5	2.3	13.2	29.5	36.1	1.8	12.5	50.4	44.3	1.4	12.1	57.8
Svay Rieng	244.0	7.5	47.1	298.5	264.1	10.6	57.0	264.1	287.5	13.2	64.8	365.4	312.7	15.0	73.4	401.1
Takeo	370.5	24.2	67.7	462.5	383.4	32.7	83.2	383.4	397.6	39.8	95.3	532.7	411.1	46.2	108.0	565.3
Oddar Meanchey	49.8	2.4	25.2	77.4	53.9	2.6	31.9	53.9	58.7	2.6	36.6	97.8	63.8	2.4	41.4	107.7
Kep	13.4	1.2	5.1	19.7	13.9	1.0	5.9	13.9	14.4	1.6	6.8	22.7	15.0	1.9	7.7	24.5
Pailin	11.1	4.9	6.9	22.9	12.7	4.0	9.0	12.7	14.2	3.2	9.7	27.1	16.5	2.5	10.6	29.6
	4,622.8	984.6	2,059.2	7,666.6	4,846.2	1,183.0	2,424.4	4,846.2	5,104.3	1,412.3	2,846.4	9,363.0	5,385.8	1,662.3	3,306.7	10,354.9

Table 8.1.1 (3) Future Socio-economic Framework for Traffic Forecast "GRDP"

	2005				2010				2015				2020			
	Primary	Secondary	Tertiary	GRDP-Total	Primary	Secondary	Tertiary	GRDP-Total	Primary	Secondary	Tertiary	GRDP-Total	Primary	Secondary	Tertiary	GRDP-Total
Banteay Meanchey	296.6	172.0	385.0	853.6	390.2	254.0	505.8	1,150.0	498.4	288.3	699.1	1,485.8	631.7	343.5	939.5	1,914.7
Battambang	397.5	323.4	630.9	1,351.8	471.5	415.0	906.6	1,793.1	571.1	497.0	1,301.9	2,370.0	691.3	601.4	1,749.6	3,042.3
Kampong Cham	922.6	426.2	576.9	1,925.7	1,064.5	688.5	894.2	2,647.2	1,254.1	1,039.9	1,409.6	3,703.6	1,475.1	1,732.6	2,276.1	5,483.8
Kampong Chhnang	223.3	62.5	151.3	437.1	284.1	102.1	223.6	609.8	362.9	153.3	323.5	839.7	439.3	229.7	431.4	1,100.4
Kampong Speu	372.0	64.4	176.8	613.2	481.4	108.2	257.7	847.3	609.5	162.5	367.3	1,139.3	772.6	246.5	489.8	1,508.9
Kampong Thom	321.9	94.5	198.9	615.3	374.9	149.2	275.6	799.7	433.4	224.0	398.8	1,056.2	524.6	339.8	535.9	1,400.3
Kampot	304.3	83.3	168.4	556.0	357.7	103.8	226.4	687.9	433.2	116.9	310.5	860.6	524.4	140.4	417.3	1,082.1
Kandal	628.8	176.1	426.1	1,231.0	732.3	227.6	612.3	1,572.2	862.7	284.8	885.9	2,033.4	965.5	376.4	1,310.5	2,652.4
Koh Kong	40.6	79.5	136.0	256.1	39.8	100.5	163.3	303.6	42.1	149.1	273.3	464.5	41.4	244.2	461.2	746.8
Kracheh	138.6	104.8	140.2	383.6	174.9	129.6	175.6	480.1	223.3	121.6	206.7	551.6	285.7	124.5	236.9	647.1
Mondul Kiri	18.3	17.0	21.3	56.6	21.9	46.9	28.4	97.2	28.0	58.7	40.2	126.9	33.5	75.4	55.3	164.2
Phnom Penh	74.7	2,359.4	2,318.3	4,752.4	82.2	3,071.1	3,046.0	6,199.3	85.9	4,419.1	4,604.5	9,109.5	86.4	6,704.4	7,147.3	13,938.1
Preah Vihear	66.4	11.2	54.9	132.5	78.0	16.2	63.7	157.9	90.2	20.3	72.2	182.7	104.1	26.1	82.7	212.9
Prey Veng	624.8	116.8	262.7	1,004.3	761.3	149.9	377.5	1,288.7	896.9	175.5	546.2	1,618.6	1,055.0	209.1	734.0	1,998.1
Pursat	156.7	264.2	204.7	625.6	201.1	695.1	304.7	1,200.9	243.5	1,534.5	417.8	2,195.8	308.7	3,584.9	561.5	4,455.1
Ratanak Kiri	54.1	12.1	29.0	95.2	67.7	12.2	38.1	118.0	108.8	12.0	45.3	166.1	166.5	12.3	51.9	230.7
Siem Reap	349.7	1,096.9	127.5	1,574.1	437.4	1,640.4	183.2	2,261.0	525.0	2,360.4	304.6	3,190.0	659.5	3,734.9	517.2	4,911.6
Sihanoukville	51.4	161.1	173.5	386.0	63.7	272.2	260.0	595.9	73.7	433.0	409.9	916.6	90.0	725.4	632.0	1,447.4
Stung Treng	35.0	14.8	36.1	85.9	40.8	13.8	41.9	96.5	55.7	13.0	47.5	116.2	80.1	13.3	54.4	147.8
Svay Rieng	313.5	39.0	136.4	488.9	351.6	59.4	172.2	583.2	425.8	91.8	245.4	763.0	515.4	137.6	329.8	982.8
Takeo	476.1	126.6	196.1	798.8	559.6	203.4	277.8	1,040.8	646.9	290.9	380.9	1,318.7	746.2	463.0	535.7	1,744.9
Otdar Meanchey	64.0	12.6	73.0	149.6	81.4	16.9	109.4	207.7	104.0	19.8	150.0	273.8	133.0	24.3	203.1	360.4
Kep	17.2	6.5	14.8	38.5	21.7	6.1	20.5	48.3	25.1	11.4	27.9	64.4	29.2	18.5	39.2	86.9
Krong Pailin	19.1	32.1	24.9	76.1	23.3	27.9	35.3	86.5	30.8	26.2	48.0	105.0	41.8	29.8	68.5	140.1
Cambodia	5,967.0	5,857.0	6,664.0	18,488.0	7,163.0	8,510.0	9,199.8	24,872.8	8,631.0	12,504.0	13,517.0	34,652.0	10,401.0	20,138.0	19,860.8	50,399.8

Table 8.1.1 (4) Future Socio-economic Framework for Traffic Forecast "Vehicle Number"

	2010			2015			2020		
	M/Cycle	Car	Total	M/Cycle	Car	Total	M/Cycle	Car	Total
Banteay Meanchey	39,903	17,810	57,713	49,842	23,054	72,896	62,540	29,753	92,294
Battambang	58,940	27,854	86,794	76,015	36,863	112,879	95,916	47,363	143,280
Kampong Cham	84,222	41,193	125,416	115,493	57,692	173,185	168,190	85,496	253,685
Kampong Chhnang	23,914	9,374	33,288	30,718	12,964	43,682	38,435	17,035	55,470
Kampong Speu	30,942	13,082	44,024	39,587	17,643	57,230	50,528	23,415	73,943
Kampong Thom	29,534	12,339	41,873	37,127	16,345	53,472	47,314	21,720	69,033
Kampot	26,224	10,592	36,816	31,337	13,290	44,627	37,893	16,749	54,642
Kandal	52,401	24,404	76,805	66,054	31,607	97,661	84,377	41,275	125,651
Koh Kong	14,850	4,592	19,442	19,612	7,104	26,716	27,967	11,512	39,479
Kracheh	20,073	7,347	27,420	22,191	8,465	30,656	25,016	9,955	34,971
Mondul Kiri	8,740	1,367	10,107	9,618	1,831	11,449	10,724	2,414	13,139
Phnom Penh	189,367	96,669	286,036	275,514	142,122	417,636	418,443	217,534	635,977
Preah Vihear	10,538	2,316	12,854	11,271	2,703	13,974	12,163	3,174	15,337
Prey Veng	44,010	19,977	63,987	53,775	25,129	78,904	65,008	31,056	96,064
Pursat	41,410	18,605	60,014	70,861	34,144	105,005	137,738	69,429	207,167
Ratanak Kiri	9,354	1,692	11,046	10,779	2,443	13,222	12,690	3,452	16,142
Siem Reap	72,791	35,162	107,953	100,289	49,670	149,959	151,249	76,558	227,807
Sihanoukville	23,503	9,157	32,659	32,994	14,165	47,159	48,708	22,455	71,164
Stung Treng	8,718	1,356	10,073	9,300	1,663	10,964	10,237	2,157	12,394
Svay Rieng	23,125	8,957	32,082	28,448	11,766	40,214	34,956	15,199	50,155
Takeo	36,671	16,105	52,776	44,899	20,445	65,344	57,513	27,101	84,614
Otdar Meanchey	12,011	3,094	15,105	13,967	4,126	18,093	16,531	5,479	22,010
Kep	7,292	604	7,896	7,768	855	8,623	8,435	1,207	9,642
Krong Pailin	8,422	1,200	9,622	8,969	1,488	10,457	10,009	2,037	12,046
Cambodia	876,955	384,847	1,261,802	1,166,429	537,578	1,704,007	1,632,580	783,528	2,416,107

8.2 Estimation of Generated and Attracted Traffic

The objective of the trip generation and attraction model is to forecast the number of vehicles that will commence and end their journeys in each traffic zone within the study area. A linear regression model by vehicle category is adopted in the study. The model parameters are calibrated as shown in **Table 8.2.1**.

$$Gi = ai*X1i + bi*X2i + Di$$
$$Aj = aj*X1j + bj*X2j + Dj$$

Where,
- Gi: Generation from Zone i
- Aj: Attraction to Zone j
- X1i, X2j: Attributes in zone i, j
- ai, aj, bi, and bj: Coefficient
- Di, Dj: Dummy Variable in zone i,j

Table 8.2.1 Trip Generation and Attraction model parameters

Model Type	Vehicle Category	Tertiary GRDP	Secondary workers	Registration of Motor Cycle	Multiple Correlation Coefficient
Trip Generation	MC	-	0.15572	0.058858	0.9780
	LV	0.001791	0.06489	-	0.9734
	HV	0.000529	0.009692	-	0.9764
Trip Attraction	MC	-	0.139854	0.077246	0.9790
	LV	0.001775	0.064058	-	0.9783
	HV	0.000454	0.010343	-	0.9668

8.2.1 Trip Production

The number of future trips by vehicle type is shown in **Table 8.2.2**.

Table 8.2.2 Future trip production

(Unit: Vehicle/day)

Year	MC	LV	HV	Total
2005	154,000	50,000	10,000	214,000
2010	206,000	69,000	14,000	289,000
2015	276,000	94,000	20,000	390,000
2020	375,000	128,000	28,000	527,000
(2020/2005)	2.42	2.56	2.80	2.46

8.2.2 Generation and Attraction

The present and future trip generation and attraction by vehicle type is shown in **Table 8.2.3 (1)** and **Table 8.2.3 (2)**. **Figure 8.2.1** shows the trip generation by zone in 2005 and 2020.

The figure shows that the Kandal Province has significantly more traffic than the other provinces; the future traffic distribution will follow the same trend. In terms of the change between 2005 and 2020, Battambang Province, Kampog Cham Province, Sihanoukville Province, Pursat Province, Siemreap Province and Takeo Province, show the highest rate, in numerical order from the highest. As the gross traffic volume of Phnom Penh is significantly higher than the other provinces, the figure does not show Phnom Penh together with the other provinces.

Table 8.2.3 (1) Trip generation and attraction by vehicle type in 2005

(Unit: Vehicle/day)

Zone No	Province	Trip Generation in 2005			Trip Attraction in 2005		
		Motor cycles	Light Vehicles	Heavy Vehicles	Motor cycles	Light Vehicles	Heavy Vehicles
1	Banteay Meanchey	3,867	1,892	219	4,016	1,706	207
2	Battambang	14,587	2,687	236	14,609	2,754	240
3	Kampong Cham	5,970	3,387	781	5,887	3,417	699
4	Kampong Chhnang	1,564	1,861	121	1,525	1,365	87
5	Kampong Speu	3,451	696	316	4,994	1,147	341
6	Kampong Thom	5,228	711	322	5,188	1,006	343
7	Kampot	6,562	974	314	6,579	1,022	318
8	Kandal	30,250	10,615	1,639	28,456	10,386	1,707
9	Koh Kong	1,821	299	109	1,845	477	95
10	Kratie	4,434	654	175	4,598	590	171
11	Mondul Kiri	855	96	27	880	96	28
12	Phnom Penh	43,852	19,027	3,640	44,691	18,761	3,533
13	Preah Vihear	261	70	14	263	63	15
14	Prey Veng	8,446	610	547	7,998	608	616
15	Pursat	1,174	262	180	1,172	237	166
16	Ratanak Kiri	991	88	16	989	89	16
17	Siemreap	8,403	2,017	342	8,262	2,122	362
18	Sihanoukville	3,878	1,045	324	3,788	1,045	326
19	Stung Treng	155	98	22	155	94	24
20	Svay Rieng	1,170	294	142	1,217	463	153
21	Takeo	5,425	1,833	450	5,372	1,817	488
22	Oddar Meanchey	1,154	149	37	1,015	167	31
23	Kep	16	70	19	15	6	26
24	Pailin	352	137	13	352	134	13
Total		153,866	49,572	10,005	153,866	49,572	10,005

Source: JICA Study Team

Table 8.2.3 (2) Trip generation and attraction by vehicle type in 2020

(Unit: Vehicle/day)

Zone No	Province	Trip Generation in 2020			Trip Attraction in 2020		
		Motor cycles	Light Vehicles	Heavy Vehicles	Motor cycles	Light Vehicles	Heavy Vehicles
1	Banteay Meanchey	7,830	3,881	455	8,082	3,496	433
2	Battambang	21,004	5,520	514	21,320	5,628	523
3	Kampong Cham	33,432	12,614	2,865	30,874	12,668	2,589
4	Kampong Chhnang	4,984	6,315	393	4,636	4,605	287
5	Kampong Speu	12,196	2,579	1,151	17,229	4,243	1,261
6	Kampong Thom	16,589	2,389	1,002	15,685	3,325	1,092
7	Kampot	8,287	1,965	648	8,403	2,056	653
8	Kandal	52,813	20,789	3,327	50,297	20,239	3,433
9	Koh Kong	5,227	883	320	5,264	1,394	285
10	Kratie	5,936	915	246	6,191	812	243
11	Mondul Kiri	2,429	389	99	2,281	385	107
12	Phnom Penh	112,184	46,689	9,082	116,654	45,795	8,786
13	Preah Vihear	458	147	25	437	131	28
14	Prey Veng	10,982	1,220	1,133	10,525	1,205	1,269
15	Pursat	12,895	3,035	1,816	11,909	2,764	1,761
16	Ratanak Kiri	1,445	116	22	1,470	112	22
17	Siemreap	27,629	6,998	1,188	26,696	7,309	1,262
18	Sihanoukville	14,625	3,754	1,132	14,365	3,720	1,153
19	Stung Treng	199	123	28	195	116	31
20	Svay Rieng	2,903	950	419	2,769	1,492	478
21	Takeo	17,811	6,402	1,503	16,888	6,314	1,655
22	Oddar Meanchey	2,193	307	80	1,880	354	65
23	Kep	32	192	50	27	15	83
24	Pailin	435	213	22	441	207	21
Total		374,518	128,385	27,520	374,518	128,385	27,520

Source: JICA Study Team

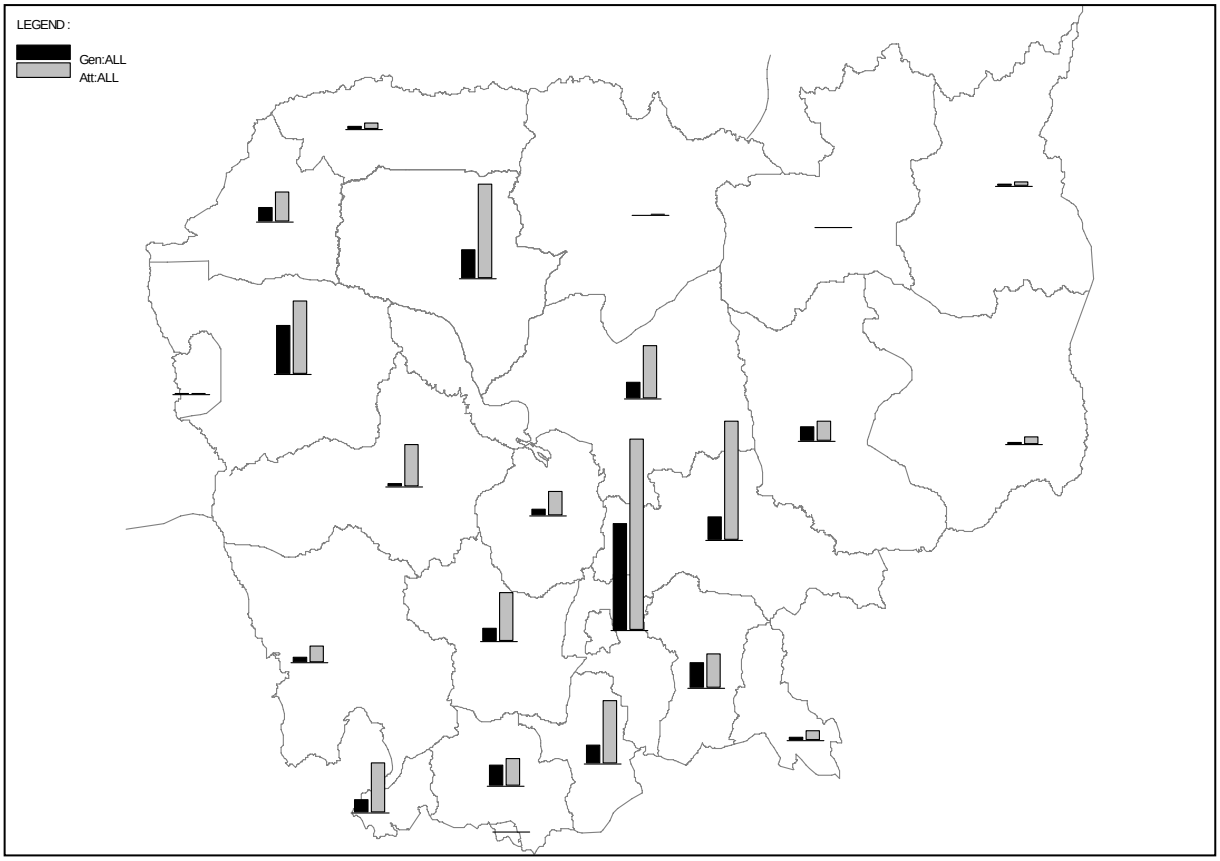


Figure 8.2.1 Future trip generation and attractions

8.3 Estimation of Future Traffic Distribution

Trip distribution is the second major step in the traffic demand modeling process. Trip production provides an estimation of the volume of generated and attracted trips within each zone. Trip distribution is the process that links the generated and attracted trips for each zone pair.

8.3.1 Trip Distribution model

In this study, the gravity model provides the best fit for calculating the model parameters for the trip distribution forecast, as shown in the following equations.

$$Tij = K \cdot Gi^{a} Aj^{b} \cdot f(dij)$$

Where; Tij : Inter-zonal trip distribution from zone i to j
Gi : Trip Generation in zone i
Aj : Trip Attraction in zone j
K,a,b : Model parameters
$f(dij)$: Composite function = $a \cdot dij^{\gamma} \cdot \exp(b \cdot dij)$

To balance the trip distribution in each zone, the doubly constrained method is applied after estimating the distribution using the gravity model. This type of model is also known as the Fratar method.

8.3.2 Calibrating trip Distribution model

The results of the calibration of the gravity models, before applying the doubly constrained method, are shown in **Table 8.3.1**.

Table 8.3.1 Inter-zonal trip distribution model parameters

Vehicle Type	K	a	b	e(dij)	dij	Multiple Correlation Coefficient
MC	0.93730	0.37075	0.37139	-0.00601	-0.09651	0.67911
LV	0.42793	0.37091	0.34805	0.34805	-0.00185	0.67730
HV	0.98155	0.033724	0.31250	-0.00315	-0.11619	0.72632

8.3.3 Future Trip Distribution

Based on the trip distribution in 2005 and 2020, the desired line by OD, which shows the trip distribution and interaction between zone pairs are illustrated in **Figures 8.3.1** and **8.3.2**.

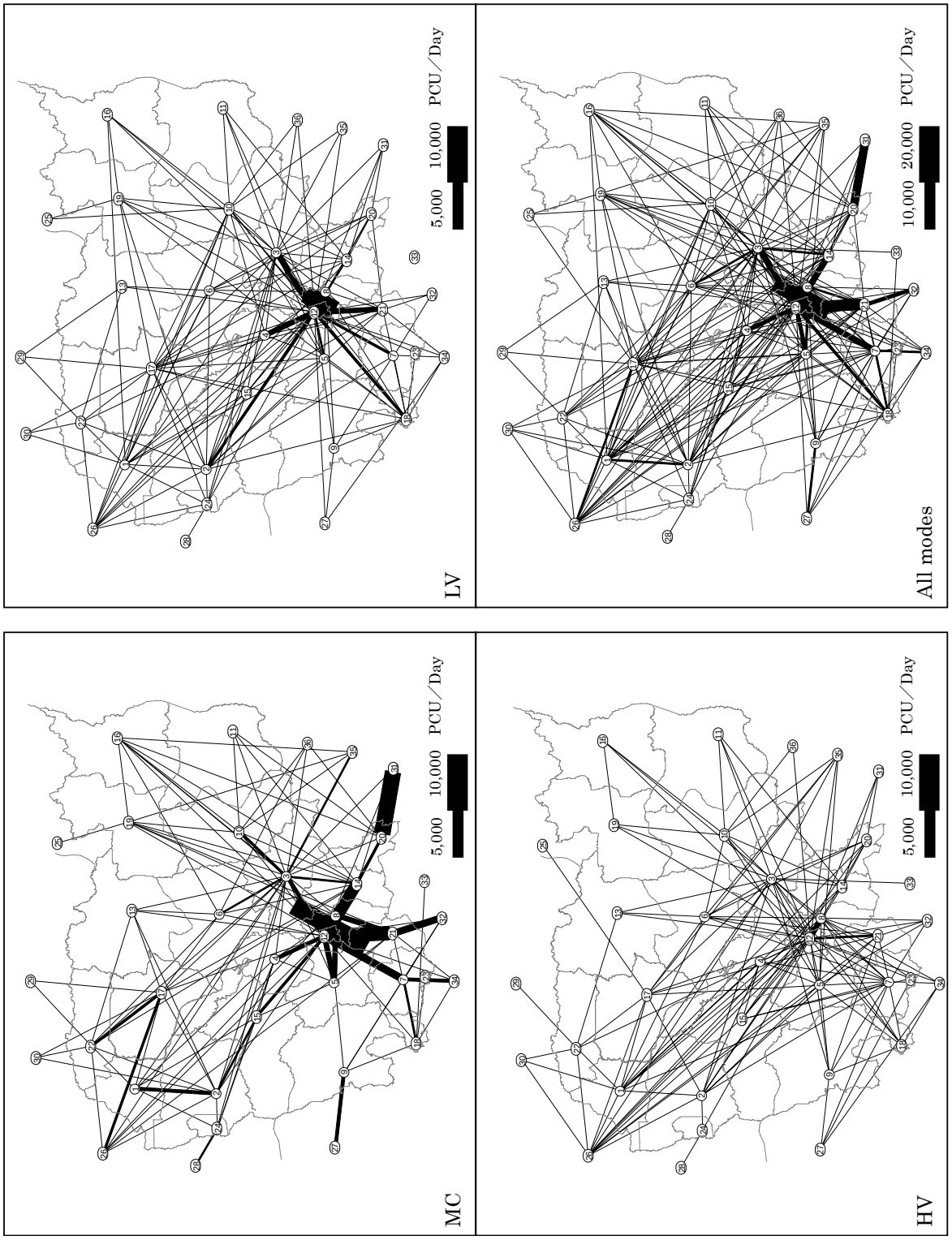


Figure 8.3.1 Desire Line for 2005

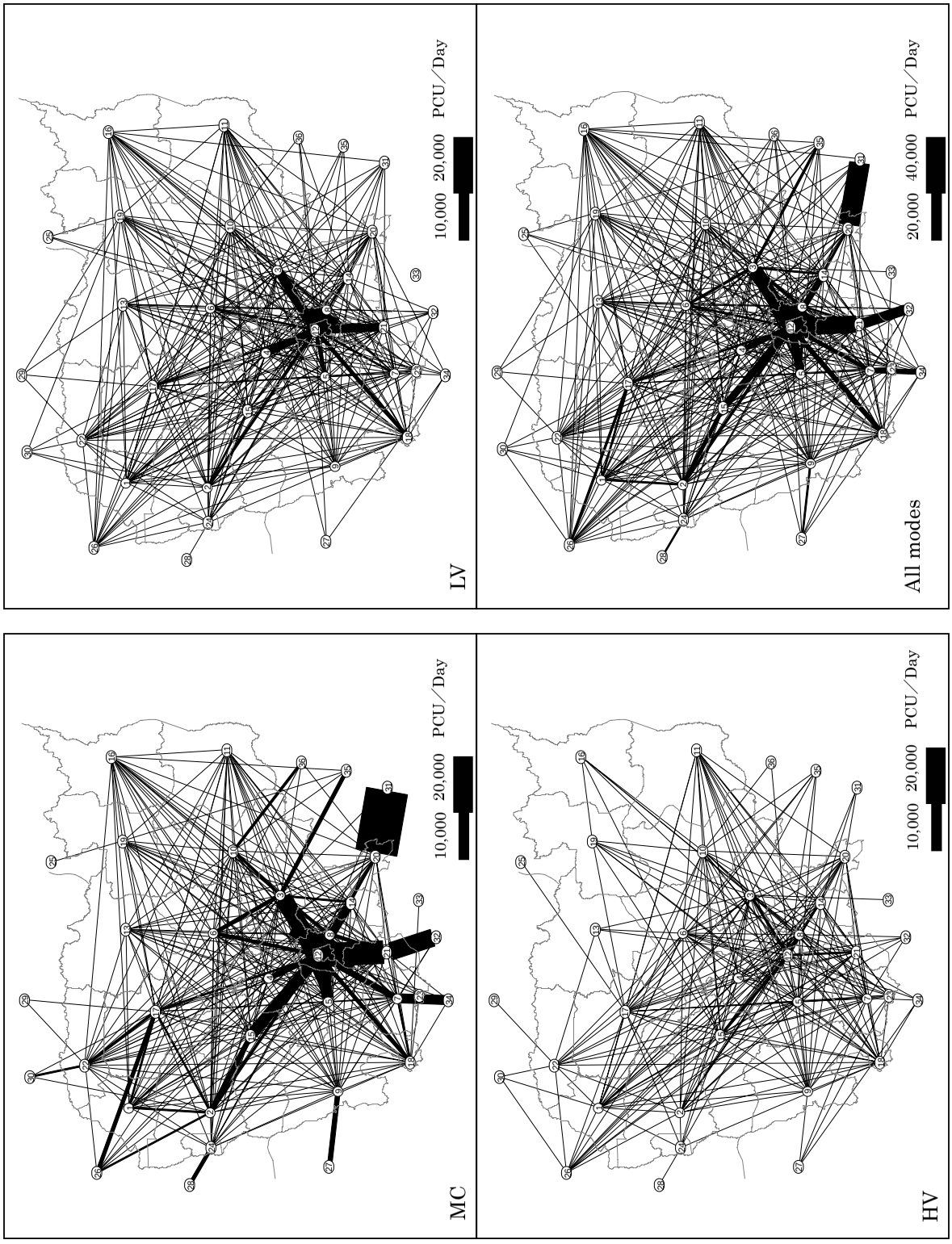


Figure 8.3.2 Desire Line for 2020

8.4 Assignment of Traffic to the Road Network

The traffic assignment process allocates the traffic to the road network links. The estimated traffic volumes for 2010, 2015 and 2020 are assigned to the road network.

This assumes the network formation after 2010, including; the new road, currently under construction, that runs parallel to National Road No.7 in Kratie, the bridge at Stung Treng where there is currently the ferry port, and bridges at four points on National Road No.48.

8.4.1 Traffic Assignment Model

JICA STRADA supports four assignment types; incremental, user equilibrium, system optimum, and time of day user equilibrium. Incremental assignment was selected for this study. Incremental assignment divides the input OD traffic data into user-specified increments and assigns each increment to the minimum route wherein the generalized cost (i.e., the impedance calculated from travel time, distance, etc) is the least.

8.4.2 Assessment of Present Road Network

In order to determine the degree of the traffic and transportation problem in the future, it was first assumed that no improvements would be made to the transportation system. This is called the "Do-Nothing" case. The traffic assignment results for the present case (2005) and the Do-Nothing case for 2010, 2015 and 2020 are shown in **Table 8.4.1** and **Figure 8.4.1**.

Comparing the future road traffic with the present traffic, the main corridors will become heavily congested in the future. The following observations are made in relation to the traffic patterns:

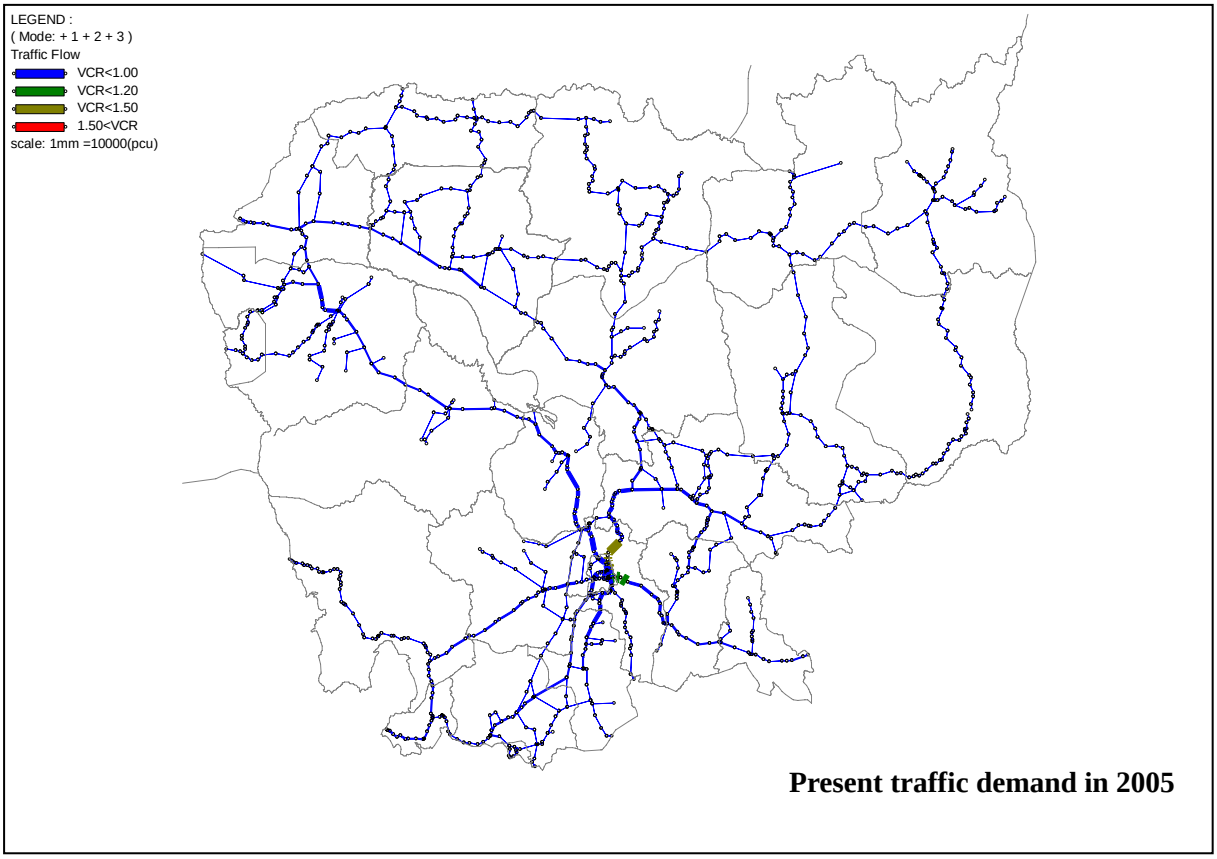
(1) In 2010, National Road No.'s 1, 5 and 6 (Kandal Province), which are connected to Phnom Penh, are predicted to exceed capacity. The congestion on National Road No.6 is the most critical.

(2) In 2015, it is predicted that National Road No.5 between Phnom Penh and Kanpong Chhnang will be congested, and National Road No.2 between Kandal Province and Takeo Province, and from Kampong Cham to National Road No.60 will start becoming congested.

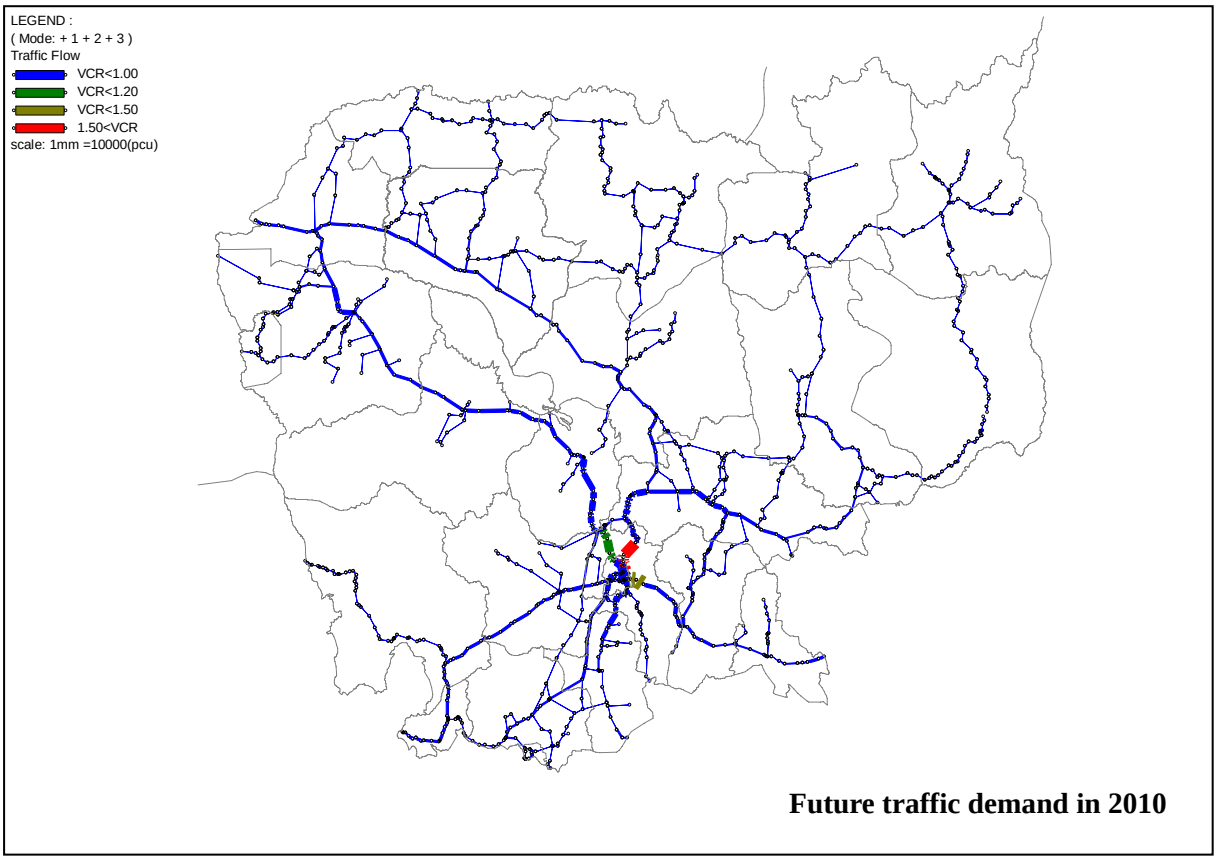
(3) In 2020, it is predicted that all of the routes that connect to Phnom Penh City will exceed capacity. The rural cities of Kanpong Chhanang, Kampong Thom, Siemreap and Battambang will also be over capacity.

Table 8.4.1 Future traffic volumes by traffic count station (unit: PCU)

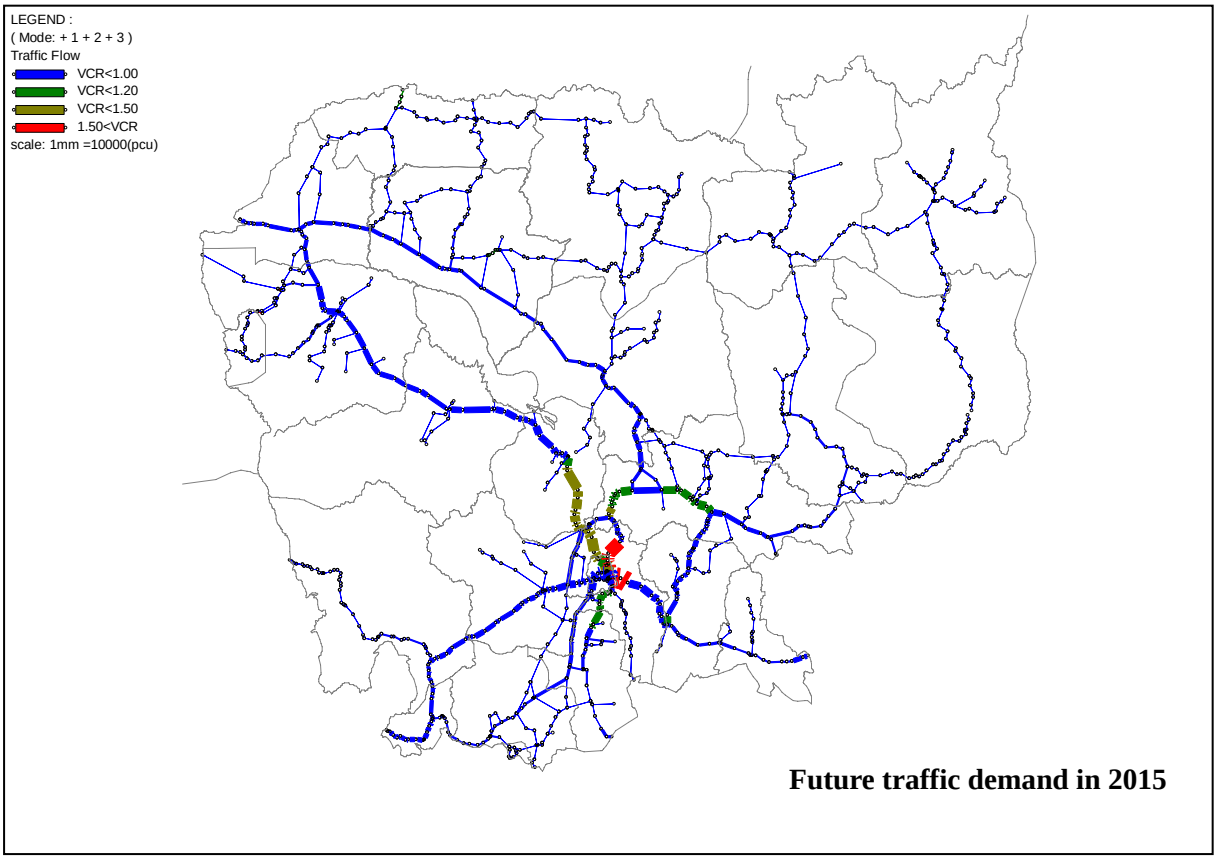
Station No.	Road No.	Year			
		2005	2010	2015	2020
1	1	29,340	39,842	55,668	73,347
2	1	6,180	10,524	20,734	31,314
3	1	3,362	5,421	8,035	13,634
4	1	3,788	6,403	11,785	16,912
5	2	9,486	15,293	18,258	19,781
6	2	3,476	5,403	8,304	11,829
7	2	1,755	2,986	5,467	8,839
8	3	9,754	12,840	19,987	31,412
9	3	2,942	4,234	5,575	11,464
10	3	3,509	4,715	5,737	9,411
11	3	1,269	2,088	2,759	6,019
12	4	4,792	7,333	12,617	17,487
13	4	3,777	6,512	10,243	13,604
14	4	5,127	7,990	12,270	18,398
15	5	13,165	23,764	29,652	43,176
16	5	4,619	9,578	16,361	25,462
17	5	4,031	7,868	12,496	17,429
18	5	4,235	8,046	12,636	17,589
19	5	8,987	12,830	17,607	21,289
20	5	3,196	6,779	10,887	15,717
21	5	5,509	7,884	10,498	13,605
22	6A	23,323	29,034	34,246	47,978
23	6A	8,915	12,270	14,534	23,103
24	6	3,445	6,839	11,885	23,431
25	6	3,843	6,488	10,749	25,481
26	6	1,683	3,645	6,831	19,472
27	6	3,735	6,122	9,961	21,754
28	6	4,321	7,593	12,109	22,096
29	6	2,560	5,577	9,444	17,091
30	7	7,938	13,035	22,750	36,151
31	7	1,639	2,960	3,878	8,051
32	7	2,289	2,498	2,661	2,760
33	7	450	570	681	2,373
34	7	72	125	188	253
35	11	3,367	5,528	13,077	20,224
36	31	1,158	1,487	1,970	2,728
37	33	713	1,204	2,231	4,127
38	48	1,771	2,064	3,478	5,341
39	48	1,070	1,599	2,440	2,941
40	51	1,481	2,669	11,107	19,962
41	56	306	419	595	1,320
42	57	1,731	2,163	2,594	4,555
43	57	475	544	612	2,198
44	57	569	834	1,287	2,397
45	61	681	5,266	8,918	18,053
46	62	226	297	375	1,807
47	66	506	727	1,111	1,637
48	64	1,687	2,534	3,882	7,068
49	64	194	275	403	1,962
50	64	267	394	604	1,217
51	68	580	704	1,003	1,389
52	68	494	676	1,138	1,575
53	71	932	1,267	1,791	8,077
54	72	1,257	2,127	3,914	6,020
55	73	791	1,075	1,336	1,710
56	74	190	329	595	1,167
57	76	541	1,187	1,622	2,961
58	78	274	306	383	701
59	78	240	243	277	326
60	274	150	157	177	181



Present traffic demand in 2005



Future traffic demand in 2010



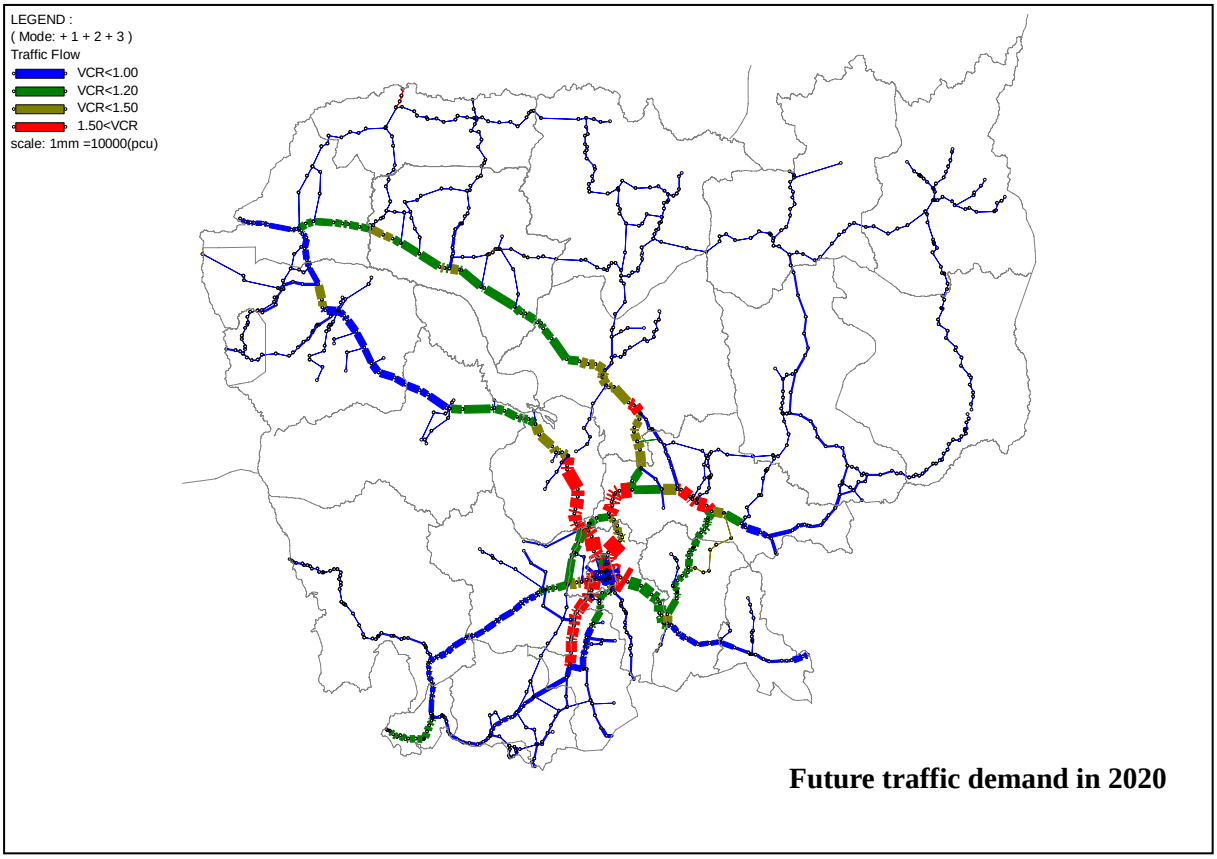


Figure 8.4.1 Traffic assignment results

APPENDIX FOR CHAPTER MP-A-8 TRAFFIC DATA

1. Actual Traffic Volume, AADT and Assigened Traffic Volume at Traffic Survey Stations

Unit: Vehicle/Day

Station No.	Road No.	Link No.	Actual Traffic Volume(2005)				AADT Traffic Volume(2005)				Assignment Result(2005)			
			MC	LV	HV	Total	MC	LV	HV	Total	MC	LV	HV	Total
1	1	L001003	27,916	10,351	1,469	39,736	33,104	12,275	1,742	47,121	32,348	12,676	1,803	46,827
2	1	L001011	6,270	1,225	556	8,051	7,435	1,452	660	9,547	6,692	1,855	730	9,277
3	1	L001019	2,182	1,079	319	3,580	2,588	1,280	378	4,246	2,560	1,271	378	4,209
4	1	L001032	7,564	856	80	8,500	8,970	1,015	95	10,080	8,956	1,009	96	10,061
5	2	L002006	8,560	2,765	804	12,129	10,151	3,279	954	14,384	10,108	3,264	960	14,332
6	2	L002016	2,338	1,071	341	3,750	2,773	1,271	403	4,447	2,756	1,260	404	4,420
7	2	L002024	3,297	205	137	3,639	3,910	243	163	4,316	3,884	236	163	4,283
8	3	L003001	6,311	2,624	1,082	10,017	7,484	3,112	1,283	11,879	7,392	3,188	1,308	11,888
9	3	L003013	3,233	810	218	4,261	3,834	960	259	5,053	3,824	965	260	5,049
10	3	L003037	4,435	814	281	5,530	5,259	966	332	6,557	5,236	959	334	6,529
11	3	L003028	1,400	488	34	1,922	1,660	578	41	2,279	1,648	583	43	2,274
12	4	L004018	626	1,439	694	2,759	742	1,707	823	3,272	728	1,701	828	3,257
13	4	L004030	456	1,104	557	2,117	541	1,308	661	2,510	524	1,324	664	2,512
14	4	L004044	2,849	1,688	518	5,055	3,379	2,002	614	5,995	3,360	1,959	613	5,932
15	5	L005005	8,486	4,738	724	13,948	10,063	5,619	859	16,541	10,836	5,931	1,015	17,782
16	5	L005025	1,472	1,190	653	3,315	1,746	1,410	775	3,931	1,568	1,482	792	3,842
17	5	L005036	1,989	1,900	404	4,293	1,860	1,778	378	4,016	1,696	1,814	447	3,957
18	5	L005042	3,599	1,734	425	5,758	3,366	1,622	397	5,385	3,188	1,691	442	5,321
19	5	L005046	14,667	3,385	487	18,539	13,717	3,166	455	17,338	13,572	3,250	511	17,333
20	5	L005050	2,794	1,241	322	4,357	2,613	1,161	301	4,075	2,448	1,224	352	4,024
21	5	L005062	5,073	2,376	558	8,007	4,744	2,222	522	7,488	4,704	2,214	522	7,440
22	6A	L006005	15,372	9,161	1,681	26,214	18,229	10,863	1,994	31,086	19,268	10,384	1,842	31,494
23	6A	L006015	2,631	3,451	1,019	7,101	3,120	4,093	1,208	8,421	4,428	3,676	1,072	9,176
24	6	L006027	1,553	1,615	557	3,725	1,452	1,511	520	3,483	1,484	1,340	467	3,291
25	6	L006042	5,155	1,585	364	7,104	4,821	1,482	340	6,643	4,876	1,360	309	6,545
26	6	L006048	453	721	317	1,491	424	675	296	1,395	496	582	278	1,356
27	6	L006060	4,401	1,363	409	6,173	4,116	1,274	383	5,773	4,180	1,265	370	5,815
28	6	L006061	6,974	1,355	284	8,613	6,522	1,267	266	8,055	6,612	1,371	319	8,302
29	6	L006066	2,486	890	215	3,591	2,325	832	201	3,358	2,416	941	260	3,617
30	7	L007006	5,097	2,682	978	8,757	4,767	2,508	915	8,190	6,020	2,798	979	9,797
31	7	L007021	1,100	460	193	1,753	1,029	430	181	1,640	976	588	220	1,784
32	7	L007037	4,339	666	118	5,123	4,058	622	111	4,791	4,164	651	145	4,960
33	7	L007050	241	229	54	524	225	204	51	480	176	200	52	428
34	7	L007066	46	43	0	89	43	26	6	75	40	26	10	76
35	11	L011018	2,018	352	263	2,633	1,887	329	230	2,446	3,352	962	443	4,757
36	31	L031001	607	547	53	1,207	720	649	62	1,431	712	636	62	1,410
37	33	L033003	1,770	107	14	1,891	2,099	124	15	2,238	2,080	119	15	2,214
38	48	L048003	1,353	543	160	2,056	1,604	645	189	2,438	1,600	644	189	2,433
39	48	L048052	1,562	350	26	1,938	1,852	415	31	2,298	1,844	413	31	2,288
40	51	L051003	1,417	263	182	1,862	1,680	312	216	2,208	1,648	328	220	2,196
41	56	L056006	379	74	55	508	354	69	50	473	324	62	50	436
42	57	L3	2,550	679	124	3,353	2,385	635	116	3,136	2,360	638	115	3,113
43	57	L057015	453	256	28	737	424	237	26	687	404	240	25	669
44	57	L057021	1,076	247	11	1,334	1,006	231	10	1,247	1,004	231	10	1,245
45	61	L061002	907	266	13	1,186	1,076	315	15	1,406	536	253	77	866
46	62	L062006	189	108	24	321	177	99	22	298	152	98	22	272
47	66	L066006	871	195	28	1,094	815	183	26	1,024	800	183	26	1,009
48	64	L064006	1,513	747	168	2,428	1,415	698	158	2,271	1,396	689	159	2,244
49	64	L064021	113	126	11	250	91	111	10	212	76	112	12	200
50	64	L064028	193	178	3	374	180	166	6	352	176	164	6	346
51	68	L068010	1,329	210	14	1,553	1,243	196	13	1,452	1,232	188	13	1,433
52	68	L068019	831	208	24	1,063	777	194	22	993	768	189	22	979
53	71	L071008	457	120	245	822	427	112	229	768	432	110	229	771
54	72	L072003	1,005	193	286	1,484	940	180	268	1,388	928	177	268	1,373
55	73	L073010	1,183	386	54	1,623	1,106	359	34	1,499	1,068	340	33	1,441
56	74	L074003	377	78	11	466	353	72	5	430	344	72	5	421
57	76	L076010	1,003	169	62	1,234	938	156	43	1,137	904	149	43	1,096
58	78	L078010	433	104	24	561	405	97	22	524	364	94	22	480
59	78	L078028	775	40	5	820	725	37	5	767	712	36	6	754
60	274	L274045	370	45	9	424	346	39	7	392	340	36	7	383

Source: JICA Study Team

2. Traffic Demand Forecast at Traffic Survey Stations (Vehicle Base), 2005, 2010, 2015 and 2020

Unit: Vehicle/Day

Station No.	Road No.	Link No.	Assignment Result(2005)				Assignment Result(2010)				Assignment Result(2015)				Assignment Result(2020)			
			MC	LV	HV	Total	MC	LV	HV	Total	MC	LV	HV	Total	MC	LV	HV	Total
1	1	L001003	32,348	12,676	1,803	46,827	40,440	17,645	2,559	60,644	54,204	23,728	4,153	82,085	66,516	32,554	5,432	104,502
2	1	L001011	6,692	1,855	730	9,277	9,364	3,632	1,215	14,211	17,708	6,860	2,578	27,146	23,088	12,300	3,470	38,858
3	1	L001019	2,560	1,271	378	4,209	3,248	2,286	584	6,118	4,640	3,319	909	8,868	6,568	7,092	1,328	14,988
4	1	L001032	8,956	1,009	96	10,061	15,100	1,707	165	16,972	27,824	3,144	300	31,268	46,904	5,302	503	52,709
5	2	L002006	10,108	3,264	960	14,332	17,004	5,014	1,592	23,610	19,960	6,170	1,852	27,982	21,304	7,296	1,930	30,530
6	2	L002016	2,756	1,260	404	4,420	3,972	1,942	661	6,575	5,892	3,056	1,004	9,952	8,624	4,463	1,429	14,516
7	2	L002024	3,884	236	163	4,283	6,572	403	280	7,255	12,108	743	504	13,355	20,436	1,231	851	22,518
8	3	L003001	7,392	3,188	1,308	11,888	8,868	4,248	1,772	14,888	14,924	6,602	2,668	24,194	24,036	10,646	3,844	38,526
9	3	L003013	3,824	965	260	5,049	4,440	1,369	471	6,280	5,752	1,768	643	8,163	8,444	3,789	1,394	13,627
10	3	L003037	5,236	959	334	6,529	5,824	1,424	493	7,741	6,624	1,740	636	9,000	8,564	3,070	1,180	12,814
11	3	L003028	1,648	583	43	2,274	2,244	946	115	3,305	2,948	1,166	189	4,303	4,780	2,399	644	7,823
12	4	L004018	728	1,701	828	3,257	2,804	2,462	1,185	6,451	6,688	4,524	1,764	12,976	7,560	6,834	2,247	16,641
13	4	L004030	524	1,324	664	2,512	2,324	2,360	994	5,678	5,192	3,582	1,490	10,264	5,608	4,713	1,837	12,158
14	4	L004044	3,360	1,959	613	5,932	5,216	3,021	970	9,207	8,268	4,676	1,453	14,397	12,848	6,982	2,145	21,975
15	5	L005005	10,836	5,931	1,015	17,782	18,292	10,157	2,165	30,614	24,160	12,261	2,762	39,183	35,300	16,229	4,359	55,888
16	5	L005025	1,568	1,482	792	3,842	4,304	3,128	1,531	8,963	10,636	4,702	2,609	17,947	18,348	6,032	4,046	28,426
17	5	L005036	1,696	1,814	447	3,957	4,052	3,452	847	8,351	8,708	5,118	1,308	15,134	11,824	6,831	1,711	20,366
18	5	L005042	3,188	1,691	442	5,321	5,556	3,311	840	9,707	10,104	4,970	1,300	16,374	13,312	6,714	1,706	21,732
19	5	L005046	13,572	3,250	511	17,333	16,280	4,860	896	22,036	20,444	6,760	1,349	28,553	23,536	8,250	1,852	33,638
20	5	L005050	2,448	1,224	352	4,024	5,208	2,669	714	8,591	9,100	4,174	1,132	14,406	11,588	5,610	1,645	18,843
21	5	L005062	4,704	2,214	522	7,440	6,612	3,149	765	10,526	9,044	4,015	1,073	14,132	12,408	5,668	1,612	19,688
22	6A	L006005	19,268	10,384	1,842	31,494	24,888	12,762	2,287	39,937	30,284	14,971	2,654	47,909	39,224	20,662	3,701	63,587
23	6A	L006015	4,428	3,676	1,072	9,176	8,184	4,799	1,409	14,392	11,076	5,525	1,620	18,221	14,744	8,689	2,379	25,812
24	6	L006027	1,484	1,340	467	3,291	4,488	2,579	832	7,899	9,296	4,352	1,374	15,022	13,220	8,440	2,459	24,119
25	6	L006042	4,876	1,360	309	6,545	7,812	2,426	501	10,739	12,860	3,978	854	17,692	20,388	10,102	2,017	32,507
26	6	L006048	496	582	278	1,356	2,152	1,387	458	3,997	4,984	2,548	800	8,332	8,808	7,668	1,954	18,430
27	6	L006060	4,180	1,265	370	5,815	6,676	2,232	555	9,463	10,996	3,587	910	15,493	18,284	8,382	2,019	28,685
28	6	L006061	6,612	1,371	319	8,302	10,084	2,570	620	13,274	15,908	4,091	1,007	21,006	25,104	7,986	1,892	34,982
29	6	L006066	2,416	941	260	3,617	5,296	2,071	555	7,922	9,788	3,376	926	14,090	14,112	6,464	1,677	22,253
30	7	L007006	6,020	2,798	979	9,797	10,272	4,556	1,591	16,419	18,844	8,024	2,670	29,538	28,128	13,733	3,676	45,537
31	7	L007021	976	588	220	1,784	2,392	1,019	363	3,774	4,024	1,170	470	5,664	5,108	3,444	571	9,123
32	7	L007037	4,164	651	145	4,960	4,604	744	139	5,487	4,860	797	150	5,807	5,128	800	159	6,087
33	7	L007050	176	200	52	428	228	257	64	549	436	256	84	776	572	1,445	101	2,118
34	7	L007066	40	26	10	76	64	49	16	129	120	64	26	210	192	102	40	334
35	11	L011018	3,352	962	443	4,757	4,724	1,764	714	7,202	10,684	4,253	1,697	16,634	13,324	8,079	2,047	23,450
36	31	L031001	712	636	62	1,410	768	861	73	1,702	928	1,100	121	2,149	956	1,216	145	2,317
37	33	L033003	2,080	119	15	2,214	3,520	197	26	3,743	6,508	378	44	6,930	10,968	626	73	11,667
38	48	L048003	1,600	644	189	2,433	1,884	689	244	2,817	2,808	1,304	382	4,494	4,332	2,671	575	7,578
39	48	L048052	1,844	413	31	2,288	2,716	628	45	3,389	4,184	943	72	5,199	6,444	1,450	109	8,003
40	51	L051003	1,648	328	220	2,196	2,532	715	381	3,628	10,036	3,950	1,221	15,207	16,224	7,295	2,008	25,527
41	56	L056006	324	62	50	436	420	87	69	576	580	126	98	804	760	212	121	1,093
42	57	L3	2,360	638	115	3,113	2,540	826	166	3,532	2,848	1,016	205	4,069	3,128	1,242	246	4,616
43	57	L057015	404	240	25	669	408	281	31	720	416	324	35	775	476	393	41	910
44	57	L057021	1,004	231	10	1,245	1,476	339	14	1,829	2,276	522	22	2,820	3,200	700	34	3,934
45	61	L061002	536	253	77	866	3,668	2,060	592	6,320	7,248	3,668	841	11,757	12,948	6,335	1,953	21,236
46	62	L062006	152	98	22	272	184	132	29	345	236	169	35	440	260	1,262	42	1,564
47	66	L066006	800	183	26	1,009	1,068	272	40	1,380	1,588	408	68	2,064	2,440	607	91	3,138
48	64	L064006	1,396	689	159	2,244	1,940	1,044	248	3,232	2,972	1,621	371	4,964	4,144	2,544	542	7,230
49	64	L064021	76	112	12	200	116	154	18	288	188	225	25	438	280	464	29	773
50	64	L064028	176	164	6	346	264	244	8	516	404	374	12	790	624	374	18	1,016
51	68	L068010	1,232	188	13	1,433	1,476	227	18	1,721	1,856	378	23	2,257	2,340	550	34	2,924
52	68	L068019	768	189	22	979	1,132	245	29	1,406	1,760	439	50	2,249	2,700	474	75	3,249
53	71	L071008	432	110	229	771	692	146	304	1,142	1,096	198	424	1,718	3,728	2,669	1,051	7,448
54	72	L072003	928	177	268	1,373	1,560	300	454	2,314	2,904	556	831	4,291	4,900	941	1,402	7,243
55	73	L073010	1,068	340	33	1,441	1,436	463	46	1,945	1,992	522	62	2,576	2,888	607	81	3,576
56	74	L074003	344	72	5	421	588	122	10	720	1,084	224	15	1,323	1,836	378	25	2,239
57	76	L076010	904	149	43	1,096	1,608	369	108	2,085	2,192	488	155	2,835	2,772	1,321	196	4,289
58	78	L078010	364	94	22	480	384	108	25	517	564	127	28	719	680	335	30	1,045
59	78	L078028	712	36	6	754	708	39	6	753	804	42	8	854	896	59	8	963
60	274	L274045	340	36	7	383	352	34	9	395	364	48	9	421	416	56	11	483

Actual traffic volume : Traffic count data
AADT traffic volume : Annual Average Daily traffic(estimation)
Assignment Result : Traffic Projection (traffic assignment)
(2005-2020)

3. Traffic Demand Forecast at Traffic Survey Stations (PCU Base), 2005, 2010, 2015 and 2020

Unit: PCU/Day

Station No.	Road No.	Link No.	Assignment Result(2005)				Assignment Result(2010)				Assignment Result(2015)				Assignment Result(2020)			
			MC	LV	HV	Total	MC	LV	HV	Total	MC	LV	HV	Total	MC	LV	HV	Total
1	1	L001003	8,087	15,845	5,409	29,341	10,110	22,056	7,677	39,843	13,551	29,660	12,459	55,670	16,629	40,693	16,296	73,618
2	1	L001011	1,673	2,319	2,190	6,182	2,341	4,540	3,645	10,526	4,427	8,575	7,734	20,736	5,772	15,375	10,410	31,557
3	1	L001019	640	1,589	1,134	3,363	812	2,858	1,752	5,422	1,160	4,149	2,727	8,036	1,642	8,865	3,984	14,491
4	1	L001032	2,239	1,261	288	3,788	3,775	2,134	495	6,404	6,956	3,930	900	11,786	11,726	6,628	1,509	19,863
5	2	L002006	2,527	4,080	2,880	9,487	4,251	6,268	4,776	15,295	4,990	7,713	5,556	18,259	5,326	9,120	5,790	20,236
6	2	L002016	689	1,575	1,212	3,476	993	2,428	1,983	5,404	1,473	3,820	3,012	8,305	2,156	5,579	4,287	12,022
7	2	L002024	971	295	489	1,755	1,643	504	840	2,987	3,027	929	1,512	5,468	5,109	1,539	2,553	9,201
8	3	L003001	1,848	3,985	3,924	9,757	2,217	5,310	5,316	12,843	3,731	8,253	8,004	19,988	6,009	13,308	11,532	30,849
9	3	L003013	956	1,206	780	2,942	1,110	1,711	1,413	4,234	1,438	2,210	1,929	5,577	2,111	4,736	4,182	11,029
10	3	L003037	1,309	1,199	1,002	3,510	1,456	1,780	1,479	4,715	1,656	2,175	1,908	5,739	2,141	3,838	3,540	9,519
11	3	L003028	412	729	129	1,270	561	1,183	345	2,089	737	1,458	567	2,762	1,195	2,999	1,932	6,126
12	4	L004018	182	2,126	2,484	4,792	701	3,078	3,555	7,334	1,672	5,655	5,292	12,619	1,890	8,543	6,741	17,174
13	4	L004030	131	1,655	1,992	3,778	581	2,950	2,982	6,513	1,298	4,478	4,470	10,246	1,402	5,891	5,511	12,804
14	4	L004044	840	2,449	1,839	5,128	1,304	3,776	2,910	7,990	2,067	5,845	4,359	12,271	3,212	8,728	6,435	18,375
15	5	L005005	2,709	7,414	3,045	13,168	4,573	12,696	6,495	23,764	6,040	15,326	8,286	29,652	8,825	20,286	13,077	42,188
16	5	L005025	392	1,853	2,376	4,621	1,076	3,910	4,593	9,579	2,659	5,878	7,827	16,364	4,587	7,540	12,138	24,265
17	5	L005036	424	2,268	1,341	4,033	1,013	4,315	2,541	7,869	2,177	6,398	3,924	12,499	2,956	8,539	5,133	16,628
18	5	L005042	797	2,114	1,326	4,237	1,389	4,139	2,520	8,048	2,526	6,213	3,900	12,639	3,328	8,393	5,118	16,839
19	5	L005046	3,393	4,063	1,533	8,989	4,070	6,075	2,688	12,833	5,111	8,450	4,047	17,608	5,884	10,313	5,556	21,753
20	5	L005050	612	1,530	1,056	3,198	1,302	3,336	2,142	6,780	2,275	5,218	3,396	10,889	2,897	7,013	4,935	14,845
21	5	L005062	1,176	2,768	1,566	5,510	1,653	3,936	2,295	7,884	2,261	5,019	3,219	10,499	3,102	7,085	4,836	15,023
22	6A	L006005	4,817	12,980	5,526	23,323	6,222	15,953	6,861	29,036	7,571	18,714	7,962	34,247	9,806	25,828	11,103	46,737
23	6A	L006015	1,107	4,595	3,216	8,918	2,046	5,999	4,227	12,272	2,769	6,906	4,860	14,535	3,686	10,861	7,137	21,684
24	6	L006027	371	1,675	1,401	3,447	1,122	3,224	2,496	6,842	2,324	5,440	4,122	11,886	3,305	10,550	7,377	21,232
25	6	L006042	1,219	1,700	927	3,846	1,953	3,033	1,503	6,489	3,215	4,973	2,562	10,750	5,097	12,628	6,051	23,776
26	6	L006048	124	728	834	1,686	538	1,734	1,374	3,646	1,246	3,185	2,400	6,831	2,202	9,585	5,862	17,649
27	6	L006060	1,045	1,581	1,110	3,736	1,669	2,790	1,665	6,124	2,749	4,484	2,730	9,963	4,571	10,478	6,057	21,106
28	6	L006061	1,653	1,714	957	4,324	2,521	3,213	1,860	7,594	3,977	5,114	3,021	12,112	6,276	9,983	5,676	21,935
29	6	L006066	604	1,176	780	2,560	1,324	2,589	1,665	5,578	2,447	4,220	2,778	9,445	3,528	8,080	5,031	16,639
30	7	L007006	1,505	3,498	2,937	7,940	2,568	5,695	4,773	13,036	4,711	10,030	8,010	22,751	7,032	17,166	11,028	35,226
31	7	L007021	244	735	660	1,639	598	1,274	1,089	2,961	1,006	1,463	1,410	3,879	1,277	4,305	1,713	7,295
32	7	L007037	1,041	814	435	2,290	1,151	930	417	2,498	1,215	996	450	2,661	1,282	1,000	477	2,759
33	7	L007050	44	250	156	450	57	321	192	570	109	320	252	681	143	1,806	303	2,252
34	7	L007066	10	33	30	73	16	61	48	125	30	80	78	188	48	128	120	296
35	11	L011018	838	1,203	1,329	3,370	1,181	2,205	2,142	5,528	2,671	5,316	5,091	13,078	3,331	10,099	6,141	19,571
36	31	L031001	178	795	186	1,159	192	1,076	219	1,487	232	1,375	363	1,970	239	1,520	435	2,194
37	33	L033003	520	149	45	714	880	246	78	1,204	1,627	473	132	2,232	2,742	783	219	3,744
38	48	L048003	400	805	567	1,772	471	861	732	2,064	702	1,630	1,146	3,478	1,083	3,339	1,725	6,147
39	48	L048052	461	516	93	1,070	679	785	135	1,599	1,046	1,179	216	2,441	1,611	1,813	327	3,751
40	51	L051003	412	410	660	1,482	633	894	1,143	2,670	2,509	4,938	3,663	11,110	4,056	9,119	6,024	19,199
41	56	L056006	81	78	150	309	105	109	207	421	145	158	294	597	190	265	363	818
42	57	L3	590	798	345	1,733	635	1,033	498	2,166	712	1,270	615	2,597	782	1,553	738	3,073
43	57	L057015	101	300	75	476	102	351	93	546	104	405	105	614	119	491	123	733
44	57	L057021	251	289	30	570	369	424	42	835	569	653	66	1,288	800	875	102	1,777
45	61	L061002	134	316	231	681	917	2,575	1,776	5,268	1,812	4,585	2,523	8,920	3,237	7,919	5,859	17,015
46	62	L062006	38	123	66	227	46	165	87	298	59	211	105	375	65	1,578	126	1,769
47	66	L066006	200	229	78	507	267	340	120	727	397	510	204	1,111	610	759	273	1,642
48	64	L064006	349	861	477	1,687	485	1,305	744	2,534	743	2,026	1,113	3,882	1,036	3,180	1,626	5,842
49	64	L064021	19	140	36	195	29	193	54	276	47	281	75	403	70	580	87	737
50	64	L064028	44	205	18	267	66	305	24	395	101	468	36	605	156	468	54	678
51	68	L068010	308	235	39	582	369	284	54	707	464	473	69	1,006	585	688	102	1,375
52	68	L068019	192	236	66	494	283	306	87	676	440	549	150	1,139	675	593	225	1,493
53	71	L071008	108	138	687	933	173	183	912	1,268	274	248	1,272	1,794	932	3,336	3,153	7,421
54	72	L072003	232	221	804	1,257	390	375	1,362	2,127	726	695	2,493	3,914	1,225	1,176	4,206	6,607
55	73	L073010	267	425	99	791	359	579	138	1,076	498	653	186	1,337	722	759	243	1,724
56	74	L074003	86	90	15	191	147	153	30	330	271	280	45	596	459	473	75	1,007
57	76	L076010	226	186	129	541	402	461	324	1,187	548	610	465	1,623	693	1,651	588	2,932
58	78	L078010	91	118	66	275	96	135	75	306	141	159	84	384	170	419	90	679
59	78	L078028	178	45	18	241	177	49	18	244	201	53	24	278	224	74	24	322
60	274	L274045	85	45	21	151	88	43	27	158	91	60	27	178	104	70	33	207

Source: JICA Study Team

4. Traffic Demand Forecast in Terms of Vehicle Base (1-Digit Roads) in 2005, 2010, 2015 and 2020

Unit: Vehicle/day

National Road	Location	Length	No of Lane	Daily Traffic Volume in 2005				Daily Traffic Volume in 2010				Daily Traffic Volume in 2015				Daily Traffic Volume in 2020			
				MC	LV	HV	Total	MC	LV	HV	Total	MC	LV	HV	Total	MC	LV	HV	Total
NR. No.1	**Phnom Penh-Vietnam Border**	**166.0**																	
1-1	Phnom Penh-Neak Luong	60.0	4	14,288	4,626	933	19,847	19,793	7,792	1,653	29,238	29,991	12,455	3,066	45,512	35,416	16,724	3,776	55,915
1-2	Neak Luong Ferry	1.7	2	6,587	1,397	614	8,598	10,544	3,665	1,267	15,476	19,061	7,435	2,610	29,106	22,421	10,689	3,202	36,312
1-3	Neak Luong-Vietnam Border	106.0	2	3,329	1,008	281	4,618	4,835	1,901	449	7,185	7,631	2,976	737	11,344	11,192	5,135	1,063	17,390
NR. No.2	**Phnom Penh-Dun Loap**	**120.0**	2																
2-1	Thakmao-Takeo	68.0	2	7,494	2,485	771	10,751	9,733	3,137	959	13,830	11,870	3,975	1,164	17,009	14,545	5,384	1,369	21,298
2-2	Takeo-Dun Loap	52.0	2	1,453	214	118	1,785	2,447	307	204	2,958	4,465	640	361	5,465	7,407	947	558	8,912
NR. No.3	**Phnom Penh-Veal Lean**	**202.0**	2	3,763	1,275	333	5,372	5,283	2,033	575	7,891	8,812	3,337	978	13,127	9,157	3,891	1,214	14,262
NR. No.4	**Phnom Penh-Sihanoukville**	**214.0**	2																
4-1	PhnomPenh-Kampong Speu	36.0	4	1,328	1,912	977	4,216	6,102	3,693	1,666	11,460	12,380	6,454	2,405	21,239	18,128	10,159	3,475	31,762
4-2	Kampong Speu-NR 48	92.0	2	632	1,639	800	3,071	3,456	2,442	1,147	7,046	7,433	4,439	1,706	13,578	8,386	6,397	2,172	16,956
4-3	NR 48-Sihanoukville	86.0	4	2,299	1,648	632	4,578	4,697	2,696	970	8,362	7,955	4,172	1,449	13,576	10,974	6,074	1,980	19,028
NR. No.5	**Phnom Penh-Thai Border (Poipet)**	**406.0**																	
5-1	Phnom Penh-Penh Odongk	37.0	4	10,804	6,776	1,259	18,839	15,500	8,075	1,544	25,119	22,446	10,240	2,260	34,947	30,592	13,772	3,444	47,807
5-2	Penh Odongk-Kampong Chhang	53.0	2	3,760	4,546	841	9,146	8,793	7,537	1,597	17,927	15,944	10,424	2,374	28,742	26,107	15,057	3,997	45,161
5-3	Kampong Chhang-Buttambang	205.0	2	2,347	1,920	669	4,936	6,246	3,667	1,210	11,124	11,600	5,100	1,754	18,455	17,468	7,011	2,783	27,261
5-4	Battambang-Poipet	111.0	2	5,808	2,443	547	8,798	9,189	3,839	877	13,905	12,824	5,070	1,207	19,101	16,107	6,172	1,739	24,018
NR. No.6	**Phnom Penh-Sisophone**	**416.0**																	
6-1	Phnom Penh-KM 20	20.0	2	15,535	8,014	1,323	24,872	21,876	10,941	1,909	34,725	27,303	12,746	2,064	42,112	37,209	19,401	3,353	59,963
6-2	KM 20-Skun	55.0	2	3,919	3,541	983	8,442	10,623	5,923	1,614	18,160	15,332	6,896	1,895	24,123	24,479	14,487	3,660	42,627
6-3	Skun-Siem Reap	243.0	2	1,736	1,056	334	3,126	5,523	2,290	604	8,417	10,511	4,232	1,259	16,001	13,565	9,060	1,978	24,603
6-4	Siem Reap-Sisophone	98.0	2	4,381	1,228	331	5,939	8,651	2,573	628	11,851	14,190	4,187	1,101	19,479	17,145	6,010	1,417	24,572
NR. No.7	**Skun-Laos Border**	**464.0**																	
7-1	Skun-NR 11	61.0	2	4,590	3,432	974	8,996	10,432	5,568	1,482	17,483	15,708	7,073	1,855	24,636	23,350	13,815	3,196	40,361
7-2	NR 11-Kratie	210.0	2	2,689	842	311	3,841	5,029	1,458	497	6,984	7,275	1,928	719	9,922	9,265	4,401	996	14,662
7-3	Kratie-Laos Border	193.0	2	529	253	64	846	777	319	75	1,171	1,080	380	100	1,560	1,368	1,021	138	2,527
NR. No.8	**Ktoch Saeuch-NR13**	**64.0**	2	-	-	-	-	1,444	518	184	2,146	2,548	914	324	3,786	2,800	1,382	328	4,509
New	Phnom Penh Ring Road	50.0	4	-	-	-	-	13,938	5,487	1,164	20,588	20,018	8,313	2,046	30,378	22,807	10,770	2,431	36,008
	2nd Japan Bridge crossing Tonlesap River	1.5	2	-	-	-	-	12,760	6,382	1,114	20,256	18,824	8,788	1,423	29,035	63,072	6,578	474	70,123
	2nd Monibong Bridge crossing Bassac River	1.2	2	-	-	-	-	20,036	7,889	1,673	29,598	25,576	10,622	2,615	38,813	30,292	14,304	3,229	47,825
	Battambang Bypass	30.0	2	-	-	-	-	7,152	2,989	682	10,823	9,804	3,876	922	14,602	11,924	4,570	1,288	17,781
	Siem Reap Bypass	30.0	2	-	-	-	-	8,460	2,516	614	11,590	11,442	3,377	888	15,707	13,236	4,640	1,094	18,969
	Kampong Chhang Bypass	20.0	2	-	-	-	-	4,376	2,570	848	7,794	8,421	3,703	1,274	13,398	11,596	4,654	1,848	18,098

Source: JICA Study Team

5. Traffic Demand Forecast in Terms of PCU Base (1-Digit Roads) in 2005, 2010, 2015 and 2020

Unit: PCU/day

National Road	Location	Length	No of Lane	Daily Traffic Volume in 2005				Daily Traffic Volume in 2010				Daily Traffic Volume in 2015				Daily Traffic Volume in 2020			
				MC	LV	HV	Total	MC	LV	HV	Total	MC	LV	HV	Total	MC	LV	HV	Total
NR. No.1	**Phnom Penh-Vietnam Border**	**166.0**																	
1-1	Phnom Penh-Neak Luong	60.0	4	3,572	5,782	2,800	12,154	4,948	9,740	4,958	19,647	7,498	15,569	9,197	32,263	8,854	20,904	11,327	41,085
1-2	Neak Luong Ferry	1.7	2	1,647	1,746	1,842	5,235	2,636	4,581	3,801	11,018	4,765	9,294	7,830	21,889	5,605	13,361	9,606	28,573
1-3	Neak Luong-Vietnam Border	106.0	2	832	1,260	842	2,934	1,209	2,376	1,347	4,932	1,908	3,720	2,212	7,840	2,798	6,419	3,190	12,407
NR. No.2	**Phnom Penh-Dun Loap**	**120.0**	2																
2-1	Thakmao-Takeo	68.0	2	1,874	3,106	2,314	7,293	2,433	3,922	2,878	9,233	2,968	4,969	3,492	11,428	3,636	6,730	4,107	14,473
2-2	Takeo-Dun Loap	52.0	2	363	267	354	985	612	384	611	1,606	1,116	799	1,083	2,998	1,852	1,183	1,673	4,708
NR. No.3	**Phnom Penh-Veal Lean**	**202.0**	2	941	1,594	1,000	3,535	1,321	2,541	1,725	5,587	2,203	4,171	2,934	9,308	2,289	4,864	3,642	10,795
NR. No.4	**Phnom Penh-Sihanoukville**	**214.0**	2																
4-1	PhnomPenh-Kampong Speu	36.0	4	332	2,390	2,930	5,651	1,525	4,616	4,997	11,138	3,095	8,067	7,215	18,377	4,532	12,699	10,424	27,655
4-2	Kampong Speu-NR 48	92.0	2	158	2,049	2,399	4,606	864	3,053	3,442	7,359	1,858	5,549	5,117	12,524	2,097	7,996	6,517	16,610
4-3	NR 48-Sihanoukville	86.0	4	575	2,059	1,896	4,530	1,174	3,369	2,909	7,452	1,989	5,215	4,346	11,550	2,743	7,593	5,941	16,277
NR. No.5	**Phnom Penh-Thai Border (Poipet)**	**406.0**																	
5-1	Phnom Penh-Penh Odongk	37.0	4	2,701	8,469	3,777	14,947	3,875	10,094	4,632	18,601	5,612	12,800	6,781	25,193	7,648	17,215	10,332	35,195
5-2	Penh Odongk-Kampong Chhang	53.0	2	940	5,682	2,522	9,144	2,198	9,422	4,792	16,411	3,986	13,030	7,122	24,138	6,527	18,821	11,991	37,339
5-3	Kampong Chhang-Buttambang	205.0	2	587	2,399	2,008	4,994	1,562	4,584	3,631	9,777	2,900	6,375	5,263	14,539	4,367	8,763	8,350	21,480
5-4	Battambang-Poipet	111.0	2	1,452	3,054	1,641	6,147	2,297	4,799	2,630	9,727	3,206	6,337	3,620	13,163	4,027	7,715	5,218	16,960
NR. No.6	**Phnom Penh-Sisophone**	**416.0**																	
6-1	Phnom Penh-KM 20	20.0	2	3,884	10,018	3,968	17,869	5,469	13,676	5,727	24,871	6,826	15,932	6,192	28,950	37,209	19,401	3,353	59,963
6-2	KM 20-Skun	55.0	2	980	4,426	2,948	8,354	2,656	7,403	4,843	14,902	3,833	8,620	5,686	18,139	6,120	18,109	10,980	35,209
6-3	Skun-Siem Reap	243.0	2	434	1,320	1,003	2,757	1,381	2,863	1,812	6,055	2,628	5,290	3,776	11,693	3,391	11,325	5,934	20,650
6-4	Siem Reap-Sisophone	98.0	2	1,095	1,535	992	3,622	2,163	3,216	1,883	7,262	3,548	5,234	3,303	12,085	4,286	7,512	4,251	16,049
NR. No.7	**Skun-Laos Border**	**464.0**																	
7-1	Skun-NR 11	61.0	2	1,148	4,291	2,921	8,359	2,608	6,960	4,447	14,015	3,927	8,842	5,565	18,333	5,838	17,269	9,588	32,694
7-2	NR 11-Kratie	210.0	2	672	1,053	932	2,657	1,257	1,822	1,490	4,570	1,819	2,410	2,158	6,387	2,316	5,502	2,987	10,805
7-3	Kratie-Laos Border	193.0	2	132	316	192	641	194	399	226	818	270	475	299	1,044	342	1,277	413	2,032
NR. No.8	**Ktoch Saeuch-NR13**	**64.0**	1	–	–	–	–	361	648	551	1,349	637	1143	972	2,380	700	1727	983	3,410
New	Phnom Penh Ring Road	50.0	4	–	–	–	–	3,484	6,859	3,492	13,835	5,005	10,392	6,139	21,535	5,702	13,462	7,294	26,458
	2nd Japan Bridge crossing Tonlesap River	1.5	2	–	–	–	–	3,190	7,978	3,341	14,509	4,706	10,985	4,269	19,960	15,768	8,222	1,421	25,411
	2nd Monibong Bridge crossing Bassac River	1.2	2	–	–	–	–	5,009	9,861	5,020	19,890	6,394	13,278	7,844	27,516	7,573	17,880	9,688	35,141
	Battambang Bypass	30.0	2	–	–	–	–	1,788	3,736	2,047	7,572	2,451	4,845	2,767	10,064	2,981	5,712	3,863	12,556
	Siem Reap Bypass	30.0	2	–	–	–	–	2,115	3,145	1,841	7,100	2,861	4,221	2,664	9,745	3,309	5,799	3,282	12,390
	Kampong Chhang Bypass	20.0	2	–	–	–	–	1,094	3,212	2,544	6,850	2,105	4,629	3,821	10,555	2,899	5,818	5,543	14,260

Source: JICA Study Team

6. Traffic Demand Forecast in Terms of Vehicle Base (2-Digit Roads) in 2005, 2010, 2015 and 2020

Unit: Vehicle / Day

No.	National Road	Road No. Connected	Length	No of Lane	Daily Traffic Volume in 2005				Daily Traffic Volume in 2010				Daily Traffic Volume in 2015				Daily Traffic Volume in 2020			
					MC	LV	HV	Total	MC	LV	HV	Total	MC	LV	HV	Total	MC	LV	HV	Total
1	NR. 11	NR. 1	90	2	3,069	1,101	390	4,560	5,338	1,914	679	7,931	9,282	3,329	1,180	13,791	14,302	7,062	1,675	23,039
2	NR. 13		45	2	1,456	522	185	2,163	2,038	731	259	3,028	2,851	1,022	362	4,235	3,534	1,745	414	5,693
3	NR. 21	NR. 2	66	2	383	102	35	520	909	242	83	1,234	2,161	575	198	2,934	1,232	2,995	116	4,343
4	NR 22		10	2	686	244	77	1,007	1,887	670	211	2,768	5,192	1,844	582	7,618	12,689	5,544	1,537	19,770
5	NR. 31	NR. 3	55	2	426	200	47	673	746	351	83	1,180	1,307	615	145	2,067	1,682	1,469	142	3,293
6	NR. 32		33	2	125	59	14	198	244	115	27	386	475	224	53	752	680	594	58	1,332
7	NR. 33-1		35	2	1,446	209	35	1,690	2,224	322	54	2,600	3,420	494	83	3,997	5,284	752	129	6,165
8	NR. 33-2		17	2	52	116	173	341	66	148	220	434	84	188	281	553	85	318	327	730
9	NR. 41	NR. 4	20	2	20	44	65	129	38	85	127	250	74	166	248	488	115	429	441	985
10	NR. 42		9	2	38	168	168	374	168	168	168	504	731	731	731	2,193	11,541	5,636	1,469	18,646
11	NR. 44		24	2	88	88	88	264	154	154	154	462	271	271	271	813	1,511	429	409	2,349
12	NR. 46		27	2	82	82	82	246	113	113	113	339	156	156	156	468	682	194	185	1,061
13	NR. 48		161	2	162	162	162	486	267	267	267	801	440	440	440	1,320	1,770	1,698	232	3,700
14	NR. 51	NR. 5	45	2	3,531	1,416	381	5,328	6,099	2,446	657	9,202	10,533	4,224	1,135	15,892	17,759	7,231	2,024	27,014
15	NR. 52		8	2	132	53	14	199	257	103	28	388	500	200	54	754	950	387	108	1,445
16	NR. 53		27	2	454	182	49	685	765	307	82	1,154	1,291	518	139	1,948	2,125	865	242	3,232
17	NR. 54		5	2	212	85	23	320	414	166	45	625	806	323	87	1,216	1,532	624	175	2,331
18	NR. 55		22	2	212	85	23	320	414	166	45	625	806	323	87	1,216	1,532	624	175	2,331
19	NR. 56		114	2	143	36	17	196	301	75	36	412	634	159	77	870	683	653	83	1,419
20	NR. 57		103	2	840	396	47	1,283	1,374	648	77	2,099	2,249	1,061	127	3,437	2,348	2,167	139	4,654
21	NR 59		16	2	210	99	12	321	355	167	20	542	600	283	34	917	1,020	590	10	1,620
22	NR. 60	NR. 6	20	2	1,987	261	333	2,581	2,461	324	412	3,197	3,049	401	511	3,961	2,355	1,772	220	4,347
23	NR. 61		16	2	1,471	1,326	340	3,137	2,650	2,389	613	5,652	4,773	4,303	1,104	10,180	12,554	6,894	2,015	21,463
24	NR. 62		128	2	119	34	7	160	312	89	18	419	822	234	46	1,102	745	1,075	48	1,868
25	NR. 63		14	2	507	145	28	680	987	281	55	1,323	1,923	548	108	2,579	1,291	1,863	83	3,237
26	NR. 64		134	2	213	129	24	366	558	337	63	958	1,460	882	165	2,507	3,453	2,434	408	6,295
25	NR 65		22	2	793	190	30	1,013	1,182	282	45	1,509	1,760	421	66	2,247	2,669	636	91	3,396
26	NR. 66A		140	2	756	196	30	982	1,126	292	45	1,463	1,678	435	67	2,180	2,236	745	82	3,063
	NR. 66B		145	2	179	46	7	232	219	57	9	285	268	70	11	349	294	98	11	403
27	NR. 68		118	2	759	138	27	924	1,500	273	27	1,800	2,967	540	53	3,560	4,439	1,045	234	5,718
28	NR 70	NR 7	14	2	766	751	8	1,525	766	751	12	1,529	1,153	1,130	19	2,302	1,851	1,671	31	3,553
29	NR. 71		58	2	344	97	65	506	1,118	313	212	1,643	3,628	1,018	689	5,335	9,229	4,826	1,816	15,871
30	NR. 72		14	2	948	182	270	1,400	1,591	305	453	2,349	2,671	512	761	3,944	4,916	472	1,402	6,790
31	NR. 73		57	2	1,427	460	36	1,923	1,907	615	48	2,570	2,546	821	64	3,431	3,654	1,052	83	4,789
32	NR. 74		18	2	670	134	10	814	918	184	13	1,115	1,257	252	18	1,527	2,191	245	28	2,464
33	NR. 76A		131	2	1,256	255	74	1,585	1,932	392	114	2,438	2,971	603	175	3,749	3,222	1,373	196	4,791
	NR. 76B		194	2	451	83	20	554	727	133	32	892	1,172	215	51	1,438	1,239	537	57	1,833
34	NR. 78A		124	2	443	69	14	526	653	102	20	775	962	151	30	1,143	1,059	332	28	1,419
	NR. 78B		70	2	314	15	3	332	421	21	4	446	564	28	5	597	652	64	5	721

Source: JICA Study Team

7. Traffic Demand Forecast in Terms of PCU Base (2-Digit Roads) in 2005, 2010, 2015 and 2020

Unit:PCU/Day

No.	National Road	Road No. Connected	Length	No of Lane	Daily Traffic Volume in 2005				Daily Traffic Volume in 2010				Daily Traffic Volume in 2015				Daily Traffic Volume in 2020			
					MC	LV	HV	Total	MC	LV	HV	Total	MC	LV	HV	Total	MC	LV	HV	Total
1	NR. 11	NR. 1	90	2	767	1,376	1,171	3,314	1,334	2,393	2,036	5,763	2,321	4,161	3,540	10,022	3,576	8,827	5,026	17,428
2	NR. 13		45	2	364	653	555	1,572	509	913	777	2,200	713	1,278	1,087	3,078	884	2,181	1,242	4,307
3	NR. 21	NR. 2	66	2	96	127	105	328	227	302	249	779	540	719	593	1,852	308	3,744	349	4,401
4	NR 22		10	2	172	305	231	707	472	838	634	1,944	1,298	2,305	1,745	5,348	3,172	6,930	4,611	14,713
5	NR. 31	NR. 3	55	2	106	250	142	499	186	439	249	874	327	769	436	1,531	421	1,836	427	2,683
6	NR. 32		33	2	31	74	42	147	61	144	81	286	119	280	159	557	170	742	173	1,085
7	NR. 33-1		35	2	361	261	105	728	556	402	161	1,119	855	618	248	1,721	1,321	939	386	2,647
8	NR. 33-2		17	2	13	145	519	677	17	185	661	863	21	235	842	1,098	21	397	980	1,398
9	NR. 41	NR. 4	20	2	5	55	196	256	10	107	382	498	19	208	744	970	29	536	1,324	1,889
10	NR. 42		9	2	10	209	503	173	42	209	503	754	183	913	2,192	3,288	2,885	7,045	4,407	14,337
11	NR. 44		24	2	22	110	264	396	39	193	463	695	68	339	813	1,220	378	536	1,228	2,142
12	NR. 46		27	2	21	103	247	370	28	142	340	510	39	195	468	702	170	242	554	967
13	NR. 48		161	2	40	202	485	728	67	333	800	1,200	110	549	1,319	1,978	443	2,123	696	3,261
14	NR. 51	NR. 5	45	2	883	1,770	1,142	3,795	1,525	3,057	1,972	6,554	2,633	5,281	3,406	11,319	4,440	9,039	6,071	19,550
15	NR. 52		8	2	33	66	43	142	64	129	83	276	125	251	162	537	238	484	325	1,046
16	NR. 53		27	2	113	228	147	488	191	384	247	822	323	647	417	1,387	531	1,081	726	2,339
17	NR. 54		5	2	53	106	69	228	103	207	134	445	201	404	261	866	383	780	524	1,686
18	NR. 55		22	2	53	106	69	228	103	207	134	445	201	404	261	866	383	780	524	1,686
19	NR. 56		114	2	36	45	52	133	75	94	109	279	159	198	231	587	171	816	250	1,237
20	NR. 57		103	2	210	495	142	847	344	810	232	1,386	562	1,326	380	2,268	587	2,708	417	3,713
21	NR 59		16	2	53	124	35	212	89	209	60	358	150	354	101	605	255	737	30	1,022
22	NR. 60	NR. 6	20	2	497	327	998	1,822	615	405	1,237	2,257	762	502	1,532	2,796	589	2,215	660	3,464
23	NR. 61		16	2	368	1,658	1,021	3,046	663	2,986	1,838	5,487	1,193	5,379	3,311	9,883	3,139	8,618	6,045	17,801
24	NR. 62		128	2	30	42	20	92	78	111	53	242	205	293	138	637	186	1,344	144	1,675
25	NR. 63		14	2	127	181	85	393	247	352	166	765	481	685	324	1,490	323	2,329	250	2,902
26	NR. 64		134	2	53	161	72	287	140	422	189	750	365	1,103	494	1,961	863	3,042	1,223	5,129
25	NR 65		22	2	198	237	90	525	295	353	134	782	440	526	199	1,165	667	795	273	1,735
26	NR. 66A		140	2	189	245	91	525	282	365	135	782	419	544	201	1,165	559	932	245	1,735
	NR. 66B		145	2	45	58	21	124	55	71	26	152	67	87	32	186	73	122	32	228
27	NR. 68		118	2	190	173	80	403	375	341	80	797	742	675	159	1,576	1,110	1,306	701	3,117
28	NR 70	NR 7	14	2	192	939	25	776	192	939	37	1,168	288	1,413	56	1,758	463	2,089	93	2,645
29	NR. 71		58	2	86	121	196	403	279	392	637	1,308	907	1,272	2,068	4,247	2,307	6,033	5,448	13,788
30	NR. 72		14	2	237	227	810	1,274	398	381	1,360	2,139	668	640	2,282	3,590	1,229	590	4,206	6,025
31	NR. 73		57	2	357	576	107	1,039	477	769	143	1,388	637	1,027	191	1,854	913	1,315	248	2,476
32	NR. 74		18	2	167	168	29	365	229	230	40	500	314	315	55	685	548	306	85	939
33	NR. 76A		131	2	314	319	222	855	483	490	342	1,315	743	754	525	2,022	806	1,716	588	3,110
	NR. 76B		194	2	113	103	59	276	182	167	95	444	293	269	154	715	310	671	172	1,153
34	NR. 78A		124	2	111	87	41	239	163	128	61	352	240	188	90	519	265	415	85	764
	NR. 78B		70	2	78	19	9	107	105	26	12	143	141	35	16	192	163	80	14	257

Source: JICA Study Team

CHAPTER A-9 DEVELOPMENT CONCEPT AND STRATEGIES

9.1 Current Development Framework

9.1.1 National Development Plan

(1) Preceding Development Plans

The Royal Government of Cambodia established the national development vision on poverty reduction in 1993, and prepared two development guidelines, namely:

- Socio-Economic Development Plan - 1 & 2 (1996-2000, and 2001-2005), (SEDP 1 &2)
- National Poverty Reduction Strategy 2003-2005 (NPRS)

In 2004, the Government introduced a new socio-economic development vision, the "Rectangular Strategy", with an emphasis on economic growth, employment opportunities, equity and efficient government practices. It also consolidated the guidelines into one plan entitled the "National Strategic Development Plan: 2006-2010" (NSDP). Preparation of this plan commenced in January 2006. It is noteworthy that the policy focus has shifted from "poverty reduction" to "acceleration of poverty reduction and good governance". This indicates that the urgent rehabilitation stage is complete and that Cambodia is now able to make a new foundation for growth through the alignment of the development participants, both domestically and internationally.

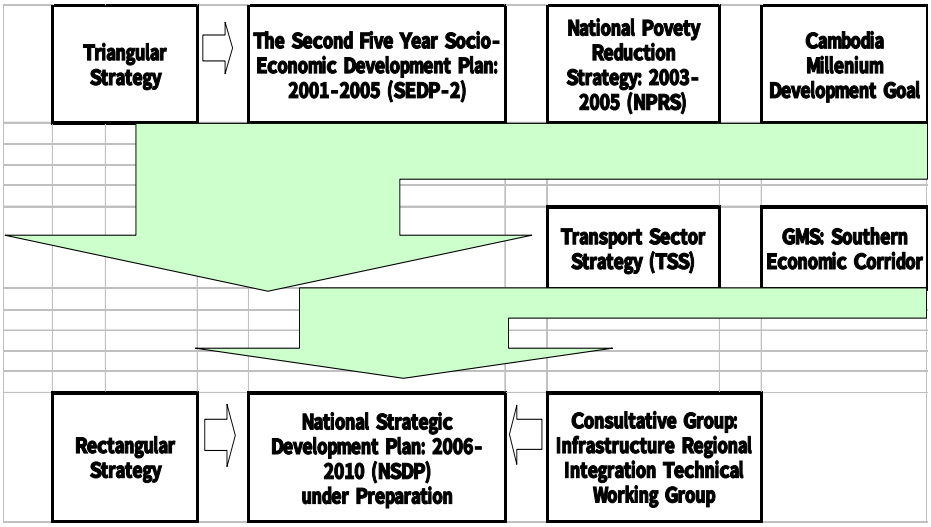


Figure 9.1.1 Structure of the Preceding Development Plans

(2) Rectangular Strategy

The present development strategy is outlined in the Rectangular Strategy, which is an extended version of previous Triangular Strategy. The current strategy was announced in the Prime Minister's speech in July 2004, and is the national development framework.

The Rectangular Strategy is aimed at promoting economic growth, full employment, equity and social justice, and enhanced the efficiency of the public sector. The strategy is based on the key elements of preceding plans, namely:

- Millennium Development Goals;
- Cambodia Socio-Economic Development Program 2001-2005 (SEDP-2);
- Cambodia National Poverty Reduction Strategy 2003-2005 (NPRS); and
- Other various policies, strategies, plans and important reform programs.

The structure of the strategy is an integrated structure of interlocking rectangles, and each "growth rectangle" has four sides as shown in **Table 9.1.1**.

Table 9.1.1 Rectangular Strategy for National Development

Rectangle 1:	Further rehabilitation of the agricultural sector (or Enhancement of the agricultural sector)*	(1) Improved productivity, and diversification of agriculture, (2) Land reform and clearing of mines, (3) Fisheries reform, and (4) Forestry reform.
Rectangle 2:	Further rehabilitation and construction of physical infrastructure	(1) Further restoration and construction of transport infrastructure (inland, marine and air transport), (2) Management of water resources and irrigation, (3) Development of energy and power grids, and (4) Development of information and communication technology.
Rectangle 3:	Private sector development and employment generation	(1) Strengthening of private sector and attraction of investment, (2) Promotion of small- and medium- enterprises (SMEs), (3) Creation of jobs and ensuring improved working conditions, and (4) Establishment of social safety nets for civil servants, employees and workers.
Rectangle 4:	Capacity building and human resource development	(1) Enhanced quality of education, (2) Improvement of health services, (3) Fostering gender equity, and (4) Improvement of population policy.

*: Both terminology are presented in "<<Rectangular Strategy>> for Growth, Employment, Equity and Efficiency", addressed by H.E. Samdech HUN SEN, Prime Minister of the Royal Government of Cambodia, 16 July 2004. The former is shown in the Figure "Rectangular Strategy Diagram". The latter is shown in the text.

9.1.2 Wider Regional Development Framework

(1) Greater Mekong Sub-Region (GMS) Economic Corridors

The GMS Economic Corridors scheme is aimed at improving and inducing infrastructure development in the region to strengthen economic linkages with neighboring countries. Another aim of the scheme is to achieve economic prosperity and stability in the region. At present, this scheme outlines transport policies for Cambodia and other countries concerned. Three corridors are listed below and are shown in **Figure 9.1.2**.

- North-South Corridor : Outside of Cambodia
- East-West Corridor : Outside of Cambodia
- South Corridor : This is also called the Second East-West Corridor, and consists of i) the southern route and ii) the northern route, and covers the whole area of Cambodia.

There is a significant gap between the national economies and budgets of the countries in the region. The traffic volumes on these routes are still less than the present road capacity in spite of the potential traffic demand due to the lack of traffic infrastructure. At present, each country independently determines an implementation schedule. However, the policies of the neighboring countries are gradually being coordinated.

The South Corridor runs through Cambodian territory. The southern route of the South Corridor connects Ho Chi Minh City, the economic hub of the Indochina peninsular, and Bangkok, the other biggest hub. Phnom Penh is located in the middle of the two international economic hubs, and the connecting roads, such as NR's 1, 5, and 6, are currently under improvement or improvement works have been planned for the road segments.

On the contrary, a development plan has not yet been formed for the northern route of the GMS South Corridor. This is because the road between Siem Reap and Stung Treng is not currently passable by vehicles, and there has not been a national consensus to improve this route to a truck road of the GMS.

One of the focal tasks of the GMS is the improvement of cross-border traffic, and periodic negotiations are progressing between the relevant countries. The Government of Cambodia has committed to the improvement of border traffic together with Vietnam, and is planning to:

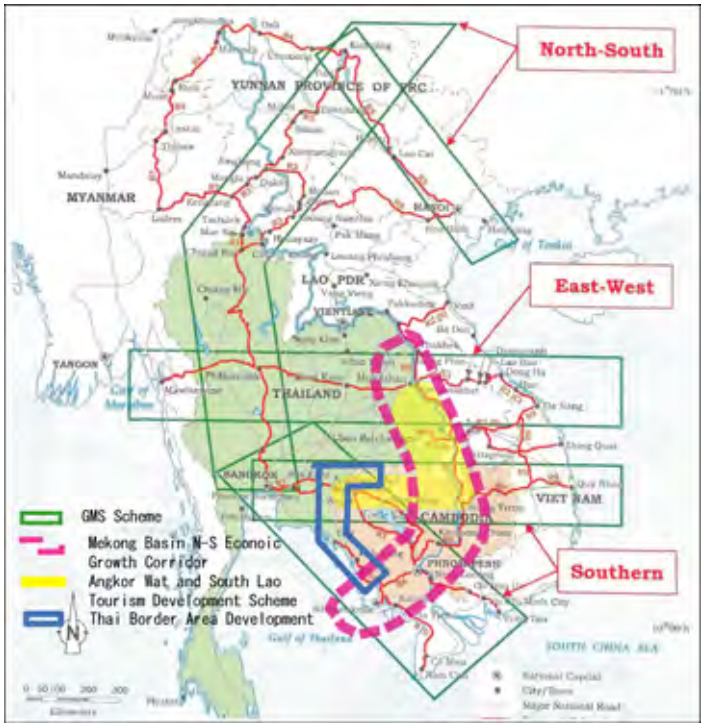


Figure 9.1.2 GMS Economic Corridor Scheme and Other Scheme

- Permit trucks from other countries to freely travel into and out of Cambodia;
- Simplify customs clearance procedures;
- Gradually reduce and/or withdraw cargo tariffs.

By the end of 2005, it is expected that vehicles will be able to pass through the border freely between Cambodia and Vietnam.

This free-flow border is expected to attract the in-flux and out-flux of a massive volume of road traffic, and will be further affected by the construction of the Meak Loeang Bridge on NR.1 over the Mekong River. It is rational to forecast a drastic increase in the volume of cargo flowing into Phnom Penh, which will cause other traffic problems within and on the outskirts of the metropolitan area.

(2) New Emerging Development Schemes

Japan has handed down its new corridor schemes which are supplementary to the GMS in a framework of the "Japan-ASEAN Action Plan" December, 2003. One of the three schemes is a completely new North-South axle corridor through Cambodia (as shown by the pink dotted line in **Figure 9.1.2**) and another is a sub-corridor spread within the new North-South axle corridor and a tourism-led economic zone (yellow zone in **Figure 9.1.2**).

1) Mekong Basin North-South Economic Growth Corridor:

This corridor covers the area between Sihanoukville at the southern edge of the corridor and

Savannakhet in southern Lao along the Mekong River and Asian Highway No. 11. The significance of this corridor is that it covers the densely-populated zone beside the southern route of the South Corridor of the GMS (i.e. the Ho Chi Minh City - Bangkok Corridor). In addition, the corridor extends the economic linkage to Lao by providing a traffic route to the sea.

This scheme consists of two components:

- Savannakhet Development Scheme;
- Sihanoukville Port related development Scheme.

The second scheme aims to further strengthen the economic linkage between the two growth poles in Cambodia in a framework presented in the JICA report entitled "The Study on Regional Development of the Phnom Penh - Sihanoukville Growth Corridor in the Kingdom of Cambodia" (June 2003, JICA). The focus of this scheme falls on the development of the Sihanoukville Port, the development of port-related industrial estates and the improvement of the railway between Phnom Penh and Sihanoukville.

2) Angkor Wat and Southern Lao Tourism Development Scheme

The two components are:

- Tourism development scheme for Angkor Wat and surrounding areas;
- Southern Lao (Wat Phu, Khong Port) tourism development.

JICA conducted a study on the former scheme in the context of a regional development plan with a transport network capable of connecting the tourism resources spreading over the region.

Other supplementary schemes are also emerging which influence the development of the transport network and national development.

3) Thai Border Area Development

In this area, the development programs are under a scheme entitled "The Joint Development Study for Economic Cooperation Plan between Thailand and Cambodia" and the report was issued in January 2002.

Industrial estates are being developed in this area, and various coastal resort developments are also planned along NR.48 in Cambodia. This route is expected to become the trunk route for international logistics between the industrial estates in Thailand and the deep seaport in Sihanoukville, even extending to Ho Chi Minh City, the southern economic hub of Indochina. A north-south axle along the Thai border is also planned in order to induce and attract the flow of traffic.

In addition, a massive influx in direct investments from China into Cambodia became apparent this year, and consequently the Chinese are developing the land routes via Lao, including NR.7.

9.1.3 Nation-wide Development Framework

(1) Triangular Strategy and Rectangular Strategy

This is the only nationwide development framework available. In this framework, the Prime Minister has designated three (3) sectors (industry, agriculture, and tourism) as the focal sectors for national growth with a special emphasis on agriculture and tourism. In addition, the target regions have been identified as shown in **Figure 9.1.3**.

Figure 9.1.3 Rectangular Objective Area

Tourism Zone	:	Triangle of Siem Reap, Preah Vihea and Kompong Thom
Industrial Zone	:	Coastal area
Agriculture Zone	:	Eastern basin of the Mekong River (including Ratanak Kiri and Mondul Kiri)

No detailed descriptions were given in the speech. This task is to be accomplished as part of the new national development guideline i.e. National Strategic Development Plan 2006-10 (NSDP).

The designated tourism zone has a plenty of heritage sites however, these potential resources are scattering over a wide area up to the Thai border. There are poor access roads within the region and consequently the sites remain in ruins.

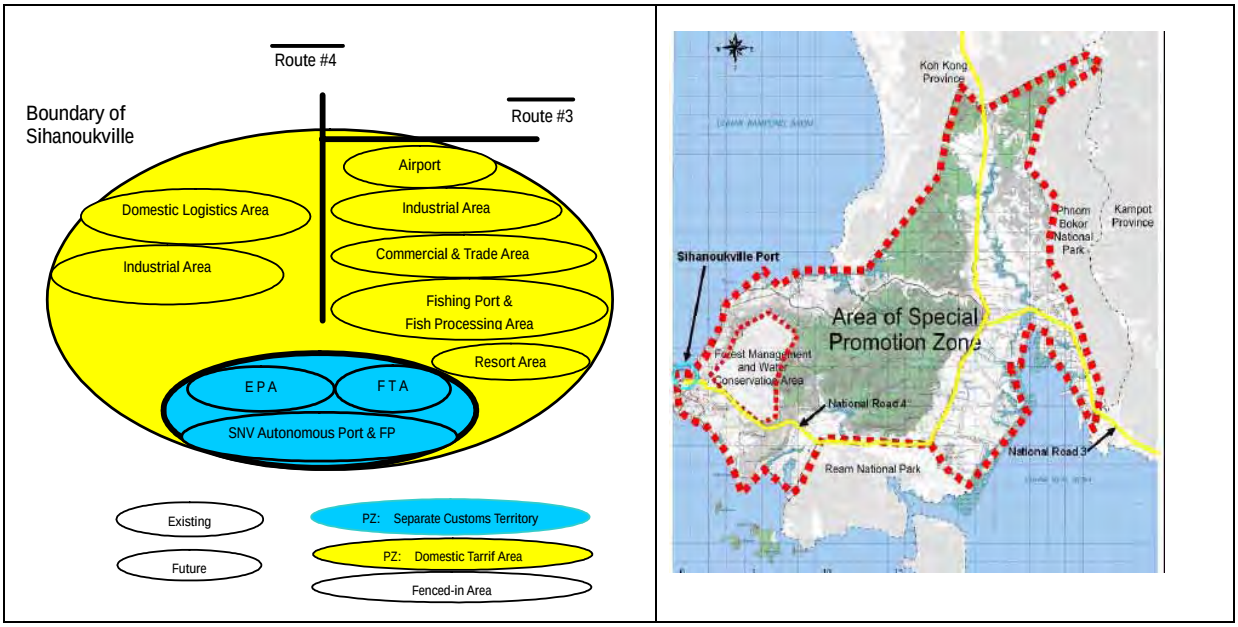
The spot development of Siem Reap is expected to extend to its surrounding area.

In the coastal area an industrial zone is emerging with its center in Sihanoukville. Private and public industrial estates are planned in the area surrounding the industrial zone and along NR.4,

and foreign direct investments are expected that will initiate and achieve sustainable economic growth together with Phnom Penh.

The industrial area is centered in Sihanoukville and is spreading along NR.4. The master plan entitled "The Study on the Regional Development of the Phnom Penh - Sihanoukville Corridor" has drawn its vision as shown in **Figure 9.1.4**. However, the investment environment has not been favorable up until the current time, and the legal framework, such as foreign direct investment legislation and institutional arrangements is expected to enable the implementation of this vision.

The designated agricultural area is a wide area to the east of the Mekong River. Field agriculture (i.e. cash crop cultivation) is concentrated in this area and rubber plantations are also active at present. Agricultural diversification from paddy to other cash crops is expected with the improved access to markets and transportation means.



Source: The Study on the Regional Development of the Phnom Penh - Sihanoukville Corridor, JICA, 2003 (Partly Re-written by Team)

Figure 9.1.4 Concept Plan for Industrial Development in Sihanoukville

9.2 Development Potential: Issues and Constraints

In developing the national road network the most influential item is the future development potential of the area. There are various constraints and also supporting factors to be considered. Eight factors are reviewed, and in themselves give an outline of the future development potential. This in turn provides an outline for the national development strategy and road development concepts.

The eight items are listed below and are explained in the following sections.

Geography
Population
GRDP
Agriculture
Manufacturing
Tourism/Service
Mining resources
Environmental conservation

9.2.1 Geography

Cambodia is divided into two geographically distinct areas:

1) Plains/lowlands: This area is around the center of Cambodia and in the south-eastern region. Almost all of this area is flood prone and is utilized to grow paddy. However, this results in the frequent interruption of land transport during the rainy reason. In particular, international logistic routes constantly suffer, and have been left in damaged conditions.

2) Plateau and mountainous area: This area is located in the western, northern, and eastern parts of Cambodia and is removed from the flood prone area. However, the steep geographical conditions mean that the area has a poor transportation network, resulting in weak integration with the rest of the country and even within the area concerned.

The Mekong River and Lake Tonle Sap geographically divide the Cambodian territory into two parts, and they are connected by three bridges and six ferry services.

Bridges (3 points)	:	i) Kizuna Bridge, ii) Chruoy Changvar Bridge, iii) Monyvong Bridge
Ferry services:		
* North-eastern area (1 point)	:	Stung Treng
* Near Phnom Penh (5 points)	:	1) crossing the Mekong River: (from north) i) Prek Anchanh, ii) Ruesser Chroy, iii) Prek Tameak, and iv) Svay Chrum 2) crossing the Tonle Sap River: Prek Kdam
* Lower Mekong River (1 point)	:	Neak Loeung

These geographical features results in:

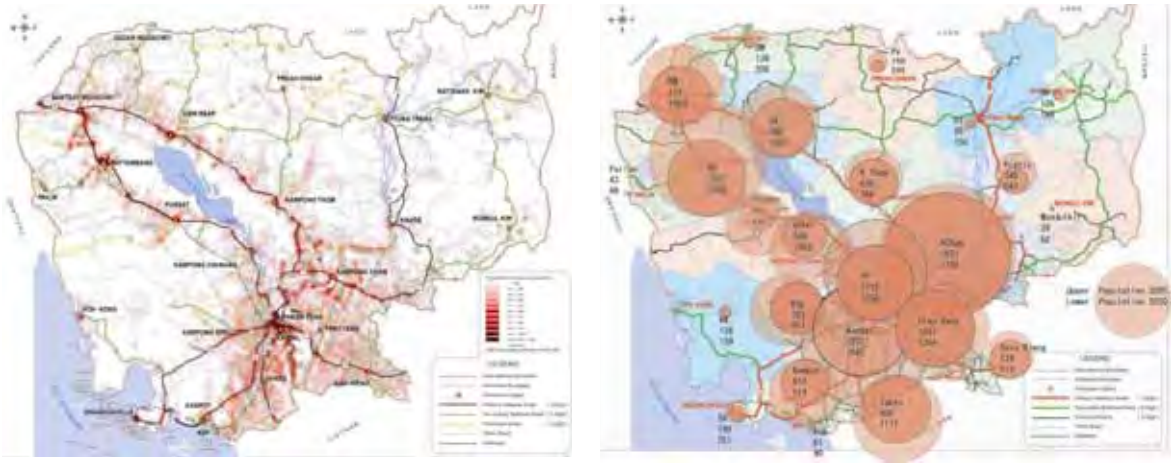
1) Inconvenient and inefficient traffic flows, especially for international traffic; and

2) Low trade and economic linkages between regions.

These factors have resulted in the fundamental constraint of communications and trade, and have further depressed regional development in Cambodia.

Figure 9.2.1 Division of Land by Flood Waters

9.2.2 Population Distribution



Source: MPWT, and NIS

Figure 9.2.2 Population Density

(1) Population Distribution

The population of Cambodia is heavily concentrated on the plains and in the Tonle Sap Region. Approximately 82% of the total population is in these two regions, and the remaining 18% reside in the coastal and plateau/mountainous regions.

The population by province is shown in **Figure 9.2.2**. The high population provinces are concentrated in the south-eastern Mekong basin, and form an urban area with a center in Phnom Penh. This high population area extends to the north-west along NR.5 and NR.6 up to the Thai border and also extends to the north-east along NR.7 and the Mekong River up to the national

border with Vietnam. This reflects the shape of the agricultural land and the logistical network that has developed mainly due to the road network and inland water services. The road network has attracted people to the land along the roadsides, resulting in a ribbon shaped town development blessed with good accessibility. This situation is apparent in **Figure 9.2.2**.

In addition, remote areas along the Thai border in the north-western region also show high population densities. The Thai markets and economic zone has induced agricultural production in this region. Along the coast, the NR.48 has a relatively high population because of its rich tourism resources.

These population patterns are important because they reflect the basic distribution of the labor force that in turn attracts new investment to the region. The quality of the labor force is proportional to the size. Therefore, a high quantity and quality labor force is most likely to be located in the regions with large populations, and therefore these regions are more likely to attract new manufacturing industries, reflecting the labor productivity of the industry concerned.

(2) Decentralization of Population Distribution

The historical trend in population distribution is revealed in **Figure 9.2.3**. This figure shows the cumulative provincial populations as a percentage of the whole in order from small to large. This highlights that the population has gradually de-centralized during the period from 1981 to 1998 (Census year).

This suggests that the urban areas outside of Phnom Penh are growing relatively faster than Phnom Penh. Rapid urbanization in the rural areas is expected in the near future.

This suggests that the transportation network should be well developed, especially in the rural areas, in order to accelerate economic activity. As this trend accelerates, higher investment will be required in the 2-Digit and 3-Digit road networks.

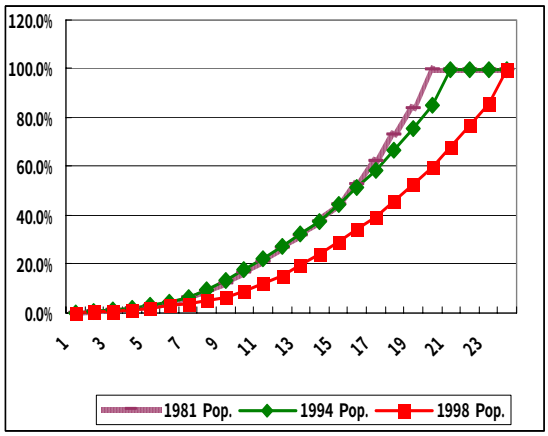


Figure 9.2.3 Population Decentralization
Source: National Statistical Yearbook, 2003

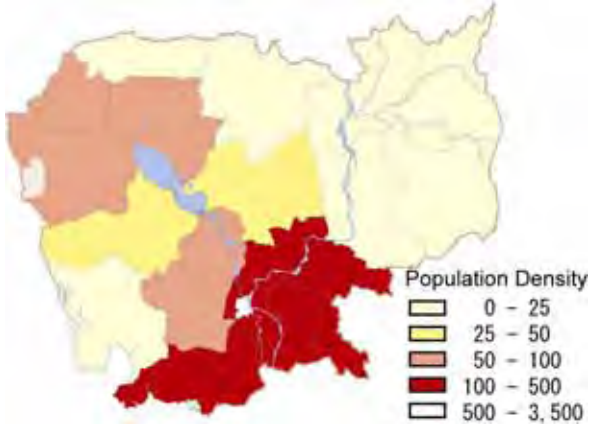


Figure 9.2.4 Population Density

This long term process of population dispersion suggests that there will be an increase in the level of road development and maintenance required in rural areas to support economic activities and to achieve a higher standard of living in these areas together with the development of other infrastructure such as power distribution systems, sanitary systems and educational facilities. Special attention should be paid towards improving accessibility to rural growth areas and/or major markets for local products. If the travel time to the markets is decreased, then there is a higher potential for rural development as has already been proven for vegetable products, fruit and flowers.

9.2.3 GDP Distribution

In 2004, the average per capita income by province (including all industries) was 357 USD and the average income in 18 of the 24 provinces was below this average.

The figures show that the GRDP per capita in the remote provinces is relatively high compared with other provinces. This highlights the discrepancy from common observation as a remote and poor province, Mondul Kiri, recorded 530 USD per capita and is positioned fourth from the top on the per capita GRDP list. The MEF believes that this discrepancy is attributable to the following facts:

1) GRDP figures for those provinces are negligibly small compared to the national GDP, and the expansion of major industries, such as the forestry industry, has a significant impact on the average GRDP per capita, and

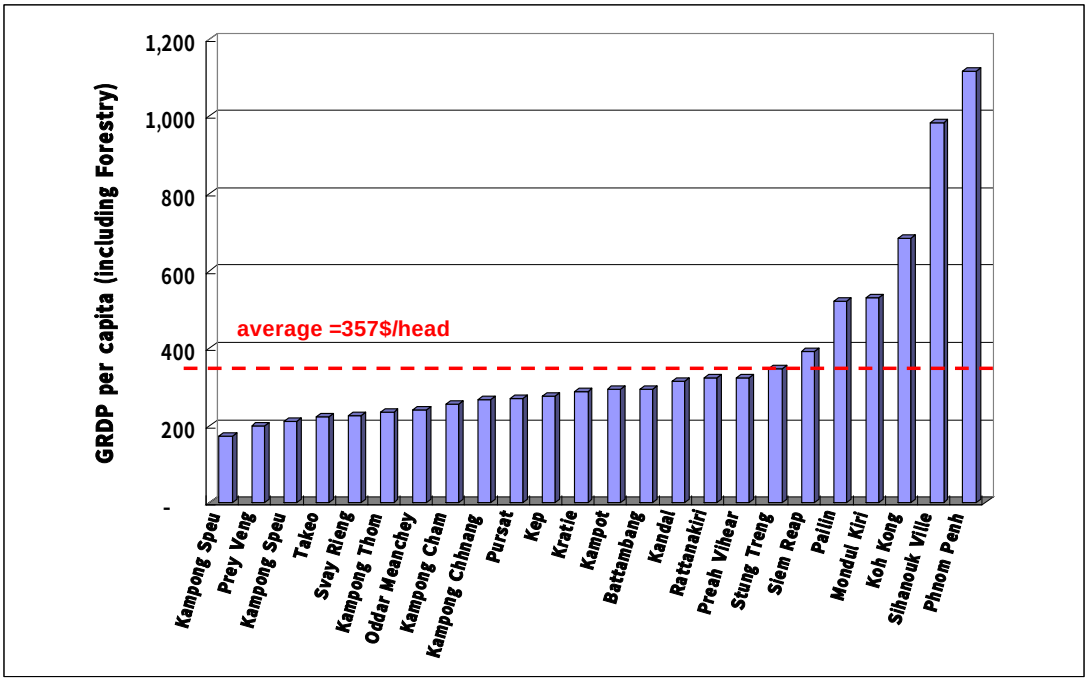
2) In provinces where the forestry industry is managed by monopoly or oligopoly companies there are extremely unequal distributions of income.

When the forestry industry is excluded from the GRDP per capita, the average figure becomes 350 USD in 2004, and 19 provinces are below the average per capita income as illustrated in **Figure 7.2.5**, which shows the level of each province in ascending order.

The provinces with a GRDP per capita higher than the national average are Phnom Penh (1,117 USD), Sihanoukville (980 USD), Koh Kong (629 USD), Pailin (495 USD), and Siem Reap (385 USD). The remaining 19 provinces are below the national average of 350 USD. These provinces can be categorized into five areas.

Table 9.2.1 Categorization of Provinces with GDP less than the National Average per Capita

Location	Features	Provinces
South-eastern area	Paddy specialized area	Prey Veng, Takeo, and Svay Rieng (4)
North-eastern area	Mountainous remote area with no apparent industry besides agriculture	Rattanakiri, Stung Treng, Mondul Kiri, and Kratie (4)
North and north-eastern area	Mountainous remote area with no apparent industry besides agriculture	Preah Vihear, and Oddar Meanchey (2)
Western area	Mountainous remote area with no apparent industry besides agriculture	Pursat, Battanbang, and Banteay Meanchey (3)
others	Area that holds a large population, but has no apparent industries besides agriculture, and an area that is located in between Phnom Penh and the national boundary	Kampong Thom, Kampong Cham, Kampong Chhnang, Kampong Speu, Kampot, Kandal, and Kep (7)



Source: MEF

Figure 9.2.5 Comparison of GRDP per capita by Province

Provinces below the national average range from 174 USD in Kampong Speu to 314 USD in Kandal, which are both below the absolute poverty line set by the UN. This does not suggest a clear priority order by which to preferentially allocate infrastructure investment between these provinces. A higher infrastructure investment shall be allocated to provinces closer to markets or a growth pole in order to induce the trickle-down effect of economic development, as well as social development in these areas.

9.2.4 Agriculture

Agricultural land uses are shown in **Figure 9.2.6.**

Agriculture has played a significant role in the national economy, and engages the majority of the population. However, the agriculture industry faces difficulties in retaining its status as there is only a small amount of appropriate land remaining for paddy cultivation, and the paddy market has not been expanding. The improvement of paddy productivity requires a huge amount of new investment for irrigation systems, high yield seeds and insecticides. A shift to these modern types of agriculture might necessitate high cost inputs and consequently place a heavy financial burden on the farmers. However, it is apparent that, at present, farmers cannot afford to pay for these inputs without a public financial support system for agriculture.

The productivity of agriculture in the high-land areas, however, has expanded and these newly opened land areas are expanding in the area near to the national boundary with Thailand and Vietnam as shown in **Figure 9.2.6**. In these locations plantation agriculture has also been active, and corn, beans and other types of high land vegetables are cultivated. These trends are supported by the market assurances offered by the Thai and Vietnamese merchants. Under these circumstances, the productivity of the high-land agriculture is increasing. Further expansion of the agriculture sector might be dependent on this kind of high productivity agriculture.

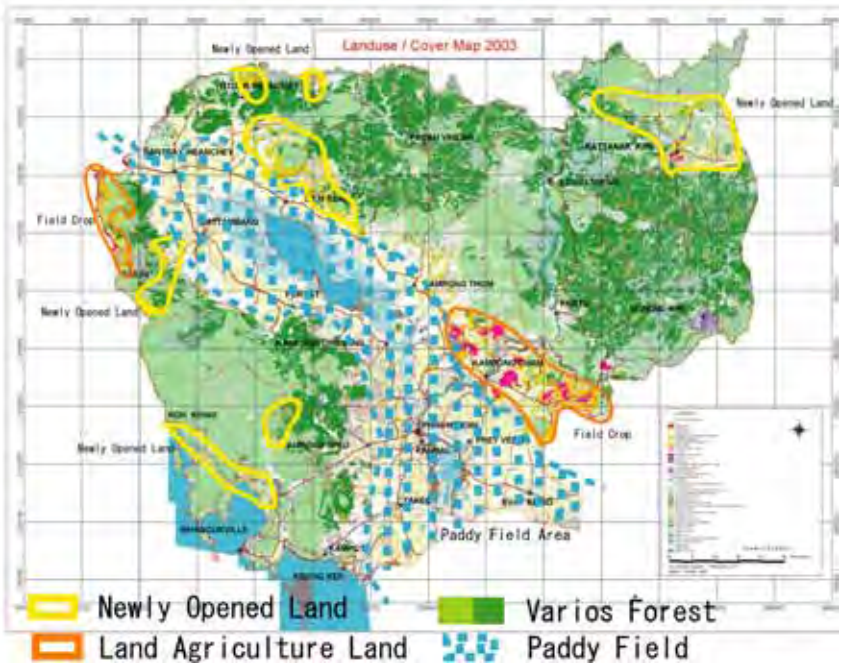


Figure 9.2.6 Agricultural Landuse Map

This kind of marketing system could contribute towards increasing the income level of the farmers and could eradicate absolute poverty. This would, however, require access roads to the market. However, the regions near the national border could strengthen economic interdependence with neighboring countries, and frictions over national sovereignty might be

alleviated. This would necessitate the strengthening of accessibility to the central and local growth poles in Cambodia and ensure economic linkages within the national territory.

9.2.5 Manufacturing

There are no indications of manufacturing areas on the land-use map. However, a major industry in Cambodia is "Wearing Apparel" and it is apparent that these manufacturing industries are concentrated in Phnom Penh and its vicinity areas, such as Kandal. This industry accounts for more than 60% of the production value of all of the manufacturing industries, many of which are factories that are afraid of the import quota sanctioned by the U.S. which is the major export destination. This shows that this industry operates under vulnerable conditions and an un-stable future.

New industrial zones are planned in Sihanoukville and Koh Kong, where industrial estates have already been established, however few factories are currently operating in this area as they have been left behind by international competition. New promotional activities are planned to attract foreign direct investment (FDI), and it is suggested that significant effort is necessary to ensure the infrastructure in the industrial estates compares to that in the neighboring countries (such as electricity, water, etc). In the case that Sihanoukvilla is established, the area along NR.4 will be turned into industrial estates as planned in the study.

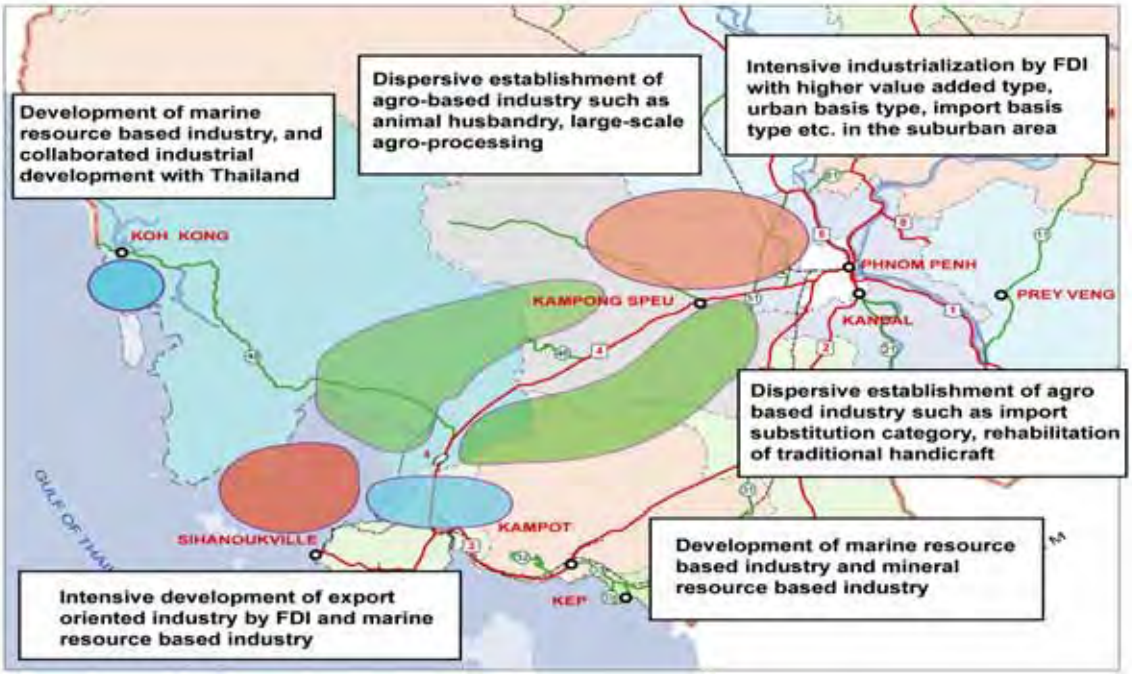
It is observed that private industrial estates are expanding along NR.1, near the border. The aim is to convert the "Wearing Apparel" industry into new potential industries as the export destinations are accounted for by the U.S. and an export quota might be expected. This can be a pioneer case. Future expansion is expected.

Industrial Zone:

There are no objections against industries that offer a high number of employment opportunities, however, at present no industrial map is available for this country, and the regional distribution of the industries has not been identified.

A preliminary plan is shown in **Figure 9.2.7.** This plan has been prepared in line with the Study on Regional Development Phnom Penh - Sihanoukville Growth Corridor. In this plan, industrial estates (actual and planned) are identified.

Figure 9.2.7 also suggests the extension of the network of 2-Digit and 3-Digit roads connecting NR4 and the industrial estates in the hinterland. However, the road network plan depends on the progress of the industrial estate development. It is noteworthy that this development has critical pre-conditions, i.e. the provision of a water supply system and electricity, and further promotional activities are indispensable for attracting foreign direct investment.



Source: The Study on Regional Development Phnom Penh - Sihanoukville Growth Corridor, JICA, 2003. (Re-written by the Study Team)

Figure 9.2.7 Industrial Zone Proposed along NR.4

9.2.6 Tourism and Services

All of the potential tourism areas are shown in **Figure 9.2.8**. These tourist attractions should be promoted through the provision of access roads and a road network within the region concerned.

Phnom Penh is the gateway for Cambodian tourism because of its international airport, various wats and the Royal Place. In most cases, tourists will stay for a night in Phnom Penh, and then move on to Siem Reap.

The Siem Reap area is designated as a tourism development area in the fundamental development guidelines for Cambodia i.e. the Rectangular Strategy. The development of this area is centered on the World Heritage, Anglor Wat site and other wats in ruin in the surrounding area. However, it is recommended that the present tourism area is widened by connecting the various wats that are in ruin and providing a pleasant longer stay in the area. The Siem Reap tourism zone can be expanded up to the Mekong River and/or the area closer to the national boundary. The most fundamental facilities are access roads connecting the heritage sites. However, this kind of tourism development strategy is dependent on the study by JICA.

Figure 9.2.8 Potential Tourism Development Areas

In the triangular area surrounded by Thailand, Laos, and Cambodia, there are many tourism development schemes such as the Emerald Triangle Development. In the north-eastern region, covering Rattanakiri, Kratie, Mondulkiri, and Stung Treng, a community-based tourism development scheme has been introduced, aimed at small-scale tourism to eradicate the poverty in these areas. This aims to marginally raise the standard of living in these areas by attracting an interest group, and is not likely to be a dynamic national trend involving a large number of tourists from other countries.

Another tourist destination is the coastal area, which is blessed by bright sunshine and an undeveloped seashore. The tourism potential is judged to be very high and the area currently attracts budget travelers from Europe. The development of this tourist area in harmony with the natural environmental would be appropriate.

In order to support the development of these tourism resources, accessibility to the tourist destinations should be improved.

9.2.7 Mining Resource Deposit Areas

Cambodia has a variety of mining resources as shown in **Figure 9.2.9**. The exploitation of these resources will affect the location of industrial areas in the future.

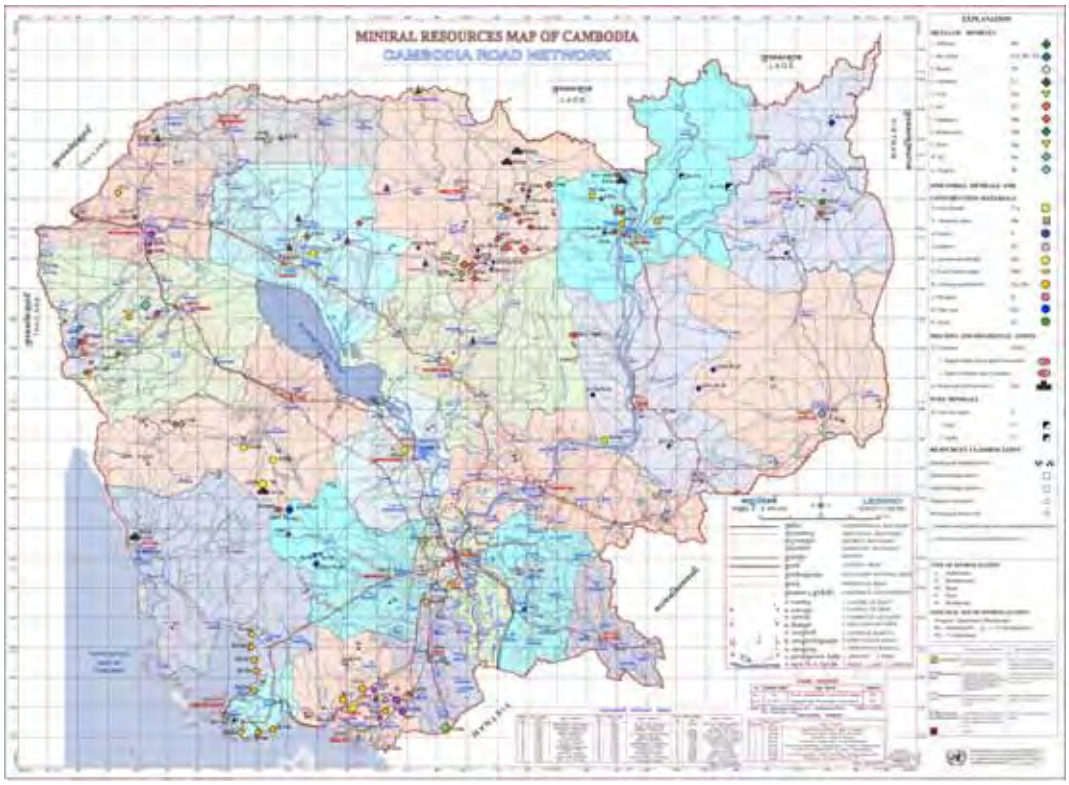


Figure 9.2.9 Location of Natural Resource Deposits

Of the various mining deposits, a bauxite vein spreads out near the border with Vietnam, where it has already been exploited, proving it is of high quality and there is a large volume of deposit. Limestone deposits for cement can be found in the south and near to Siem Reap. The Thai cement company is already advancing into this industry in Cambodia. An increase in the volume of cement could be expected if the bulk transportation system is developed. This kind of heavy bulk commodity is suitable for railway transport. The stable and safely operated railway system can contribute to the development of this kind of mining industry.

Crude oil and natural gas have been found off-shore on the boundary with Thailand. Due to a national sovereignty issue the exploitation of this resource cannot yet be initiated. The development of this natural resource could contribute towards a gain in international currency and in turn an increase in the national budget. However, this is unlikely to affect logistical flows across the national boundary, and would have a limited impact on the national road network.

As for the other mining resources, a huge amount of production has not yet been planned.

9.2.8 Environmental Conservation Areas

There are a number of designated natural conservation areas in Cambodia as shown in **Figure 9.2.10**. The minimum condition is to retain the current condition of the natural conservation areas. The construction of new roads through the conservation areas should be avoided, and/or at least some measures should be taken to minimize the environmental impact on the conservation areas. This can also apply to improvement works on the roads.

The widening of NR.48, the coastal road between Koh Kong and NR.4, runs through a natural conservation area and no countermeasures have been put in place. There are also additional cases to the NR.48 where the natural conservation areas have not been taken into account. In preparing the national road development plan, natural conservation areas should be recognized and sufficient measures put into place in order to avoid this kind of case in the future.

Furthermore, forest clearing might occur along the route of a planned new road. Much of this de-forestation would be from speculation on land price hikes, and this kind of speculation should be restricted by the national law since it can devastate natural scenery and cause soil erosion, resulting in natural disasters. The detailed assessment is explained in the chapter concerned.

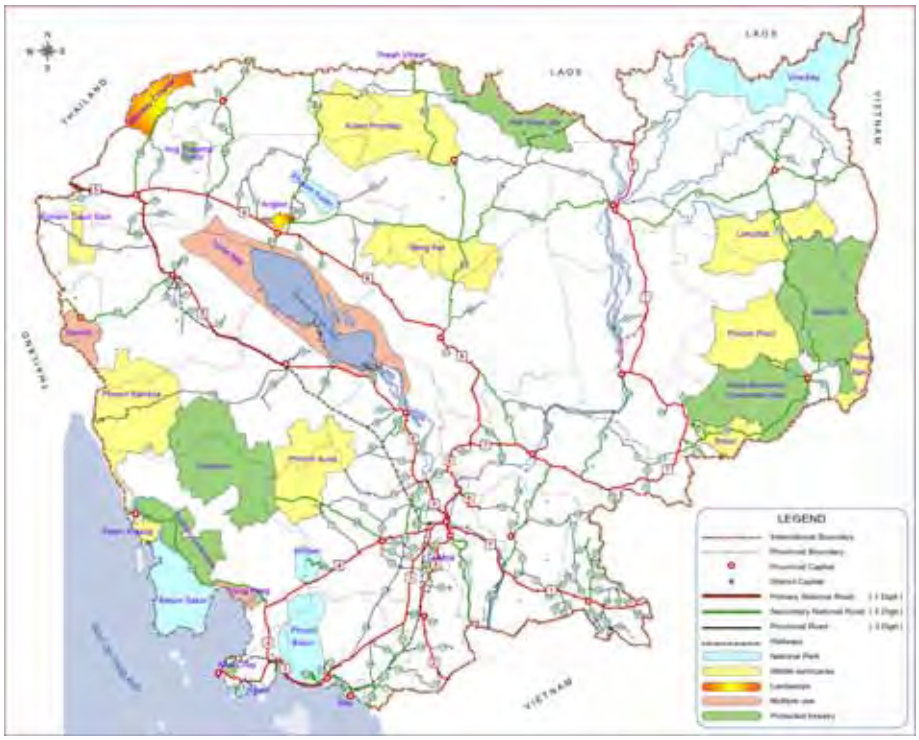


Figure 9.2.10 Natural Conservation Areas

9.2.9 Development Potential: Summary

Figure 9.2.11 summarizes the various potential development areas on one map, i.e. tourism, manufacturing sector and agriculture. These potential development areas are spread out into isolated areas, far from Phnom Penh, the center of Cambodia where a self-sustainable growth has already been initiated. The figure also reflects the target development areas as designated in the Rectangular Strategy addressed by the Prime Minister in 2004. It also shows the similar patterns of the international and domestic development corridor schemes . These facts suggest that the existing development schemes and the new JICA Development Scheme are consistent and supplementary to each other, justifying the rational and effectiveness of the schemes.

One more important suggestion relates to the development directions that should be given support through investment and policies. These are aligned from the densely inhabited area around Lake Tonle Sap to the sparsely inhabited and isolated areas along the national boundary with Thailand, Laos, and Vietnam. The development directions in the future are suggested by the arrows in **Figure 9.2.12**. These development directions face natural conservation areas and have poor access roads, and furthermore some areas are surrounded by steep geographical conditions, resulting in a higher unit cost for infrastructure development. This provides a rationale reason why accessibility should be improved in these areas.

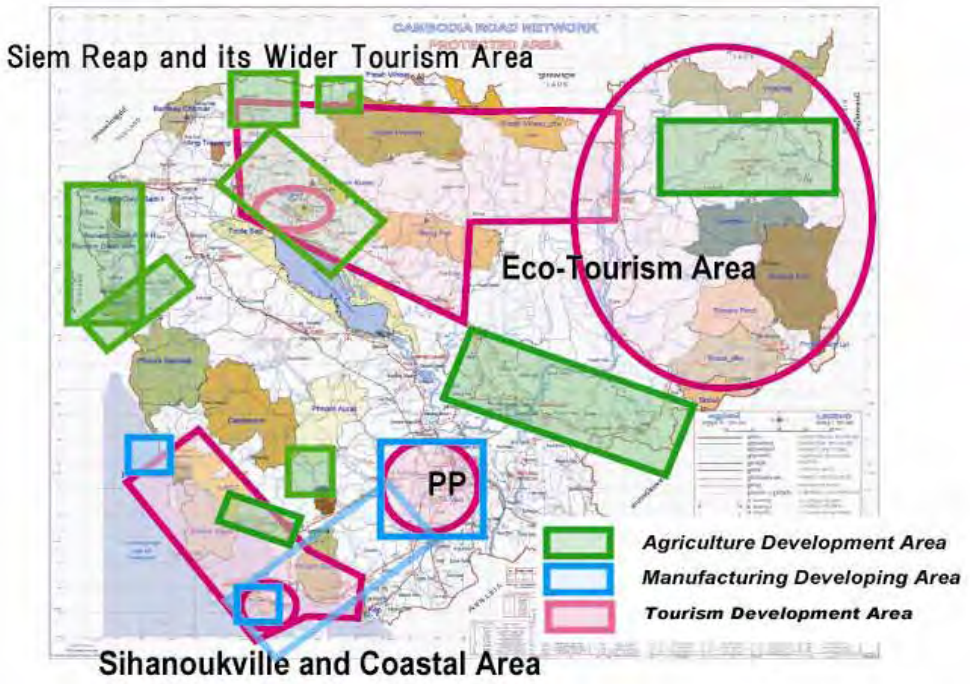


Figure 9.2.11 Potential Development Areas

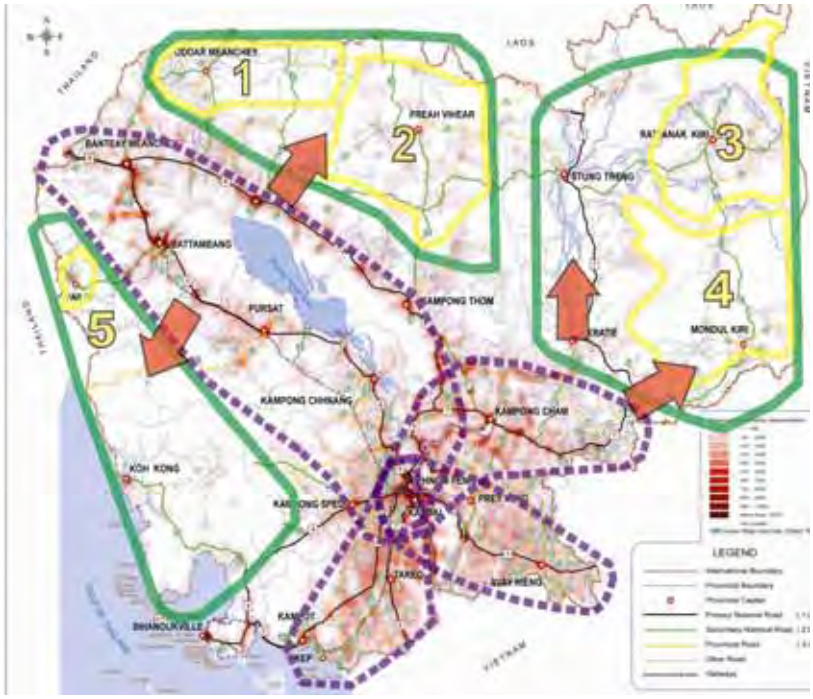


Figure 9.2.12 Directions of Future Development

9.3 Development Issues

9.3.1 Imbalanced Development caused by Single Growth Pole

Economic growth is concentrated on Phnom Penh. GRDP in Phnom Penh makes up 24.1% of GDP as shown in the following table. While Rectangular Strategy aims equity, social justice and efficiency of the public sector. In this context, imbalanced economic structure between Phnom Penh and other provinces should be corrected so as to achieve balanced economic development.

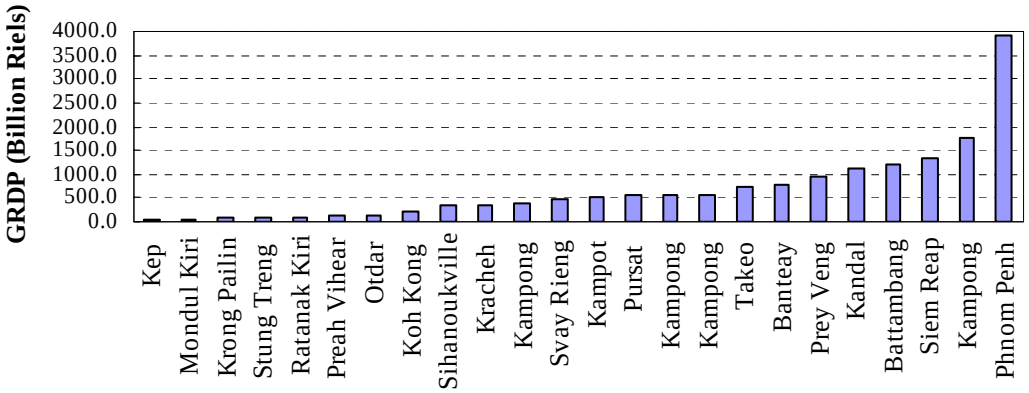


Figure 9.3.1 GRDP by Province (2003)

In terms of road network development, 1-Digit national roads connecting to Phnom Penh has been developed mostly while development of 2-Digit national roads, provincial roads and rural roads is behind. Road network development, which contributes to the balanced development and correct the single development pole structure, is required.

9.3.2 Encroachment of neighboring socio-economy

Cambodia shares borders with Thailand, Vietnam and Laos. Among these three (3) countries, Thailand and Vietnam have a strong economic connection with Cambodia. These two (2) countries are placed within the tenth of both import and export of Cambodian international trade. The balance of trade for Cambodia, however, 745.2 mil. US$ and 105.2 mil. US$ in the red to Thailand and Vietnam, respectively. These trade defects might encourage illegal export of illegal logged woods[1].

While in Koh Kong, Pailin, Oddar Meanchey, Preah Vihear and Bantey Meanchey, where share borders with Thailand, Thai baht of Thai currency is circulated and Thai products are distributed widely. Even thought Vietnam currency is not circulated in the border areas in Mondul Kiri and Ratana Kiri, where share borders with Vietnam, products made in Vietnam are oversupplied. In such border areas, neighboring economy is encroaching.

[1] Interview in the border area in Mondul Kili Province (JST)

In terms of road network conditions connecting to these areas, it is difficult to drive from these provincial capitals with borders to 1-Digit national roads as a national backbone in the rainy season because these roads are not connected with all whether condition pavement. In addition to these conditions, it is much easier to trade with neighboring countries than provincial capital or other provinces because roads from the border areas to border areas in the neighboring countries are well developed and in better condition rather than roads to the provincial capitals.

Therefore socio-economy in these border areas is encroached by the neighboring countries. The encroachment is disincentive for the Cambodian economic development. Due to the vulnerable road network, central administrative services are not distributed well. The socio-economic encroachment and stronger connection with the neighboring countries in the border areas make a problem in terms of governance.

In this connection, road development issue is to secure stable traffic access to these isolated areas near the borders in all year so as to strengthen the governance by providing administrative service, and to enhance economy and international competitiveness by strengthening industrial and economic coordination with other areas in other provinces.

Table 9.3.1 Trading Partners (Year 2003)

(unit: Million US $)

	Exports			Imports		
	total	**2,031.8**	**100%**	**total**	**2,802.4**	**100%**
1	US	1,214.3	59.8%	**Thailand**	756.5	27.0%
2	Germany	211.3	10.4%	Hong Kong	411.2	14.7%
3	UK	150.3	7.4%	Singapore	338.2	12.1%
4	Japan	80.1	3.9%	China	324.1	11.6%
5	Singapore	67.8	3.3%	Korea	144.6	5.2%
6	France	40.5	2.0%	**Vietnam**	135.5	4.8%
7	**Vietnam**	30.3	1.5%	Indonesia	84.5	3.0%
8	Netherlands	25.6	1.3%	Malaysia	68.9	2.5%
9	China	23.6	1.2%	Japan	67.3	2.4%
10	**Thailand**	11.3	0.6%	France	53.6	1.9%

Source: ADB, Key Indicators 2003: Education for Global Participation

9.3.3 Insufficient International Corridor

Cambodia has border with Thailand, Vietnam and Laos. International corridors are expected an important role of international cross border traffic in the Mekong/Indochina region such as south corridor and north-south corridor of the GMS Economic Corridors, and Asian Highway. As Cambodian economic is developed more and the international competitiveness is stronger in the future, Cambodia can be developed more by international trade with these neighboring countries.

Roads from the capitals of the provinces with border to the crossing border are not developed well. These roads might be an obstacle to the international trade, which is expected in the future.

Therefore road development issues are to develop international corridors and improve access roads to the border areas so that international trade contributes to the future economic growth..

9.3.4 Difficult Access to Development Potential Areas

In preparing national road network, most influential items are development potentials in the future. Various factors can function as constrains and also supporting forces. Here, eight factors are reviewed, and make themselves give outline of future development potentials. And it gives outline for national development strategy and road development concepts.

Eight (8) items, that is Geography, Population, GRDP, Agriculture, Manufacture, Tourism/Service, Mining resources and Environmental conservation are considered and as a result, **Figure 9.3** summarizes various development potential areas on one map i.e. tourism, manufacturing sector, agriculture, and those potential areas are spreading isolated areas, far from Phnom Penh, the center of the Cambodia where a self-sustainable growth has already initiated.

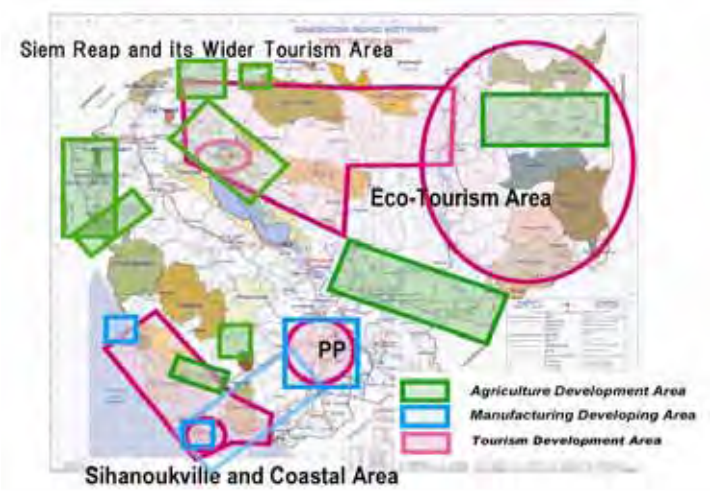


Figure 9.3.2 Development Potential Areas

Development for these potential areas is crucial for balanced development to reduce the gap between rural and the center.

Roads in and access to these potential areas are, however, not developed well. Therefore there are a lot of development potentials which have not been functioned yet, for example, Angkor ruins which cannot be accessed due to the undeveloped access roads.

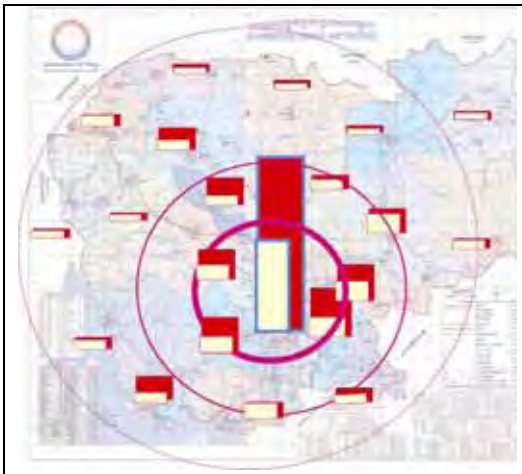
The road development issues are to improve accessibility to the development potential areas so that development potentials can be utilized and maximized, hence balanced development in the rural area.

9.3.5 Insufficient Community Roads (Provincial/Rural Roads)

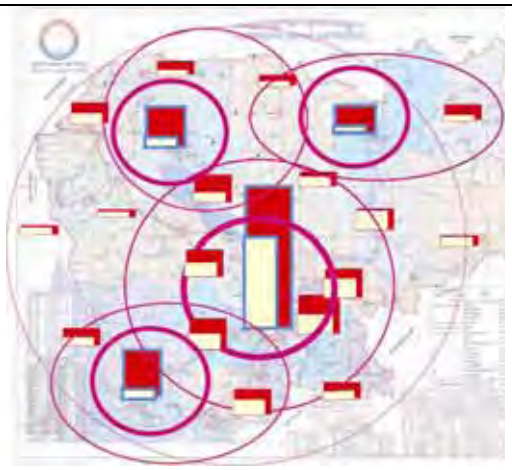
Provincial and rural roads are essential for community life, such as access to schools, hospitals, other public facilities, working place and market. Most of these roads are, however, not developed or not maintained properly. As a result, these insufficient community roads make community life difficult due to an obstruction to safe and smooth traffic and disconnection in the rainy season.

It can be that development and maintenance of provincial and rural roads as community roads are crucial issue so that community roads contribute to improvement for transport of farm crops and market access, hence poverty reduction in the poverty rural areas.

9.4 Economic Growth Patterns and Vision



i) single growth pole scenario



ii) multiple growth pole scenario

iii) rural development priority scenario

Figure 9.4.1 Three Patterns of Economic Growth Scenario

Three patterns of economic growth scenario shown in **Figure 9.4.1** are assessed:
In this study, ii) scenario is found to be most suitable in this country.

Taking into consideration of the national and regional development frames as well as the development potential, the following future vision and philosophies are proposed in terms of national economic development and poverty reduction in order to formulate national road development master plan:

Proposed Vision: "rehabilitation" to "economic development"

The nation is in the transition from rehabilitation of internal turmoil to development in peace, therefore, the road network development in Cambodia has to proceed in order to realize sustainable and stable socio-economic development with poverty alleviation of the people and stabilization of daily life, especially in rural areas, as a nation located in the global center of the Greater Mekong Region.

Philosophy 1: Road development which contribute to the national governance and economic development

Philosophy 2: Road Development which contributes to the regional development and poverty reduction

9.5 Development Strategies

To achieve the above vision, five (5) development strategies have been established based on the philosophies:

Philosophy 1: Road development which contribute to the national governance and economic development

Strategy 1: Multi Growth Pole Development
Strategy 2: National Integration
Strategy 3: Development of International Corridor

Philosophy 2: Road Development which contributes to the regional development and poverty reduction

Strategy 4: Enhancement of Rural Economic Development
Strategy 5: Regional Development for Poverty Reduction

9.6 Objectives and Target of each Development Strategy

(1) Strategy 1: Multi Growth Pole Development

Objectives: To contribute to multi core national development instead of that of sole initiative by Phnom Penh

Target: Expansion to 4 lanes on the 1-Digit national roads connecting to Phnom Penh and introduction of Ring Road and by-pass construction at major regional cities such as Siem Reap and Kapong Chnang.

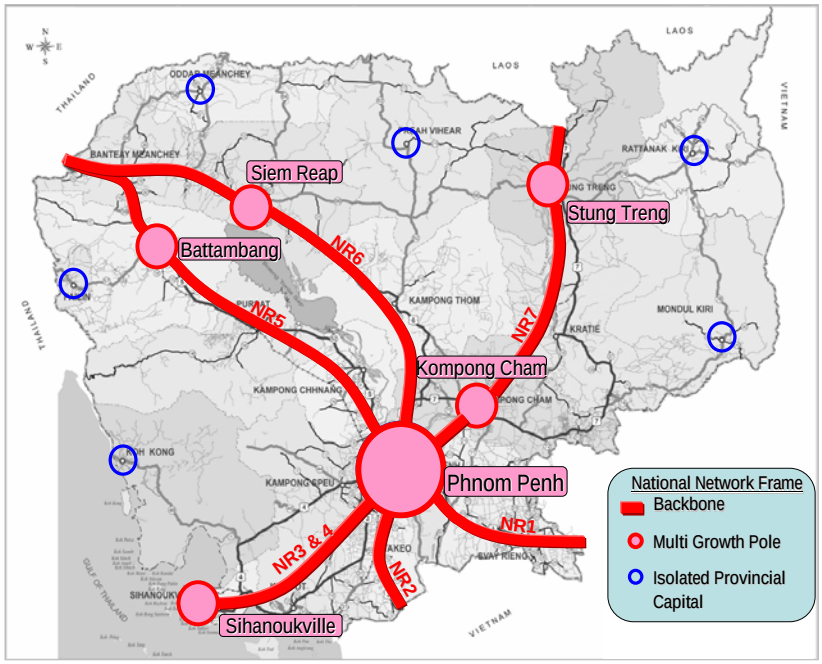


Figure 9.6.1 Strategy 1: Multi Growth Pole Development

(2) Strategy 2: National Integration

Objectives: To contribute to a national integrity and administration with remote areas where road access is very limited.

Target: Improvement into all-weather roads at the sections of 2-Digit national roads so as to realize easy connection to Phnom Penh even in the rainy season.

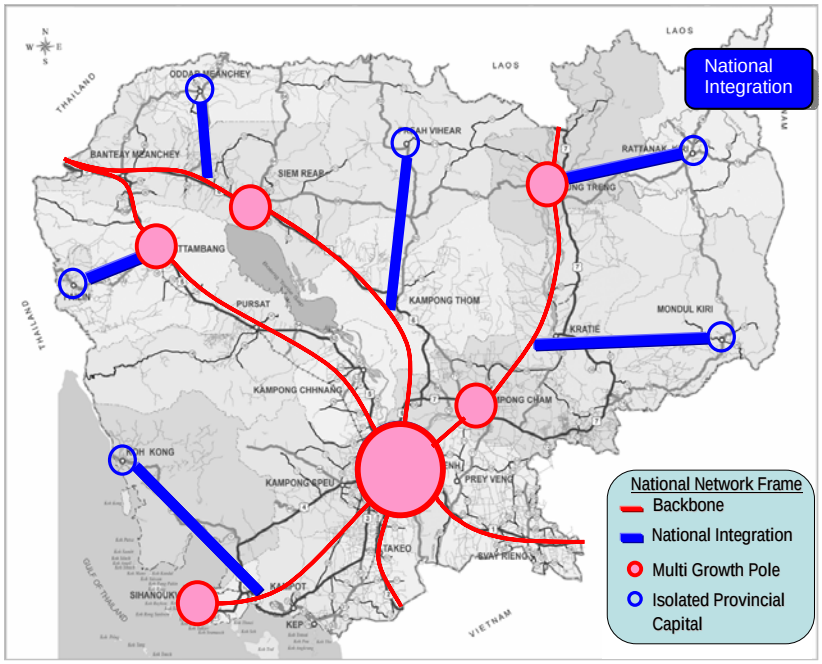


Figure 9.6.2 Strategy 2: National Integration

(3) Strategy 3: Development of International Corridor

Objectives: To contribute to an expansion of trade and commodity flows to and from neighboring countries

Target: Functional strengthening of 1-Digit and 2-Digit roads, improvement of 2-Digit roads in the area adjacent to boarders, improvement of accessibility to rail, waterway and distribution centers.

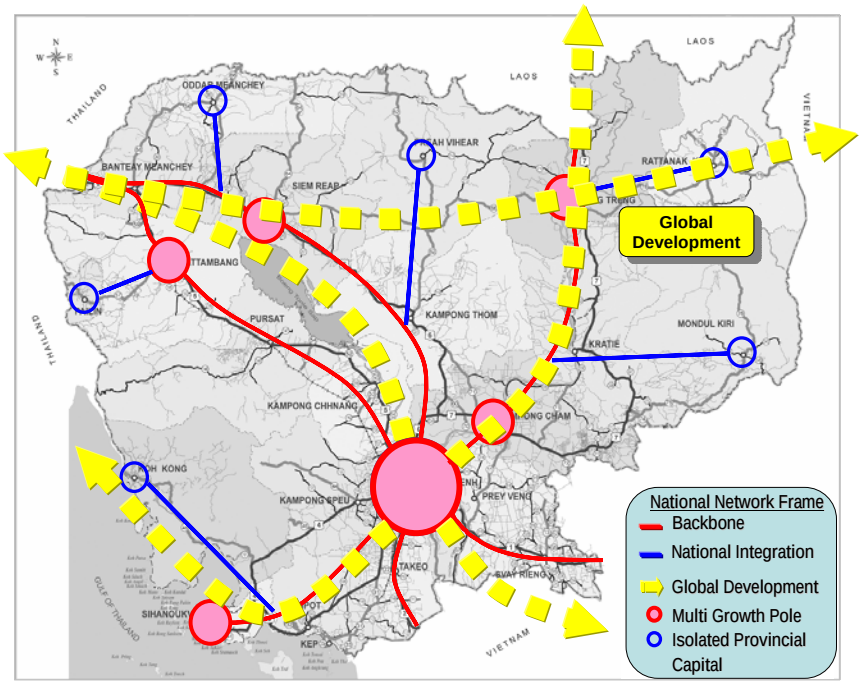


Figure 9.6.3 Strategy 3: Development of International Corridor

(4) Strategy 4: Enhancement of Rural Economic Development

Objectives: To contribute to a promotion of regional industries, a expansion of investment and an increase in employment

Target: Enhancement of road access, especially by 2-Digit roads, to high potential areas of tourism, agriculture and manufacturing.

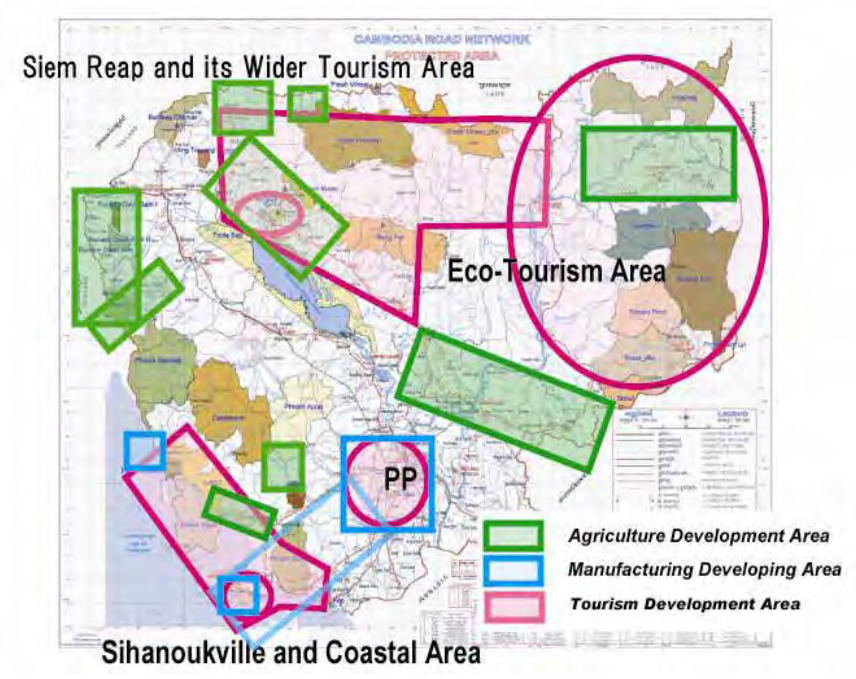


Figure 9.6.4 Strategy 4: Enhancement of Rural Economic Development

(5) Strategy 5: Regional Development for Poverty Reduction

Objectives: To contribute to an enhancement of Basic Human Need (BHN), employment, education, safety and health.

Target: Improvement of provincial roads and rural roads located in strategically selected areas including CLV border area for poverty reduction by strengthened road maintenance work

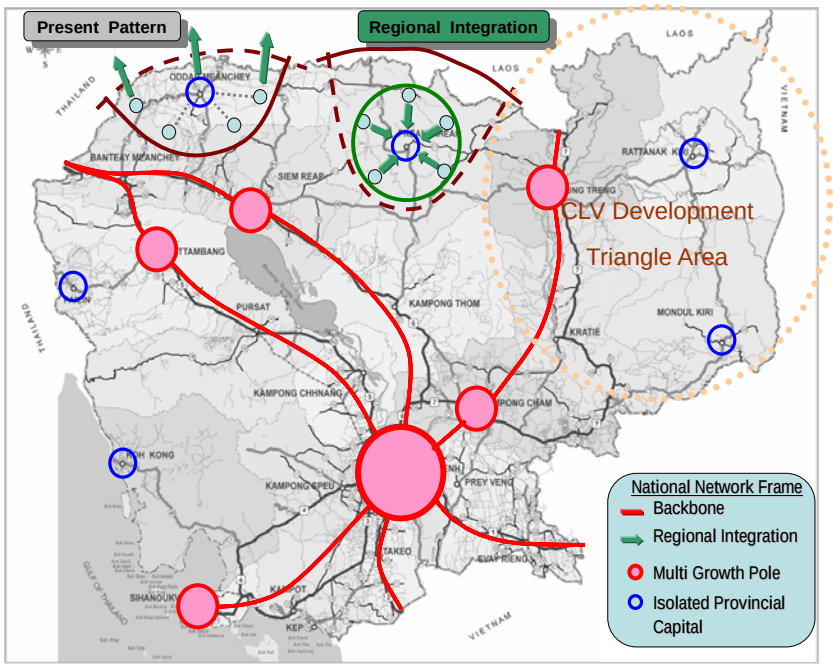


Figure 9.6.5 Strategy 5: Regional Development for Poverty Reduction