CHAPTER A-5 EXISTING TRAFFIC CONDITIONS

5.1 Traffic Accident Survey and Analysis

5.1.1 Road Traffic Accidents in Cambodia

(1) General Situation

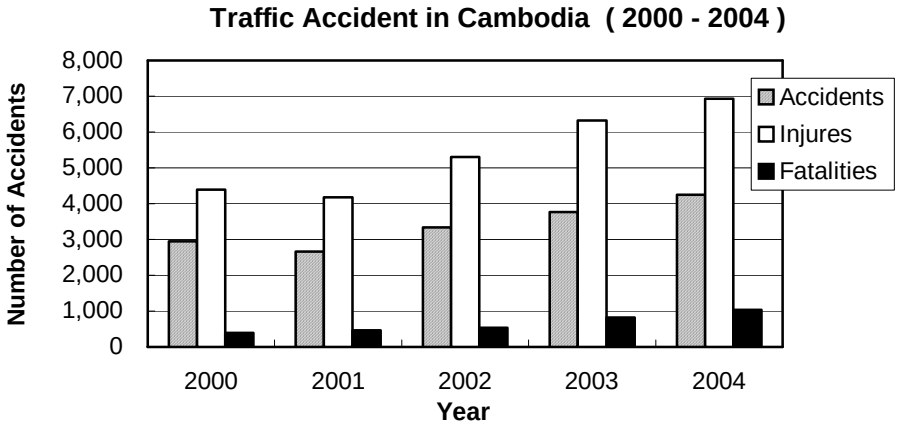
Table 5.1.1 and **Figure 5.1.1** show the annual number of road traffic accidents, fatalities, injuries and incidents by type of road user from 2000 to 2004. In 2004, there were 4,255 road accidents which resulted in 1,042 fatalities and 6,925 injuries.

Since 2000, the number of road traffic accidents has significantly increased, even though there was a minor decrease in 2001 compared to the previous year. During this 5-year period, the number of accidents, fatalities and injuries has increased 1.4 times, 2.6 times and 1.6 times, respectively. This indicates that the number of serious accidents, causing death, is growing remarkably.

Table 5.1.1 Road Traffic Accidents in Cambodia (2000-2004)

Year	Number of Vehicle	Number of Accident (Times)	Severity of Injures (persons)				Number of Damage by Type of Road User						
			Fatalities	Injures			Number of Vehicle						Pede-strian (persons)
				Serious	Not Serious	Total	Light Vehicle	Heavy Vehicle	Motor-cycle	Bicycle	Other	total	
2000	331,904	2,951	401	1,998	2,391	4,389	824	243	2,171	-	219	3,457	93
2001	383,017	2,669	459	1,771	2,413	4,184	858	257	2,608	-	336	4,059	79
2002	410,027	3,335	535	2,113	3,188	5,301	1,379	340	3,579	187	223	5,708	438
2003	447,428	3,760	824	2,714	3,615	6,329	1,697	332	3,909	239	399	6,576	688
2004	485,612	4,255	1,042	3,185	3,740	6,925	2,001	403	4,391	362	379	7,536	803

Source : Land Transport Department, MPWT



Source : Land Transport Department, MPWT

Figure 5.1.1 Road Traffic Accident in Cambodia (2000-2004)

(2) International Comparison

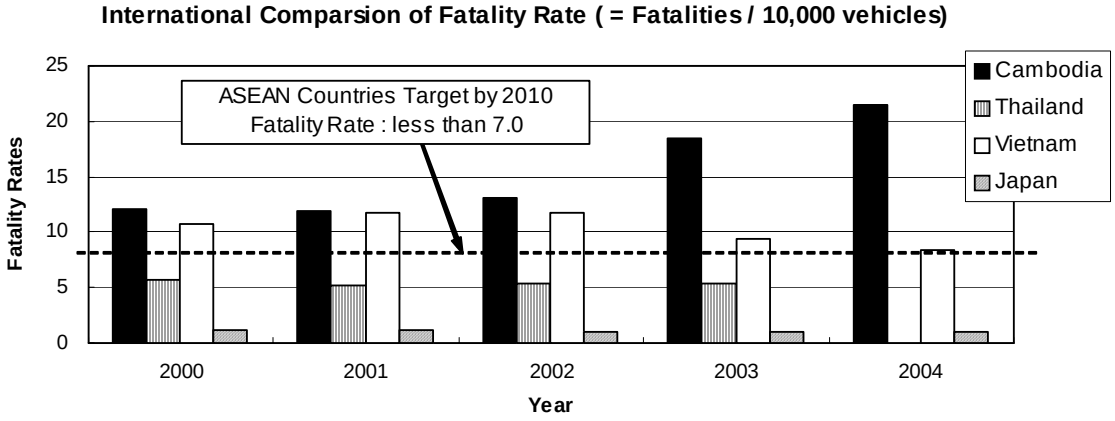
In order to boost what the economic integration in the region accelerates, all ASEAN countries agreed to set up a target to reduce the number of road traffic accidents, as follows:

- Stage 1 : reducing fatality rate to 10.0 by 2004
- Stage 2 : reducing fatality rate to 7.0 by 2010
- Stage 3 : reducing fatality rate to 2.0 by 2020

(Note: the fatality rate is the number of fatalities per 10,000 vehicles.)

As an international comparison, **Figure 5.1.2** shows the trend in the fatality rate by road traffic accidents from 2000 to 2004 for Cambodia, Thailand, Vietnam and Japan. This comparison indicates that the traffic accident situation in Cambodia is extremely serious.

The fatality rate for Thailand has remained at approximately five over the past five years. This is already below the ASEAN target. Since 2002, the fatality rate for Vietnam has reduced towards the target, and in 2004 the rate reached 10.1. However, the fatality rate for Cambodia has rapidly increased since 2002, and exceeded 20 in 2004. The situation in Cambodia definitely suggests that the number of traffic accidents is one of the major issues to be improved in the road transportation sector and effective measures for traffic safety shall be included in the master plan for the road network.



Road Traffic Fatality Rates

Year	Cambodia	Thailand	Vietnam	Japan
2000	12.08	5.75	10.77	1.21
2001	11.98	5.16	11.73	1.16
2002	13.05	5.35	11.76	1.00
2003	18.42	5.41	9.39	1.00
2004	21.46	-	8.34	0.95

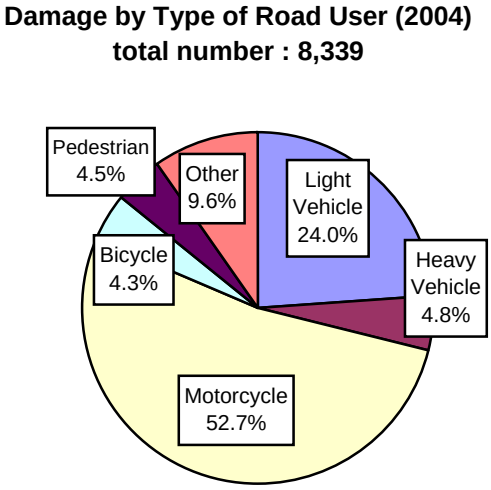
Source
Cambodia : Land Transport Department, MPWT
Thailand : Thailand Road Safety Action Plan 2004-2008
Vienam: National Traffic Safety Committee, Vienam
Japan: Traffic Bureau of National Police Agency, Japn

Figure 5.1.2 International Comparison of Fatality Rate by Road Traffic Accidents

(3) Characteristics of Accidents

1) Accidents by Transportation Mode

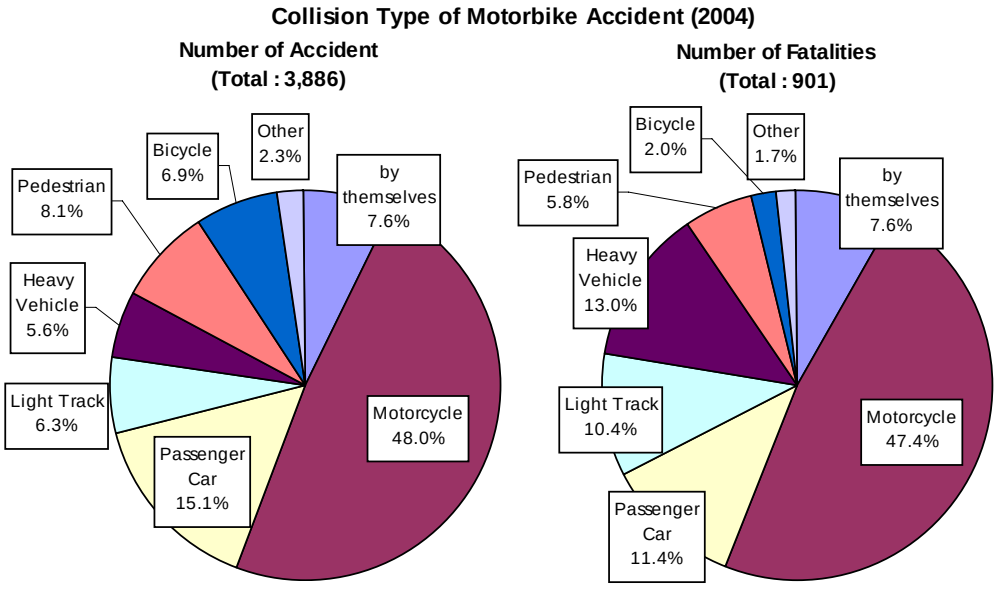
Figure 5.1.3 shows the percentage of incidents by type of road user in 2004. The number of motorcycle incidents accounts for 52.7% of the total number of incidents. In fact, 90.9% of all incidents (4,235 incidents) in 2004 were related to motorcycles, and 86.5% of all fatalities (1,042 persons) and 84.3% of injuries (6,925 persons) were motorcycle drivers or passengers. Under these circumstances, countermeasures for the reduction of fatal accidents involving motorcycles are essential for traffic safety.



Source : Land Transport Department, MPWT

Figure 5.1.3 Incidents by Transportation Mode (2004)

Figure 5.1.4 shows the percentage of motorcycle collisions by transportation mode based on the number of accidents and fatalities in 2004. With regard to motorcycle accidents in Cambodia, the number of motorcycle collisions accounts for approximately 50%. Based on the number of fatalities by motorcycle, 47.4% were caused by collisions with other motorcycles and 34.8% were collisions with other automobiles.

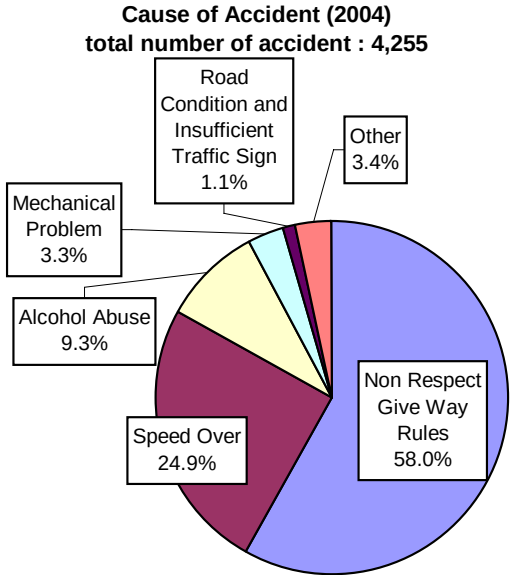


Source : Land Transport Department, MPWT

Figure 5.1.4 Motorcycle Collisions (2004)

2) Major Causes of Accidents

Based on the accident data analysis of the Land Transport Department of the MPWT shown in **Figure 5.1.5**, road traffic accidents in Cambodia are mainly due to driving errors caused by the road users. In Cambodia, the road infrastructure, particularly the 1-Digit national roads, has been significantly improved over the last decade. Therefore, road users tend to speed up under light traffic conditions. Dangerous overtaking, poor road observations and the misuse of lanes by trucks, buses and passenger cars involves the slower speed vehicles such as motorcycles in accidents under mixed traffic situations.



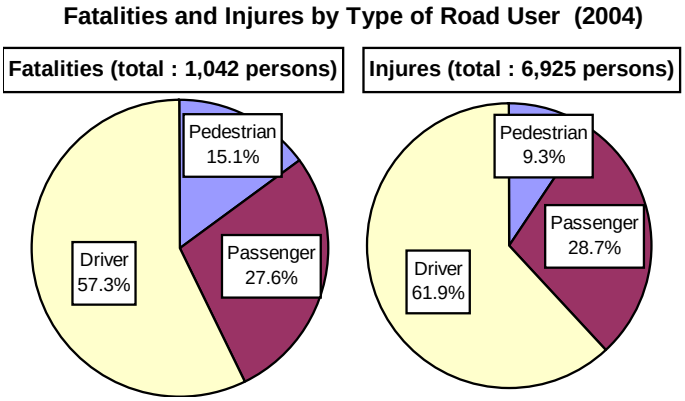
Source : Land Transport Department, MPWT

Figure 5.1.5 Cause of Accidents (2004)

This situation suggests that the enforcement of traffic regulations and traffic education for the road users are essential for the reduction of traffic accidents. In parallel with these measures, a number of engineering measures, such as the improvement of road surface conditions including pavement shoulders, improved geometric design of the roads, installation of traffic signs and road markings, and the introduction of traffic signals on the major intersections, among others, are still necessary.

3) Casualties by Type of Road User

As shown in **Figure 5.1.6**, 15.1% of all fatalities (1,042 persons) and 9.3% of all injuries (6,925 persons) in 2004 were to pedestrians who are the weakest road users. Considering that the percentage of casualties to pedestrians in Thailand and Vietnam is around 5%, the percentage of pedestrian incidents in Cambodia is considered to be at a high level.



Source : Land Transport Department, MOW

Figure 5.1.6 Fatalities and Injuries by Type of Road User (2004)

Traffic education for school children and the introduction of infrastructure measures, such as guardrails and pedestrian bridges on the road sections where traffic volumes are a high, will be introduced in the next stage of the road network development plan.

5.1.2 Road Traffic Accidents on Major National Roads

(1) National Roads Selected for the Road Accident Survey

The Study Team selected the following four 1-Digit national roads and conducted interview surveys for the accidents which occurred in 2004:

a. NR.1 (Phnom Penh – Vietnam Border: 160.6 km)
b. NR.4 (Phnom Penh – Sihanouk Ville: 217.7 km)
c. NR.5 (Phnom Penh – Poipet: 411.0 km)
d. NR.6A ~ NR.6 ~ NR.7 (Phnom Penh – Kratie: 334.5 km)

The criteria for selecting the survey routes were 1) they should be major routes not only in Cambodia but in the Mekong Region, and 2) the rehabilitation program has been completed on the route. The accident data was collected from the provincial traffic police and the district traffic police directory.

Table 5.1.2 Traffic Accidents on Major National Roads (2004)

Road No.	Province	Distance (km)	Number of Accident (Times)	Severity of Injure (persons)			
				Fatalities	Injures		
					Serious	Not Serious	Total
NR.1	Phnom Penh	3.0	24	4	29	9	38
	Kandal	44.3	22	5	22	23	45
	Prey Veng	48.6	52	17	69	45	114
	Svay Rieng	64.7	76	20	60	59	119
	Total	**160.6**	**174**	**46**	**180**	**136**	**316**
Accident Rate (per km)		-	1.08	0.29	-	-	1.97
NR.4	Kandal	19.0	145	20	142	92	234
	Kampong Speu	77.7	173	61	179	153	332
	Koh Kong	49.3	22	3	11	39	50
	Sihanouk Ville	68.2	62	32	43	39	82
	Total	**214.2**	**402**	**116**	**375**	**323**	**698**
Accident Rate (per km)		-	1.88	0.54	-	-	3.26
NR.5	Phnom Penh	12.2	83	12	73	59	132
	Kandal	27.7	27	17	14	12	26
	Kampong Chhnang	93.3	160	31	95	135	230
	Pursat	97.2	122	34	80	84	164
	Battam Bang	111.7	316	67	175	242	417
	Banteay Meanchey	68.9	318	34	105	335	440
	Total	**411.0**	**1,026**	**195**	**542**	**867**	**1,409**
Accident Rate (per km)		-	2.50	0.47	-	-	3.43
NR.6A ~ NR.6 ~ NR.7	Phnom Penh	10.4	107	27	73	44	117
	Kandal	29.9	88	26	92	66	158
	Kampong Cham	199.4	427	112	399	372	771
	Kratie	94.8	22	5	44	6	50
	Total	**334.5**	**644**	**170**	**608**	**488**	**1,096**
Accident Rate (per km) (without Kratie)		-	1.93 (2.60)	0.51 (0.69)	-	-	3.28 (4.36)

Source: Provincial Traffic Police and District Traffic Police

Table 5.1.2 shows a summary of the traffic accidents on the four national roads selected for the survey. The accidents all occurred in 2004, and **Figure 5.1.7** shows the proportion of accidents,

fatalities and injuries on each of the roads. According to **Figure 5.1.7**, the number of accidents, fatalities and injuries occurring on the four selected roads accounted for more than 50% of the total number of incidents, even though the road length of four selected roads is only 3% of the total road length in Cambodia (approximately 40,000 km). Considering that the volume of traffic will increase in the future, the implementation of the measures for the major national roads is considered to be essential for traffic safety in the master plan.

The traffic accident situation on NR.5 is most serious, 24.1% of the total number of accidents, 18.7% of the fatalities and 20.3% of the injuries occurred on NR.5. In addition, there were 2.50 accidents per km on NR.5 which is the highest accident frequency of any of the selected routes (as shown in **Table 5.1.2**).

The percentage of fatalities on NR.4 and NR.6A/NR.7 (to Kratie) was higher than the percentage of accidents (as shown in **Figure 5.1.7**), that may be supposed that risks of serious accident are intervened on the said road. The number of fatalities per km on NR.4 (as shown in **Table 5.1.2)** was 0.54 persons which is the highest of the four selected routes. However, if the accident data for Kratie, for which there are low traffic volumes at present, is not considered, the accident rate on NR.6A/NR.7 (up to Kampong Cham) would be the highest of the four routes.

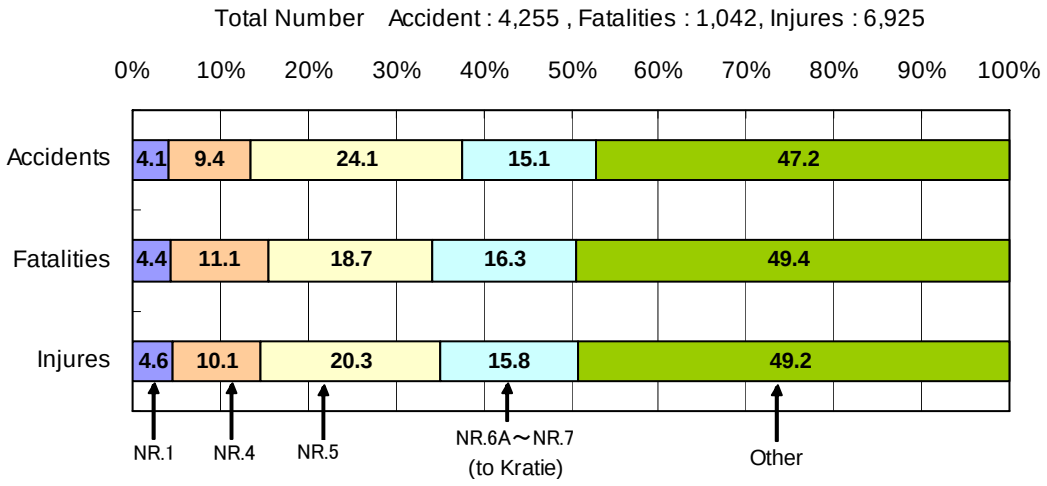


Figure 5.1.7 Percentage of Accidents on Selected National Roads (2004)

(2) Traffic Accidents on NR.1

1) Current Status of Road Infrastructure on NR.1

The rehabilitation of the road section between Neak Loeung and the Vietnam Border was completed in May 2003 under ADB Loan No.1659-CAM(SF), Ho Chi Minh City to Phnom Penh Highway Improvement Project (Neaqk Loeung to Banet Section). This road section now consists of a 2-lane carriageway with a lane width of 3.75 m and a 1.5 m wide paved shoulder on each side. The pavement type is DBST, except for a total 17.5 km length of asphalt concrete overlay in some of the town sections.

The entire section between Phnom Penh and Neak Loeung is 5 m to 7 m wide, DBST pavement, and is in a poor condition, even though a 5.7 km length of this section was rehabilitated under ADB Loan No.1824-CAM(SF), Emergency Flood Rehabilitation Project. Improvements to the Phnom Penh to Neak Loeung section are planned under the Japanese grant aid. The section between PK 0.4 and PK 1.8 will be improved through the construction of an asphalt concrete 4-lane carriageway with 3.50 m wide lanes, a 2.50 m wide motorcycle lane and a 2.50 m wide paved shoulder on each side. Other sections will be 2-lane carriageways with 2.50 m wide asphalt paved shoulders.

2) Traffic Flow on NR.1

Motorcycles are the dominant form of road traffic in Cambodia. People use motorcycles for private use, business, and even cargo transport and semi transit using trailers. Motorcycles are used mainly for short distance travel. Therefore, the proportion of motorcycles in urban areas is relatively higher than that in rural areas. The share of light vehicles has increased in both urban and rural areas in recent years. In rural areas, it is observed that light vehicles travel near to children and/or cattle at dangerous speeds. The cruising speed of light vehicles in the rehabilitated rural sections is estimated to be in the range of 80-100 km/h.

NR.1 is the main road connecting Phnom Penh and Vietnam. The highest traffic volume was observed on the road section near Phnom Penh, with 39,736 vehicles per day. The lack of a bridge over the Mekong River means that there are tracks detouring to NR.6A and NR.7 from NR.1. In the current state, the volume of trucks on NR.1 is not high compared to other selected roads; 526 vehicles per day at Preaek Khsay Kha (Neak Loeung) and 223 vehicles at Kraol Kou (border between Prevy Veng Province and Svay Rieng). However, the volume of traffic is expected to increase after improvement of the transit procedure at the Vietnam border and construction of Neak Loeung Bridge.

Table 5.1.3 Traffic Condition on NR.1

Location	unit	Motor - cycle	Light Vehicle	Bus	Truck	Total
Nirouth (PK 8.6)	Veh.	27,916 (70.3%)	8,764 (22.1%)	1,674 (4.2%)	1,382 (3.5%)	39,736
	PCU	8,375 (33.8%)	8,764 (35.4%)	4,185 (16.9%)	3,455 (13.9%)	24,779
Preaek Khsay Kha (PK 52.9)	Veh.	6,270 (77.9%)	742 (9.2%)	513 (6.4%)	526 (6.5%)	8,051
	PCU	1,881 (36.0%)	742 (14.2%)	1,283 (24.6%)	1,315 (25.2%)	5,221
Kraol Kou (PK101.5)	Veh.	2,182 (60.9%)	768 (21.5%)	407 (11.4%)	223 (6.2%)	3,580
	PCU	655 (21.8%)	768 (25.6%)	1,018 (33.9%)	558 (18.6%)	2,998
Vietnam Border (PK166.2)	Veh.	7,564 (88.9%)	790 (9.3%)	83 (1.0%)	70 (0.8%)	8,507
	PCU	2,269 (65.9%)	790 (23.0%)	208 (6.0%)	175 (5.1%)	3,442

Note : PCU Motercycle = 0.3, Light Vehicle = 1.0, Bus and Truck = 2.5 Source: JICA Study Team

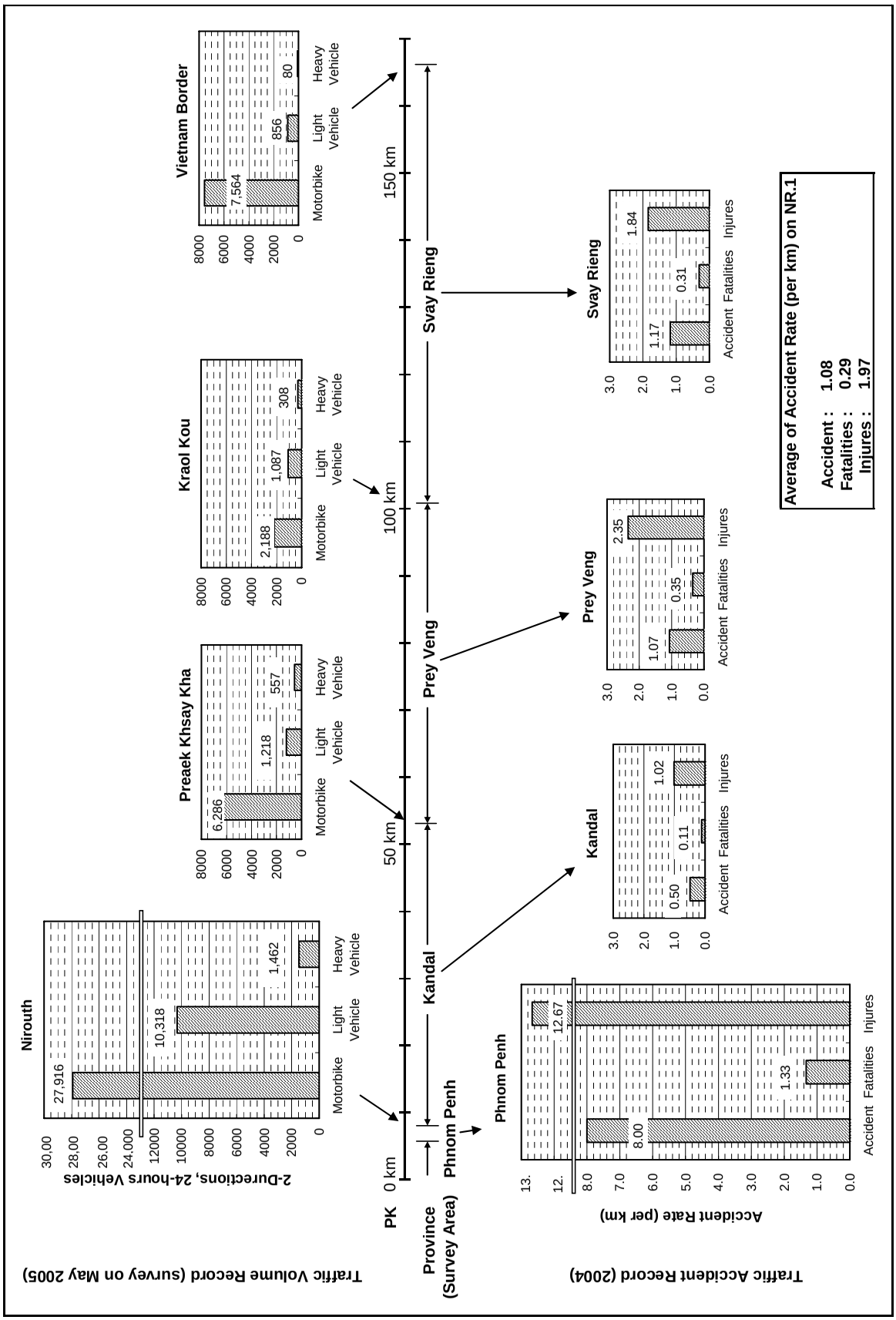


Figure 5.1.8 Traffic Accidents and Traffic Volume on NR.1

3) Traffic Accident Characteristics on NR.1

Figure 5.1.8 shows a comparison between the traffic volumes and the frequency of traffic accidents, fatalities and injuries per km. The traffic volumes are based on the traffic counting survey conducted in the Study and the accident rate is based on the 2004 records from the provincial traffic police.

The figure indicates that the accident rate is proportional to traffic volumes, that is, that the accident rate on the Phnom Penh section of NR.1 is extremely high compared to other provinces. One factor affecting the accident rate on the Phnom Penh section may be the current road conditions; rough DBST pavement with a width of 7 m does not correspond to the traffic demand on NR.1. In terms of injuries, Prey Veng province has a higher rate of injuries than the average figure for NR.1. **Table 5.1.4** shows the number of incidents by type of road user in Prey Veng in 2004. This indicates that the number of motorcycle incidents accounts for more than 50% of the incidents for all transportation modes. Overall, the figures show the same characteristics as the national records (as shown in **Figure 5.1.3**).

Table 5.1.4 Number of Incidents by Type of Road User in Prey Veng Province (2004)

	Light Vehicle	Heavy Vehicle	Motorcycle	Bicycle	Other Vehicle	Pedestrian	Total
Number	24	3	58	6	2	9	102
(%)	(23.5)	(2.9)	(56.9)	(5.9)	(2.0)	(8.8)	

Source: Provincial Traffic Police

(3) Traffic Accidents on NR.4

1) Current Road Infrastructure Status of NR.4

In 1996, NR.4 was rehabilitated by USAID to a 2-lane asphalt pavement carriageway with a width of 3.5 m per lane. The paved shoulder with a width of 1.5 m on each side of the road is provided as a motorcycle lane up to PK20.8, however, the shoulder of the remaining section is only covered with a laterite material. The NR.4 has 31 bridges with a total length of 993 m and a width of 8.2 m or 9.0 m.

Maintenance work on NR.4 is consigned to a private company. The private company secures the maintenance costs through the collection of toll charges from road users, so that the surface of the road pavement may be maintained in a good condition.

2) Traffic Flow on NR.4

NR.4 is the main route for cargo transport in Cambodia. Cargo shipments arriving in Sihanoukville are transported to Phnom Penh and other inland cities by truck via NR.4. The proportion of trucks on NR.4 is the highest in Cambodia at around 20% to 40% in terms of PCU's as shown in **Table 5.1.5**. The volume of heavy vehicles such as trucks and trailers is expected to increase due to the activation of Sihanoukville Port after the completion of the Sihanoukville Port rehabilitation Project Phase-2 funded by the JBIC.

Compared to other national roads, there are a low proportion of motorcycles on the rural sections of NR.4; the PCU of motorcycles in Ti Prammuory (on the border of Kampong Speu Province and Koh Kong) and Ta Ney (on the border of Koh Kong Province and Sihanoukville) is approximately 4%.

Table 5.1.5 Traffic Conditions on NR.4

Location	unit	Motor - cycle	Light Vehicle	Bus	Truck	Total
Choam Chau (PK 31.6)	Veh.	6,311 (63.0%)	1,764 (17.6%)	873 (8.7%)	1,069 (10.7%)	10,017
	PCU	1,893 (22.2%)	1,764 (17.6%)	2,183 (25.6%)	2,673 (31.4%)	8,513
Ti Prammuoy (PK 109.3)	Veh.	626 (22.7%)	781 (28.3%)	682 (24.7%)	670 (24.3%)	2,759
	PCU	188 (4.3%)	781 (28.3%)	1,705 (39.2%)	1,675 (38.5%)	4,349
Ta Ney (PK158.6)	Veh.	456 (21.5%)	743 (35.1%)	390 (18.4%)	528 (24.9%)	2,117
	PCU	137 (4.3%)	743 (35.1%)	975 (30.7%)	1,320 (41.6%)	3,175
East Sihanukville (PK220.0)	Veh.	2,849 (56.4%)	1,356 (26.8%)	370 (7.3%)	480 (9.5%)	5,055
	PCU	855 (19.7%)	1,356 (26.8%)	925 (21.3%)	1,200 (27.7%)	4,336

Note : PCU Motercycle = 0.3, Light Vehicle = 1.0, Bus and Truck = 2.5 Source: JICA Study Team

3) Traffic Accident Characteristics on NR.4

Figure 5.1.9 shows a comparison between the traffic volumes and the accident rate based on the 2004 records of the district traffic police. On NR.4 there is a higher risk of traffic accidents occurring in the town areas, such as the suburban areas of Phnom Penh and Sihanoukville.

The characteristics of the accidents occurring in the towns are slightly different than the accidents that occur in rural areas. **Table 5.1.6** shows the type of collisions by transportation mode for Samrong Tong District, which is advancing in terms of urbanization, and in Phnom Srouch District which is an entirely rural area in Kampong Speu Province. Most accidents in Samrong Tong are related to motorcycle, however, there is a high share of automobile accidents in Phnom Srouch. Based on a hearing survey of the district traffic police, the major cause of accidents in both districts is speeding and dangerous overtaking.

Table 5.1.6 Type of Collisions in Samrong District and Phnom Srouch District on NR.4 (2004)

Province :	Kampong Speu											
District :	Samrong Tong (PK 31.6 - PK 43.6)						Phnom Srouch (PK 57.9 - PK109.3)					
Type of Collision	Accidents		Fatalities		Injures		Accidents		Fatalities		Injures	
Motorcycle & Pedestrian	0		0		0		3	(4.1%)	1	(2.4%)	2	(1.5%)
Motorcycle & Bicycle	6	(9.0%)	0		13	(12.5%)	1	(1.4%)	0		2	(1.5%)
Motorcycle & Motorcycle	42	(62.7%)	16	(88.9%)	64	(61.5%)	5	(6.8%)	1	(2.4%)	13	(10.0%)
Motorcycle & Automobile	11	(16.4%)	0		25	(24.0%)	30	(41.1%)	9	(22.0%)	39	(30.0%)
Automobile & Pedestrian	2	(3.0%)	1	(5.6%)	1	(1.0%)	7	(9.6%)	6	(14.6%)	1	(0.8%)
Automobile & Bicycle	2	(3.0%)	1	(5.6%)	1	(1.0%)	0		0		0	
Automobile & Automobile	4	(6.0%)	0		0		21	(28.8%)	22	(53.7%)	59	(45.4%)
Other	0		0		0		6	(8.2%)	2	(4.9%)	14	(10.8%)
Total :	67		18		104		73		41		130	

Source: District Traffic Police

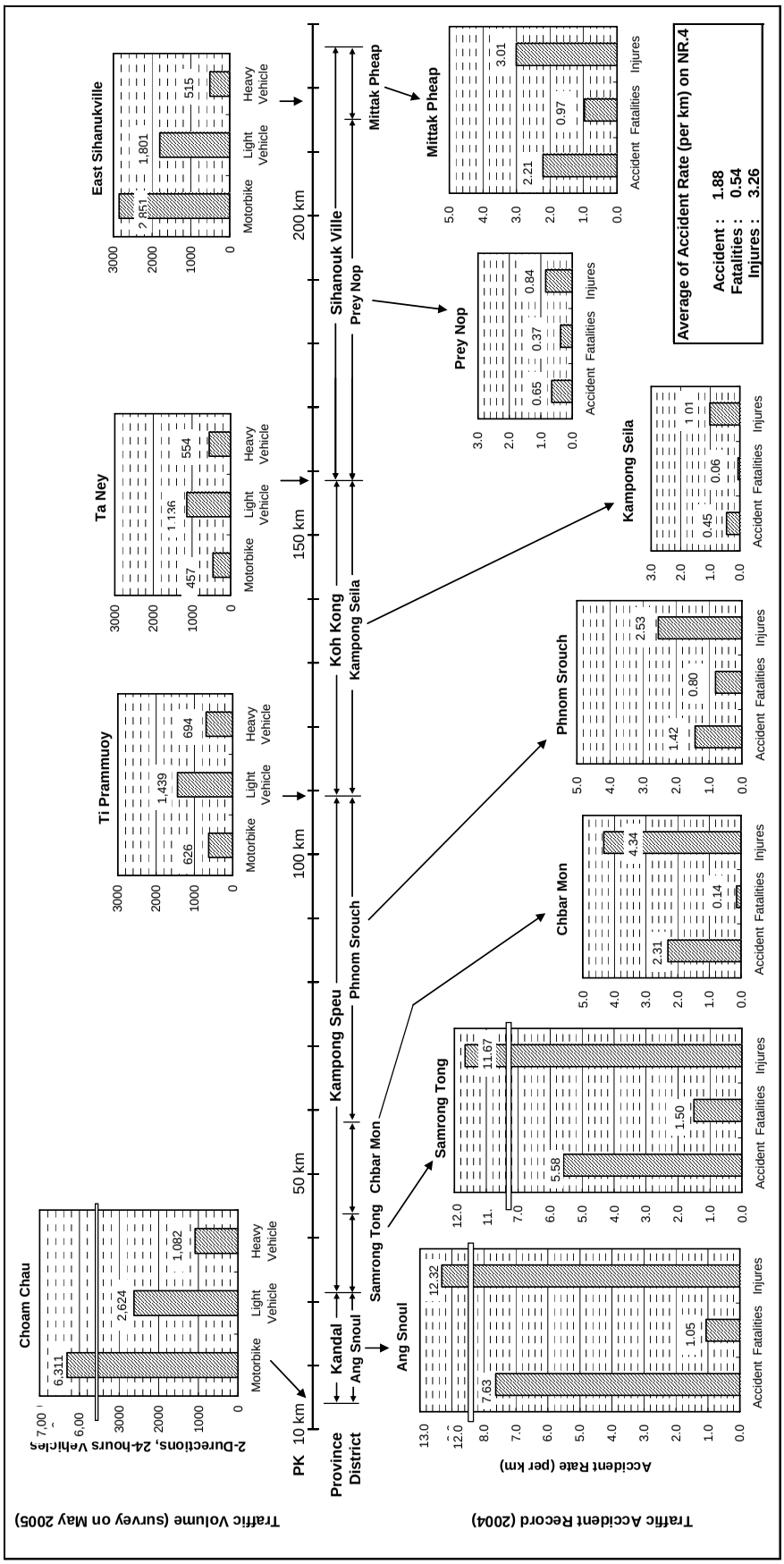


Figure 5.1.9 Traffic Accidents and Traffic Volumes on NR.4

(4) Traffic Accidents on NR.5

1) Current Road Infrastructure Status of NR.5

The rehabilitation of NR.5 up to Sisophon (PK358.6) was completed in August 2003 by means of the national fund and the ADB fund. This road section consists mainly of a 2-lane carriageway (3.5 m x 2 = 7.0 m), except for some 4-lane sections in Phnom Penh. The pavement type is mainly DBST except for a section with asphalt surfacing up to PK 12.6 in Phnom Penh. Following are the major issues relating to traffic safety on NR.5 on the section between Phnom Penh and Sisophon:

- The road safety facilities, such as road markings, traffic signs and guardrails are in very poor condition over the entire route;
- The road sections between PK 92.0 and PK 171.0 and between PK303.2 and PK358.6, which were rehabilitated by the ADB Loan No.1824-CAM(SF), Emergency Flood Rehabilitation Project, do not have a paved shoulder to provide space for motorcycles. Other sections have 1.5 m of paved shoulder with DBST pavement.
- There are a significant number of narrow bridges and box culverts still remaining. In 57 locations (total of 366.7 m) the structures are less than 5.0 m wide and in 108 locations (total of 1,472.8 m) the structures are less than 10.0 m wide.

On the section between Sisophon and Poipet, the road width is between 5.0 m and 7.0 m and the current condition of the road pavement is poor with a rough DBST surface. However, this section will be improved with the construction of a 2-lane carriageway constructed from asphalt pavement (7.0 m) and 1.5 m to 2.0 m paved shoulders on each side of the carriageway. This will be carried out using the ADB Loan No.1945-CAM(SF), Road Improvement Project.

2) Traffic Flow on NR.5

NR.5 is part of Asian Highway No.1, and runs along the south side of Tonle Sap Lake up to the border with Thailand. The daily traffic volume on NR.5 varies from 3,300 vehicles/day on the border of Kampong Chhnang Province and Pursat Province (at Ponly), to 18,500 vehicles/day to the north of Battambang City, as shown in **Table 5.1.7**. The proportion of motorcycles in the town areas such as Preaek Phnov, South and North Battambang, Boeng Pring and Poipet accounts for more than 60%, and in rural areas such as Ponley and Svay Doun Keo the proportion of motorcycles is approximately 40%.

In terms of PCU's per peak hour, the traffic in Preaek Phnov (on the border of Phnom Penh Municipality and Kandal Province) was observed to be at 1,001 PCU/hour and in North Battambang at 857 PCU/hour. Based on the "Road Traffic Capacity Design Standard" of the Japanese Road Association, the road traffic capacities of Preaek Phnov and North Battambang are 1,170 PCU/hour and 1,140 PCU/hour, respectively. Therefore, the existing traffic volumes on these sections are nearing the available capacity.

Table 5.1.7 Traffic Conditions on NR.5

Location	unit	Motor - cycle	Light Vehicle	Bus	Truck	Total
Preaek Phnov (PK 39.9)	Veh.	8,486 (60.8%)	4,146 (29.7%)	720 (5.2%)	596 (4.3%)	13,948
	PCU	2,546 (25.5%)	4,146 (41.5%)	1,800 (18.0%)	1,490 (14.9%)	9,982
Ponley (PK133.2)	Veh.	1,472 (44.4%)	799 (24.1%)	641 (19.3%)	403 (12.2%)	3,315
	PCU	442 (11.5%)	799 (20.8%)	1,603 (41.6%)	1,008 (26.2%)	3,851
Svay Doun Keo (PK230.4)	Veh.	1,989 (46.3%)	1,442 (33.6%)	578 (13.5%)	284 (6.6%)	4,293
	PCU	597 (14.2%)	1,442 (34.4%)	1,445 (34.5%)	710 (16.9%)	4,194
South Bat Dambang (PK296.0)	Veh.	3,599 (62.5%)	1,232 (21.4%)	628 (10.9%)	299 (6.6%)	5,758
	PCU	1,080 (23.3%)	1,232 (26.6%)	1,570 (33.9%)	748 (16.1%)	4,629
North Bat Dambang (PK305.5)	Veh.	14,667 (79.1%)	2,839 (15.3%)	605 (3.3%)	428 (2.3%)	18,539
	PCU	4,400 (44.8%)	2,839 (28.9%)	1,513 (15.4%)	1,070 (10.9%)	9,822
Boeng Pring (PK342.1)	Veh.	2,794 (64.1%)	920 (21.1%)	377 (8.7%)	266 (6.1%)	4,357
	PCU	838 (24.9%)	920 (27.3%)	943 (28.0%)	665 (19.8%)	3,366
Poipet (Thai Border) (PK405.8)	Veh.	5,073 (63.4%)	1,937 (24.2%)	523 (6.5%)	474 (5.9%)	8,007
	PCU	1,522 (25.6%)	1,937 (32.5%)	1,308 (22.0%)	1,185 (19.9%)	5,951

Note : PCU Motercycle = 0.3, Light Vehicle = 1.0, Bus and Truck = 2.5 Source: JICA Study Team

3) Traffic Accident Characteristics on NR.5

Figure 5.1.10(1) and **Figure 5.1.10(2)** show a comparison between the traffic volumes and the accident rate on NR.5 up to Poipet (Thai Border). NR.5 has a higher risk of traffic accidents in the town areas such as suburban Phnom Penh, Kampong Chhnang, Battambang and Sisophon. However, the Battambang section has the highest accident rate for all types of accidents.

Table 5.1.8 shows the type of collisions by transportation mode for the four districts through which NR.5 passes, including Phnom Penh, Boribour District of Kampong Chhnang Province, Battambang District and Thmo Koul District of Battambang Province. Phnom Penh and Battambang may be classified as town areas, and Boribour and Thmo Koul are classified as rural areas. The accident characteristics are similar to those for NR.4. The proportion of accidents caused by motorcycles in the town areas is higher than in the rural areas. In addition, there is a high proportion of collisions between motorcycles in the town areas.

Collisions with the road facilities should not be disregarded on NR.5. The number of collisions between automobiles and bridges, as shown in **Table 5.1.9,** was confirmed in an interview survey of the district traffic police conducted in the Study. However, the accurate location of these collisions could not be determined as the exact location of the accidents was not mentioned in the accident records.

Table 5.1.8 Type of Collisions on NR.5 (2004)

Province :	Phnom Penh (PK 0.0 - PK 12.2)						Kampong Chhnang					
District :							Boribour (PK110.3 - PK133.2)					
Type of Collision	Accidents		Fatalities		Injures		Accidents		Fatalities		Injures	
Motorcycle & Pedestrian	6	(7.2%)	0		4	(3.0%)	1	(2.9%)	0		1	(2.1%)
Motorcycle & Bicycle	15	(18.1%)	0		33	(25.0%)	0		0		0	
Motorcycle & Motorcycle	24	(28.9%)	2	(16.7%)	32	(24.2%)	5	(14.3%)	1	(10.0%)	7	(14.9%)
Motorcycle & Automobile	9	(10.8%)	6	(50.0%)	19	(14.4%)	4	(11.4%)	2	(20.0%)	4	(8.5%)
Automobile & Pedestrian	5	(6.0%)	0		6	(4.5%)	6	(17.1%)	2	(20.0%)	4	(8.5%)
Automobile & Bicycle	1	(1.2%)	0		2	(1.5%)	4	(11.4%)	2	(20.0%)	3	(6.4%)
Automobile & Automobile	15	(18.1%)	2	(16.7%)	32	(24.2%)	14	(40.0%)	1	(10.0%)	24	(51.1%)
Other	8	(9.6%)	2	(16.7%)	4	(3.0%)	1	(2.9%)	2	(20.0%)	4	(8.5%)
Total :	83		12		132		35		10		47	

Province :	Battam Bang											
District :	Battam Bang (PK296.0 - PK305.5)						Thmo Koul (PK305.5 - PK342.1)					
Type of Collision	Accidents		Fatalities		Injures		Accidents		Fatalities		Injures	
Motorcycle & Pedestrian	4	(2.8%)	1	(4.2%)	4	(3.0%)	0		0		0	
Motorcycle & Bicycle	4	(2.8%)	0		5	(3.8%)	2	(3.2%)	0		2	(4.2%)
Motorcycle & Motorcycle	54	(37.8%)	9	(37.5%)	54	(40.9%)	15	(23.8%)	3	(20.0%)	13	(27.1%)
Motorcycle & Automobile	59	(41.3%)	7	(29.2%)	59	(44.7%)	28	(44.4%)	4	(26.7%)	23	(47.9%)
Automobile & Pedestrian	10	(7.0%)	4	(16.7%)	9	(6.8%)	5	(7.9%)	3	(20.0%)	2	(4.2%)
Automobile & Bicycle	4	(2.8%)	1	(4.2%)	4	(3.0%)	0		0		0	
Automobile & Automobile	5	(3.5%)	0		0		13	(20.6%)	5	(33.3%)	8	(16.7%)
Other	3	(2.1%)	2	(8.3%)	16	(12.1%)	0		0		0	
Total :	143		24		151		63		15		48	

Source: District Traffic Police

Table 5.1.9 Number of Collisions between Automobiles and Bridges (2004)

Province	District	Accidents	Fatalities	Injures
Kampong Chhnang	Kampong Tralach	4	1	7
	Rolear Biear	4	1	9
Battom Bang	Sanglae	3	0	5

Source: Hearing Survey for District Traffic Police by JICA Study Team

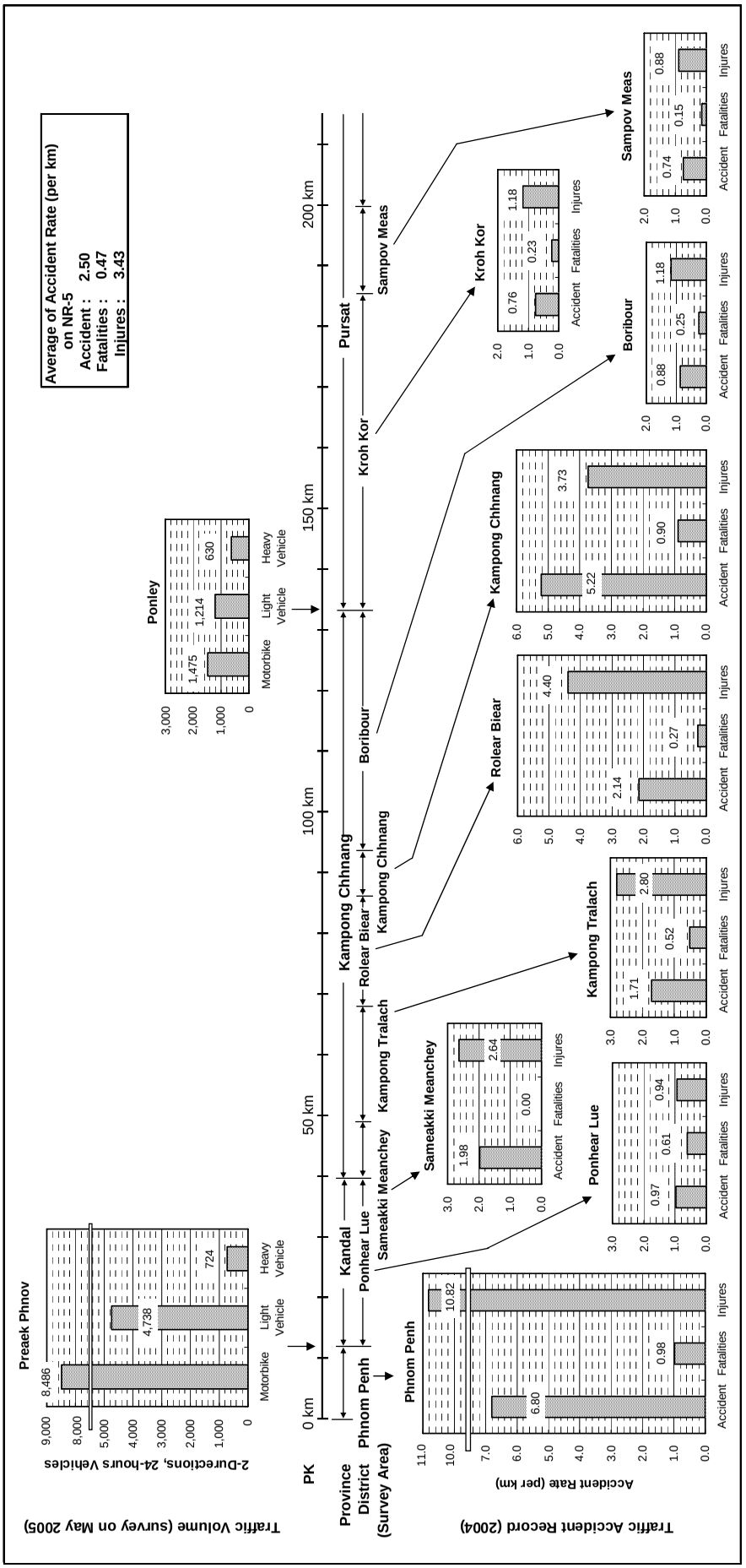


Figure 5.1.10(1) Traffic Accidents and Traffic Volumes on NR.5 (1/2)

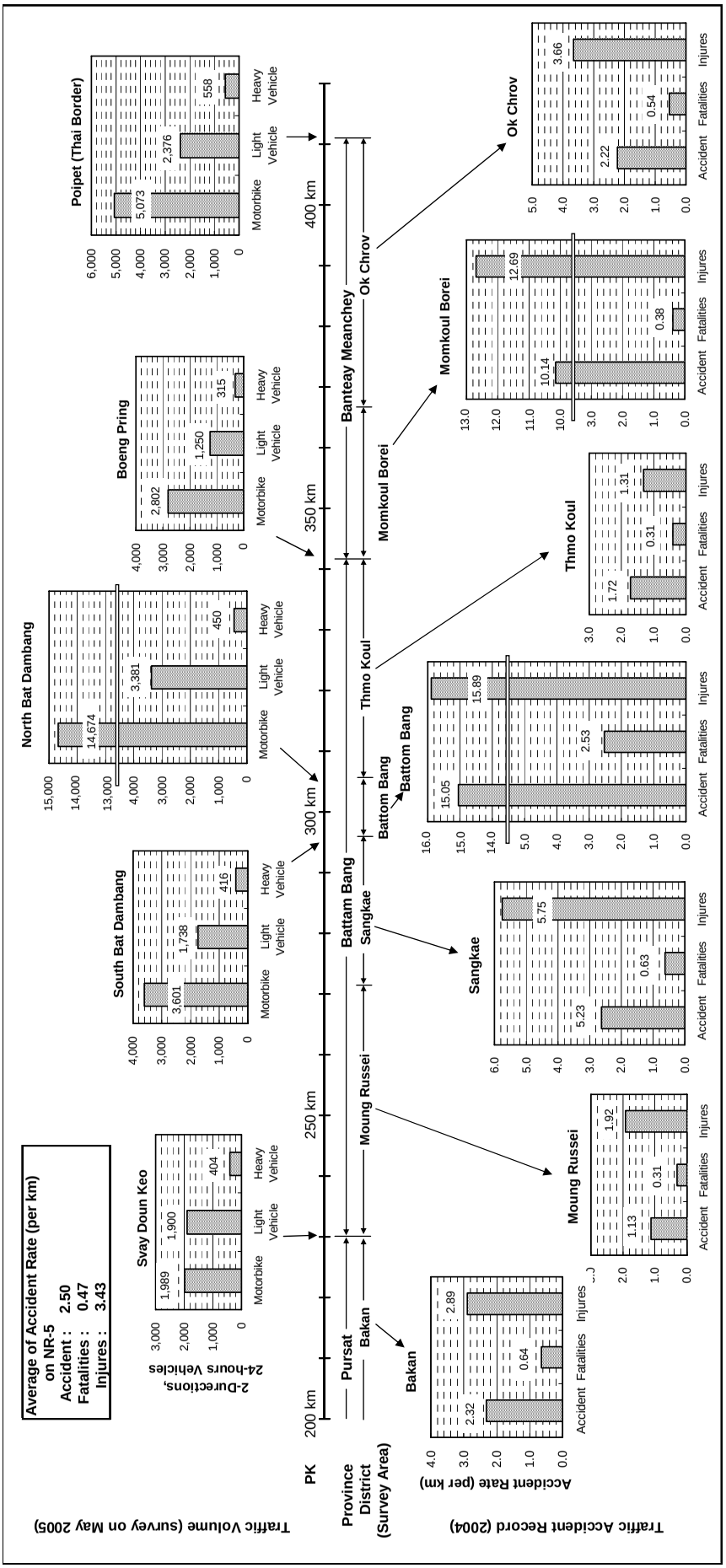


Figure 5.1.10(2) Traffic Accidents and Traffic Volumes on NR.5 (2/2)

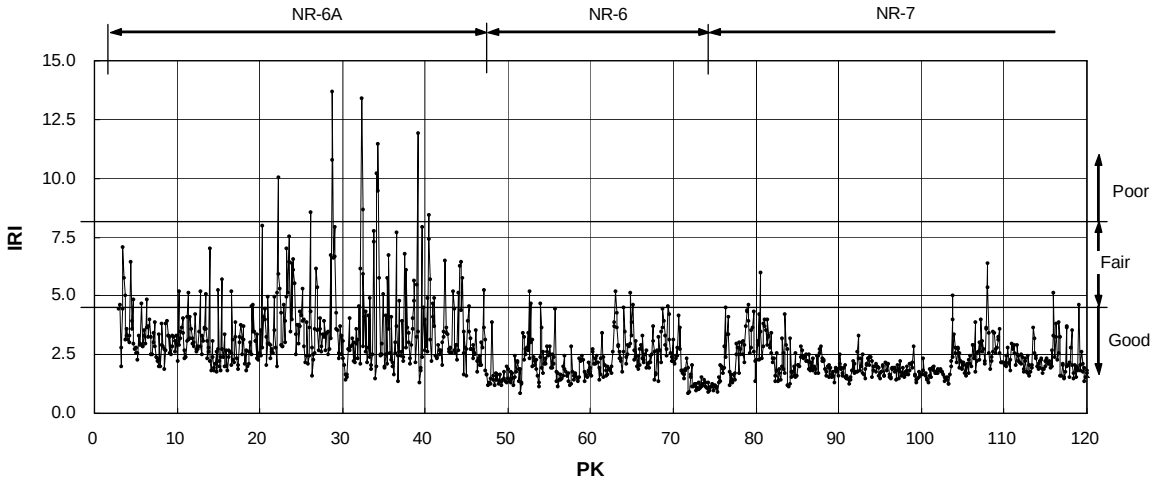
(5) Traffic Accidents on NR.6A/NR.7 up to Kratie

1) Current Road Infrastructure Status of NR.6A/NR.7 up to Kratie

The section between PK 2.1 and PK136.2 (at the junction with NR.11 in Kampong Cham Province) was rehabilitated with the construction of an asphalt concrete pavement by means of the Japan Grant Aid. Cross sections of the carriageway differ by project as shown in **Table 5.1.10**. In the section between PK 2.9 and PK120.6, some road damage such as potholes, cracking and rutting were observed on the pavement surface. **Figure 5.1.11** shows the IRI (International Roughness Index) distribution between PK 2.9 and PK120.6 carried out in the 2003 study; "JICA Preliminary Study for NR.6A, NR.6 and NR.7 Rehabilitation Project".

Table 5.1.10 Road Surface Width of the Japan Grant Aid Section of NR.6A/NR.7

Road No.	PK		Road Width(m)	
	from	to	Vehicle Lane	Paved Shoulder
NR.6A	2.9	47.0	2 @ 3.5 = 7.0	None
NR.6	47.0	75.1	2 @ 3.5 = 7.0	2 @ 1.5 = 3.0 or 2 @ 1.0 = 2.0
NR.7	75.1	120.6		
	120.6	136.2	2 @ 3.5 = 7.0	2 @ 1.5 = 3.0



Source: JICA Preliminary Study for NR.6A, NR.6 and NR.7 Rehabilitation Prolect (2004)

Figure 5.1.11 IRI between PK 2.9 and PK120.6 on NR.6A/NR.7

The section between PK136.1 and PK334.6 up to Kratie was rehabilitated by means of ADB Loan No.1697-CAM(SF), Primary Roads Restoration Project. The lane composition of the said section is a 2-lane carriageway with a lane width of 3.5 m per lane constructed from DBST pavement with a 1.5 m paved shoulder on each side constructed from SBST pavement.

2) Traffic Flow on NR.6A/NR.7 up to Kratie

NR.6A and NR.6 run along the north side of Tonle Sap Lake up to Sisophon. During peak hours

there is traffic congestion on the road section near Phnom Penh, as the road width is insufficient for the large volume of traffic (26,214 vehicles per day).

NR.7 up to NR.72 is the main road for cargo transport to Vietnam. Track volumes to the east of Kampong Cham are 925 vehicles per day. However, after NR.72, track volumes decrease significantly. Truck volumes on the border of Kampong Cham Province and Kratie City are 177 and 95 vehicles per day, respectively.

The PCU per peak hour recorded at Preack Leab (on the border of Phnom Penh Municipality and Kandal Province) was 2,042 PCU/hour. Based on the "Road Traffic Capacity Design Standards" of the Japanese Road Association, the road traffic capacity in Preack Leab is 1,280 PCU/hour. The current traffic volumes have been exceeding the available capacity of the roads.

Table 5.1.11 Traffic Conditions on NR.6A/NR.7 up to Kratie

Location	unit	Motor - cycle	Light Vehicle	Bus	Truck	Total
Preack Leab (PK 12.5)	Veh.	15,372 (58.6%)	7,290 (29.2%)	2,030 (7.7%)	1,522 (5.8%)	26,214
	PCU	4,612 (22.2%)	7,290 (35.1%)	5,075 (24.4%)	3,805 (18.3%)	20,782
Tang Krang (PK 42.4)	Veh.	2,631 (37.1%)	2,220 (31.3%)	1,447 (20.4%)	803 (11.3%)	7,101
	PCU	789 (9.1%)	2,220 (25.7%)	3,618 (41.9%)	2,008 (23.3%)	8,634
East Kampong Cham (PK230.4)	Veh.	5,097 (58.2%)	1,898 (21.7%)	837 (9.6%)	925 (10.6%)	8,757
	PCU	1,529 (19.5%)	1,898 (24.2%)	2,093 (26.7%)	2,313 (29.5%)	7,832
Khcheay (PK296.0)	Veh.	1,100 (62.7%)	288 (16.4%)	188 (10.7%)	177 (10.1%)	1,753
	PCU	330 (21.6%)	288 (18.8%)	470 (30.7%)	443 (28.9%)	1,531
East Kratie (PK305.5)	Veh.	4,339 (84.7%)	570 (11.1%)	119 (2.3%)	95 (1.9%)	5,123
	PCU	1,302 (54.1%)	570 (23.7%)	298 (12.4%)	238 (9.9%)	2,407

Note : PCU Motercycle = 0.3, Light Vehicle = 1.0, Bus and Truck = 2.5 Source: JICA Study Team

3) Traffic Accident Characteristics on NR.6A/NR.7 up to Kratie

Figure 5.1.12(1) and **Figure 5.1.12(2)** show a comparison between the traffic volumes and the accident rate on NR.6A, NR.6 and NR.7 up to Kratie. NR.6 has higher risk of traffic accidents occurring in the town areas such as suburban Phnom Penh, Kampong Siem and the Kampong Cham District of Kampong Cham Province.

Table 5.1.12 shows the type of collisions by transportation mode for the four districts on NR.6A and NR.7. This table indicates that, as for other national roads, there are a high number of motorcycle accidents and a high number of collisions between motorcycles on the Phnom Penh section of NR.6A.

Table 5.1.12 Collision Types on NR.6A, NR.6 and NR.7 (2004)

Province :	Phnom Penh (PK 2.1 - PK 12.5)						Kandal					
District :							Mukh Kampoul (PK 12.5 - PK 42.4)					
Type of Collision	Accidents		Fatalities		Injures		Accidents		Fatalities		Injures	
Motorcycle & Pedestrian	3	(2.8%)	0		3	(2.6%)	11	(12.5%)	0		1	(0.7%)
Motorcycle & Bicycle	2	(1.9%)	2	(7.4%)	4	(3.4%)	2	(2.3%)	1	(3.8%)	3	(2.1%)
Motorcycle & Motorcycle	61	(57.0%)	16	(59.3%)	68	(58.1%)	15	(17.0%)	1	(3.8%)	27	(19.0%)
Motorcycle & Automobile	15	(14.0%)	7	(25.9%)	20	(17.1%)	38	(43.2%)	16	(61.5%)	53	(37.3%)
Automobile & Pedestrian	5	(4.7%)	0		4	(3.4%)	3	(3.4%)	1	(3.8%)	2	(1.4%)
Automobile & Bicycle	1	(0.9%)	0		2	(1.7%)	5	(5.7%)	1	(3.8%)	5	(3.5%)
Automobile & Automobile	20	(18.7%)	2	(7.4%)	16	(13.7%)	11	(12.5%)	4	(15.4%)	27	(19.0%)
Other	0		0		0		3	(3.4%)	2	(7.7%)	24	(16.9%)
Total :	107		27		117		88		26		142	

Province :	Kampong Cham											
District :	Cheung Prey (PK 64.4 - PK 79.8)						Kampong Siem (PK106.5 - PK118.4)					
Type of Collision	Accidents		Fatalities		Injures		Accidents		Fatalities		Injures	
Motorcycle & Pedestrian	3	(6.8%)	0		8	(7.8%)	10	(10.2%)	0		14	(7.7%)
Motorcycle & Bicycle	5	(11.4%)	0		5	(4.9%)	10	(10.2%)	1	(6.3%)	13	(7.2%)
Motorcycle & Motorcycle	11	(25.0%)	3	(13.0%)	17	(16.7%)	20	(20.4%)	2	(12.5%)	47	(26.0%)
Motorcycle & Automobile	13	(29.5%)	3	(13.0%)	25	(24.5%)	33	(33.7%)	7	(43.8%)	68	(37.6%)
Automobile & Pedestrian	3	(6.8%)	1	(4.3%)	2	(2.0%)	3	(3.1%)	1	(6.3%)	2	(1.1%)
Automobile & Bicycle	1	(2.3%)	0		1	(1.0%)	5	(5.1%)	1	(6.3%)	10	(5.5%)
Automobile & Automobile	8	(18.2%)	16	(69.6%)	44	(43.1%)	9	(9.2%)	2	(12.5%)	16	(8.8%)
Other	0		0		0		8	(8.2%)	2	(12.5%)	11	(6.1%)
Total :	44		23		102		98		16		181	

Source: District Traffic Police

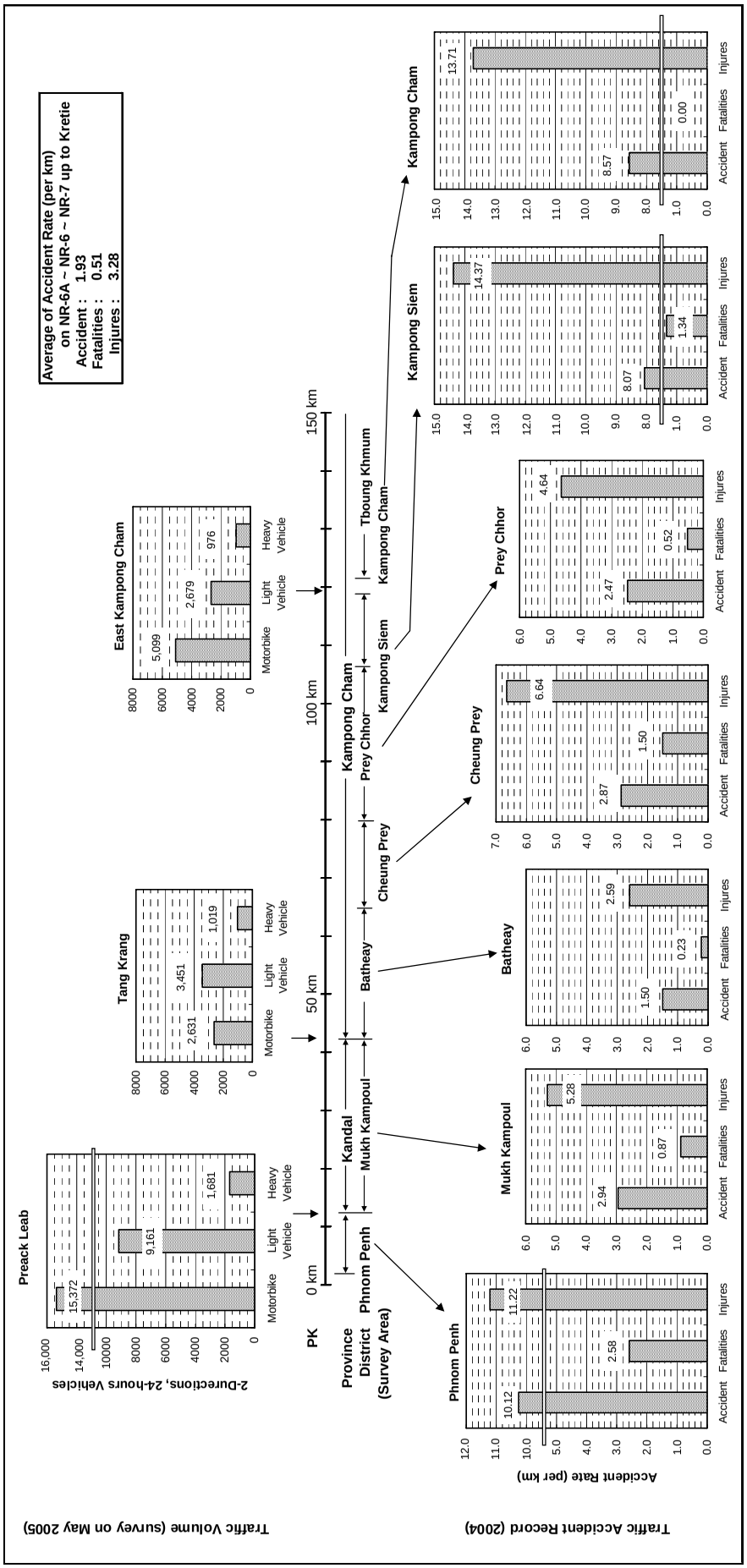


Figure 5.1.12(1) Traffic Accidents and Traffic Volumes on NR.6A – NR.6 – NR.7 (up to Kratie) (1/2)

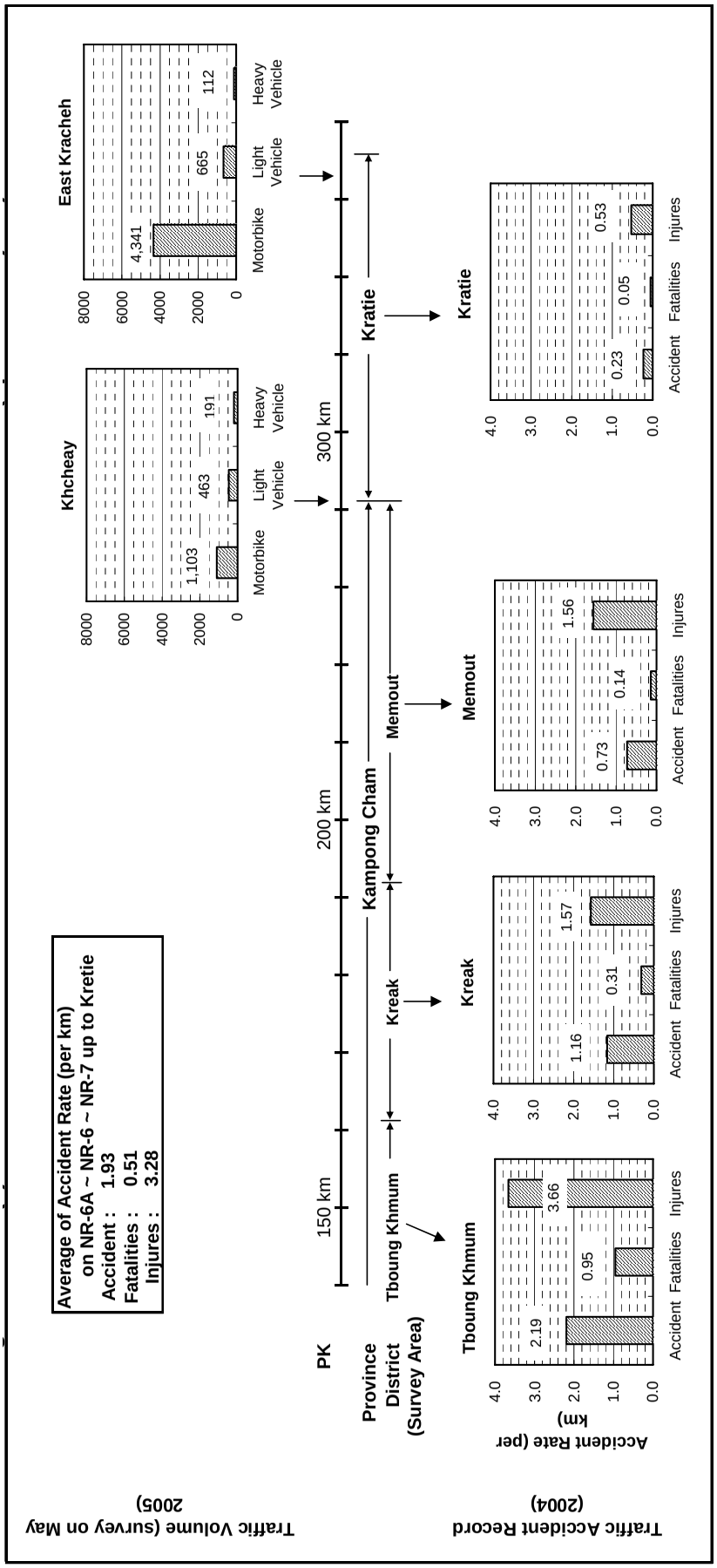


Figure 5.1.12(2) Traffic Accidents and Traffic Volumes on NR.6A – NR.6 – NR.7 (up to Kratie) (2/2)

5.2 Car Registration Statistics

5.2.1 Trend in Car Registrations

Tables 5.2.1 and **5.2.2** show the trend in the number of car registrations by type of vehicle from 1990 to 2004 and the number of registered cars by province in 2004, respectively.

Table 5.2.1 shows the irregular trend in the total number of cars registered annually. The table also indicates that the total number of cars has not significantly changed since the 1990's, except for passenger cars (light vehicles) which have increased from 4,181 in the 1990's to 13,856 in 2004. This might be an indication that the main mode of transport is beginning to shift from motorcycles, as the chief means of transport in the past, to cars.

However, as seen in **Table 5.2.2**, 28,609 vehicles (74.9%) were registered in Phnom Penh. This indicates that the cars are concentrated in the capital of Phnom Penh and the shift to cars, as the chief means of transport, is progressing only in the area around Phnom Penh. In addition, there appear to be a high number of non-registered cars in the rural areas, so it is difficult to determine whether there is a shift to cars in the rural areas unless the number of non-registered car is added to the registered cars.

5.2.2 Analysis of Car Registrations

Out of the total of 485,612 vehicle registrations, motorcycles account for 74%, light vehicles for 22% and heavy vehicles for 4% as shown in **Table 5.2.1**. The Study Team conducted a survey on car registrations through an OD traffic survey at a number of sites. It was found that there are many non-registered vehicles, in particular the ratio of non-registered motorcycles was found to be very high at 60% to 80%, as seen in **Figure 5.2.1**. A high ratio of non-registration was also observed for other vehicles at 20% to 30%. If non-registered vehicles are added to the registered vehicles, the total number of vehicles that should be registered increases to approximately 1,060,000 or 2.2 times the current level of 485,000.

Figure 5.2.2 shows the car registration statistics for NR.5 and indicates that the number of non-registered vehicles is higher in areas further away from Phnom Penh or in areas near the border. It is assumed that most of the non-registered cars come from smuggling.

The Study Team considers that this situation is unfair to people who pay the registration charges and car holding taxes. Therefore, it is recommended that the MPWT undertake the appropriate actions for the improvement of the registration system. The introduction and strengthening of a penalty system will be one solution. In addition, if the registration system is improved and strictly administrated, the countries annual revenue will increase resulting in an improved financial situation.

Table 5.2.1 Trend in the number of car registrations from 1990 to 2004

Year	Motorcycles (I)					Light Vehicles (II)						Heavy Vehicles (III)						Grand Total
	State Owned	O. I. Owned	CD & ONU Owned	Private Owned	Total (I)	O. I. Vehicle	Car	Mini Bus	Pick-up	State Owned	Total (II)	Bus	Truck	Trailer	Special Vehicle	State Owned	Total (III)	
1990	0	0	0	43,733	43,733	135	2,849	221	533	443	4,181	105	683	0	0	748	1,536	49,450
1991	0	0	0	27,432	27,432	148	3,421	218	570	750	5,107	105	506	0	0	677	1,288	33,827
1992	0	0	0	36,443	36,443	405	3,996	305	727	147	5,580	42	576	0	3	72	693	42,716
1993	0	0	0	12,544	12,544	150	3,276	310	1,336	150	5,222	102	1,171	0	14	70	1,357	19,123
1994	0	0	0	12,818	12,818	147	4,340	182	1,027	147	5,843	146	742	0	16	69	973	19,634
1995	0	0	0	19,080	19,080	220	4,528	384	986	150	6,268	153	1,131	0	27	73	1,384	26,732
1996	0	0	0	18,422	18,422	527	3,838	890	1,450	528	7,233	107	1,211	119	37	279	1,753	27,408
1997	0	0	0	10,794	10,794	290	4,516	795	1,931	497	8,029	65	1,569	79	199	146	2,058	20,881
1998	0	0	0	21,756	21,756	393	2,785	485	1,138	199	5,000	51	799	35	21	45	951	27,707
1999	0	0	0	20,147	20,147	323	4,654	1,112	2,672	244	9,005	56	857	32	36	18	999	30,151
2000	386	278	68	24,064	24,796	860	4,134	986	2,190	369	8,539	39	636	2	12	205	894	34,229
2001	909	756	65	41,960	43,690	486	3,684	593	1,624	323	6,710	71	626	3	0	20	720	51,120
2002	823	437	21	15,675	16,956	289	4,740	903	2,346	289	8,567	182	1,189	81	0	35	1,487	27,010
2003	714	380	61	26,736	27,891	427	4,705	1,028	1,804	303	8,267	107	1,089	0	7	79	1,282	37,440
2004	1,352	384	198	20,730	22,664	242	9,832	1,205	2,376	201	13,856	202	1,430	8	12	12	1,664	38,184
Total	4,184	2,235	413	352,334	359,166	5,042	65,298	9,617	22,710	4,740	107,407	1,533	14,215	359	384	2,548	19,039	485,612

Table 5.2.2 Number of registered cars by province in 2004

No.	Province	Motorcycles (I)					Light Vehicles (II)						Heavy Vehicles (III)						Grand Total
		State Owned	O.I. Owned	CD & ONU Owned	Private Owned	Total (I)	O.I. Vehicle	Car	Mini Bus	Pick-up	State Owned	Total (II)	Bus	Truck	Trailer	Special Vehicle	State Owned	Total (III)	
1	Banteay Meanchey	0	0	0	46	46	0	79	2	24	0	105	9	26	0	0	0	35	186
2	Battambang	0	0	0	241	241	0	175	17	56	0	248	12	46	0	0	0	58	547
3	Kampong Cham	0	0	0	1254	1254	0	260	93	140	0	493	16	330	0	0	0	346	2093
4	Kampong Chhnang	0	0	0	137	137	0	26	7	34	0	67	0	20	0	0	0	20	224
5	Kampong Speu	0	0	0	288	288	0	62	83	143	0	288	0	44	0	0	0	44	620
6	Kampong Thom	0	0	0	204	204	0	42	18	41	0	101	1	63	0	0	0	64	369
7	Kampot	0	0	0	102	102	0	54	33	48	0	135	0	39	0	0	0	39	276
8	Kandal	0	0	0	1751	1751	0	443	118	218	0	779	2	85	0	0	0	87	2617
9	Koh Kong	0	0	0	0	0	0	23	13	16	0	52	0	3	0	0	0	3	55
10	Kratie	0	0	0	311	311	0	29	7	15	0	51	1	9	0	0	0	10	372
11	Mondul Kiri	0	0	0	0	0	0	5	0	9	0	14	0	2	0	0	0	2	16
12	Phnom Penh	1352	384	198	15538	17472	242	8045	665	1318	201	10471	137	497	8	12	12	666	28609
13	Preah Vihear	0	0	0	74	74	0	4	0	3	0	7	0	3	0	0	0	3	84
14	Prey Veaeng	0	0	0	191	191	0	50	56	40	0	146	0	92	0	0	0	92	429
15	Pursat	0	0	0	38	38	0	44	4	15	0	63	0	23	0	0	0	23	124
16	Ratanak Kiri	0	0	0	0	0	0	11	0	6	0	17	0	8	0	0	0	8	25
17	Siemreap	0	0	0	270	270	0	195	4	86	0	285	24	37	0	0	0	61	616
18	Sinahoukville	0	0	0	0	0	0	162	41	81	0	284	0	16	0	0	0	16	300
19	Stung Treng	0	0	0	89	89	0	6	1	2	0	9	0	0	0	0	0	0	98
20	Svay Rieng	0	0	0	34	34	0	42	21	11	0	74	0	16	0	0	0	16	124
21	Takeo	0	0	0	141	141	0	67	22	61	0	150	0	64	0	0	0	64	355
22	Oddar Meanchey																		
23	Kep	0	0	0	0	0	0	3	0	0	0	3	0	1	0	0	0	1	4
24	Pailin	0	0	0	21	21	0	5	0	9	0	14	0	6	0	0	0	6	41
Total		1352	384	198	20730	22664	242	9832	1205	2376	201	13856	202	1430	8	12	12	1664	38184

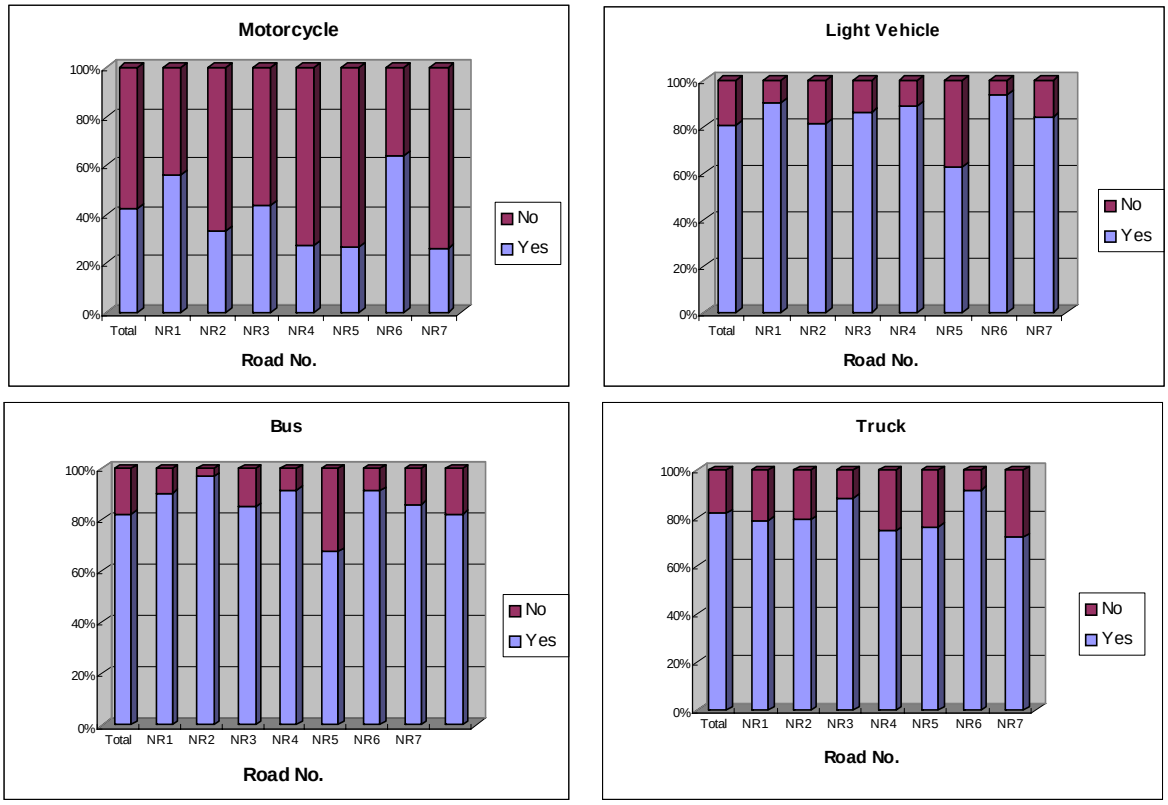


Figure 5.2.1 Summary of the Car Registration Survey

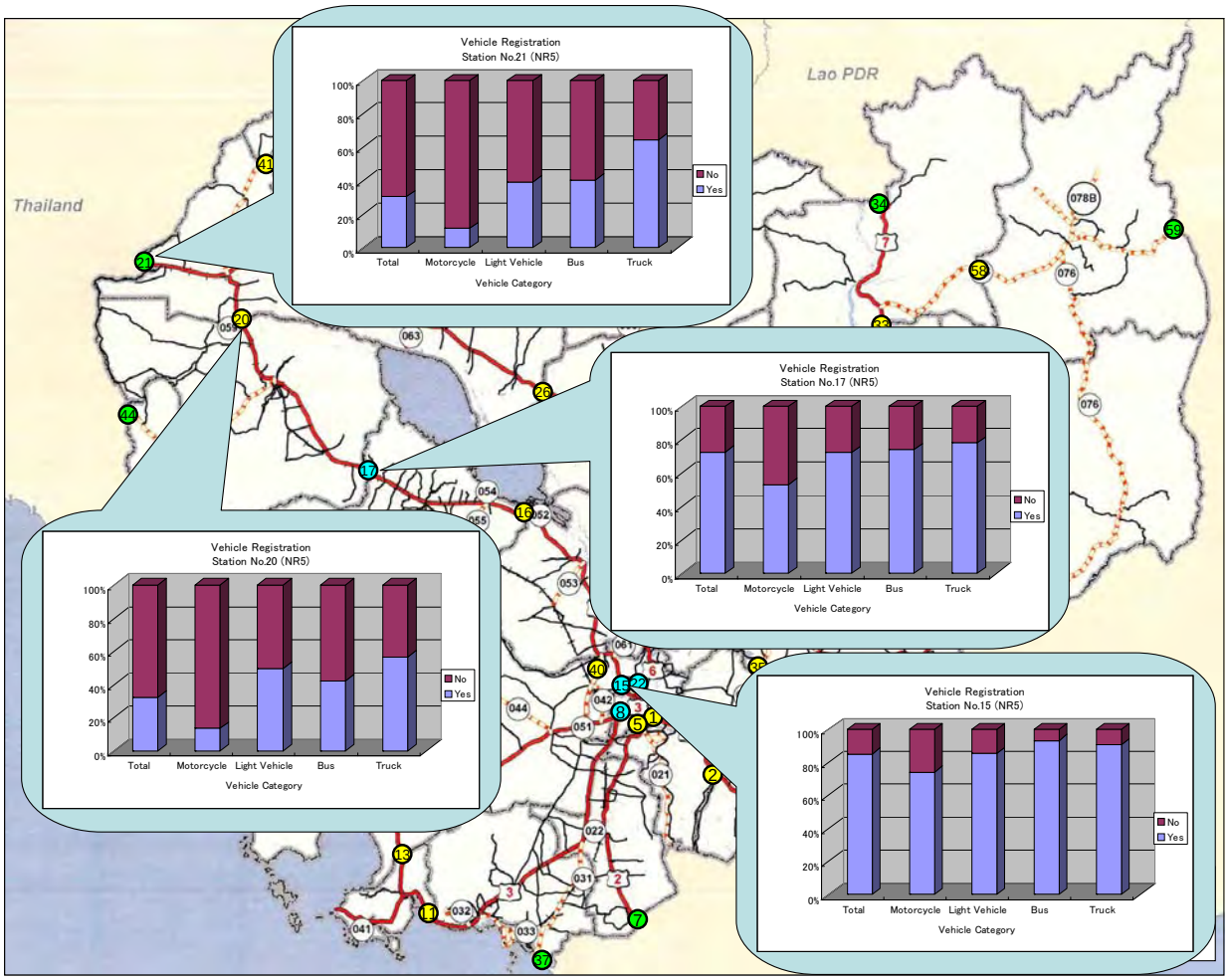


Figure 5.2.2 Car Registration Statistics along NR.5

CHAPTER A-6 TRAFFIC SURVEY AND ANALYSIS

6.1 Traffic Survey

6.1.1 Introduction

In order to formulate the road network master plan, it is important to acquire practical and reliable information on the current transport conditions. In the past, some traffic surveys have been conducted in Cambodia; however, these were only on a specific project basis.

Due to the lack of adequate traffic data, a series of nationwide traffic surveys were conducted using a local consultant in order to grasp the current road traffic conditions in Cambodia. This survey was the first nationwide traffic survey in Cambodia.

The following three types of traffic surveys were conducted in April and May 2005. **Table 6.1.1** shows an outline of the survey.

- Roadside Traffic Count Survey (60 stations)
  (12 hrs: 42 stations, 24 hrs: 6 stations, Operating hours of international borders: 12 places)
- Origin and Destination (OD) Interview Survey (41 stations)
  (12 hrs: 24 stations, 24 hrs: 12 stations, Operating hours of international borders: 5 places)
- Travel Time Survey (21 routes)
  (1-Digit road: 7 routes, 2-Digit road: 14 routes)

In addition, from the viewpoint of the technical transfer of knowledge, the staffs of the provincial Department of Public Works and Transport (DPWT) were trained in conducting traffic count surveys and OD interview surveys.

The data collected from these surveys was used for a traffic demand forecast, and in the planning of the road network development and road maintenance.

Table 6.1.1 Outline of the Traffic Survey

Survey Title	Objectives	Method	Survey Coverage	Survey Date
Roadside Traffic Count Survey	To understand traffic volumes and vehicle types on the major road sections	Traffic count (vehicles) 24/12 hours	■ Survey stations and survey period (Total of 60 stations) - 12 hrs x 1 day (42 stations) - 24 hrs x 1 day (5 stations) - 24 hrs x 7 days (1 station) - Operating hours of international borders (12 stations) ■ Vehicle Classification (Total of 8 types) - Motorcycle x 2 types - Light Vehicle x 3 types - Heavy Vehicle x 3 types	Tuesday, Wednesday and Thursday between April 20 and May 14, 2005 (Except for 24hrs x 7 days survey)
OD Interview Survey	To capture trip information for the vehicles on the major road sections	Direct interview of drivers at roadsides 24/12 hours	■ Survey stations and survey period (Total of 41 stations) - 12 hrs x 1 day (24 stations) - 24 hrs x 1 day (12 stations) - Operating hours of international borders (5 stations) ■ Vehicle Classification (total of 8 types) - The same as the Traffic Count Survey ■ Interviewed Items - Origin and destination of travel - Objective of travel - Seating capacity and number of passengers - Commodity and its load - Estimated travel time - Vehicle registration	Tuesday, Wednesday and Thursday between April 20 and May 11, 2005
Travel Time Survey	To understand travel speeds on major routes by road section	“Floating car” method 1 round trip per route	■ Surveyed routes (Total of 21 routes) - 7 routes of 1-Digit national roads - 14 routes of 2-Digit national roads	Tuesday, Wednesday and Thursday between April 20 and May 11, 2005

6.1.2 Traffic Count and OD Interview Surveys

(1) Survey Objectives

The objective of the traffic count survey was to measure the traffic volumes on the main roads throughout Cambodia. This data will be useful for expanding the OD matrices and understanding the present traffic situation.

The main objective of the OD interview survey was to capture trip information for vehicles traveling through Cambodia. The results of the OD interview will be utilized in the preparation of the current OD matrices.

(2) Description of Survey

1) Survey Items

- Vehicular traffic count

- Roadside interview

2) Survey Method

The traffic count survey was manually conducted to determine the hourly traffic volumes by vehicle type and direction of travel. The vehicle classification applied in this survey is shown in **Table 6.1.2** and follows the sub-decree for the issuance of license plates for vehicles in Cambodia.

Table 6.1.2 Vehicle Classification for the Traffic Survey

I	Motorcycle (MC)	1	Motorcycle, M.Tricycle
		2	Motorcycle Trailer
II	Light Vehicle (LV)	3	Sedan, Wagon, Light Van
		4	Pick-up, Jeep, Light Truck (>3.5t)
		5	Mini Bus (Van type and Pick-up Type)
III	Heavy Vehicle (HV)	6	Short and Long Body Bus
		7	Short and Long Body Truck (<3.5t)
		8	Semi and Full Trailer Truck

The OD interview survey was conducted to collect the following information.

Table 6.1.3 Interview Items for the OD Interview Survey

(1) Survey Time	(6) Origin & Destination
(2) Vehicle Type	(7) Major Commodity
(3) Seating Capacity	(8) Load Factor
(4) No. of Passengers on Board	(9) Estimated Travel Time
(5) Trip Purpose	(10) Vehicle Registration

The above information was collected through the interview of sampled vehicles at roadsides, in cooperation with traffic police enforcers. The vehicle classification used for the traffic count survey was also applied in the OD interview survey.

3) Survey Coverage

In order to determine and quantify the present traffic movements on the main roads in Cambodia, the survey stations for the traffic count survey and the OD interview survey were selected using the following criteria;

- To achieve an appropriate OD data match with the zoning in the future traffic demand forecast (24 internal zones and 12 outer zones),
- To get the periodic traffic count data if there are past traffic count data, and
- To minimize disruptions to the traffic flow and ensure the safety of the surveyors.

A total of 60 survey stations were selected for the traffic count survey, mainly on the one and two-Digit national roads. Of the 60 survey stations, 42 stations were selected for 12-hour surveys, and five stations were selected for 24-hour surveys. At the 12 international borders, the survey period was set as the same period as the border operating hours. A 24-hour, 7-day traffic count survey was conducted on NR.6A near Phnom Penh to determine the weekly traffic fluctuations.

Of the 60 survey stations, 41 survey stations at provincial borders and international borders were selected for the OD interview survey. The survey period for the OD interview survey was the same as for the traffic count survey. **Figures 6.1.1** and **6.1.2** show the location of the selected survey stations for the traffic count survey and the OD interview survey, respectively.

Traffic Count Survey

OD Interview Survey

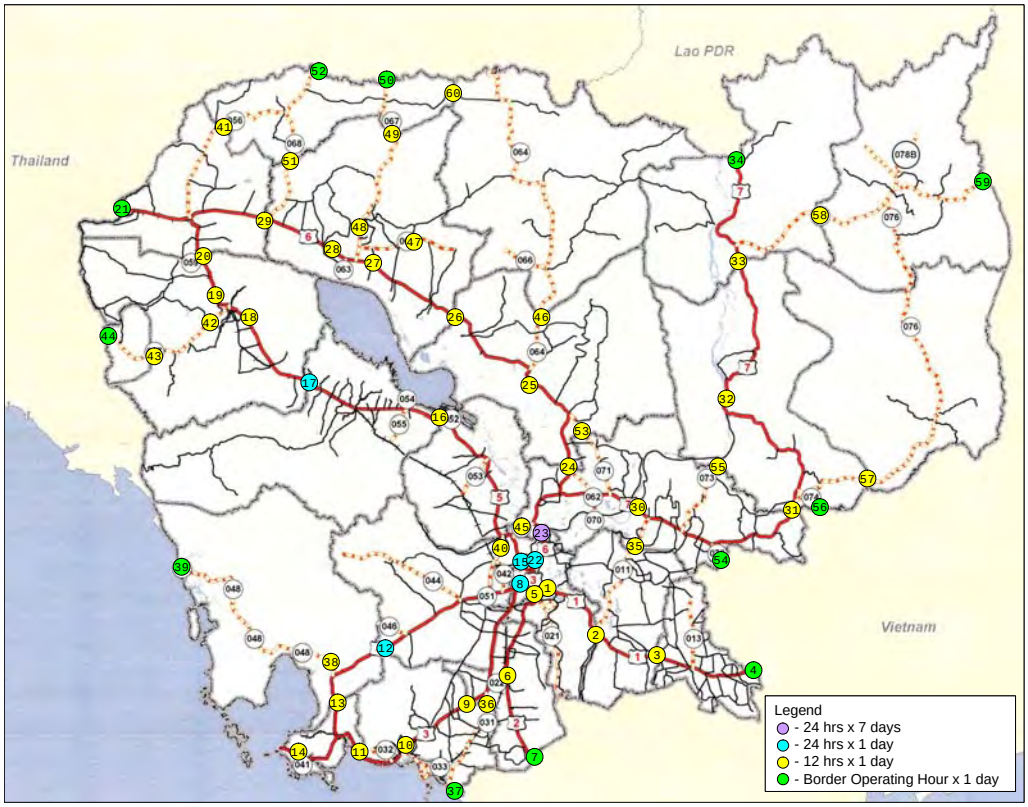


Figure 6.1.1 Survey Stations for the Traffic Count Survey

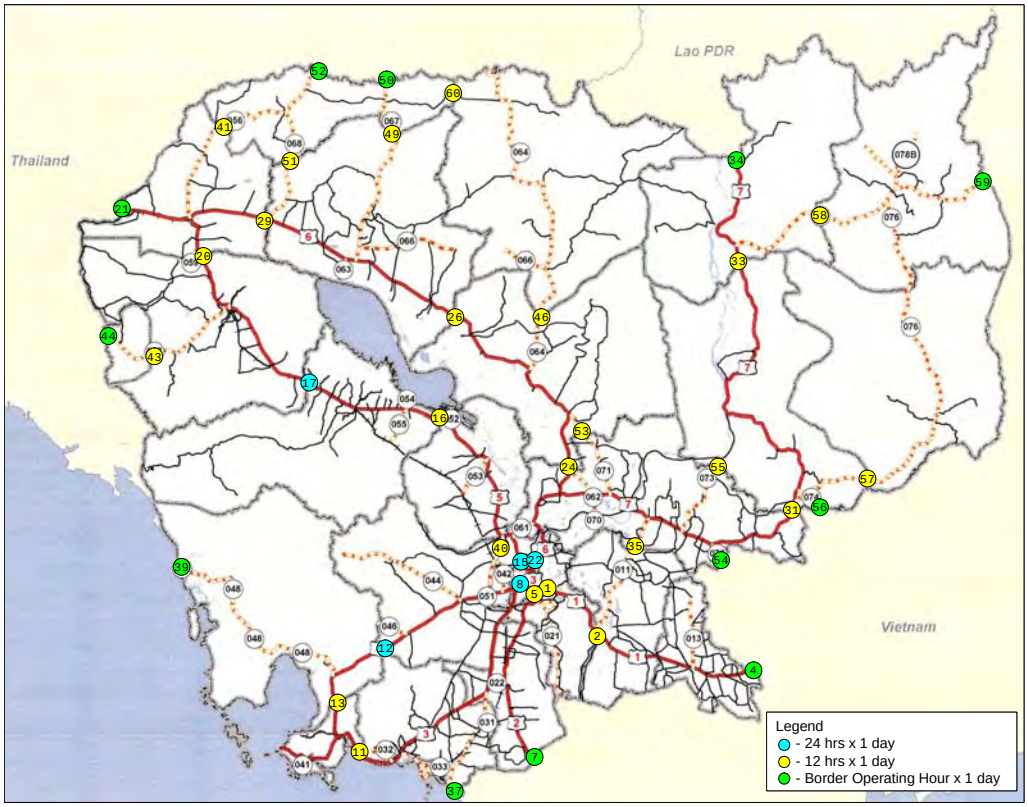


Figure 6.1.2 Survey Stations for the OD Interview Survey

4) Zoning

In this study, Cambodia has been divided into 24 zones matching the provincial zones. However, in the OD interview survey, the origin and destination information was collected by district. The zone codes applied to this study for the interior of Cambodia follow those applied by the National Statistical Center (NIS). In addition, the Cambodian border has been divided into 12 zones. The zoning map and zoning codes are shown in **Figure 6.1.3** and **Table 6.1.4** respectively.

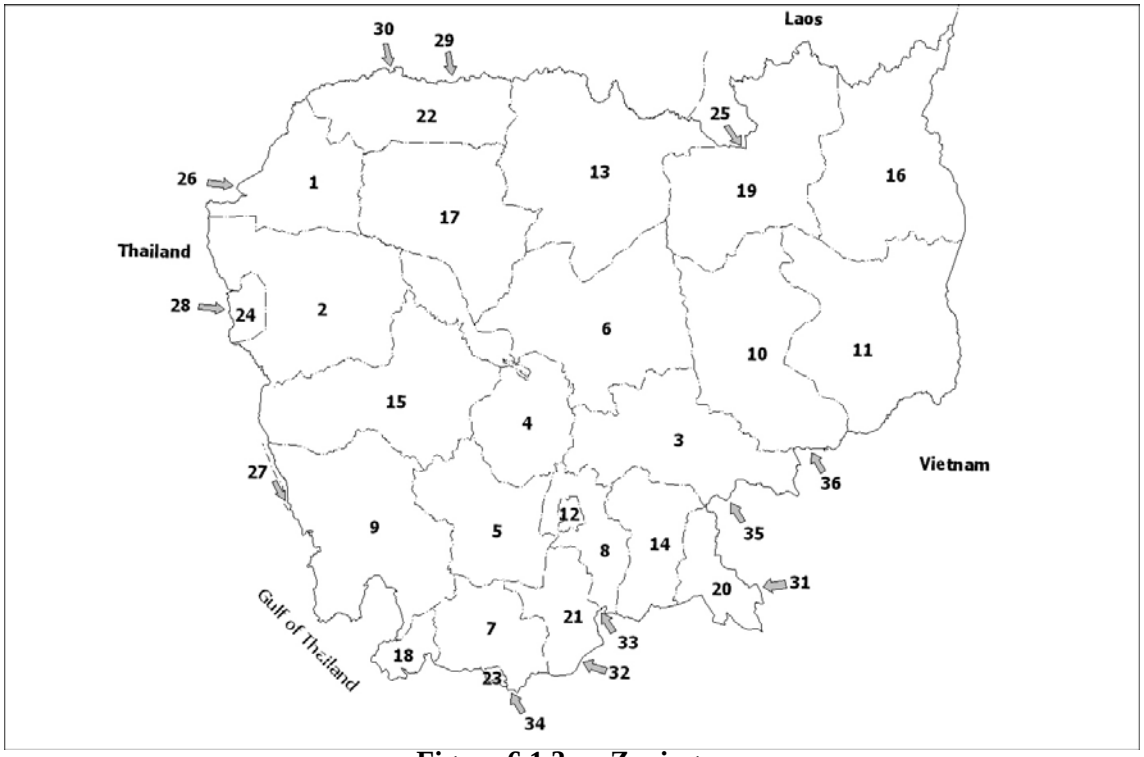


Figure 6.1.3 Zoning map

Table 6.1.4 Zoning codes

Province	Zone No	District	Code
Banteay Meanchey	1	Mongkol Barei	0102
		Phnum Srok	0103
		Preah Netr Preah	0104
		Ou Chrov	0105
		Serei Saophoan	0106
		Thma Puok	0107
		Svay Chek	0108
		Malai	0109
Battambang	2	Banan	0201
		Thma Koul	0202
		Bat Dambang	0203
		Bavel	0204
		Aek Phnum	0205
		Moung Ruessei	0206
		Rotanak Mondol	0207
		Sangkae	0208
		Samlout	0209
		Sampov Lun	0210
		Phnum Proek	0211
		Kamrieng	0212
		Koas Krala	0213
Kampong Cham	3	Batheay	0301
		Chamkar Leu	0302
		Cheung Prey	0303
		Dambae	0304
		Kampong Cham	0305
		Kampong Siem	0306
		Kang Meas	0307
		Kaoh Soutin	0308
		Krouch Chhmar	0309
		Memot	0310
		Ou Reang Ov	0311
		Ponhea Kraek	0312
		Prey Chhor	0313
		Srei Santhor	0314
		Stueng Trang	0315
		Tboung Khmum	0316
Kampong Chhnang	4	Baribour	0401
		Chol Kiri	0402
		Kampong Chhnang	0403
		Kampong Leaeng	0404
		Kampong Tralach	0405
		Rolea B'ier	0406
		Sameakki Mean Chey	0407
		Tuek Phos	0408
Kampong Speu	5	Basedth	0501
		Chbar Mon	0502
		Kong Pisei	0503
		Aoral	0504
		Odongk	0505
		Phnum Sruoch	0506
		Samraong Tong	0507
		Thpong	0508
Kampong Thom	6	Baray	0601
		Kampong Svay	0602
		Stueng Saen	0603
		Prasat Balangk	0604
		Prasat Sambour	0605
		Sandan	0606
		Santuk	0607
		Stoung	0608
Kampot	7	Angkor Chey	0701
		Banteay Meas	0702
		Chhuk	0703
		Chum Kiri	0704
		Dang Tong	0705
		Kampong Trach	0706
		Kampot	0707
		Kampong Bay	0708
Kandal	8	Kandal Stueng	0801
		Kien Svay	0802
		Khsach Kandal	0803
		Kaoh Thum	0804
		Leuk Daek	0805
		Lvea Aem	0806
		Mukh Kampul	0807
		Angk Snuol	0808
		Ponhea Lueu	0809
		S'ang	0810
		Ta Khmau	0811
Koh Kong	9	Botum Sakor	0901
		Kiri Sakor	0902
		Kaoh Kong	0903
		Smach Mean Chey	0904
		Mondol Seima	0905
		Srae Ambel	0906
		Thma Bang	0907
		Kampong Seila	0908
Kratie	10	Chhloung	1001
		Kracheh	1002
		Preaek Prasab	1003
		Sambour	1004
		Snoul	1005
Mondul Kiri	11	Kaev Seima	1101
		Kaoh Nheaek	1102
		Ou Reang	1103
		Pechr Chenda	1104
		Saen Monourom	1105
Phnom Penh	12	Chamkar Mon	1201
		Doun Penh	1202
		Prampir Meakkara	1203
		Tuol Kouk	1204
		Dangkao	1205
		Mean Chey	1206
		Ruessei Kaev	1207

Province	Zone No	District	Code
Preah Vihear	13	Chey Saen	1301
		Chhaeb	1302
		Choam Khsant	1303
		Kuleaen	1304
		Rovieng	1305
		Sangkom Thmei	1306
		Tbaeng Mean Chey	1307
Prey Veng	14	Ba Phnum	1401
		Kamchay Mear	1402
		Kampong Trabaek	1403
		Kanhchriech	1404
		Me Sang	1405
		Peam Chor	1406
		Peam Ro	1407
		Pea Reang	1408
		Preah Sdach	1409
		Prey Veaeng	1410
		Kampong Leav	1411
		Sithor Kandal	1412
Pursat	15	Bakan	1501
		Kandieng	1502
		Krakor	1503
		Phnum Kravanh	1504
		Sampov Meas	1505
		Veal Veaeng	1506
Ratanak Kiri	16	Andoung Meas	1601
		Ban Lung	1602
		Bar Kaev	1603
		Koun Mom	1604
		Lumphat	1605
		Ou Chum	1606
		Ou Ya Dav	1607
		Ta Veaeng	1608
		Veun Sai	1609
Siemreap	17	Angkor Chum	1701
		Angkor Thum	1702
		Banteay Srei	1703
		Chi Kraeng	1704
		Kralanh	1706
		Puok	1707
		Prasat Bakong	1709
		Siem Reab	1710
		Soutr Nikom	1711
		Srei Snam	1712
		Svay Leu	1713
		Varin	1714
Sihanoukville	18	Mittakpheap	1801
		Prey Nob	1802
		Stueng Hav	1803
Stung Treng	19	Sesan	1901
		Siem Bouk	1902
		Siem Pang	1903
		Stueng Traeng	1904
		Thala Barivat	1905
Svay Rieng	20	Chantrea	2001
		Kampong Rou	2002
		Rumduol	2003
		Romeas Haek	2004
		Svay Chrum	2005
		Svay Rieng	2006
		Svay Teab	2007
Takeo	21	Angkor Borei	2101
		Bati	2102
		Bourei Cholsar	2103
		Kiri Vong	2104
		Kaoh Andaet	2105
		Prey Kabbas	2106
		Samraong	2107
		Doun Kaev	2108
		Tram Kak	2109
		Treang	2110
Oddar Meanchey	22	Anlong Veaeng	2201
		Banteay Ampil	2202
		Chong Kal	2203
		Samraong	2204
		Trapeang Prasat	2205
Kep	23	Damnak Chang'aeur	2301
		Kaeb	2302
Pailin	24	Pailin	2401
		Sala Krau	2402
Laos	25	NR7	
Thailand	26	NR5	
	27	NR48	
	28	NR57	
	29	NR67	
	30	NR68	
Vietnam	31	NR1	
	32	NR2	
	33	NR21	
	34	NR33	
	35	NR72	
	36	NR74	

6.1.3 Travel Speed Survey

(1) Survey Objectives

The aim of the travel speed survey was to measure the average travel speed on the major 1 and 2-Digit national roads. The results of the survey are essential for understanding the road sections in Cambodia that are congested or are in a bad condition. The results are also useful for determining the quantity and velocity formula for the network links for the traffic demand forecast.

(2) Description of the Survey

1) Survey Items

Information to be collected on certain road sections: time of departure and arrival (start and end points of route); time of passing checkpoints; and time of stop/restart with reason for stopping.

2) Survey Method

The travel speed survey was conducted by the "floating car method", which requires the survey vehicle to keep the same position in the traffic flow; i.e. if the survey vehicle is overtaken by other vehicles, it should overtake the same number of vehicles.

3) Survey Coverage

For this survey, 21 routes of 1 and 2-Digit national roads were identified to cover the major roads in Cambodia as shown in **Table 6.1.5**. For each route, one sample (round trip) was obtained in the weekdays between 20 April 2005 and 10 May 2005.

Table 6.1.5 Surveyed Route of Travel Time Survey

Road No.	Origin and Destination	Check Point
1	From P.P to Border	Phum Thum, Kampong Phnum, Preaek Khsay Kha and Svay Rieng
2	From P.P to Border	Ta Khmau and Takaev
3	From P.P to Veal Renh	Tram Kak, NR.31, Kampot and NR.32
4	From P.P to Sihanoukville	NR.42, NR.51, Kampong Spueu, NR.46, NR.48, Veal Renh and NR.41
5	From P.P to Poipet	NR.51, Kampong Chhnang, NR.52, NR.54, Pousat, Moung Ruessei, Bat Danbang, NR.59, Mongkol Borei and Sisophon
6	From P.P to Sisophon	NR.61, Sukoun, NR.62, NR.71, Kampong Thum, NR.64, Stoung, Kouk Thlok Kraom, Siem Reap and NR.68
7	From Sukoun to Border	NR.62, NR.71, Kampong Cham, NR.11, NR.73, NR.72, NR.74, NR.76, Kracheh, NR.78 and Stoeng Treng
11	From NR.1 to NR.7	Prey Veaeng, PR316 and Kong Chey
31	From NR.3 to NR.33	PR114, PR115, PR113 and PR117
33	From NR.3 to Border	Damnak Changaeur and NR.31
48	From NR.4 to Border	Srae Ambel, Andoung Tuek, Trapeang Rung and Peam Krasoap
51	From NR.5 to NR.4	Khsem Khsan

56	From Sisophon to Samraong	Treas, Thma Puck and Banteay Chhmar
57	From Bat Danbang to Border	Snoeng and Pailin
64	From Kampong Thum to Border	PR220, PR219, PR213, Tbaeng Mean Chey, Kulen and PR212
67	From Siem Reap to Border	Banteay Srei, Sre Noy, Rumchek, Anlong Veaeng and Phum Phaav
68	From Kraalnh to Border	PR202, Srei Snam, Chong Kal and Samraong
71	From NR.7 to NR.6	Bos Knaor and Chamkar Leu
73 & 308	From Kandol Chrum to Kracheh	Dambae and Chloung
76	From NR.7 to Sen Monorom	Sre Preah
78	From NR.7 to Border	Ban Lung

6.2 Survey Results and Identification of Traffic Characteristics

6.2.1 Results of Traffic Count Survey

The traffic count survey was undertaken by eight survey teams at 60 survey stations between 20 April 2005 and 14 May 2005. The survey stations were grouped by region and all survey teams conducted the survey as described below. The weather conditions during the survey were mostly fine although there was a short period of rain at some stations.

Table 6.2.1 Survey Schedule by Region

Week	Date	Region	Province
1	April 20 and 22	North-East Region	Stung Treng, Ratana Kiri, Kratie, Mondul Kiri and Kampong Cham
2	April 26, 27 and 28	North and West Region	Kampong Thom, Preah Vihear, Siemreap, Oddar Meanchey, Banteay Meanchey, Battanbang, Pailin and Pursat
3	May 3, 4 and 5	South Region	Kampong Chhnang, Kampong Speu, Kampot, Koh Kong, Sihanoukville, Kep, Takeo, Prey Veng and Svay Rieng
4	May 8-14	Phnom Penh Area	Kandal and Phnom Penh

(1) 24-hour Traffic Volumes

1) 24-hour to 12-hour (daytime) Traffic Volume Ratios

The 24-hour traffic counts were conducted at three survey stations around Phnom Penh, and two survey stations in rural areas. **Figures 6.2.1** and **6.2.2** show the hourly fluctuations in the traffic volumes along NR.5 at Preaek Phnov (Station No.15, urban area) and Svay Doun Keo (Station No.17, rural area), respectively. The 24-hour traffic volumes at these two stations were 13,948 at Preaek Phnov, and 4,293 at Svay Doun Keo.

At Preaek Phnov, a peak hour traffic volume of 1,922 vehicles or 13.8% of the 24-hour traffic volume was observed between 6 am and 7 am. A peak hour traffic volume of 537 vehicles or 12.5% of the 24-hour traffic volume was observed at Svay Doun Keo between 9 am and 10 am. In both the urban and rural areas, the traffic volumes after 20:00 were significantly smaller than the daytime traffic volumes. The average traffic volume ratio (ratio of 24-hour volume to daytime

12-hour volume (from 6:00 to 18:00)) by vehicle type for both urban and rural areas was calculated as shown in **Table 6.2.2**.

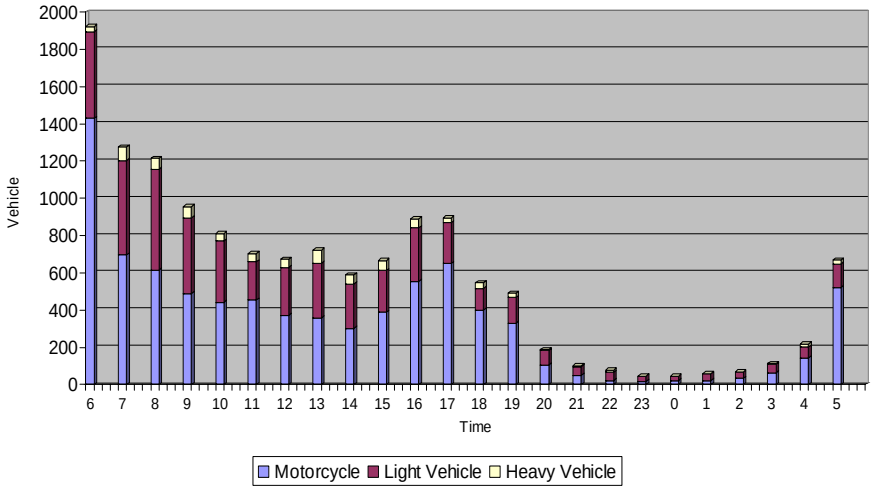


Figure 6.2.1 Time Distribution of Traffic on NR.5 in Urban Areas (Station No.15, Preaek Phnov)

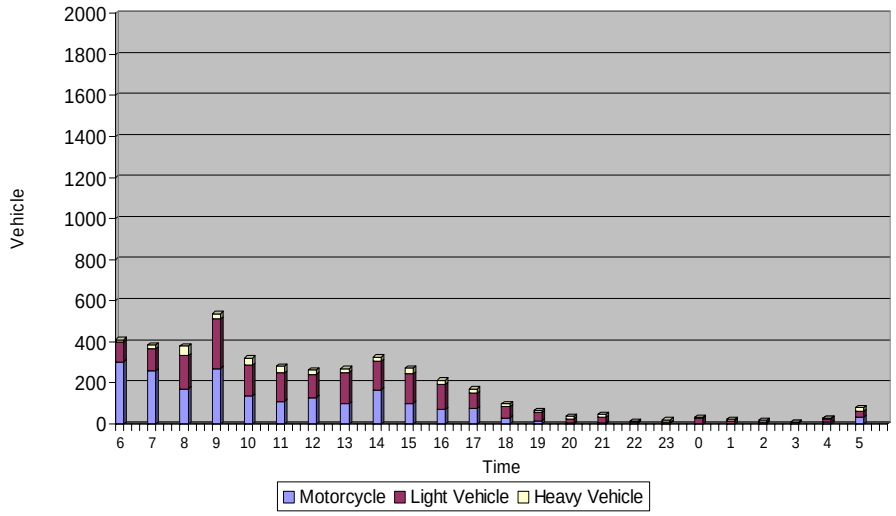


Figure 6.2.2 Time Distribution of Traffic on NR.5 in Rural Areas (Station No.17, Svay Doun Keo)

Table 6.2.2 Traffic Volume Ratios (24-hour to 12-hour (daytime))

(24hrs/12hrs)

Vehicle Type	1 Motor-cycle	2 MC Trailer	3 Sedan, Jeep	4 Pickup, L. Track	5 Minibus	6 Bus	7 Track	8 Trailer
Urban Area	1.20	1.32	1.21	1.34	1.18	1.08	1.28	1.64
Rural Area	1.21	1.03	1.13	1.19	1.18	1.01	1.61	1.83

Source: JICA Study Team

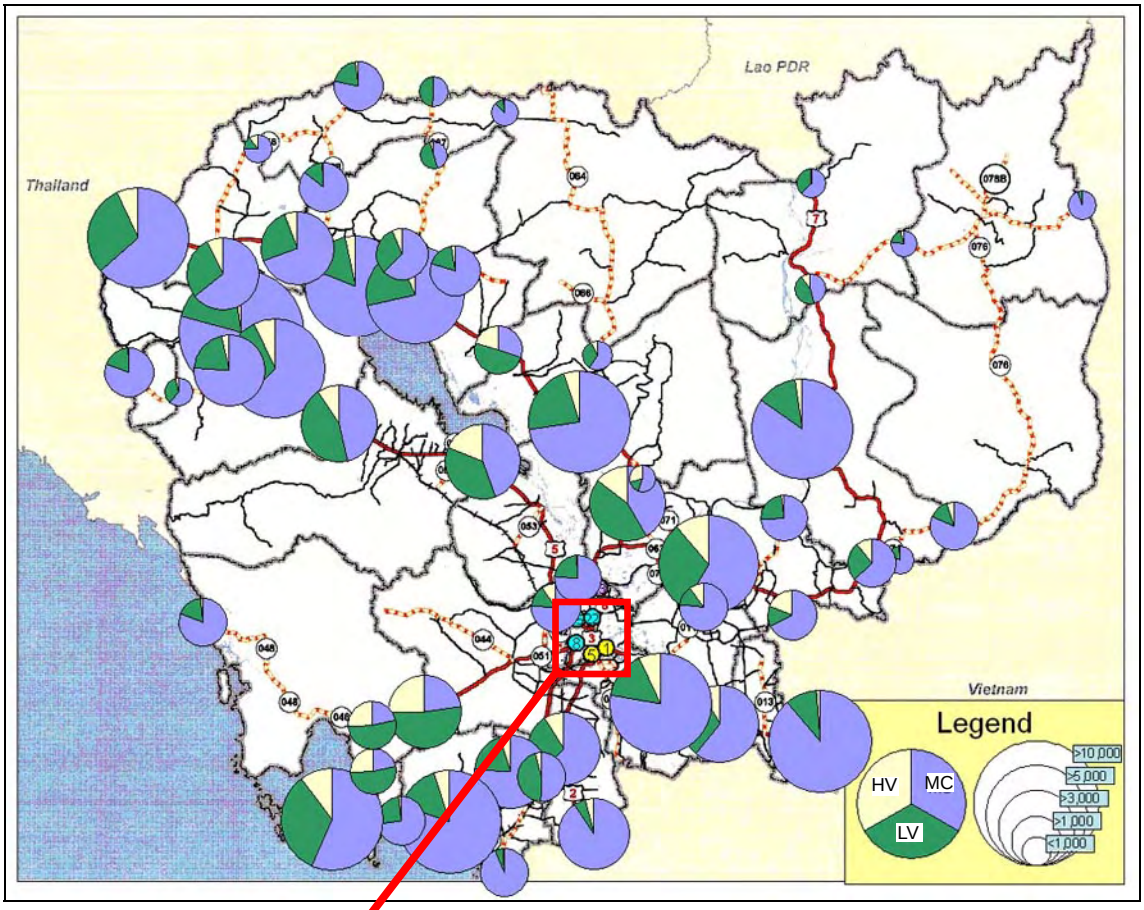
2) 24-hour Traffic Volumes

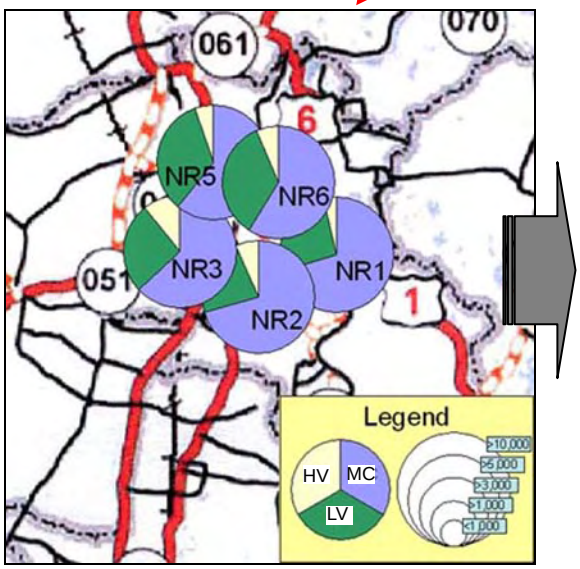
Figure 6.2.3 shows the 24-hour traffic volumes recorded at the survey stations. The detailed data for the 24-hour traffic volumes is shown in **Table 6.2.3**. The traffic volumes observed at the 12-hour survey stations (42 stations) and international borders (12 stations) were converted into 24-hour traffic volumes based on the traffic volume ratios shown above.

Daily traffic volumes of over 10,000 vehicles were observed at stations No.1, No.5, No.8, No.15, No.19 and No.22. Of these six stations, five are located around Phnom Penh. The last station is to the north of Bat Danbang City. The largest traffic volume was observed at station No.1 (Nirouth, on NR.1) at 39,736 vehicles per day. Of these 39,736 vehicles, 27,916 or 70.3% were motorcycles. There were 10,358 or 26.1% light vehicles and 1,462 or 3.7% large vehicles observed at station No.1.

Motorcycles are the dominant mode of road transport in Cambodia. People use motorcycles for private, business, and even cargo transport and semi transit using trailers. The average proportion of motorcycles is calculated to be 66.5%. However, motorcycles were not observed as the principal transport mode at stations No.12 (NR.4), No.13 (NR.4), No.23 (NR.6A) or No.26 (NR.6). NR.4 is the main route for cargo transport through Cambodia. Cargo shipments arriving in Sihanoukville are carried to Phnom Penh and other inland cities by trucks via NR.4. Therefore, the share of trucks on NR.4 is the highest in Cambodia at around 25%, and that of motorcycle on the NR.4 is the lowest at around 22%.

The traffic volumes observed on the 2-Digit national roads were considerably smaller than those on the 1-Digit national roads. The average daily traffic volume on the 2-Digit national roads is only 1,312, however on the 1-Digit national roads the average volume is 7,330. The daily traffic volumes vary between 250 vehicles at station No.49 (NR.67, provincial border of Siem Reap and Banteay Meanchey) and 3,350 at station No.42 (NR.57, west of Bat Danbang City).





24-hour Traffic Volumes around Phnom Penh

ST No. (Road No.)	Motor-cycle	Light Vehicle	Heavy Vehicle	Total
ST1 (NR.1)	27,916	10,358	1,462	39,736
ST5 (NR.2)	8,560	2,771	798	12,129
ST8 (NR.3)	6,311	2,624	1,082	10,017
ST15 (NR.5)	8,486	4,738	724	13,948
ST22 (NR.6)	15,372	9,161	1,681	26,214

Source: JICA Study Team

Figure 6.2.3 24-hour Traffic Volumes

Table 6.2.3 24-hour Traffic Volumes (1/2)

Station	I Motorcycle		II Light Vehicle			III Heavy Vehicle			Total
	1 Motor-cycle	2 MC Trailer	3 Sedan, Jeep	4 Pickup, L. Track	5 Minibus	6 Bus	7 Track	8 Trailer	Vehicle Count
1	25,769	2,147	5,585	3,179	1,594	80	1,312	70	39,736
2	6,008	262	508	234	487	26	513	13	8,051
3	2,106	76	526	242	322	85	212	11	3,580
4	7,539	25	699	91	66	17	61	9	8,507
5	7,933	627	1,244	827	700	78	681	39	12,129
6	2,255	83	529	238	310	42	244	49	3,750
7	3,178	119	102	71	32	3	134	0	3,639
8	6,189	122	1,093	671	860	13	1,019	50	10,017
9	3,028	205	403	179	229	8	187	22	4,261
10	3,972	463	402	296	117	3	254	23	5,530
11	1,351	49	227	120	141	2	27	5	1,922
12	514	112	568	213	658	24	186	484	2,759
13	386	70	489	254	365	25	177	351	2,117
14	2,685	164	1,082	274	335	35	103	377	5,055
15	7,291	1,195	2,330	1,816	592	128	487	109	13,948
16	1,384	88	511	288	414	227	204	199	3,315
17	1,865	124	1,119	323	458	120	121	163	4,293
18	3,560	39	757	475	511	117	161	138	5,758
19	14,240	427	1,801	1,038	551	54	276	152	18,539
20	2,706	88	613	307	328	49	175	91	4,357
21	4,941	132	1,284	653	439	84	192	282	8,007
22	15,220	152	5,271	2,019	1,871	159	1,430	92	26,214
23	2,538	93	1,461	759	1,231	216	701	102	7,101
24	1,421	132	763	326	542	113	375	53	3,725
25	4,976	179	670	496	426	97	221	39	7,104
26	446	7	353	188	189	79	183	46	1,491
27	4,383	18	653	380	336	82	300	21	6,173
28	6,791	183	691	483	185	65	176	39	8,613
29	2,396	90	402	193	300	40	121	49	3,591
30	4,990	107	1,269	629	788	49	801	124	8,757
31	1,098	2	218	70	174	14	175	2	1,753

Source: JICA Study Team

Table 6.2.3 24-hour Traffic Volume (2/2)

Station	Counted Traffic Volume (24hrs)								
	I Motorcycle		II Light Vehicle			III Heavy Vehicle			Total
	1 Motor-cycle	2 MC Trailer	3 Sedan, Jeep	4 Pickup, L. Track	5 Minibus	6 Bus	7 Track	8 Trailer	Vehicle Count
32	4,214	125	372	198	97	22	74	21	5,123
33	238	3	136	65	28	7	42	5	524
34	46	0	34	5	4	0	0	0	89
35	2,001	17	118	96	138	11	236	16	2,633
36	596	11	177	114	260	22	27	0	1,207
37	1,745	25	37	21	49	0	14	0	1,891
38	1,319	34	248	126	170	6	80	73	2,056
39	1,561	1	165	112	73	7	18	1	1,938
40	1,358	59	95	116	53	4	148	29	1,862
41	379	0	26	34	14	0	55	0	508
42	2,515	35	292	252	135	2	117	5	3,353
43	449	4	164	39	53	0	21	7	737
44	1,069	7	149	74	24	0	11	0	1,334
45	854	53	75	132	59	0	11	2	1,186
46	189	0	33	23	52	0	24	0	321
47	861	10	97	64	34	0	24	4	1,094
48	1,490	23	367	190	201	104	53	0	2,428
49	111	2	42	20	64	0	11	0	250
50	193	0	96	51	31	0	3	0	374
51	1,299	30	107	57	46	0	14	0	1,553
52	822	9	158	27	23	3	21	0	1,063
53	445	12	32	64	24	0	243	2	822
54	984	21	124	47	22	6	241	39	1,484
55	1,179	4	144	97	145	6	48	0	1,623
56	373	4	65	8	5	0	10	1	466
57	1,000	3	34	53	82	8	23	31	1,234
58	428	5	42	29	33	0	24	0	561
59	775	0	29	8	3	0	5	0	820
60	370	0	20	11	14	0	5	4	424

Source: JICA Study Team

6.2.2 Results of the OD Interview Survey

The OD interview survey was conducted by 6 survey teams at 42 survey stations between 20 April and 11 May. The interview survey was conducted on the same day and at the same time as the traffic count survey. With the appropriate traffic control being managed by the traffic police enforcers, the interview survey was safely conducted at all survey stations without any accidents or problems.

The interview results, excluding the origin and destination information, are described in this subsection. The results and their characteristics are mentioned in the next subsection; "Present OD Table".

1) Number of Samples

The number of samples obtained in the OD interview survey, by transport mode, is described in **Table 6.2.4**. The sampling rate at stations No.1, No.2, No.5, No.15 and No.22 was less than 10% due to the heavy traffic around Phnom Penh. The lowest sampling rate was 2.3% at station No.1 as this was where the heaviest traffic was observed. The total sampling rate was 7.3% due to the high sampling rate achieved in the rural areas. From a statistical point of view, the sampling data is sufficient to be analyzed and used in future traffic demand forecasts.

Table 6.2.4 Number of Samples (1/2)

Station No.	Sampling Rate	Number of Samples								
		Total	1 Motor-cycle	2 MC Trailer	3 Sedan, Jeep	4 Pickup, L. Track	5 Minibus	6 Bus	7 Track	8 Trailer
1	2.3%	747	256	85	138	56	137	22	44	9
2	6.5%	433	187	41	46	22	67	9	60	1
4	10.3%	879	459	7	308	34	20	16	26	9
5	4.9%	484	76	31	110	52	133	20	55	6
7	12.5%	454	252	56	45	65	5	0	31	0
8	11.7%	1169	393	29	136	127	218	7	218	25
11	24.3%	392	151	7	106	52	66	2	8	0
12	13.0%	360	8	1	63	34	75	0	31	148
13	20.9%	350	43	18	69	40	77	9	33	61
15	5.2%	726	103	84	173	102	96	53	79	39
16	14.9%	409	55	0	101	18	136	39	37	23
17	12.1%	521	44	3	136	28	153	56	40	61
20	25.5%	920	406	23	177	70	143	20	54	27
21	14.0%	1122	455	30	227	100	159	29	63	65
22	5.1%	1329	396	14	260	144	199	40	227	49
24	13.2%	408	60	15	81	30	100	56	54	13
26	24.9%	305	64	6	54	23	68	22	53	10

Source: JICA Study Team

Table 6.2.4 Number of Samples (2/2)

Station No.	Sampling Rate	Number of Samples								
		Total	1 Motor cycle	2 MC Trailer	3 Sedan, Jeep	4 Pickup, L. Track	5 Minibus	6 Bus	7 Track	8 Trailer
29	12.6%	376	84	1	111	8	95	21	34	22
31	20.3%	291	112	0	37	21	57	12	52	0
33	82.1%	351	182	0	90	25	24	7	20	3
34	61.8%	45	31	0	34	5	1	0		0
35	15.9%	339	89	3	50	44	64	11	69	9
37	37.7%	712	600	9	37	13	40	0	14	0
39	21.1%	408	244	1	68	63	16	5	11	0
40	13.9%	212	115	5	20	22	17	0	30	4
41	50.2%	206	142	0	8	11	11	0	34	0
43	79.0%	485	278	0	127	33	41	0	5	1
44	19.3%	257	125	0	77	34	10	0	11	0
46	60.2%	158	76	0	20	19	30	0	13	0
49	100.0%	199	92	0	37	11	54	0	6	0
50	41.1%	153	56	0	46	24	24	0	3	0
51	14.3%	186	78	5	46	9	38	0	9	1
52	17.6%	187	104	0	34	23	15	3	8	0
53	58.2%	370	186	1	13	45	4	1	118	1
54	15.0%	223	85	8	18	9	4	0	89	16
55	19.6%	262	316	2	69	23	76	1	30	0
56	63.9%	293	235	0	37	6	5	0	10	0
57	11.9%	119	30	0	17	10	42	6	14	0
58	38.6%	179	104	2	32	8	18	0	15	0
59	17.6%	144	116	0	15	8	0	0	5	0
60	85.1%	297	265	0	8	9	11	0	3	1
Total	7.2%	17,460	7,153	487	3,281	1,480	2,549	467	1,716	604

Source: JICA Study Team

2) Average Passenger Occupancy

The average occupancy by vehicle type, obtained from the results of the OD interview survey, is shown in **Table 6.2.5**. The average occupancy of minibuses exceeds the average seating capacity by 4.67 passengers/vehicle. It was observed that pickup and van type minibuses carry passengers not only in their cabins but also on the roof and even on the bonnet (see the photo below).

Table 6.2.5 Average Seating Capacity

Vehicle Type	Total Passengers	Number of Samples	Average Occupancy (passengers / vehicle)	Average Seating Capacity
1. Motorcycle	13,315	7,118	1.87	2.03
2. MC Trailer	4,070	478	8.51	8.76
3. Sedan, Jeep	12,979	3,266	3.97	4.72
4. Pickup, L. Track	504	103	4.89	4.37
5. Minibus	32,207	2,528	12.74	8.07
6. Bus	13,383	454	29.48	31.95

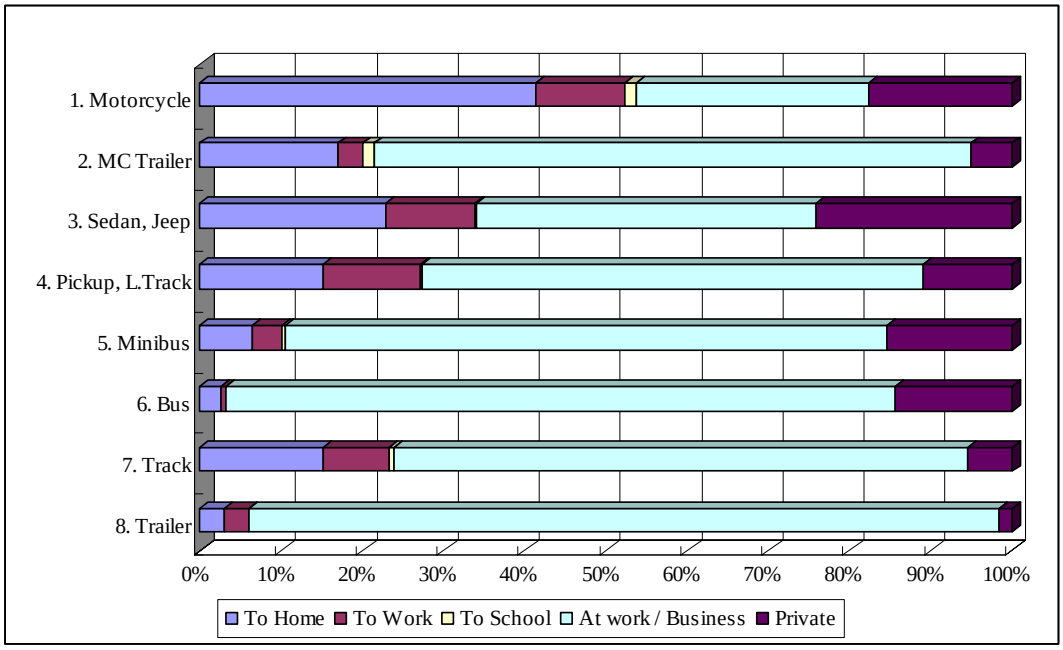
Source: JICA Study Team

Minibus (Pick-up type)

Minibus (Van type)

3) Trip Purpose

The trip purpose was varied by vehicle type as illustrated in **Figure 6.2.4**. “At work / Business” was the highest purpose except for motorcycle. For motorcycle, the highest purpose was “To home”.



Source: JICA Study Team

Figure 6.2.4 Trip Purpose by Vehicle Type

4) Commodity Type

Table 6.2.6 shows the type of commodities carried by pick-up and truck. "Construction" and "Agriculture" items recorded the highest shares, accounting for 22.0% and 21.5%, respectively.

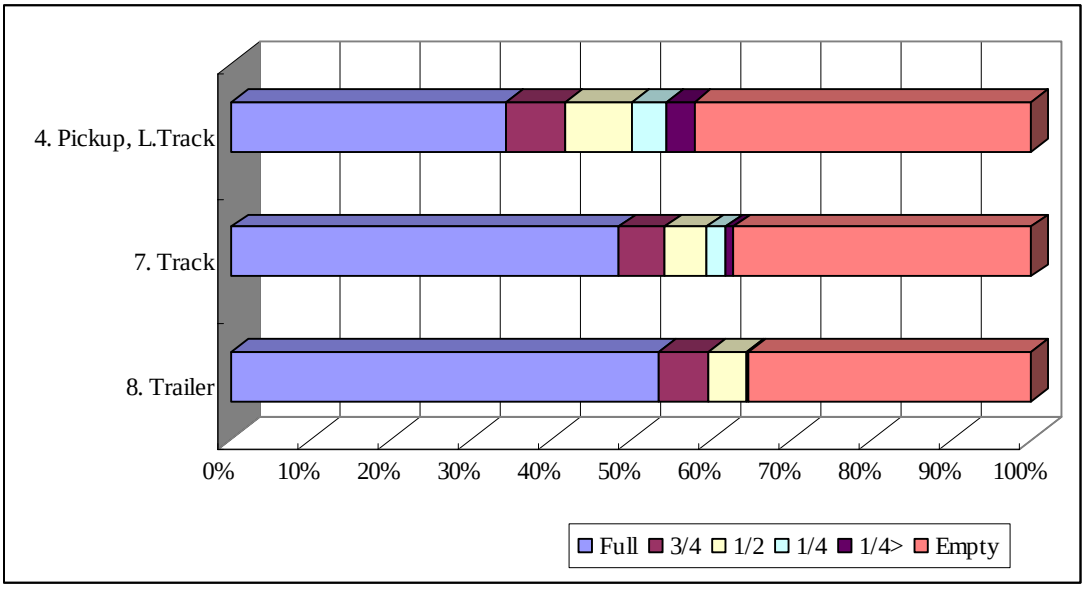
Table 6.2.6 Commodity Type

Major Commodity	%
Construction (Sand, Gravel, Asphalt, Concrete, Re-Bar, Beam, etc)	22.0%
Agriculture (Rice, Vegetable, Fruit, etc)	21.5%
Chemical (Petroleum, Cement, Alcohol, Acid, etc)	7.8%
Forest (Log, Timber, Plywood, etc.)	6.2%
Marine (Fish, Shell, Seaweed, etc.)	3.4%
Miscellaneous Industry (Garment, Shoes, etc)	3.3%
Metal & Machine (Steel, Generator, Car & Bike, etc)	3.0%
Light Industry / Electronics (Machine Parts, IC, Electronic Appliances, etc)	2.9%
Mineral (Coal, Copper, Iron, Salt, etc)	2.6%
Others	27.3%
Total	100.0%

Source: JICA Study Team

5) Loading Condition of Freight Transport

Figure 6.2.5 shows the loading conditions by vehicle type. As the vehicle size increases, the loading capacity tends to increase. The loading condition of "Full" was observed for 34.5%, 48.4% and 53.5% of Pickups and Light Trucks, Heavy Trucks, and Trailers, respectively.



Source: JICA Study Team

Figure 6.2.5 Loading Factor by Vehicle Type

6) Travel Time

Table 6.2.7 and **Figure 6.2.6** show the average estimated travel time and distribution of estimated travel time by vehicle type, respectively. For buses and trucks, as the vehicle size increases the average estimated travel time increases.

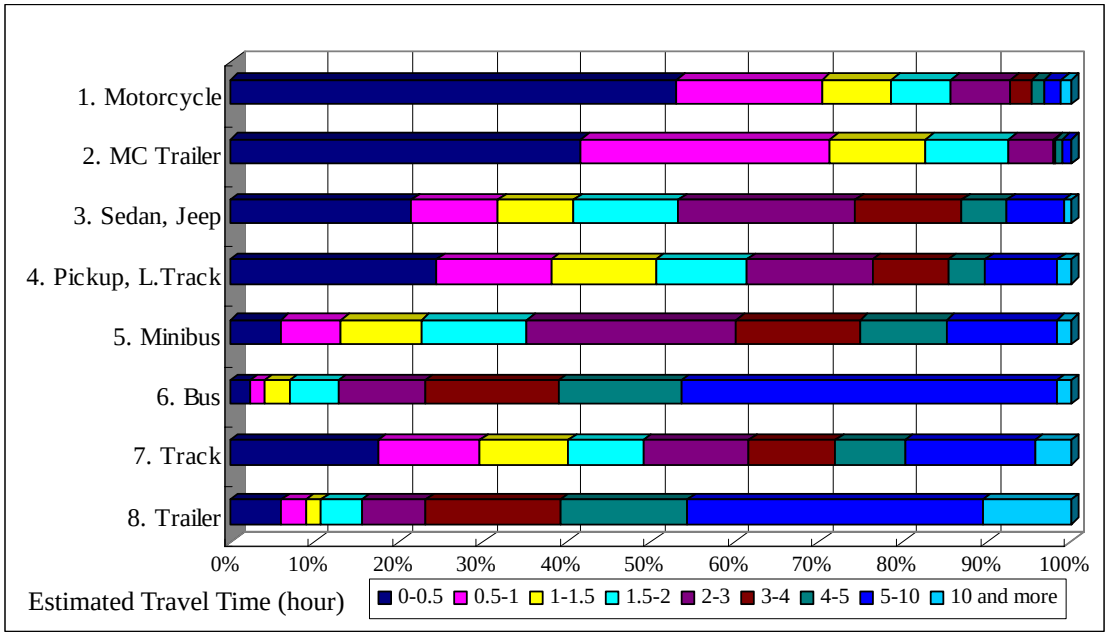
For motorcycles, more than half of the respondents said that their travel time was less than half an hour. For cars (Vehicle type 3), only 20% of respondents said that their travel time was less than 30 minutes. This indicates that people mainly use motorcycles for small trips, and cars are used for relatively longer trips.

Table 6.2.7 Average Estimated Travel Time by Vehicle Type

(hour)

	1 Motor-cycle	2 MC Trailer	3 Sedan, Jeep	4 Pickup, L. Track	5 Minibus	6 Bus	7 Track	8 Trailer
Average Travel Time	1.26	1.06	2.45	2.40	3.35	5.05	3.39	5.89

Source: JICA Study Team



Source: JICA Study Team

Figure 6.2.6 Estimated Travel Time

6.2.3 Results of Travel Speed Survey

The results of the average travel speed by route and the road surface description of the route are summarized in **Table 6.2.8**. In Cambodia, road surface conditions are the dominant factor affecting travel speeds except for in the Phnom Penh area and the center of some of the large cities.

With regard to the 1-Digit national roads, the average travel speed on NR.1 (except for the Phnom Penh to Loueng section), NR.4, NR.5 and NR.6 exceeds 60 km/h. Despite having the highest proportion of trucks, NR.4 showed the fastest average speed of the 1-Digit national roads at 63.0 km/h because of the well maintained road surface conditions. NR.2 showed the lowest average travel speed at 44.8 km/h as it has the highest proportion of non-rehabilitated road sections of the 1-Digit national roads.

In terms of the 2-Digit national roads, the average travel speed varied by road from 29.7 km/h to 80.0 km/h due to the road surface conditions. The maximum average travel speed of 80.0 km/h was observed on NR.51. The rehabilitation of NR.51 has just been finished by the DBST and the volume of traffic on this road is small in comparison to the design specifications for the road (1,862 vehicles/day). Therefore, the test vehicles were able to run at a free speed along the entire length of the road. The minimum average speed of 29.7 km/h was observed on NR.78. There is a low volume of traffic on NR.78 (426 vehicles/day) and the road surface conditions are poor, consisting of laterite.

Table 6.2.8 Average Travel Speed by Route

Road No.	Surveyed Total Distance (km)	AverageSpeed (km/h)	Section Distance (surveyed) (km)			Section Speed (km/h)	Road Surface Condition
NR1	167.97	60.2	Phnom Penh	- Phum Thom	18.63	27.5	DBST
			Phum Thom	- Kampong Phnom	40.61	54.1	DBST
			Kampong Phnom	- Preaek Khsay Kha	3.54	21.4	DBST
			Preaek Khsay Kha	- Border	105.18	69.4	DBST
NR2	125.74	44.8	Phnom Penh	- Takhmau	11.00	21.0	Asphalt,DBST
			Takhmau	- Siem Reap	14.25	42.7	DBST
			Siem Reap	- Bati	31.26	80.1	DBST
			Bati	- Border	69.23	32.7	DBST,Laterite
NR3	201.90	52.1	Phnom Penh	- Kampong Toul	24.10	35.7	Asphalt,DBST
			Kampong Toul	- NR22	50.78	55.7	DBST
			NR22	- NR31	7.23	58.1	DBST
			NR31	- NR32	73.94	49.9	DBST,Laterite
			NR32	- Preaek Tnaot	20.66	36.5	DBST
			Preaek Tnaot	- Veal Renh	25.18	72.1	DBST
NR4	220.50	63.0	Phnom Penh	- NR42	21.46	41.8	Asphalt
			NR42	- NR51	9.68	65.3	Asphalt
			NR51	- NR46	50.02	55.8	Asphalt
			NR46	- NR48	48.59	70.8	Asphalt
			NR48	- NR41	67.50	66.1	Asphalt
			NR41	- Sihanoukville	18.26	58.8	Asphalt
NR5	406.84	62.2	Phnom Penh	- NR51	38.00	50.1	DBST
			NR51	- NR52	86.41	67.4	DBST,Laterite
			NR52	- NR54	30.00	72.1	DBST,Laterite
			NR54	- NR59	176.74	65.8	DBST,Laterite
			NR59	- Sisophon	28.75	69.1	DBST
			Sisophon	- Poipet	46.94	34.8	DBST
NR6	418.38	59.9	Phnom Penh	- NR61	46.30	55.6	Asphalt
			NR61	- NR62	45.35	59.2	Asphalt,DBST
			NR62	- NR71	37.65	71.9	DBST
			NR71	- NR64	42.32	60.0	DBST,Laterite
			NR64	- Siem Reap	141.69	74.8	Asphalt,DBST,Laterite
			Siem Reap	- NR68	54.31	36.2	DBST
			NR68	- Sisophon	50.76	37.0	DBST,Laterite
NR7	497.85	61.6	Skun	- NR62	20.53	60.9	Asphalt
			NR62	- NR71	10.84	63.2	Asphalt
			NR71	- NR11	36.43	74.9	Asphalt,DBST
			NR11	- NR73	35.19	67.8	DBST
			NR73	- NR72	20.80	68.7	DBST
			NR72	- NR74	67.36	60.3	DBST,Laterite
			NR74	- NR76	7.70	46.7	DBST
			NR76	- Krachesh	100.88	87.6	DBST,Laterite
			Krachesh	- NR78	122.26	43.7	DBST,Laterite
			NR78	- Stoeng Treng	18.36	59.9	Laterite
			Stoeng Treng	- Border	57.30	37.2	Laterite
NR11	104.26	41.8					DBST
NR31	64.65	63.6					Laterite
NR33	55.51	48.9					DBST,Laterite
NR48	162.62	50.6					DBST,Laterite
NR51	38.00	80.0					DBST
NR56	112.45	35.0					Laterite
NR57	124.52	49.9					DBST
NR64	247.49	44.0					Earth
NR67	133.12	35.1					DBST,Earth
NR68	116.69	35.4					Laterite
NR71	57.98	35.2					DBST,Laterite,Earth
NR73-PR308	90.56	44.6					Laterite,Earth
NR76	126.10	42.5					Laterite,Earth
NR78	189.64	29.7					Laterite

Source: JICA Study Team

6.3 Recommendations for Future Traffic Surveys

6.3.1 General

Traffic data is important for transportation planning. In the master plan phase, the future transportation network should be formulated based on the future development scenario and future traffic demand forecast. In the project implementation phase, road traffic data and demand forecasts are the most fundamental factors in deciding the specifications for roads and bridge structures. Furthermore, periodic road maintenance should be based on traffic data.

In Cambodia, traffic surveys and traffic demand forecasts have been conducted on a road project basis only. Therefore, there is no periodic fixed point traffic data except for at the toll gates on the NR.4, international borders and some ferries. Periodic fixed point traffic data is valuable in improving precision of and updating the traffic demand forecasts, and for periodic maintenance planning. The traffic data and traffic demand forecasts prepared in this study should be updated by the MPWT after an appropriate period.

6.3.2 Organization of Future Traffic Surveys

At present, responsibility for the implementation of traffic surveys and data management has not been assigned to a specific department. It is recommended that the Public Works Research Center (PWRC) of the MPWT should be made responsible for all of the traffic surveys and data management. The PWRC should plan the traffic surveys, including the arrangement of police assistance and announcements to the public, and instruct the DPWT in each province to implement the survey. The DPWT of each province should be responsible for the implementation of the survey, and the checking and processing of data collected. The electronic data processed by the DPWT should be sent to the PWRC. The PWRC should manage the data and ensure easy access to the data from any other department of the MPWT/DPWT or any other ministries.

The recommended organization chart is shown in **Figure 6.3.1**.

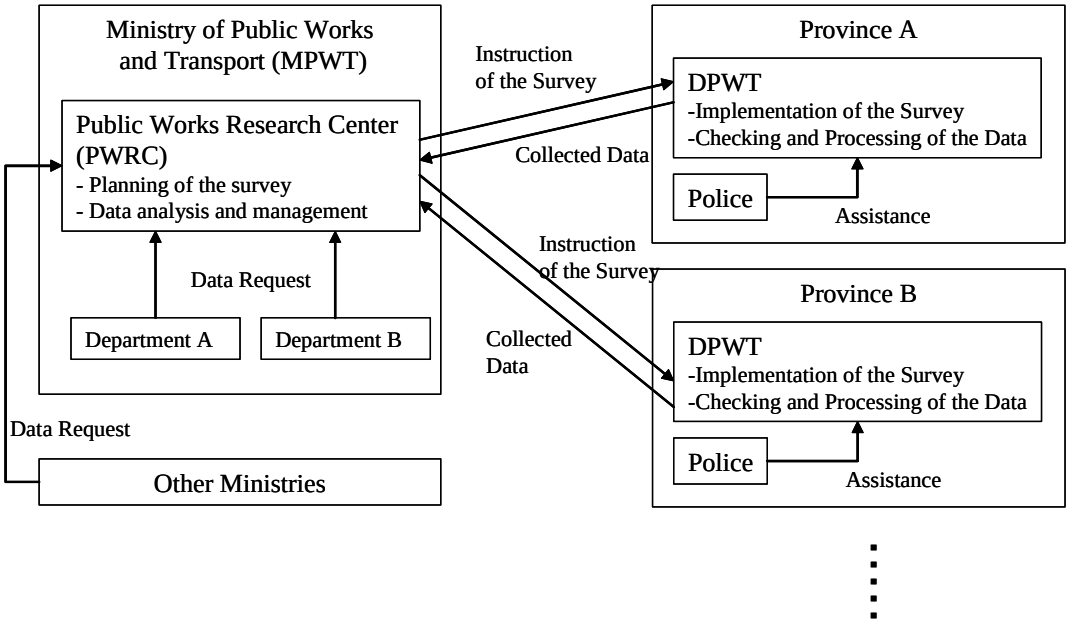


Figure 6.3.1 Recommended Organization Chart for Traffic Surveys and Data Management

6.3.3 Issues Relating to the Traffic Survey

In this traffic survey, issues were encountered that should be improved in future traffic surveys conducted by the MPWT. **Table 6.3.1** shows the issues identified in this traffic survey.

Table 6.3.1 Issues to be Considered in the Future Traffic Surveys

Survey Title	Issues	Description	Recommendation
General	Lack of notification of the survey to the public	The notification of the survey through mass communication was proposed to the MPWT by the JICA Study Team but unfortunately was refused. As a result, it was difficult to catch the interviewee vehicles during the OD interview survey, especially passenger cars.	The survey should be notified through mass communication in advance of the implementation in order to achieve the understanding and cooperation of the people to be surveyed.
OD Interview Survey	Lack of field training for the OD Survey	Field training for the OD survey was not implemented in advance of the actual survey as police permission and assistance had not been granted. Therefore, it took one or two days before the surveyors were able to effectively pick up the interviewee vehicles.	Field training for all survey items should be included in the survey schedule. In addition, the recruitment of qualified surveyors must be considered, especially for the interview survey. Police permission and assistance, and the permission and/or assistance of other related organizations should be prepared in advance of the field training.
Traffic Count Survey OD Interview Survey	Difficulty in identifying the survey sites	Survey sites were mainly set at the border between provinces. However, there are no sign boards on the road side to signify the location of the border. GPS data showing the survey sites was given to the local consultants, but was not used efficiently.	GPS is the most appropriate method of accurately identifying the survey sites. Therefore, it is recommended that enough GPS devices are prepared for all of the survey teams. For the supplemental information on the survey sites, photos and landmark information should be given to the survey team.
Traffic Count Survey OD Interview Survey	Starting time of the survey	The surveys commenced at 06:00 hours, however it was observed that people start their activities prior to 06:00 hours in Cambodia.	Surveys should commence at 05:00 hours. 12-hour surveys commencing at 05:00 hours will end at 17:00 hours. This period is too short to grasp the traffic characteristics. Therefore, it is recommended that the survey period is extended to 16 hours (to end at 21:00 hours).
Travel Speed Survey	Lack of distance data	Odometer records at checkpoints were not collected during the implementation of the survey. Therefore, the distance between checkpoints was measured from GIS maps in the data processing period. As a result, there are some errors in the calculation of travel speeds.	Odometer records at checkpoints must be collected in order to attain accurate travel speed data.
Travel Speed Survey	Insufficient number of samples	The travel speed survey was conducted for one round trip only for each survey route (two samples).	Multiple survey vehicles should be prepared for each survey route in order to improve the accuracy of the data. The following number of samples should be collected for each route: Urban Area: three round trips during peak hours and off-peak hours Suburban Area: three round trips

6.4 Present OD table

6.4.1 Preparation of the OD table

As a route has the characteristics of time and location, traffic volumes can vary from time to time throughout a year. In this Study, the traffic volume, as an Annual Average Daily Traffic (AADT) volume, has been calculated as the average of the nationwide traffic using the traffic data obtained through the traffic survey. The method of calculating the volume was as follows: AADT was computed from i) the weekly variation, which was calculated from the data obtained during the continuous traffic survey for a week at traffic count survey point No.23 on the National Road No.6A and ii) the monthly variation based on the number of vehicles that board the ferry that crosses the Mekong River at Neak Loueng. The figures, converted into AADT at each point, are shown in **Table 6.4.1**.

Based on the results of the traffic survey, the AADT was calculated using the following formula:

AADT = Av x Af x Mf

Where: AADT : Annual Average Daily Traffic

AV : Actual Traffic volume

Af : Average Daily Traffic factor

Mf : Average monthly Traffic factor

6.4.2 Zoning system

The provincial zoning in the study area is divided into 185 zones in Cambodia and outside the country the study area is divided into 12 zones linked by road with Laos, Thailand and Vietnam. The total number of zones is 197. In order to ensure accurate modeling and forecasting, this zoning system was adopted.

6.4.3 Summary of OD table

The summarized OD trips are presented in tables in the form of matrices. The OD tables were first based on the district zoning, and were then aggregated on a provincial zoning basis. OD trips were prepared for all vehicles, motorcycles, light vehicles and heavy vehicles.

According to the total number of OD trips by mode of transport, the results showed that the number of motorcycle OD trips is approximately 176,000 vehicles/day, 53,000 vehicles/day for light vehicles and 11,000 vehicles/day for heavy vehicles, with the total being 240,000 vehicles/day.

Table 6.4.1 Average Annual Daily Traffic

Station No.	Route No.	Annual Average Daily Traffic (AADT)				Passenger Car Unit
		MC	LV	HV	Total	(PCU)
1	1	33,104	12,275	1,742	47,121	28,846
2	1	7,435	1,452	660	9,547	5,654
3	1	2,588	1,280	378	4,246	3,381
4	1	8,970	1,015	95	10,080	3,796
5	2	10,151	3,279	954	14,384	9,499
6	2	2,773	1,271	403	4,447	3,491
7	2	3,910	243	163	4,316	1,770
8	3	7,487	3,112	1,283	11,882	9,611
9	3	3,833	960	259	5,052	2,935
10	3	5,261	966	332	6,559	3,519
11	3	1,661	578	41	2,280	1,261
12	4	743	1,707	823	3,273	4,789
13	4	542	1,308	661	2,511	3,754
14	4	3,380	2,002	614	5,996	5,190
15	5	10,066	5,619	859	16,544	12,117
16	5	1,747	1,410	775	3,932	4,524
17	5	1,864	1,778	378	4,020	3,823
18	5	3,369	1,622	397	5,388	4,061
19	5	13,717	3,166	455	17,338	8,752
20	5	2,613	1,161	301	4,075	3,008
21	5	4,745	2,222	522	7,489	5,530
22	6A	18,229	10,863	1,994	31,086	24,118
23	6A	3,120	4,093	1,208	8,421	9,520
24	6	1,454	1,511	520	3,485	3,812
25	6	4,823	1,482	340	6,645	4,078
26	6	425	675	296	1,396	1,838
27	6	4,116	1,274	383	5,773	3,771
28	6	6,523	1,267	266	8,056	4,013
29	6	2,324	832	201	3,357	2,224
30	7	4,768	2,508	915	8,191	7,072
31	7	1,036	430	181	1,647	1,340
32	7	4,058	622	111	4,791	2,125
33	7	227	204	51	482	465
34	7	44	26	10	80	74
35	11	1,888	329	230	2,447	1,573
36	31	721	649	62	1,432	1,178
37	33	2,099	124	15	2,238	725
38	48	1,605	645	189	2,439	1,775
39	48	1,853	415	31	2,299	1,075
40	51	1,681	312	216	2,209	1,458
41	56	355	69	50	474	325
42	57	2,386	635	116	3,137	1,738
43	57	425	237	26	688	481
44	57	1,007	231	10	1,248	571
45	61	1,077	315	15	1,407	708
46	62	177	99	22	298	234
47	66	816	183	26	1,025	511
48	64	1,415	698	158	2,271	1,700
49	64	91	111	10	212	192
50	64	180	166	6	352	271
51	68	1,243	196	13	1,452	595
52	68	778	194	22	994	503
53	71	428	112	229	769	934
54	72	941	180	268	1,389	1,264
55	73	1,107	359	34	1,500	828
56	74	353	72	5	430	193
57	76	931	156	43	1,130	557
58	78	405	97	22	524	289
59	78	725	37	5	767	243
60	212	347	39	7	393	157

Source: JICA Study Team

6.4.4 Desire Line

The results of the OD survey indicated that the number of trips to and from Phnom Penh (zone 12) and surrounding areas is overwhelming. In particular, the volume of trips between Phnom Penh and Kandal Province (zone 8) is several times larger than anywhere else in Cambodia, as shown in **Figure 6.4.1**.

Motorcycle transport is overwhelmingly abundant in and around Phnom Penh, when compared to other modes of transport. The main cities in each province, such as Battambang Province（zone 2）, Siemreap Province (zone 17） Kampong Cham Province（zone 3）and Kampot Province（zone 7）, have the same characteristics in that the zones adjacent to the provincial centers have the majority of the share. Moreover, there are more than 8,000 vehicles/day traveling between Svay Rieng Province（zone 20）and Vietnam (Zone 31), indicating that NR.1 is the major route for people and goods to be transported across the border.

Light vehicles, as well as motorcycles, have more trips between Phnom Penh and adjacent zones. However, there are also medium distance trips, such as between Phnom Penh and Sihanoukville (zone 18) or Battambang（zone 2）, which have a direct relationship with Phnom Penh in terms of the distribution of industry.

The volume of heavy vehicle trips is highest between Phnom Penh and Kandal Province, followed by Takeo (zone 21), and Sihanoukville provinces. Long distance trips linking Phnom Penh with other provinces are striking, but not in between provinces not passing through Phnom Penh. This indicates that agricultural products are still concentrated in Phnom Penh.

6.4.5 Present Traffic Volumes

(1) General Condition

The all-or-nothing assignment method, without capacity constraints, was adopted for traffic assignment. An incremental assignment, successive proportions of OD tables are assigned on the minimum route search and travel time recalculated based on the assigned traffic volume.

(2) Passenger car unit

Following modified passenger car unit(pcu) equivalent shall be applied for traffic assignment. The PCU Equivalents used in this study are shown below.

Categories	MC	LV	HV
PCU Equivalents	0.25	1.25	3.00

(3) Results of Traffic Assignment

The current (2005) traffic volumes are illustrated in **Figure 6.4.2(1)** and **Figure 6.4.2(2)**.

As was apparent in the traffic distribution mentioned above, the volume of traffic flowing into Phnom Penh is extreme. As for the volume of traffic on each link, the NR.1 carries 29,000 pcu per day, the NR.2 carries 9,200 pcu per day, the NR.3 carries 9,800 pcu per day, the NR.4 carries 5,300 pcu per day, the NR.5 carries 17,000 pcu per day and the Route No.6 carries 20,000 pcu per day.

The rural cities with a higher volume of traffic include; Kampong Chhnang and Battambang with around 9,000 pcu per day each, and Banteay Meanchey and Shianoukville with around 5,200 pcu per day each.

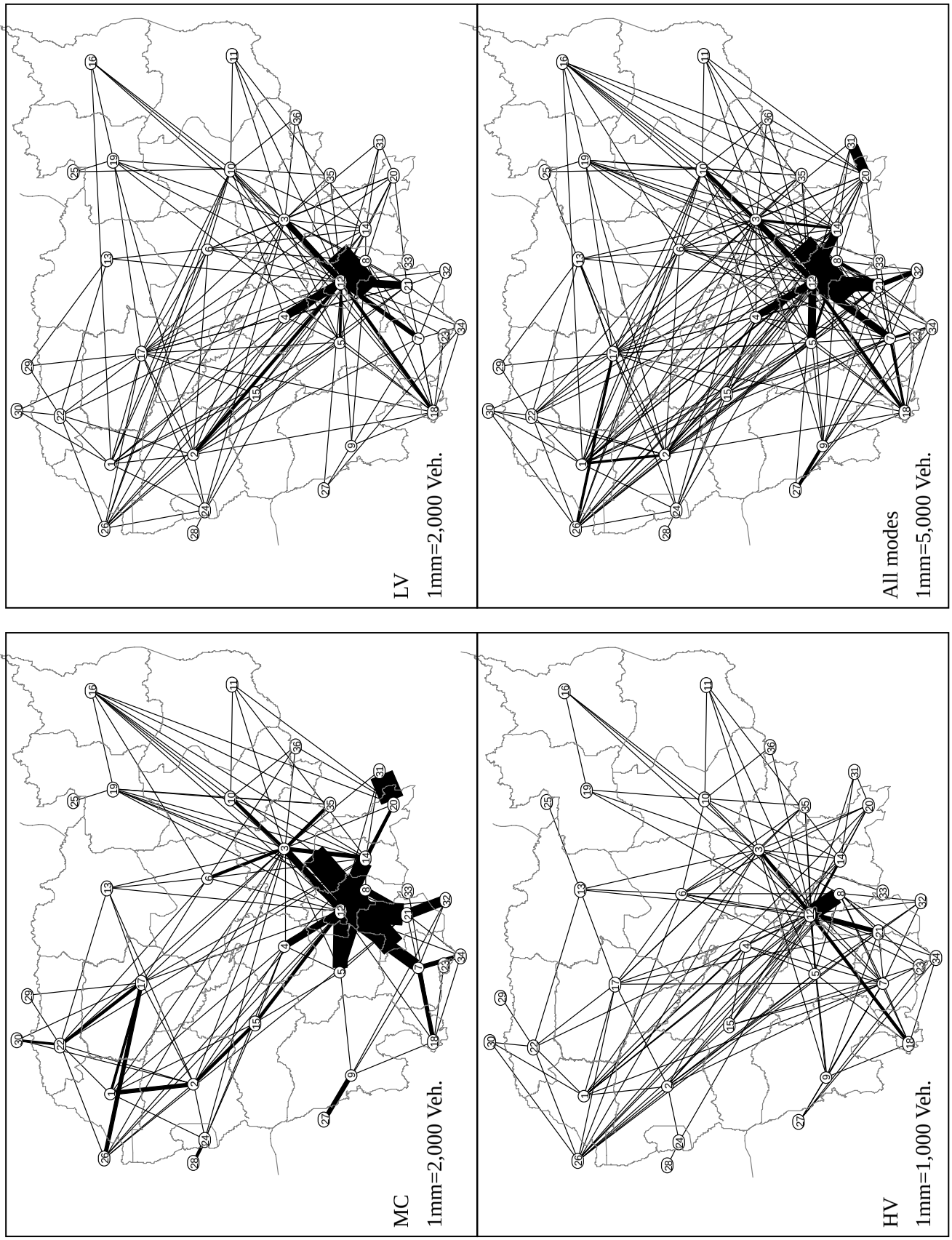


Figure 6.4.1 Desire Line in 2005

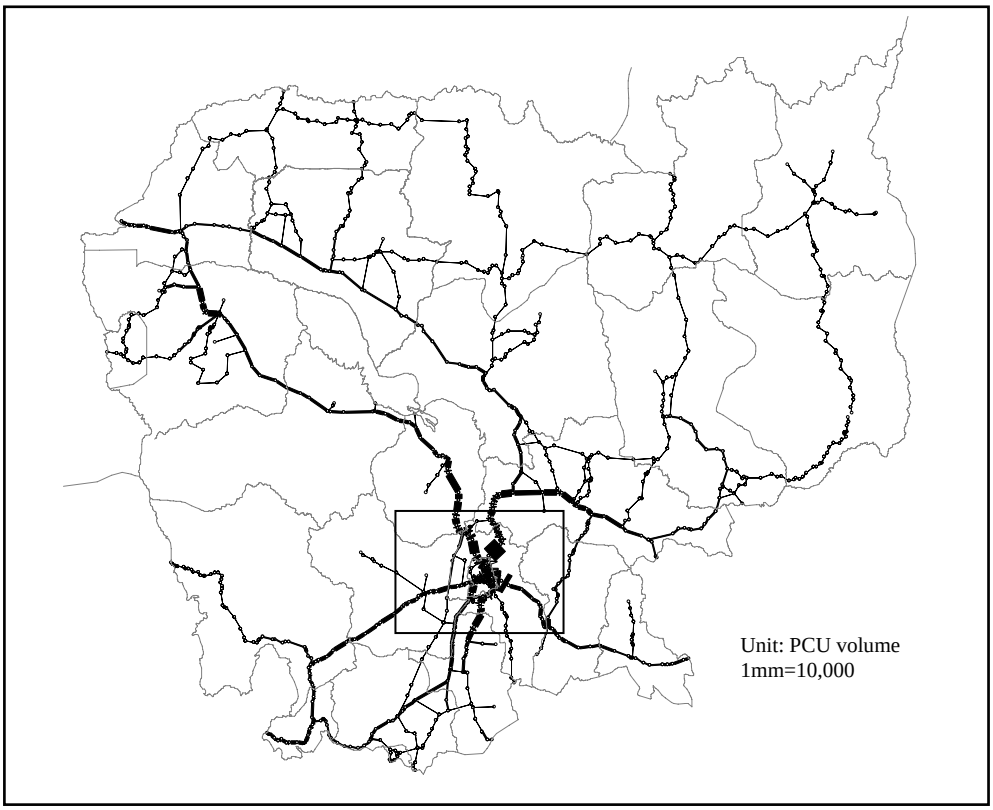


Figure 6.4.2 (1) Traffic assignment volumes in 2005

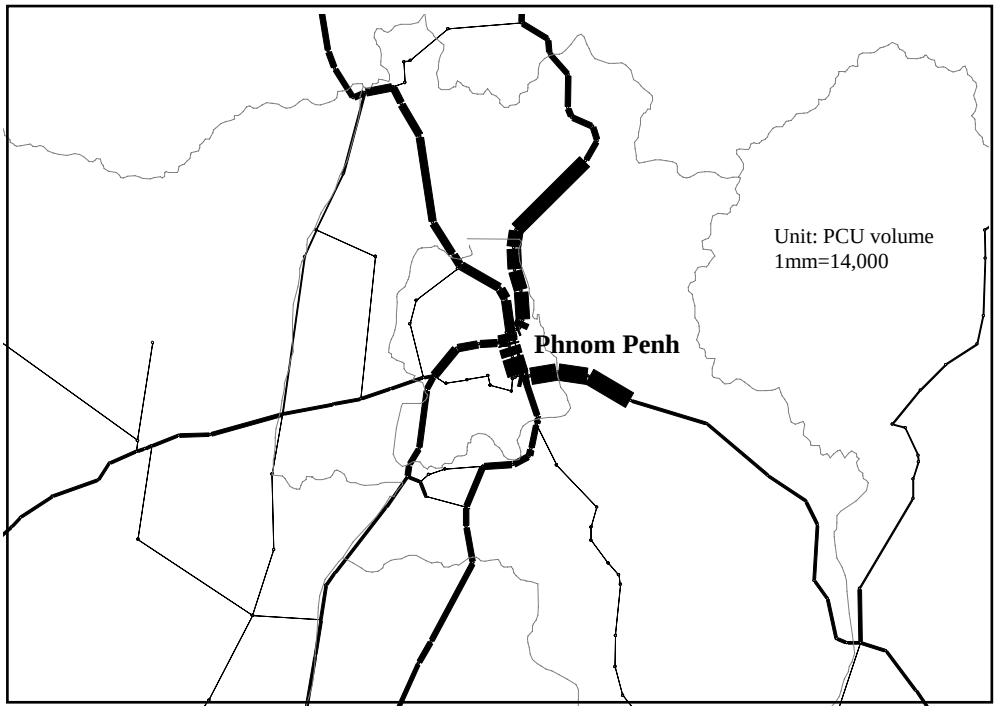


Figure 6.4.2 (2) Traffic assignment volumes in 2005

6.5 Present Traffic Bottlenecks and Issues

(1) Traffic Composition

It was observed that the vehicle composition in Cambodia is a mixture of motorcycles (including motor tricycles and motorcycle trailers), light vehicles and heavy vehicles (with semi and full trailer trucks). This combination of slow and fast-moving vehicles contributes to the traffic congestion in urban centers and areas where there is a high proportion of motorcycles.

(2) Markets Along Roads

In most of the urban areas, markets are located along the roads with vendors and parked vehicles (including motorcycles) occupying most of the shoulders. This narrows down the effective lane width causing through traffic to slow down and build up along these areas.

(3) Traffic Control and Safety Facilities

Although some major cities, such as Phnom Penh, are equipped with traffic signal lights, warning signs and lane markings, it is still necessary to improve these traffic safety facilities, especially in other urban centers and along national roads. Moreover, the many intersections that are not equipped with traffic signal lights have been observed to be a cause of traffic bottlenecks.

(4) Capacity Overflow

National roads between Phnom Penh and the Kandal Province and other city centers, including Siem Reap and Battambang, appear to have reached or are approaching their traffic capacity. This has caused congestion in these areas during peak hour periods.

(5) Road User Behavior

A major cause of traffic accidents in Cambodia is road user behavior, including:

- Misuse of lanes;
- Traffic violations;
- Over-speeding;
- Disregard of traffic rules and regulations;
- Use of shoulders for parking;
- Over-loading.

The above road user behaviors also cause traffic congestion on the national roads.

CHAPTER A-7 FUTURE SOCIO-ECONOMIC FRAMEWORK

7.1 Present Socio-Economic Conditions in Cambodia

In this sub-chapter, the present socio-economic conditions in Cambodia will be studied in order to understand the real lives of the people living in both the rural and urban areas.

7.1.1 Purpose and Methodology of the Socio-Economic Analysis

(1) Purpose of the Socio-Economic Analysis

The road network plans should be prioritized based on the criteria of the development policies of the "Socio Economic Development Plan (SEDP)", the "National Poverty Reduction Strategy (NPRS)" and Cambodia Millennium Development, including both social and economic factors as well as technical and cost-effective factors for the road network itself. The goal of the road network project is to boost the living standards of Cambodian citizens through the construction of a convenient road network. Improved access to social facilities will provide equal opportunities and fair conditions to all Cambodians. The Study Team has determined five factors that should be taken into consideration for the Master Study, as summarized below. Items (b) Social factor and (c) Economic factor will be focused on in this chapter.

(a) Policy factor
Based on the infrastructure development policy written in the SEDP, NPRS and the Cambodia Millennium Development,

(b) Social factor
Includes; welfare, poverty reduction, equal opportunity to road access, access to social facilities and centers and, environment.,

(c) Economic factor
Includes; support for development, contribution to the macro economy, access to industrial and commercial areas and, return on investment.,

(d) Technical factor
Includes; completeness of road network, current road conditions (road inventory), sufficient road structure, proper design, security (accidents) and, urgency of projects.,

(e) Cost-effectiveness factor (construction)
Includes; number of beneficiaries (traffic survey), cost of construction, cost-benefit ratio, maintenance cost, and population density.

In other words, the overall goal is to improve the socio-economic conditions for the people of Cambodia. However, as far as public investment plans are concerned, the impact and synergy of the planed projects should be considered in the selection of the priority projects. The socio-economic indicators are regarded more as indirect information and the technical and

cost-effective factors are considered when carrying out the road construction plans.

Although the socio-economic information is supplementary data, there are important points to be considered in particular i) the benchmark of the present conditions, ii) the traffic demand projection and iii) the prioritization of the potential projects in the first stage. **Figure 7.1.1** illustrates the steps to utilize the socio-economic indicators for the Road Network Master Plan.

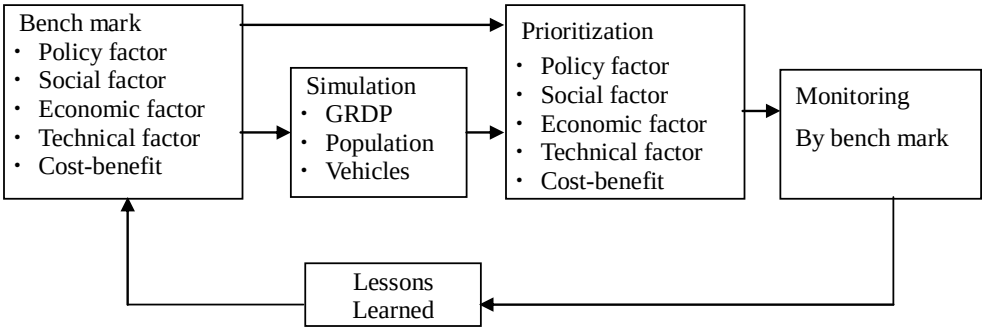


Figure 7.1.1 Reasons for including the socio-economic indicators

(2) Methodology for Socio-Economic Analysis

In order to understand the socio-economic conditions in Cambodia, two analysis of methodologies should be considered: qualitative analysis and quantitative analysis.

Qualitative Analysis:

Site observation, interviews, and discussions with related agencies and inhabitants are important activities for determining essential points relating to site potential and constraints. Through discussions with related agencies, including the Ministry of Commerce and the Ministry of Agriculture, Fishery and Forestry, the synergy effects will be considered in the road network construction and rehabilitation projects. Group discussions with counterparts are good opportunities for brainstorming and considering a prioritization strategy. The voices of communities who will directly benefit are also important in the establishment of a user-friendly network plan. The Study Team also refers to their comments to determine appropriate criteria and indicators.

Quantitative Analysis:

While carrying out the qualitative interview and discussion, the Study Team also collected socio-economic statistical data. Unlike the traffic survey, in which traffic was counted during a field survey conducted by the Study Team, in this case the existing public socio-economic data was utilized as the source of analysis even though it is secondary data. Reliable statistical data was validated using a multivariable analysis and through understanding the current socio-economic conditions from the statistical indicators. The Study Team tried to identify the characteristics of 185 districts over the entire country according to category.

7.1.2 PRESENT LIVING CONDITIONS

(1) Social Conditions in the Districts

The social condition indicators are population, education and public health. Based on the data collected under the supervised Seila Program, the Study Team plotted the population density and the degree of education indicated by the illiteracy ratio by district as shown in **Figure 7.1.2** and **Figure 7.1.3** respectively[1]. The illiteracy ratio is the number of illiterate people over the age of 15 years divided by the population over the age of 15 years.

1) Population and Migration

The population density along Tonle Sap Lake and the Mekong River is very high because most people are engaged in farming and fishing activities. In addition, the security in the forests was uncertain due to the presence of land mines as a result of the civil war, preventing people from moving into the forests and isolated remote areas.

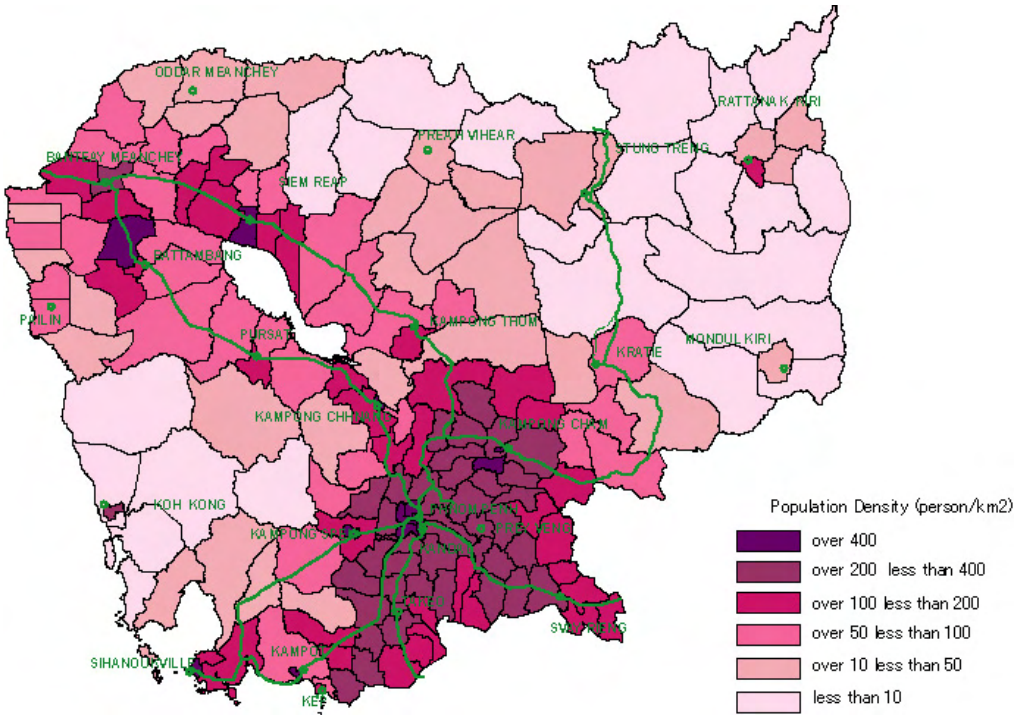


Figure 7.1.2 Population Density by District

As the population has increased and national security has improved, migration has occurred from conjoining areas such as Takeo and Prey Veng to the new frontiers of the northeast area. The forested area in the northeast provinces of Stung Treng, Kratie, Rattana Kiri and Mondul Kiri, have been opened to allow the population acquire farmland for cultivation purpose. Many cases have been observed where a farmer obtains a mortgage to take over the farmland. Population pressures, such as the case of brothers who can not share the inherited land amongst themselves,

[1] Source: Seila Program 2003, and Maps were processed by the Study Team

have caused some of the population to acquire farmland in the frontiers. Refugee resettlement areas should be continuously observed to see if they take root.

People living in farmlands also often move to urban areas in order to earn money, particularly during dry season. The young generation dreams of living in the city as well. The Government has been encouraging ethnic groups living in the forests in the northern areas to move to the land along the roadsides. The population growth rate has not been as rapid as expected but migration between districts continues. The regional development policy, including the road network plan and the investment plan, is a significant policy for the distribution of national property. By establishing the road network and promoting investments, socio-economic activities will be promoted.

2) Education Level

According to the rural development database built through the Seila program, in Cambodia the illiteracy ratio of adults over the age of 15 years was 17.6% in 2003. In terms of gender, the female illiteracy ratio is higher, at 19.5% compared to 15.5% for males.

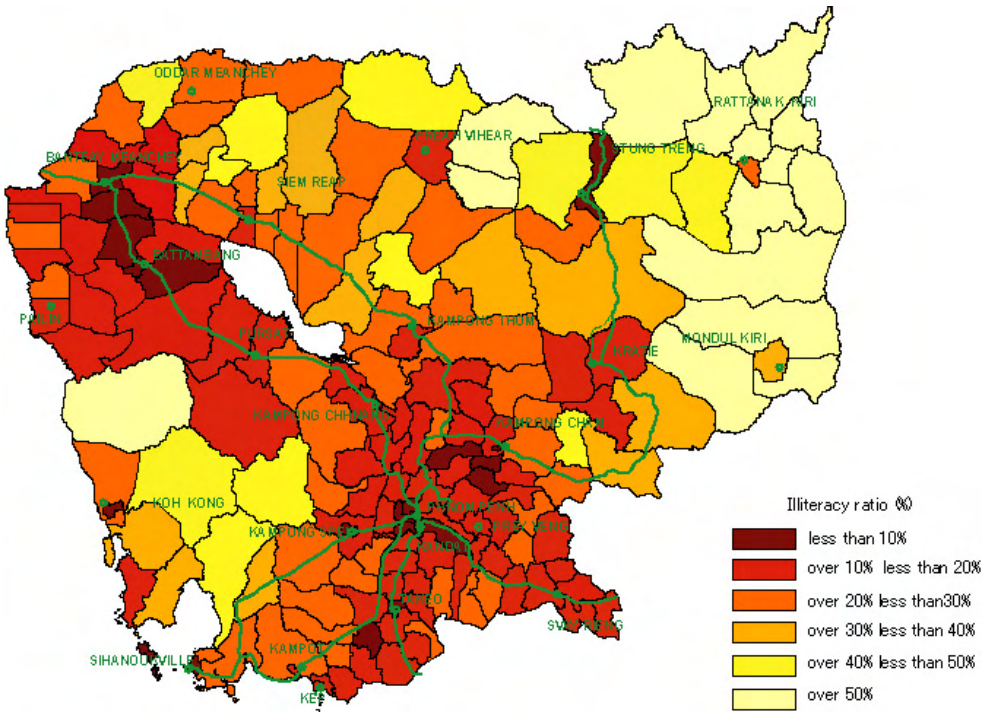


Figure 7.1.3 Illiteracy Ratio by District

As shown in **Figure 7.1.3** above, there is a low level of education in the northern mountainous area. One reason might be that the ethnic groups living there do not speak the Cambodian language.

Koh Kong Province, Kampong Spue Province and a part of Pursat Province, which are isolated areas surrounded by mountains, are also low education areas. Historically, these areas were

territories of the Pol Pot Party supported by the Khmer Rouge, and the people in these areas were engaged in warfare day in and day out. It is remarkable that they were denied even a standard education. This situation has been changing and the education systems in these areas are now improving.

Accessibility to schools in rural areas is not yet ideal. However, since 2000 many rural roads have been rehabilitated at the direction of Ministry of Rural Development with the support of the international fund. However, the issue of maintaining the laterite pavement still needs to be addressed.

3) Access to Public Health Facilities

There are six national hospitals, five military hospitals and six national programs in Cambodia according to the latest information released by the NIS and the Ministry of Health. Referral health facilities are listed in **Table 7.1.1** below.

According to interviews with villagers in the rural areas, access to health care facilities is one of the highest priorities when considering the rural road network, as well as access to schools.

Table 7.1.1 Number of Hospitals and Health Posts in the Provinces

Provinces	Referral Hospital	Operational District	Health Center	Health Post	Provinces	Referral Hospital	Operational District	Health Center	Health Post
Banteay Meanchey	4	4	52	-	Preah Vihear	1	1	12	4
Battambang	4	5	74	1	Prey Veng	7	7	90	1
Kg Cham	10	10	128	1	Pursat	2	2	31	4
Kg Chhnang	2	2	34	1	Ratanak Kiri	1	1	10	9
Kg Speu	3	3	50	2	Siemreap	3	3	53	3
Kg Thom	3	3	50	-	Sihanoukville	1	1	9	-
Kampot	4	4	47	-	Stung Treng	1	1	8	-
Kandal	5	8	88	-	Svay Rieng	3	3	37	-
Koh Kong	2	2	12	3	Takeo	5	5	70	-
Kratie	2	2	22	4	Oddar Meanchey	1	1	11	1
Mondul Kiri	1	1	6	10	Kep	1	1	4	-
Phnom Penh	1	4	21	4	Pailin	1	1	3	1
					Total	**68**	**75**	**922**	**49**

Source: National Institute of Statistics, 2005

(2) Economic Conditions in the Districts

The Study Team selected family assets such as roofing material, TV sets and accessibility to markets as the representative economic indicators for the districts after a basic analysis of the Rural Development Database. As income data could no be found for all of Cambodia, this data was used to evaluate the economic level of each district. The number of households with motorcycles and vehicles was also analyzed.

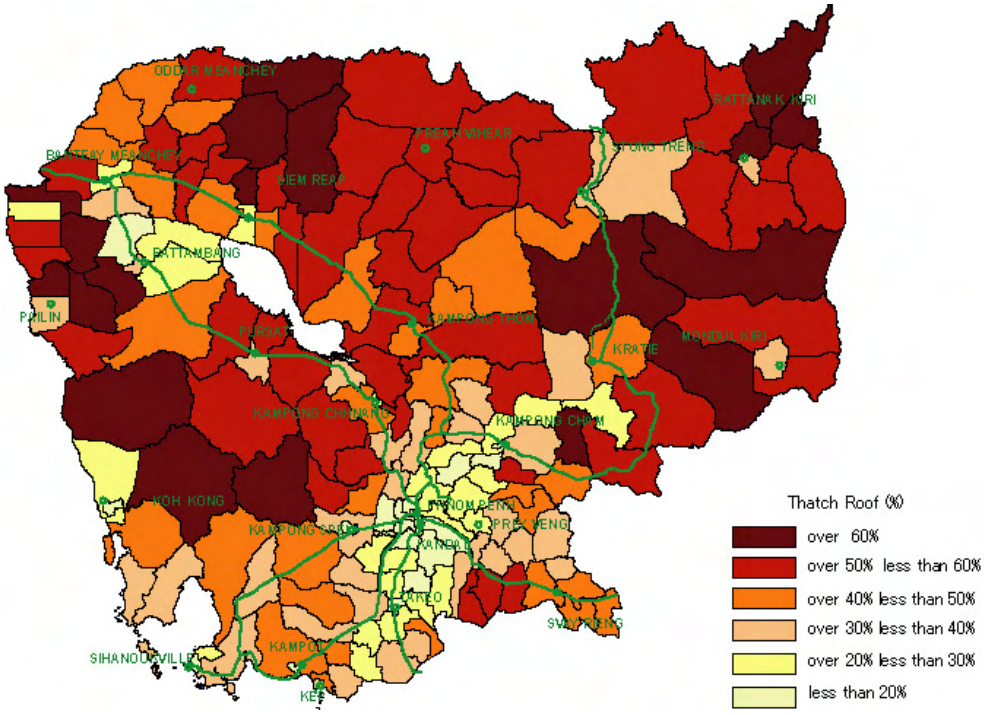


Figure 7.1.4 Proportion of Houses with Thatched Roofs by District

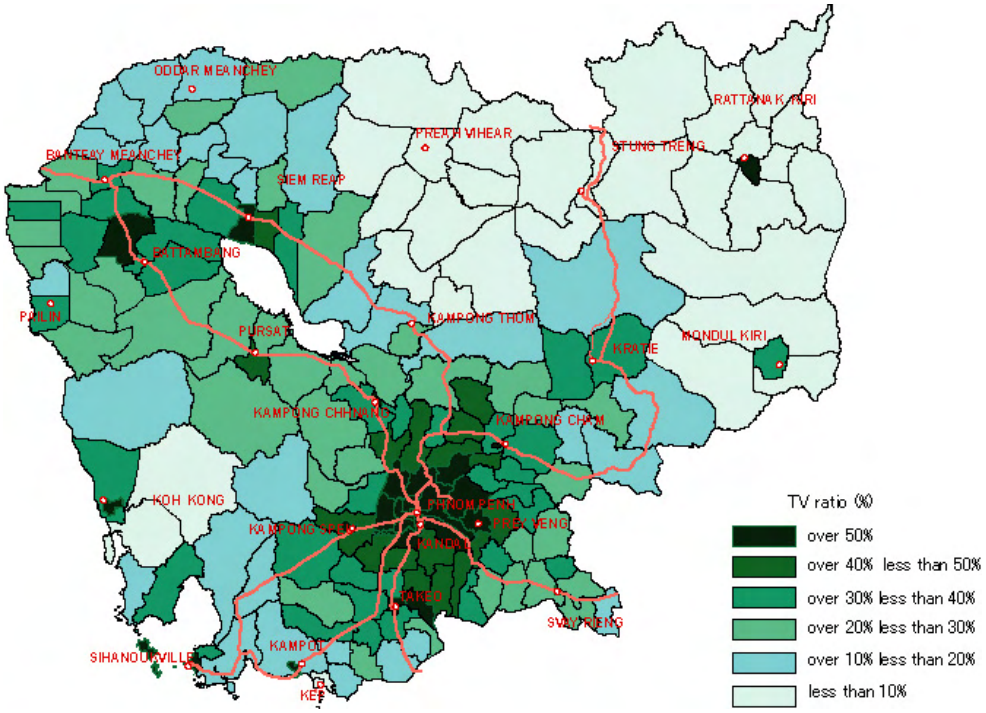


Figure 7.1.5 Proportion of Households Owning TV Sets by District

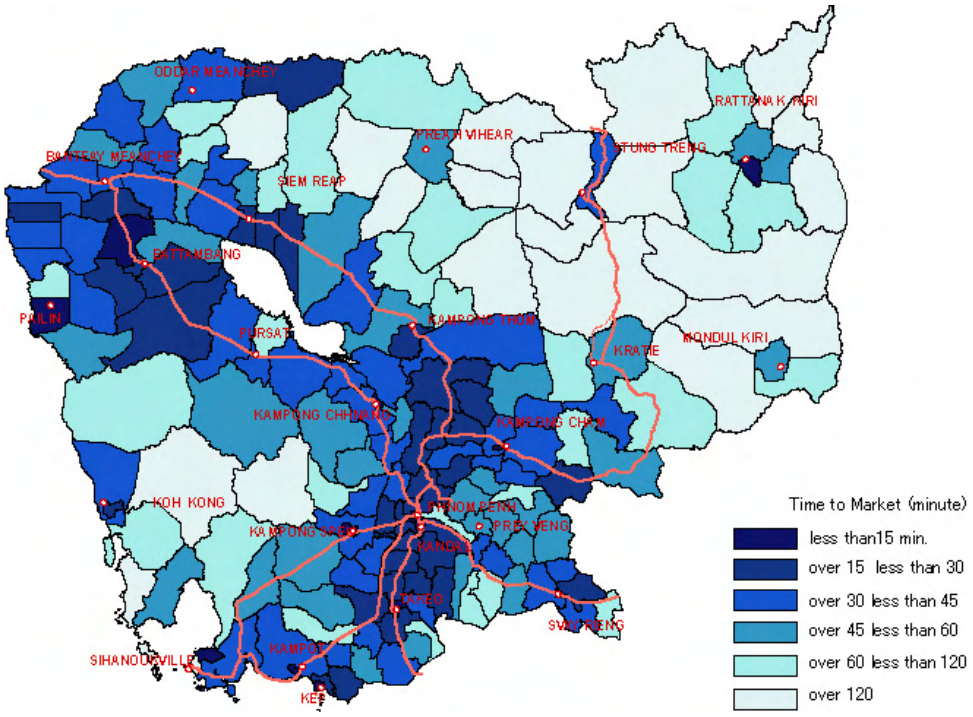


Figure 7.1.6 Accessibility to Markets by District

1) Thatched Roofs

The proportion of houses with thatched roofs was one of the indicators used to assess the degree of improvement in living conditions. The poorest districts can be identified by the darkest color. (See **Figure 7.1.4**)

2) TV sets

According to the Rural Development Database of the Seila Program, TV sets are not only an indicator of wealth but also of electrification, which is regarded as an important public infrastructure.

There are two types of electrification systems; 'On Grid', and 'Off Grid'. On Grid is the electricity facility established mainly by MIME and linked from power plants to the site by power lines and distribution lines to end users. Off Grid consists of private power stations (i.e. using diesel to make electricity and connecting to end users having contracts or charging batteries for consumers).

The electrification projects should be taken into account in the consideration of the synergy effect of economic development. (See **Figure 7.1.5**)

3) Motorcycle/Vehicle Ownership and Accessibility to Markets

Accessibility to markets is one of the indicators of the advantages of living conveniences when

assessing fairness or equal opportunity. (See **Figure 7.1.6**)

The districts surrounding a provincial capital are relatively accessible to markets. However, some provincial capitals have not been well developed as the center of trading activities and the access roads to the markets have not been well maintained, as shown in Preah Vihear Province, Stung Treng Province, Mondul Kiri Province and Rattana Kiri Province.

Anlong Veeng District in the Oddar Meanchey Province is regarded as a less developed district in terms of population density, education and living standards. However, residents in this district may obtain commodities from the border and have an opportunity to trade them. According to the records of foreign visitors through the border in this location, more than 67,843 visitors crossed the Oddar Meanchey border in 2004. This means that a similar number of Cambodian people may also cross this border. There are large markets in the provinces of Surin and Si Sa Ket in Thailand and these provinces have populations of 1,327,901 and 1,405,500 respectively[2]. The volume of trade occurring in Oddar Meanchey Province has been accelerating rapidly. Development strategies should be considered for this province.

In terms of areas functioning as hubs in the region, the Pursat Province should also be considered for development. As Pursat is located in the middle of NR.5, drivers stop to rest in this area. The area has a surplus of agricultural products and there is a high potential for development of the agro-products if the irrigation system is improved. If access to the border with Thailand is developed, access to the Industrial Park along the coast near Bangkok will greatly improve.

In terms of the proportion of households owning motorcycles, there is a close relationship between the number of houses having thatched roofs and TV's (the living standard indicators) and the number of households owing motorcycles. In total 24.4% of the households, or 603,837 households, own motorcycles, and motorcycle ownership is increasing in proportion to the living standards. On the other hand, only 3.4% of households or 83,175 households own a vehicle. The vehicle ownership characteristics by district are shown in **Figure 7.1.7**. There is some relationship with living standards but also with location.

It was predictable that households in Phnom Penh would have a high ratio of car ownership and it was observed that more than 10% own a car. However, it was unexpected based on living standards that more than 5% of households in Banteay Meanchey and Oddar Meanchey provinces would have vehicles. As described in Chapter 5, the ratio of vehicles without registration near Banteay Meanchey is rather high. It is thought that the people in this area may be using the vehicles to engage in trade. In terms of the border with Vietnam, they have the alternative of using a vehicle to carry agricultural products.

[2] Census of Thailand in 2000, http://web.nso.go.th/pop2000/indiregion/netab1.htm

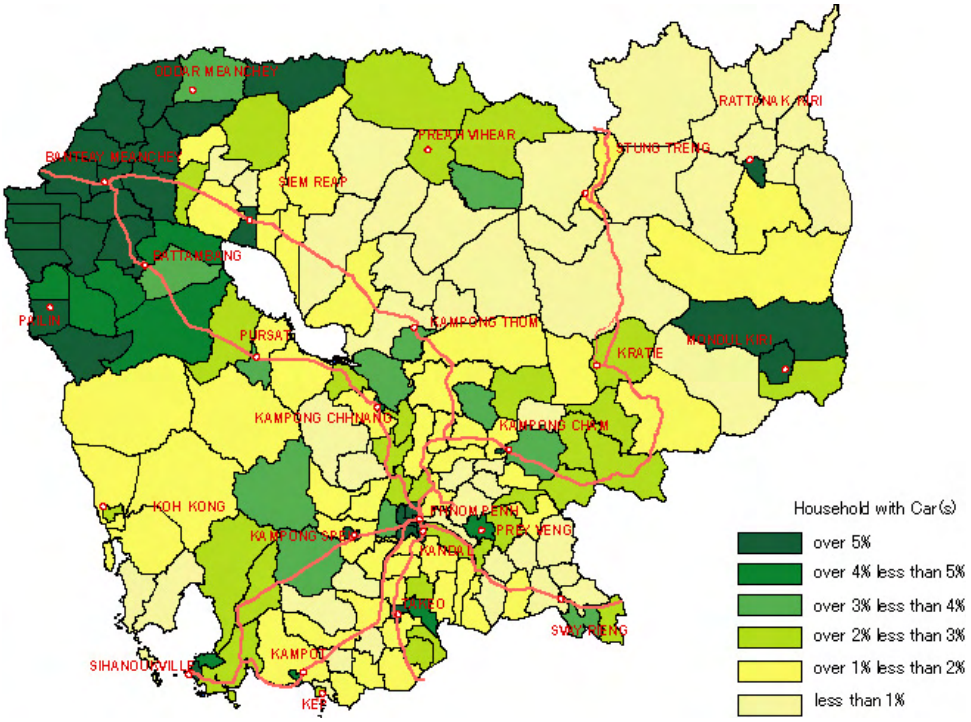


Figure 7.1.7 Households with Car(s) by District

7.2 Socio-Economic Projection

7.2.1 Socio-economic Indicators for the Projection of the Traffic Demand

In order to estimate future traffic demands and an image of what Cambodia will be like in the future, a socio-economic framework was established. After consideration of the various indicators mentioned above, the Study Team settled on the socio-economic framework for the projection.

- Population Projection
- GRDP Projection
- Projected Number of Vehicles

7.2.2 Principals of the Projection Methodology

(1) Population Projection

The time span covered by this Study is until 2020 so that population projections have been taken into consideration for that period. According to the NIS, the population growth rates for 2005, 2010, 2015 and 2020 are as follows.

Table 7.2.1 Projected Annual Growth Rate by Province (%)

Year	1999-2000	2004-2005	2009-2010	2014-2015	2019-2020
Cambodia	**1.79**	**1.93**	**2.06**	**2.07**	**1.93**
Banteay Meanchey	2.84	2.71	2.73	2.65	2.46
Battambang	1.57	1.82	2.07	2.13	2.00
Kampong Cham	1.21	1.45	1.60	1.64	1.54
Kampong Chhnang	2.13	2.31	2.52	2.60	2.50
Kampong Speu	2.05	2.16	2.31	2.32	2.15
Kampong Thom	1.80	1.90	1.97	1.96	1.80
Kampot	0.95	1.27	1.52	1.62	1.53
Kandal	1.28	1.47	1.62	1.67	1.55
Koh Kong	5.61	4.17	3.72	3.40	3.11
Kracheh	2.75	2.63	2.53	2.42	2.27
Mondul Kiri	3.11	2.90	2.84	2.90	2.91
Phnom Penh	3.56	3.21	2.92	2.62	2.34
Preah Vihear	2.70	2.64	2.58	2.56	2.43
Prey Veng	0.50	0.84	1.05	1.12	1.03
Pursat	1.17	1.56	1.98	2.16	2.05
Ratanak Kiri	2.77	2.82	2.90	2.95	2.89
Siem Reap	2.25	2.34	2.42	2.39	2.24
Sihanoukville	3.66	3.42	3.27	3.08	2.84
Stung Treng	2.84	2.73	2.67	2.62	2.47
Svay Rieng	0.86	1.07	1.27	1.34	1.21
Takeo	0.99	1.24	1.46	1.57	1.47
Otdar Meanchey	2.48	2.48	2.60	2.65	2.48
Kep	3.29	3.21	3.16	3.07	2.81
Krong Pailin	6.39	3.89	3.55	3.34	3.08

Source: First Revision Populations for Cambodia 1998-2020, NIS

There are tendencies observed that Provinces close to borders, industrial bases and new frontiers are estimated to have higher growth ratios while typical farming areas in the south-east areas are It is observed that provinces close to the borders, industrial bases and new frontiers are expected

to have higher growth rates while farming areas in the south-east are estimated to have lower growth rates. Some migration is expected from the lower growth farming areas to the higher growth provinces in the new frontiers, as mentioned in previous chapter.

a) Higher Annual Growth Rates (greater than 2.5%)
- Close to the border: Banteay Meanchey, Koh Kong, Krong Pailin, Preah Vihear
- Industrial bases: Phnom Penh, Sihanoukville, Kep
- New frontiers: Mondul Kiri, Ratanak Kiri, Stung Treng

b) Lower Annual Growth Rates (less than 1.5%)
- Farming areas: Prey Veng, Svay Rieng, Takeo

For the purpose of an estimation of population growth in 185 Districts, the Study Team referred to the Rural Development Database that comprises the latest available data of the districts' population released by the Ministry of Planning and the Seila Program. The population in 2003 was 12,503,401 according to the database. Since the projected population for the year 2003 by the NIS is 13,287,053, which is about 7 million more than the actual, the Study Team used the Database for adjustment of the reality. Projected populations in 2005, 2010, 2015 and 2020 were calculated using the growth rate shown in **Table 7.2.2**.

Table 7.2.2 Projection Based on the Actual Data of 2003

Year	Projection			
	2005 (Base Year)	2010	2015	2020
Population	13,350	14,732	16,261	17,945
Labor Force	7,820	8,630	9,526	10,512
Primary	4,715	4,945	5,199	5,479
Secondary	1,027	1,232	1,457	1,706
Tertiary	2,077	2,453	2,869	3,327

Source: JICA Study Team estimation using data from "First Revision Populations for Cambodia 1998-2020, NIS" and "Rural Development Database 2003, Seila program"

(2) Projection of Gross Regional Domestic Product

1) Method of GDP Projection

In order to formulate the GRDP projection by province up until 2020, the appropriate long term focus of GDP growth was examined by the Study Team. The following three scenarios were compared and discussed to determine the optimal scenario.

(i) Trend Scenario

The trend scenario was based on the average annual GDP growth between 1994 and 2003. The average annual growth rate for the primary sector (agriculture) was 3.0%, for the secondary sector (industry), was 14.8%, and for the tertiary sector (service) was 5.9%. The trend scenario does not taken into account the large fluctuations caused by climate and political issues. Therefore, the GDP growth is simply accelerating until 2020. (See **Table 7.2.3**)

Table 7.2.3 Projected GDP Growth Rate and GDP by Trend

	Actual GDP growth rate			Projected GDP growth rate			
	1994-95	1999-00	2002-03	2004-05	2009-10	2014-15	2019-20
Primary	3.3%	-1.5%	9.6%	3.0%	3.0%	3.0%	3.0%
Secondary	23.2%	30.8%	6.6%	14.8%	14.8%	14.8%	14.8%
Tertiary	8.5%	5.6%	2.1%	5.9%	5.9%	5.9%	5.9%
Overall	6.9%	7.0%	5.3%	7.4%	8.2%	9.4%	10.6%
	Actual GDP (Bill. Riel, constant 2000)			Projected GDP			
	1995	2000	2003	2005	2010	2015	2020
Primary	4,484	5,191	5,638	6,310	7,318	8,488	9,845
Secondary	1,291	3,040	43,218	6,004	11,962	23,830	47,474
Tertiary	3,271	4,904	5,444	6,435	8,559	11,834	15,142
Overall	9,372	13,850	16,246	18,749	27,839	43,702	72,460

Source: NIS (actual), JICA Study Team (projection)

(ii) MEF Scenario

MEF has released the projection of GDP growth rate until 2010. The Study Team utilized the sector GDP projection of 2010 and estimated the growth rate of 2015 and 2020 as well. The growth ratio is a rather conservative 6.3% in the period of 2014-15 and 6.4% in the period of 2019-20, and the projected GDP in 2015 and 2020 are 33,699 billion Riel and 45,884 billion Riel respectively as shown in **Table 7.2.4**.

Table 7.2.4 GDP Projection by MEF

	GDP growth rate				Projected GDP			
	2004-05	2009-10	2014-15	2019-20	2005	2010	2015	2020
Primary	-2.0%	3.8%	3.8%	3.8%	5,967	7,163	88,631	10,401
Secondary	16.1%	7.2%	7.2%	7.2%	5,857	8,510	12,104	17,216
Tertiary	9.2%	7.1%	7.1%	7.1%	6,664	9,200	12,963	18,267
Overall	7.7%	6.0%	6.3%	6.4%	18,490	24,873	33,699	45,884

Source: MEF (2005, 2010) and JICA Study Team (2015, 2020)

(iii) Proposed Scenario

The gap between the trend scenario and the MEF scenario is very large; therefore, the Study Team estimated the third scenario in consideration of new investment and infrastructure including road projects and so on.

In terms of the growth rate of the primary sector, the projected rate is also assumed stable, at 3.8%, because the agriculture sector is usually not expected to achieve a high constant growth rate even if the irrigation system is introduced.

On the other hand, new investment of electricity encouraging development of factories and education is expected in the industrial, or secondary, sector, the so that 8% and 10% are considered appropriate growth rates in 2014-15 and 2019-20, respectively.

The last sector, the tertiary sector of the service industry, is assumed to grow in conjunction with the growth of the secondary sector. The Study Team fixed it at 8.0% in both 2014-15 and

2019-20 as stated in **Table 7.2.5**.

Table 7.2.5 GDP Projection by MEF and JICA Study Team

	GDP growth rate			Projected GDP			
	2006-10	**2011-15**	**2016-20**	2005 (Base Year)	2010	**2015**	**2020**
Primary	3.8%	3.8%	3.8%	5,967	7,163	8,631	10,401
Secondary	7.2%	8.0%	10.0%	5,857	8,510	12,504	20,138
Tertiary	7.1%	8.0%	8.0%	6,664	9,200	13,517	19,861
Overall	6.0%	6.9%	7.8%	18,490	24,873	34,653	50,401

Source: MEF and JICA Study Team

2) GDP Projection

As shown in **Figure 7.2.1**, the three kinds of GDP projections were compared and the Study Team accepted the proposed scenario which is in the middle of the trend scenario and the MEF scenario for the estimation of vehicles and traffic demands.

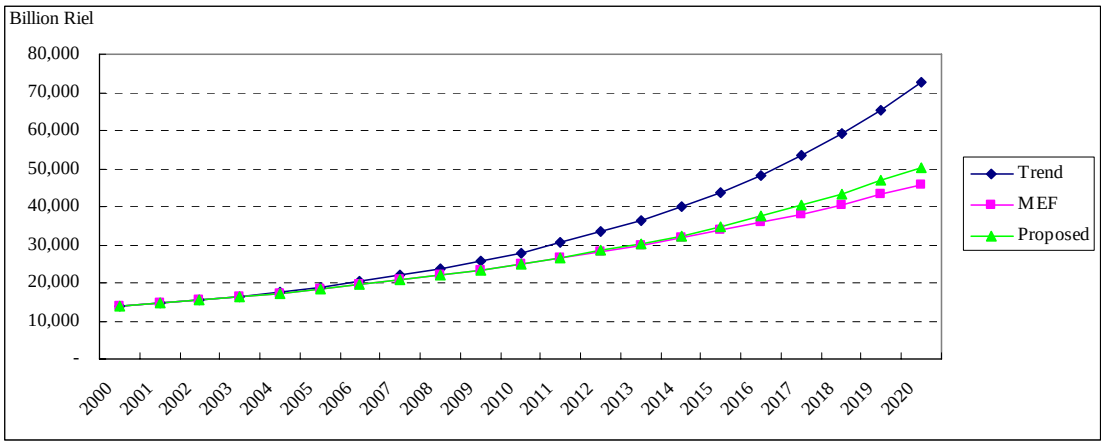


Figure 7.2.1 GDP Projections until 2020

(3) Projection of Number of Vehicles and Motorcycles

1) Methodology of Projection of Number of Vehicles and Motorcycles

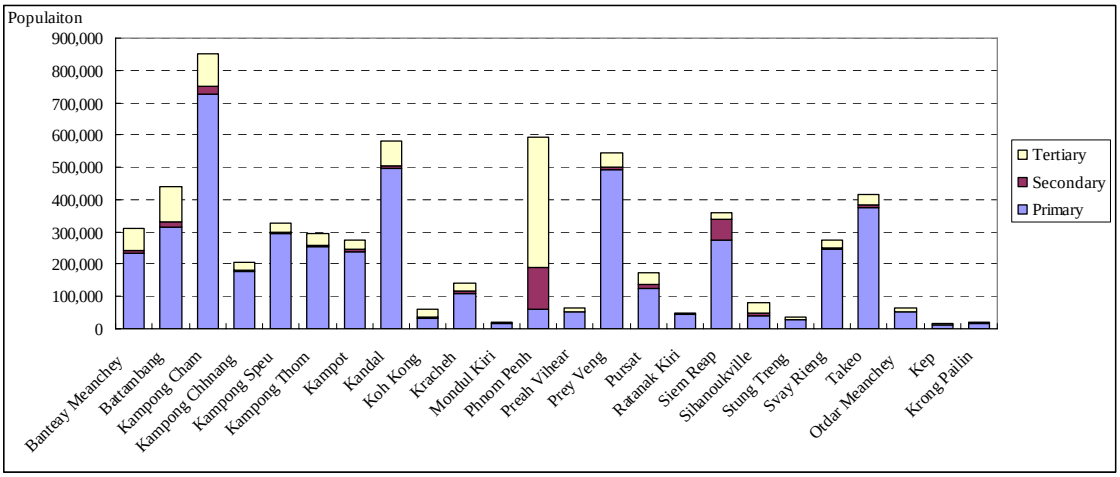
The number of registered vehicles and motorcycles is shown in previous chapter, but the traffic survey uncovered the issue of un-registered vehicles. Therefore, the Study Team referred to the rural development database for the projection.

In principal, the number of vehicles/motorcycles is influenced by the GDP, in other words income levels. Therefore, the Study Team identified the correlation and regression formula between GDP and the number of households having vehicles and motorcycles in 2003.

(i) Proportion of sector employment by province

Before starting the regression analysis, the provincial GDP, or the so-called GRDP, was identified by using the sector employment data illustrated in **Figure 7.2.2**. The GDP was prorated in

accordance with the proportion of provincial population engaged by each sector.



Source: Who's Who 2004/05

Figure 7.2.2 Sector Employment by Province

(ii) Estimated GRDP

The provincial GRDP was integrated by using the proportion of sector employment as shown in **Table 7.2.6**. The GRDP of Phnom Penh is 24.05% followed by 10.76% in Battambang.

Table 7.2.6 Estimated GRDP by Province in 2003

	Primary	Secondary	Tertiary	GRDP (mil Riel)	Proportion of GDP
Banteay Meanchey	295,547	133,845	331,724	761,116	4.69%
Battambang	396,133	251,637	543,593	1,191,364	7.33%
Kampong Cham	919,431	331,610	497,090	1,748,130	10.76%
Kampong Chhnang	222,514	48,669	130,344	401,527	2.47%
Kampong Speu	370,759	50,127	152,366	573,251	3.53%
Kampong Thom	320,747	73,507	171,405	565,659	3.48%
Kampot	303,270	64,816	145,110	513,196	3.16%
Kandal	626,648	137,061	367,079	1,130,789	6.96%
Koh Kong	40,432	61,866	117,166	219,464	1.35%
Kracheh	138,166	81,526	120,828	340,520	2.10%
Mondul Kiri	18,195	13,237	18,363	49,795	0.31%
Phnom Penh	74,428	1,835,953	1,997,386	3,907,766	24.05%
Preah Vihear	66,184	8,698	47,338	122,221	0.75%
Prey Veng	622,608	90,915	226,369	939,892	5.79%
Pursat	156,112	205,591	176,369	538,072	3.31%
Ratanak Kiri	53,886	9,377	25,016	88,279	0.54%
Siem Reap	348,448	853,538	109,893	1,311,879	8.08%
Sihanoukville	51,217	125,325	149,514	326,055	2.01%
Stung Treng	34,852	11,530	31,102	77,484	0.48%
Svay Rieng	312,392	30,377	117,507	460,277	2.83%
Takeo	474,471	98,479	168,963	741,912	4.57%
Otdar Meanchey	63,799	9,772	62,883	136,453	0.84%
Kep	17,170	5,055	12,750	34,975	0.22%
Krong Pailin	18,988	25,006	21,452	65,445	0.40%
Cambodia	5,946,394	4,557,516	5,741,609	16,245,520	1.00%

Source: JICA Study Team

(iii) Regression Formula

Figures 7.2.3 are the result of regression analysis between the estimated GRDP and the number of vehicles / motorcycles.

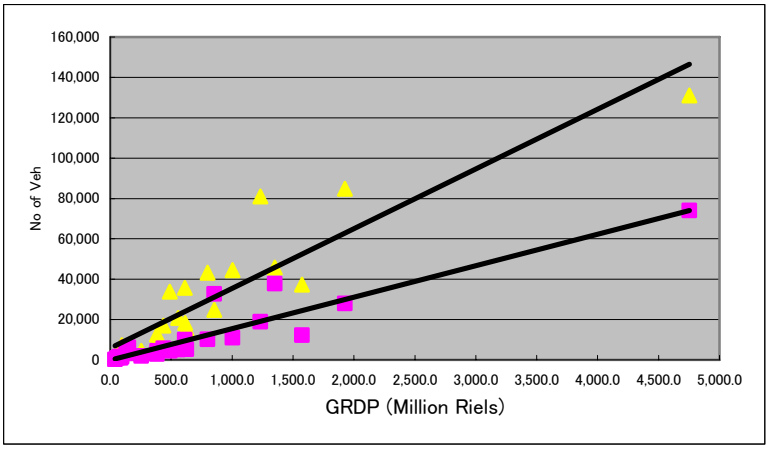


Figure 7.2.3 Result of Regression Analysis (GDP and Vehicle/Motorcycle)

Regression Formula

Y= 15.518X – 150.69 Y= number of cars, X=GRDP in mil. Riel (1)

Y= 29.601X – 5,862.3 Y= number of motorcycle, X=GRDP in mil. Riel (2)

2) Projection of Number of Vehicles and Motorcycles

Figure 7.2.4 describes the projected number of vehicles and motorcycles in 2005, 2010, 2015, and 2020, which are calculated by formulas. The provincial GRDP is growing according to the proportion of the sector growth rate with the prior condition that the proportion of sector employment would not change until 2020.

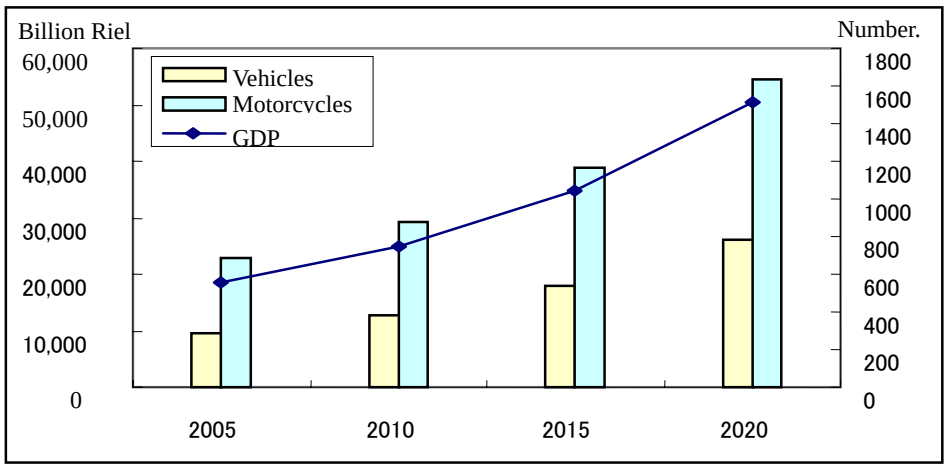


Figure 7.2.4 Projection of Number of Vehicles and Motorcycles

7.3 Formulation of Socio-Economic Frame

The socio-economic frame from 2005 until 2020 in steps of 5 years is tentatively formulated as follows in **Table 7.3.1**.

Table 7.3.1 Socio-Economic Framework in 2005, 2010, 2015 and 2020

	2005 (Base Year)		2010		2015		2020	
Population ('000)	13,350	1.00	14,732	1.10	16,261	1.10	17,945	1.11
Labor Force ('000)	7,820	1.00	8,630	1.10	9,526	1.10	10,512	1.10
Primary	4,715	1.00	4,945	1.05	5,199	1.05	5,479	1.05
Secondary	1,027	1.00	1,232	1.20	1,457	1.18	1,706	1.17
Tertiary	2,077	1.00	2,453	1.18	2,869	1.17	3,327	1.16
GDP (Billion Riel)	18,490	1.00	24,873	1.35	34,653	1.39	50,401	1.45
Primary	5,967	1.00	7,163	1.20	8,631	1.20	10,401	1.21
Secondary	5,857	1.00	8,510	1.45	12,504	1.47	20,138	1.63
Tertiary	6,664	1.00	9,200	1.38	13,517	1.47	19,861	1.47
Vehicles	285125	1.00	384.847	1.35	537,578	1.39	783,528	1.45
Motorcycles	687,960	1.00	876,955	1.27	1,166,429	1.33	1,632,580	1.40

Source: JICA Study Team