



Kingdom of Cambodia

RURAL TRANSPORT STUDIES: THREE BASELINE SURVEYS IN CAMBODIA



**Rural Transport Infrastructure Research:
Seim Reap and Oddar Meanchey Provinces, Kingdom of Cambodia**



MINISTRY OF RURAL DEVELOPMENT



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Rural Transport Studies:

Travel, Transport and Vehicular Traffic Research

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Table of Contents

<i>Table of Contents</i>	<i>i</i>
<i>Acronyms</i>	<i>v</i>
<i><u>PART ONE</u> – Peak Snaeng Baseline Study: Travel and Transport at the Household Level</i>	<i>1</i>
<i>Executive Summary</i>	<i>2</i>
<i>Introduction</i>	<i>3</i>
<i>The Household Study</i>	<i>4</i>
The Research Area	4
Methodology	4
Explanation of Basic Terms	5
<i>The Research Results</i>	<i>7</i>
Socio-economic Characteristics	7
Peak Snaeng Travel and Transport Trends	8
Comparison of Trips per Annum	8
Comparison of Travel Time per Annum	9
Comparison of Distance Travelled per Annum	10
Comparison of Weight Transported per Annum	11
Comparison of Transport Effort per Annum	12
<i>Stratification of the Surveyed Households</i>	<i>14</i>
Gender Comparison	14
Seasonal Comparison	17
<i>Conclusions</i>	<i>22</i>
<i>Appendices</i>	
Appendix 1: Map of Siem Reap Province	23
Appendix 2: Additional Tables	24
<i>Tables and Figures</i>	
Table 1: Population of Angkor Thom District	4
Table 2: Identified Travel Related Activities	5
Table 3: Vehicle Ownership – Types and Numbers	7
Table 4: Number of Trips per Household per Year	9
Table 5: Annual Weight Transported per Household	11
Table 6: Annual Transport Effort per Household	12
Table 7: Daily Weight Transported by Gender and Age Group	16
Table 8: Annual Transport Effort by Gender and Age Group	17
Table 9: Frequency of Use for Different Transport Modes by Season	18
Table 10: Annual Transport Effort by Season	21
Figure 1: Main source of Income in Surveyed Households	7

Figure 2: Frequency of Use for Different Modes of Transport	8
Figure 3: Travel Time per Household per Year	9
Figure 4: Annual Distance Travelled per Household	10
Figure 5: Annual Weight Transported per Household	11
Figure 6: Annual Transport Effort per Household	12
Figure 7: Five Main Travel and Transport Indicators	13
Figure 8: Daily Trip Frequency by Gender and Age Group	14
Figure 9: Daily Travel Time by Gender and Age Group	15
Figure 10: Daily Travel Distance by Gender and Age Group	15
Figure 11: Daily Weight Transported by Gender and Age Group	16
Figure 12: Annual Transport Effort by Gender and Age Group	17
Figure 13: Daily Trip Frequency by Season	18
Figure 14: Daily Travel Time by Season	19
Figure 15: Daily Travel Distance by Season	19
Figure 16: Daily Weight Transported by Season	20
Figure 17: Annual Transport Effort by Season	20
<i><u>PART TWO</u></i> – <i>Vehicular Traffic on National Road 68: A Baseline Traffic Study</i> <i>Between Samraong and O’Smach</i>	29
<i>Executive Summary</i>	30
<i>Introduction</i>	31
<i>Traffic Count</i>	32
Days of the Week	32
Hours of the Day	33
Traffic Density at Three Different Locations	34
Vehicle Type	36
<i>Origin and Destination Survey</i>	38
General Characteristics of the Surveyed Traffic	38
Vehicle Load	39
Traffic Along National Road 68	41
<i>Conclusions</i>	45
<i>Appendices</i>	
Appendix 1: Map of Survey Locations	46
Appendix 2: Survey Questionnaire Forms	47
<i>Tables and Figures</i>	
Table 1: Vehicle Categories	32
Table 2: Daily Traffic Flow	33
Table 3: Traffic Density per Hour	34
Table 4: Traffic Density at the Three Traffic Count Locations	35
Table 5: Vehicle Division at the Three Traffic Count Locations	37
Table 6: Comparison of Travel Time and Frequency	38
Table 7: Categories of Vehicle Load	39
Table 8: Ranking of Products per Vehicle	40

Table 9: Average Product Load	41
Table 10: Average Passenger Load	41
Table 11: Vehicle Origin (in and outside of Oddar Meanchey Province)	42
Table 12: Comparison of District of Origin	43
Table 13: Comparison of Commune of Origin	44
Table 14: Comparison of Village of Origin	44
Figure 1: Daily Traffic Density	33
Figure 2: Traffic per Hour	34
Figure 3: Traffic Volume at Three Traffic Count Locations	35
Figure 4: Comparison of All Vehicle Types	36
Figure 5: Comparison of Eight Vehicle Types	36
Figure 6: Vehicle Load	40
Figure 7: Origin of Interviewed Traffic	42
Figure 8: Commune of Origin	43
<i><u>PART THREE</u> – Banteay Srei District Traffic Features: Research in Rural Transport</i>	50
<i>Executive Summary</i>	51
<i>Introduction</i>	52
<i>Traffic Count</i>	53
Time of Day	53
Traffic Density	55
Vehicle Type	55
<i>Origin and Destination Survey</i>	58
<i>General Characteristics of the Surveyed Traffic</i>	58
District Market Traffic Flows	61
Banteay Srei District Travel	63
<i>Conclusions</i>	66
<i>Appendices</i>	
Appendix 1: Map of Banteay Srei Market Area	67
Appendix 2: Map of Banteay Srei District	68
Appendix 3: Map of Siem Reap Province	69
<i>Tables and Figures and Tables</i>	
Table 1: Vehicle Types	53
Table 2: Hourly Differences in Traffic Density	54
Table 3: Comparison of Traffic Density at Three Traffic Count Locations	55
Table 4: Vehicle Intensity at Three Locations	57
Table 5: Comparison of Average Travel Times and Frequencies	58
Table 6: Classification of Vehicle Load	59
Table 7: Average Vehicle Load (products)	60
Table 8: Ranking of Products Transported per Vehicle Type	60
Table 9: Average Vehicle Load (passengers)	61

Table 10: Market Bound Traffic	61
Table 11: Quantities of Products Transported to Market	62
Table 12: Frequency of Market Visits per Day	63
Table 13: Districts of Origin of Road Users	64
Table 14: Road Users per Commune in Banteay Srei District	64
Table 15: Market Bound Road Users by Village	65
Figure 1: Volume of Traffic per Hour	54
Figure 2: Traffic Volume at Three Observation Posts	55
Figure 3: Comparison of All Vehicle Types	56
Figure 4: Comparison of Eight Vehicle Types	56
Figure 5: Commune to Market Travel Time	63
<i>References</i>	70

Acronyms

ADB	Asian Development Bank
ASIST A-P	Advisory, Support, Information, Services and Training Programme – Asia Pacific (ILO)
BME	Benefit Monitoring and Evaluation
H.E.	His Excellency
ILO	International Labour Organisation
IRAP	Integrated Rural Accessibility Planning
LBAT	Labour Based Appropriate Technology
MRD	Ministry of Rural Development
NR	National Road
O&D	Origin and Destination
PDRD	Provincial Department of Rural Development
PPTA	Project Preparation Technical Assistance
PR	Provincial Road
RR	Rural Road
RTI	Rural Transport Infrastructure
ZOA	Dutch Refugee Agency

PART ONE

Peak Snaeng Baseline Study: *Travel and Transport at the Household Level*

Executive Summary

Integrated Rural Accessibility Planning (IRAP) is a planning process based on the view that limited access to goods and services is one of the fundamental constraints to rural development. This report provides baseline accessibility data for Peak Snaeng Commune, Angkor Thom District, Siem Reap Province, an area prioritised for infrastructure investment by the Provincial Department of Rural Development (PDRD).

Two villages with poor accessibility in Peak Snaeng Commune, Peak Snaeng Thmei and Leip were surveyed. At the household level, travel and transport trends were described and quantified. The data was analysed leading to detailed information on daily trips, travel time, distance travelled and weight transported at the family level.

Most trips were made on foot (70.3%). Bicycles and cars were the most commonly used vehicles. Peak Snaeng families spent an average of 6 hours and 21 minutes per day travelling and transporting goods. Households made an average of 12 trips per day and more than 66 percent involved water collection. On average, a Peak Snaeng household travels approximately 23 kilometres per day.

The gender stratification shows that in the survey area, the travel and transport burden is rather balanced. Travel time and travel distance, were similar for males and females. However, females tended to make more daily trips while the males tended to make a larger transport effort.

The survey reveals seasonal patterns of travel. Although more trips are made in the dry season, mainly for water collection, rural families spend more time on travelling in the wet season because of deteriorated road conditions and the lack of vehicular transport.

Introduction

The *International Labour Organisation* (ILO) has promoted social and economic development through *Labour Based Appropriate Technologies* (LBAT) since the early 1970s. The ILO introduced LBAT in Cambodia in 1992. LBAT is a means of generating employment through improving and maintaining rural infrastructure.

The ILO has been involved in rural infrastructure improvement projects in Siem Reap Province since 1993. The first two projects (CMB/92/008 and CMB/95/011) focused on rehabilitating rural roads and setting up maintenance systems. The present project (Upstream Project–CMB/97/M02/SID) complements the previous projects by building capacities to develop Rural Transport Infrastructure (RTI). This project has introduced the *Integrated Rural Accessibility Planning* (IRAP) method to Cambodia.

IRAP is a local planning process based on the concept that limited access to goods and services is one of the fundamental constraints to rural development. It is designed to assist local decision makers to prioritise RTI investments. Improving accessibility to goods and services through enhanced mobility or improved transport systems is a major tool in poverty reduction. Reducing travel times to economic and social services lies at the core of ILO Upstream's RTI improvement projects.

Travel time is one of the main topics of this present study. It aims to measure the detailed characteristics of *travel and transport at the household level* in a Cambodian rural Commune, basically following the methodology used in earlier ILO Upstream Socio-Economic studies.¹ The main reason for carrying out this research is to obtain baseline data on travel and transport trends that will help to direct RTI investments.

In March 2000, the IRAP planning process was introduced in Angkor Thom District, leading to a list of prioritised investments. The priority investments for Peak Snaeng Commune included tertiary road improvements and the construction of a large causeway.² These investments were undertaken in 2001. This baseline survey on household travel and transport was carried out to document the impact of these infrastructure investments on the inhabitants of Peak Snaeng Commune after the investments are completed, the survey will be repeated to measure the impact on the accessibility situation in Peak Snaeng.

¹ The ILO socio-economic team conducted a similar survey in Puok District, Siem Reap Province, which resulted in the study: "*Household Travel and Transport: Rural Transport Infrastructure Research*", ILO Upstream Socio Economic Series No. 3, Phnom Penh, September 2000.

² Both construction activities are underway at the time of writing.

The Household Study

The study centres on the issue of *travel time*. In September 2000 - after the IRAP cycle was completed in Angkor Thom District, Siem Reap Province, the socio-economic team visited Peak Snaeng Commune and interviewed 74 families about their local and regional travelling patterns. This section will provide some information about the research area; the methodology used and will explain the basic terms used in this survey.

The Research Area

This series of household interviews was carried out in two villages in Peak Snaeng Commune, Angkor Thom District. Angkor Thom is the second district in which the ILO Upstream Project undertook an IRAP study.³ Angkor Thom District has 16,734 inhabitants. It consists of four Communes and 26 villages, as shown in the next table.

No	Commune	Number of villages	Total Population	Number of Households
1	Chob Ta Trav	5	2,656	486
2	Leang Dai	9	7,248	1,268
3	Peak Snaeng	6	2,265	584
4	Svay Chek	6	4,565	824
	Total	26	16,734	3,162

Table 1: Population of Angkor Thom District

The IRAP study revealed that accessibility varied significantly from village to village. The IRAP methodology used a combination of six indicators (access to water, schools, health care, markets, employment and transport infrastructure) to determine the accessibility situation for the different villages.

Two villages in Peak Snaeng Commune with poor accessibility were selected. In Peak Snaeng Thmei, 60 households were interviewed and in Leip, 14 households were interviewed. In both cases, the sample was about 30 per cent of the total population, which is a good representation of the village population.

Methodology

The survey questionnaire consisted of three sections. The first section contained questions relating to socio-economic characteristics (number of adults/children, age, source of income etc.). The second section asked respondents to describe a typical day in both the wet and the

³ MRD/ILO Upstream Project, Angkor Thom District Accessibility Action Plan, 2000.

dry seasons, focussing on local and regional travel and transport activities (*a family time budget study*). The third section was a structured interview. This consisted of 13 sets of questions that systematically documented daily travel related activities.⁴ These questions were used to verify and expand on the daily activity description in section two. Data on these 13 activities was collected for both seasons.

No	Travel Related Activity
1	Collecting Water
2	Fetching Firewood
3	Fishing
4	Cultivating Rice
5	Growing Vegetables
6	Growing Fruit
7	Raising Animals
8	Non Agricultural Activities
9	Visiting Market
10	Attending School
11	Visiting Health Facilities
12	Visiting Pagoda
13	Social Visits

*Table 2: Identified Travel Related Activities*⁵

Interviews took between one and one and a half hours, depending on the family situation. Villagers were asked to estimate the number of trips made, the time taken, distance travelled, quantity of goods carried and the fare paid, for each of the 13 activities. Interviews also covered the mode of transport used, gender and age differences, etc.

Researchers interviewed 20 male household members (27%) and 54 female household members (73%), during the two-week research period. In all, 74 interviews were conducted. The average age of respondents was 38 years.

The research encountered some methodological problems. Respondents found it difficult to estimate time and distance. Villagers measured the length of their trips by changes in the position of the sun. Respondents also found it difficult to distinguish between wet and dry seasons. Asking respondents to describe a typical day both in wet and dry seasons in section two of the survey made the comparison easier during the structured interviews. Respondents found the number of trips and weight carried easier to estimate.

Explanation of Basic Terms

⁴ A 14th activity (Selling Fish) was originally included in the questionnaire. It was later removed, as the time spent on this activity was negligible.

⁵ This list of activities excludes ‘peak’ agricultural activities like transplanting and harvesting. Major religious ceremonies are also excluded.

Although the terms *transport* and *travel* are often used interchangeably, they refer to different types of mobility. Travel is a personal movement, the interaction between households and the wider socio-economic environment to access services or fulfil social functions (travel to school, hospital, etc.). Most of this travel does not involve carrying a load.

Transport, on the other hand, refers to the *carrying* of goods and commodities. This is similar to the distinction made in the Laos IRAP household survey between personal trips and load carrying trips.⁶ Only three of the 13 activities surveyed in the study involved a significant transport element - carrying water, collecting firewood and fishing. Other trips generally did not involve major transportation efforts e.g.; trips to the rice field only involve transporting harvested rice for a few days during each season.

Each of the 13 travel or transport related household activities was analysed using the following five indicators:

Number of Trips per Household per Annum. The total number of *round* trips per household per year.

Travel/transport Time per Household per Annum. A travel time figure is calculated by estimating the time spent on travel/transport per household per year. For example, trip time would include the time spent travelling from the house to the forest and back, but not the time spent in the forest collecting firewood.

Travel/transport Distance per Annum. The total distance covered for each activity per year.

Tonnes per Household per Annum. The total weight of goods moved per household per year for each of the three load carrying activities.

Tonne-km per Household per Annum. The total transport effort expended per household per year. Tonne-km is the standard unit for measuring the magnitude of a load carrying activity. One (1) tonne-km is the transport effort involved in moving a one tonne load over a distance of one kilometre.⁷

⁶ This section draws heavily on the IRAP/UNDP Laos household survey report (Guillin 1999).

⁷ A transport activity involving the movement of 50kg over a distance of 5km is repeated 100 times during a year. The total transport effort is calculated as $(50/1000) \times 5 \times 100 = 25$ tonne-km per annum.

The Research Results

Socioeconomic Characteristics of Households

In total 74 households were interviewed during two weeks of surveying. The average household size was 5.9 members. This is slightly higher than the Angkor Thom District average of 5.3 people per household. Approximately 53 per cent of the household members were below 15 years and the average age of the total sample was 38 years. Twenty seven per cent of the surveyed family members were male, while 73 per cent were female.

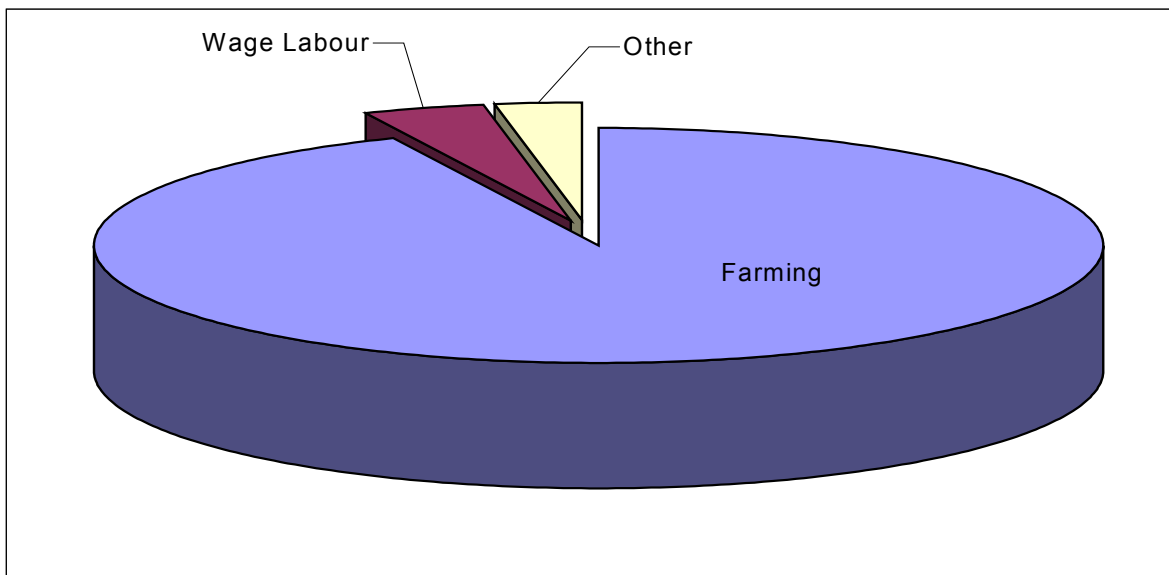


Figure 1: Main Source of Income in Surveyed Households (Appendix 2, table A)

Farming is the main source of income for the majority of the surveyed households (93.2%). Wage labour was the most important source of income for 4.1 per cent of the families and other sources of income made up about 2.7 per cent as shown in figure 1.

No	Type of Vehicle	Total Number of Vehicles	Number of Households per Vehicle Type
1	Bicycle	64	52
2	Motorbike	5	5
3	Oxcart	13	13
4	No Vehicle	-	4
	Total	82	74

Table 3: Vehicle Ownership - Types and Numbers

Bicycles, motorbikes and oxcarts were the most commonly owned vehicles. Fifty-two households (70%) owned at least one bicycle and five households (7%) owned one motorbike. Thirteen households (18 %) owned an oxcart.

Peak Snaeng Travel and Transport Trends

Seventy percent of trips registered by the survey were made on foot. This figure reflects the fact that most trips are local, however people travel by foot even over long distances. Travelling outside the village takes a long time even if villagers own a bicycle or oxcart. This is due to the poor quality of roads or the absence of RTI. This is a problem especially in the wet season. The next figure shows a comparison of the different modes of transport used by survey respondents.

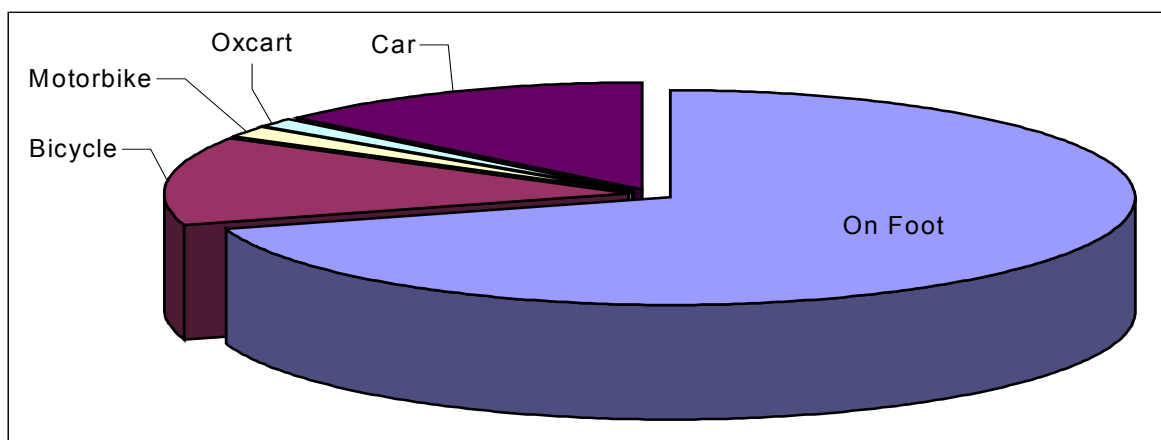


Figure 2: Frequency of Use for Different Modes of Transport (Appendix 2, Table B)

Comparison of Trips per Annum

Each household in the survey sample made an average of 4,344 trips per year or about 12 trips per day. This is considerably lower than the daily number of trips for the households in the Puok District survey, where the average was approximately sixteen trips per day.⁸

The division of the various trips is similar to Puok District: most trips made by surveyed families in Angkor Thom District were from the house to the water source and back (65.5%). This adds up to about eight trips to the water source per family per day. In the Puok District study, 62.7 per cent of all trips were made to collect water.

⁸ MRD/ILO Upstream Project, Puok District Household Travel and Transport Analysis, Socio-Economic Series No.3, 2000.

No	Travel Activity	Annual Number of Trips per Household	Percentage (%)	Cumulative Percentage (%)
1	Collecting Water	2,846	65.5	65.5
2	Fetching Firewood	302	7.0	72.5
3	Cultivating Rice	296	6.8	79.3
4	Attending School	252	5.8	85.1
5	Growing Vegetables	156	3.6	88.7
6	Raising Animals	120	2.8	91.5
7	Non Agricultural Activities	97	2.2	93.7
8	Visiting Health Facilities	78	1.8	95.5
9	Fishing	69	1.6	97.1
10	Growing Fruit	56	1.2	98.3
11	Visiting Pagoda	48	1.1	99.4
12	Visiting Market	22	0.5	99.9
13	Social Visits	2	0.1	100
	Total	4,344	100%	

Table 4: Number of Trips per Household per Year⁹

Trips to the fields for fetching firewood account for seven per cent of annual household trips. Trips to the rice field amount to 6.8 per cent and trips to attend school add up to about 5.8 per cent of annual household trips. Trips for growing vegetables, raising animals and for non-agricultural activities represent 3.6 per cent, 2.8 per cent and 2.2 per cent of all the household trips respectively. The remaining 6.3 per cent are divided among the other six travel destinations.

Comparison of Travel Time per Annum

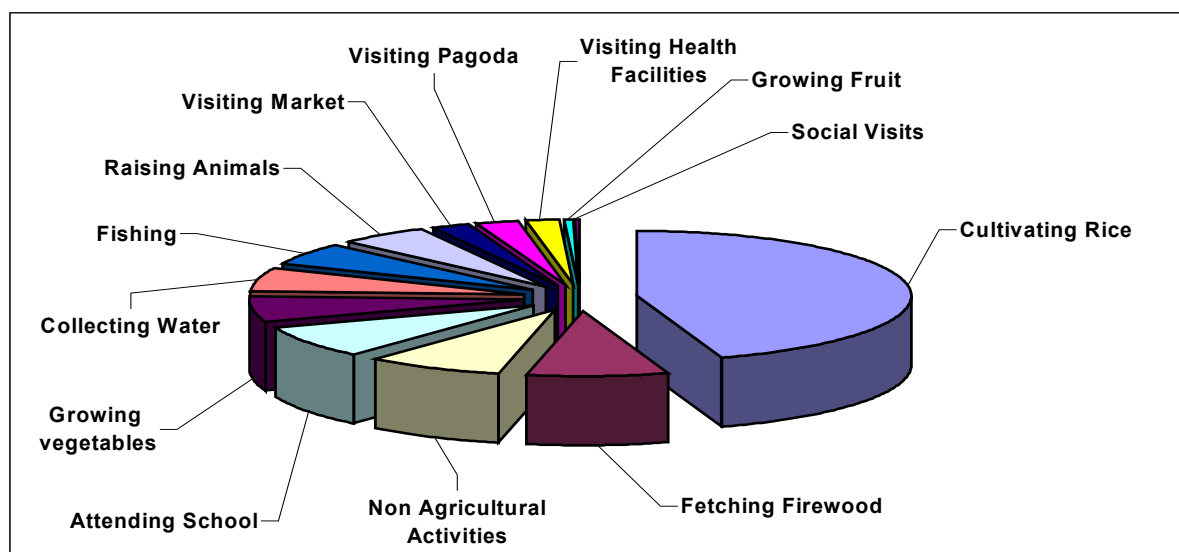


Figure 3: Travel Time per Household per Year (Appendix 2, table C)

⁹ Some trips have multiple purposes; e.g., trips to the paddy fields may be combined with fishing.

The Peak Snaeng households surveyed travelled an average of 6 hours and 21 minutes per day while Puok households averaged 6 hours and 43 minutes per day. With an average household size of 5.9 members, this is an average of one hour and three minutes travel per family member per day.

Figure three above shows that travel to the rice field takes up the largest amount of family travel time (45%). Trips to collect firewood, attend school and for non-agricultural activities account for a substantial amount of the total travel time (each about 8%). For the school and firewood trips it is the high number of trips that leads to the long travel time, while for the trips related to non-agricultural activities it is the distances involved that lead to long travel times.

Comparison of Distance Travelled per Annum

Figure four below shows the annual distance covered per household for each of the main travel and transport activities. More distance is covered to cultivate rice than in any other travel activity. It accounts for 36.4 per cent of the total distance travelled in a year or approximately 2,992 kilometres, which is more than that of the Puok households. The average round trip to the rice field is about 10km in Peak Snaeng versus 5.8km in Puok.

Visiting markets and trips related to fetching firewood and non-agricultural activities combined make up 31 per cent of the total distance covered in a year. Trips for growing fruit and social visits only account for a small share of the total distance travelled, as these activities are carried out close to home or do not occur often.

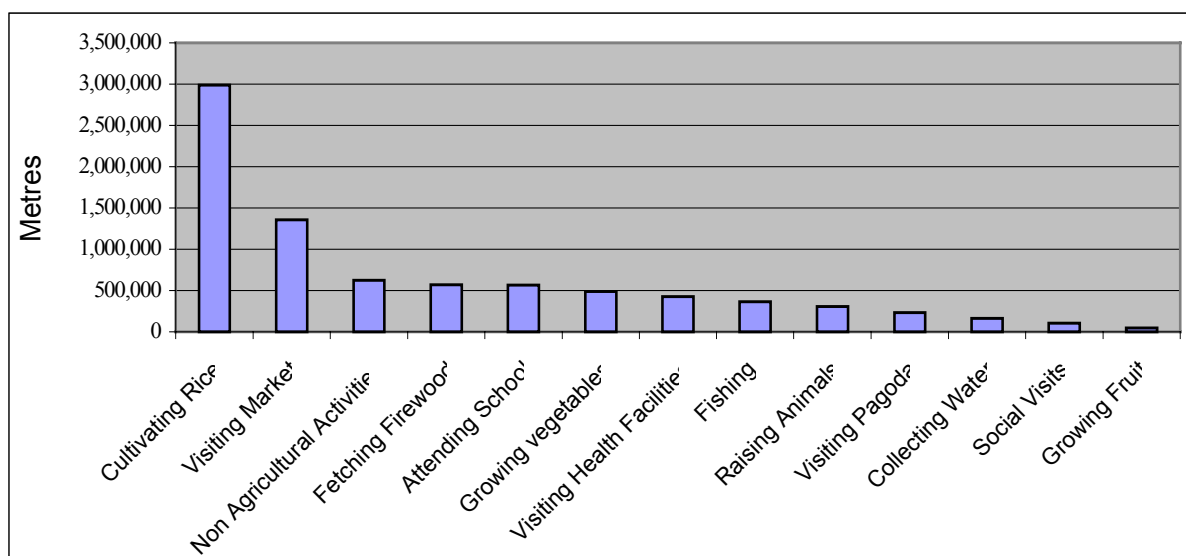


Figure 4: Annual Distance Travelled per Household (Appendix 2, table D)

Peak Snaeng Commune households travel on average 22km daily, or about 8,229km per year. A similar household in Puok District travels 8,300km per annum. On average, a Peak Snaeng trip covered approximately 1.9km.

Comparison of Weight Transported per Annum

This section focuses on the three major transport activities, water collection, fetching firewood and fishing. Water collection trips account for more than 85 per cent of the total weight carried per household per annum. Almost 32 tonnes of water are carried per year, or about 89 kg per day. The second most significant activity is fetching firewood (13.8%), with more than five tonne transported per year. Almost 0.1 tonne of fish is transported per annum or 0.3 kg per day.

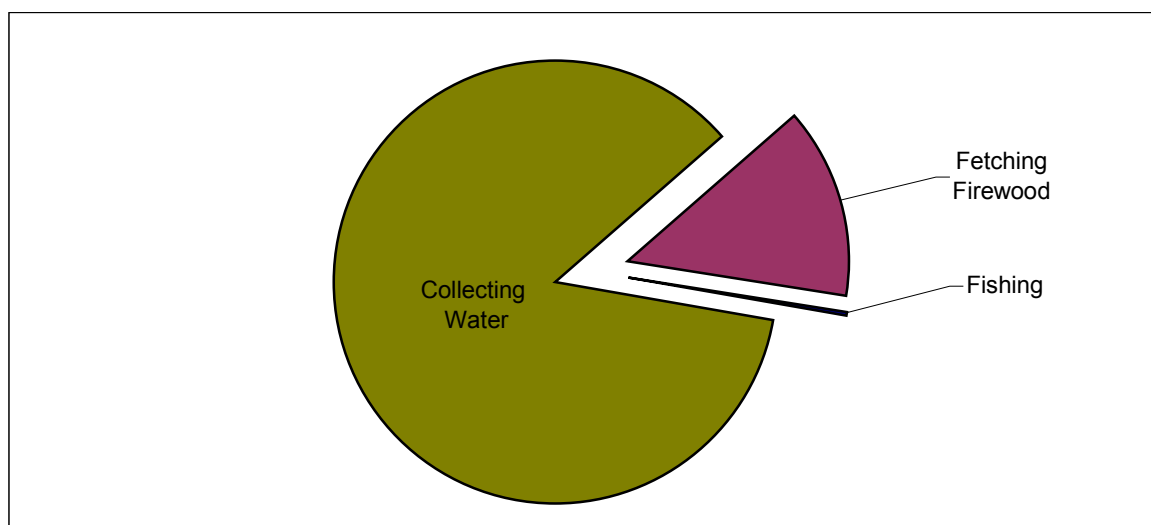


Figure 5: Annual Weight Transported per Household

No	Travel Activity	Annual Weight Carried per Household (tonne)	Daily Weight Carried per Household ¹⁰ (kg)	Percentage (%)	Cumulative Percentage (%)
1	Collecting Water	32.0	88.9	85.9	85.9
2	Fetching Firewood	5.1	14.2	13.8	99.7
3	Fishing	0.1	0.3	0.3	100
	Total	37.2 tonne	103.4 kg	100	

Table 5: Annual Weight Transported per Household¹¹

¹⁰ One litre is equivalent to one kilogram.

¹¹ These figures do not include the weight of the containers goods were transported in.

Comparison of Transport Effort per Annum

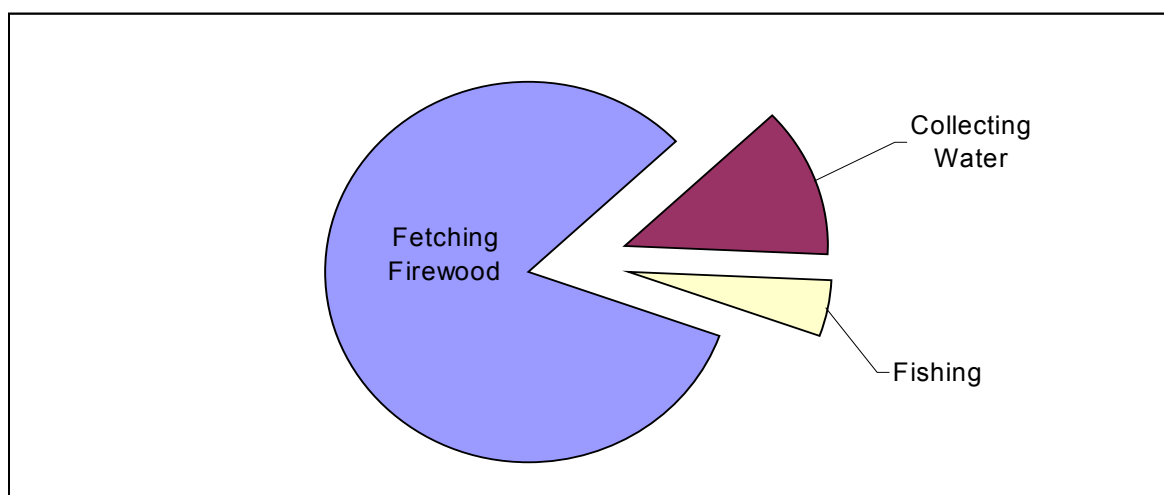


Figure 6: Annual Transport Effort per Household (Tonne-km)

No	Travel Activity	Transport Effort per Annum per Household (tonne-km)	Percentage (%)	Cumulative Percentage (%)
1	Fetching Firewood	13.3	82.5	82.5
2	Collecting Water	2.1	12.7	95.2
3	Fishing	0.8	4.8	100
	Total	16.2 tonne-km	100	

Table 6: Annual Transport Effort per Household (Tonne-km)

In Peak Snaeng Commune, 82.5 per cent of the load carrying effort is spent collecting firewood at 13.3 tonne-km per annum (Puok District households spent about 71% at 47.4 tonne-km per annum). The second most significant activity is collecting water at 12.7 per cent or 2.1 tonne-km per year. Transporting fish adds up to 4.8 per cent or 0.8 tonne-km of the total transport effort, (for Puok District, however, it is 15.2% or 10.2 tonne-km per year). The total transport effort appears to be significantly less for Peak Snaeng Commune families than for Puok District families (16.2 tonne-km per annum versus 66.8 tonne-km per annum).

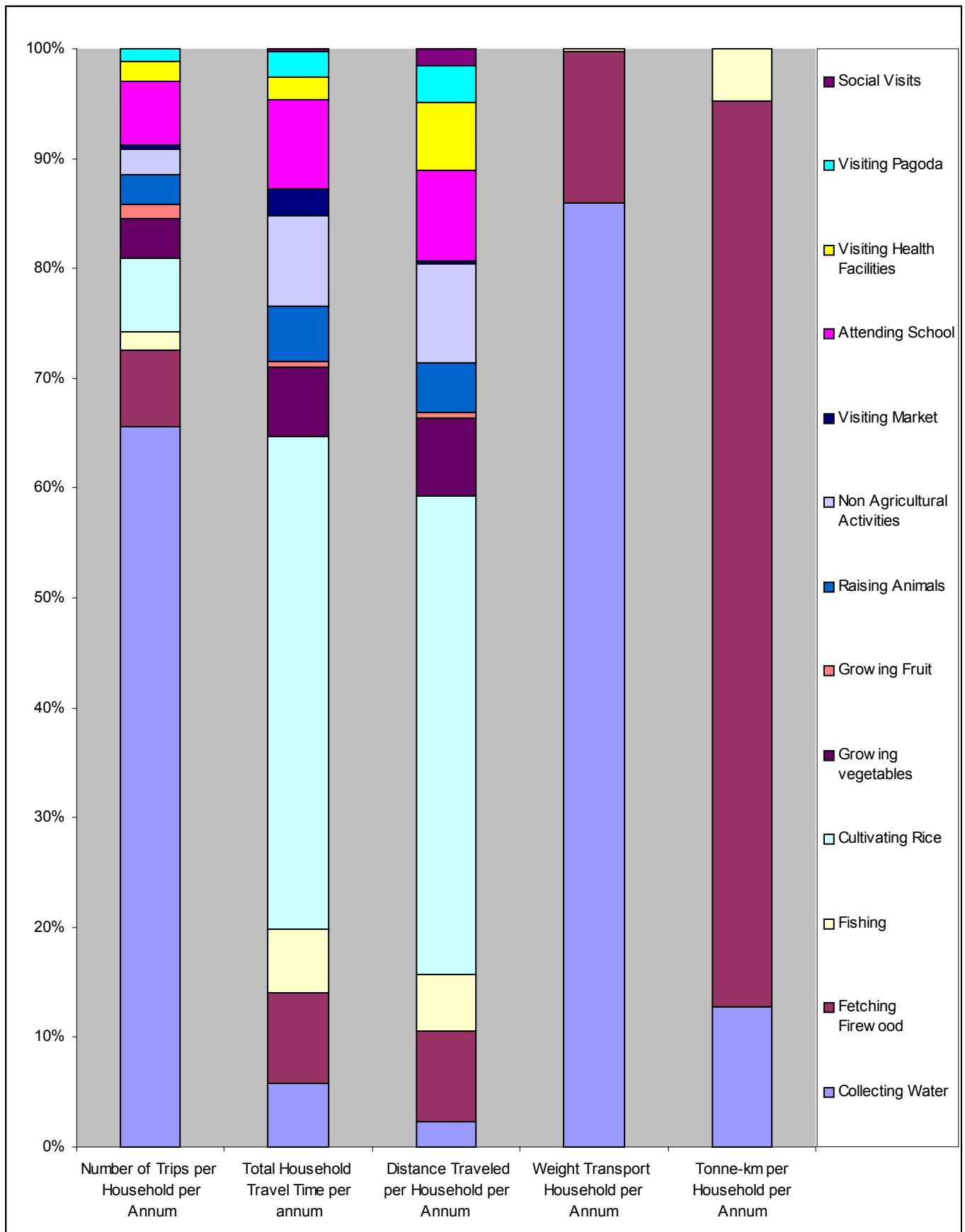


Figure 7: Five Main Travel and Transport Indicators for Peak Snaeng Commune

Stratifications of the Surveyed Households

Gender comparison

Rural transport patterns have been studied in many developing countries, especially in Africa. Many studies have found a heavier transport and travel burden for females. In these studies, it was found that the female members of the family undertake the majority of household travel and transport activities.¹²

In Cambodia, the travel and transport burden seems more equally divided. Women make more trips and carry more weight, however men travel for longer over greater distances and expend more transport effort. Trips by women are usually shorter in time and distance and involve less transport effort. To get a more detailed understanding of the gender comparison, it is necessary to examine the different travel and transport activities.

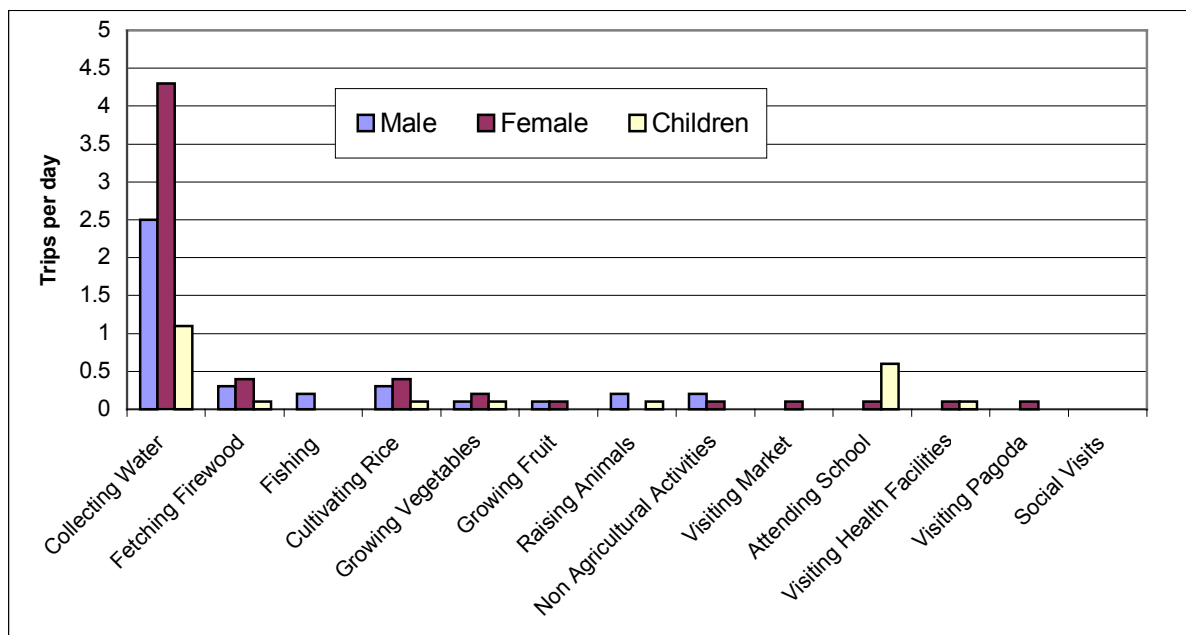


Figure 8: Daily Trip Frequency by Gender and Age Group (Appendix 2 table E)

Women undertake 49.2 per cent of all the household trips in the surveyed families (48.5% in the Puok survey). Men make 32.5 per cent of all the family trips and children's trips account for the remaining 18.3 per cent.¹³ Women make most of the trips for water collection, fetching firewood and cultivating rice. Men make most fishing trips and trips related to raising animals.

¹² Barwell et al 1987; Barwell 1996; IRFTD 1999

¹³ Children are defined as those under 15 years.

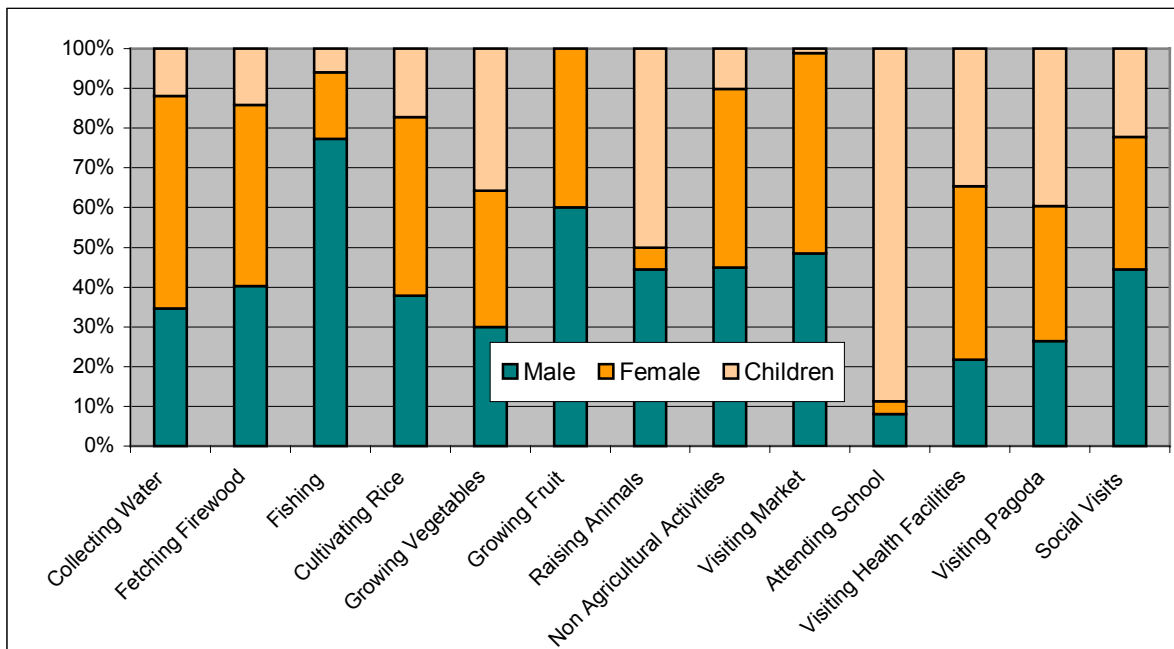


Figure 9: Daily Travel Time by Gender and Age Group (Appendix 2, table F)

In Peak Snaeng Commune, the household ‘travel burden’ is more balanced. Male household members spend an average of 2 hours and 24 minutes per day travelling (which is less than males in Puok District who spend 3 hours and 21 minutes travelling). Women in Peak Snaeng Commune spend approximately 2 hours and 23 minutes per day travelling (Puok District females spend 2 hours and 18 minutes on travelling per day).

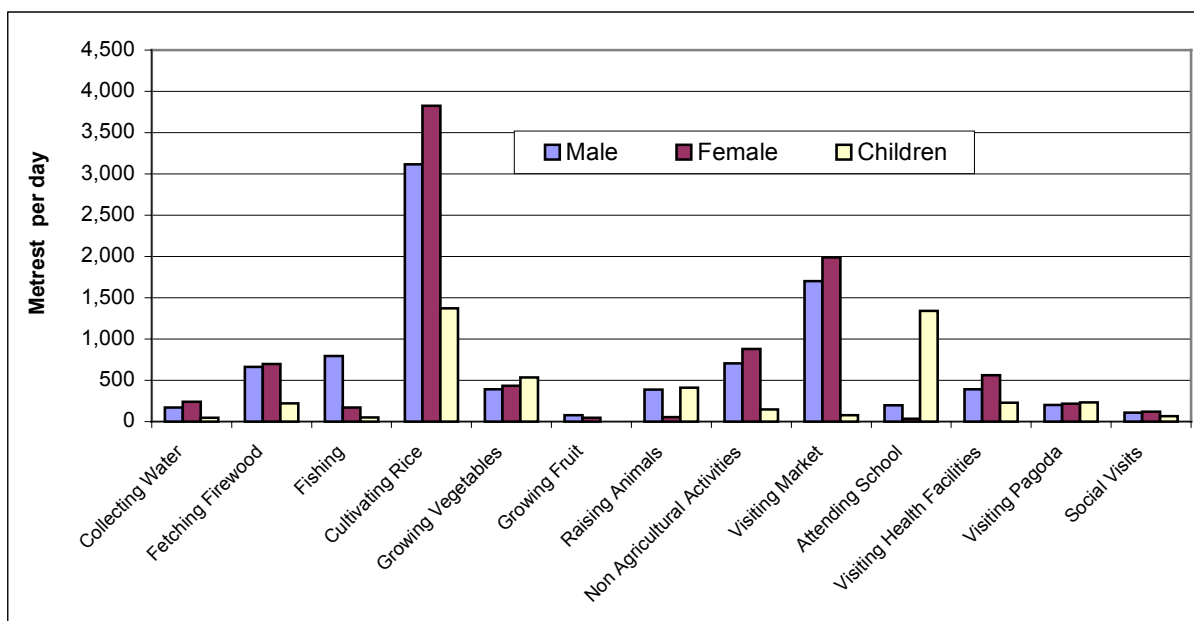


Figure 10: Daily Travel Distance by Gender and Age Group¹⁴ (Appendix 2, table G)

¹⁴ The male and female figures for attending school include children older than 15 attending high school.

The gender difference is more apparent when the distance travelled is examined. The households surveyed covered an average of 22,860m per day (23,058m daily in Puok District). Men in Peak Snaeng Commune travel an average of 8,891m (Puok District 12,320m per day) and women 9,256m (Puok District 7,657m per day). Children travel the remaining family distance, mainly for cultivating rice and attending school.

Combining these figures with trip numbers, the average trip distance for males is 2,280m and the average female trip is 1,569m. The average trip lasts 37 minutes for males and 24.3 minutes for women.

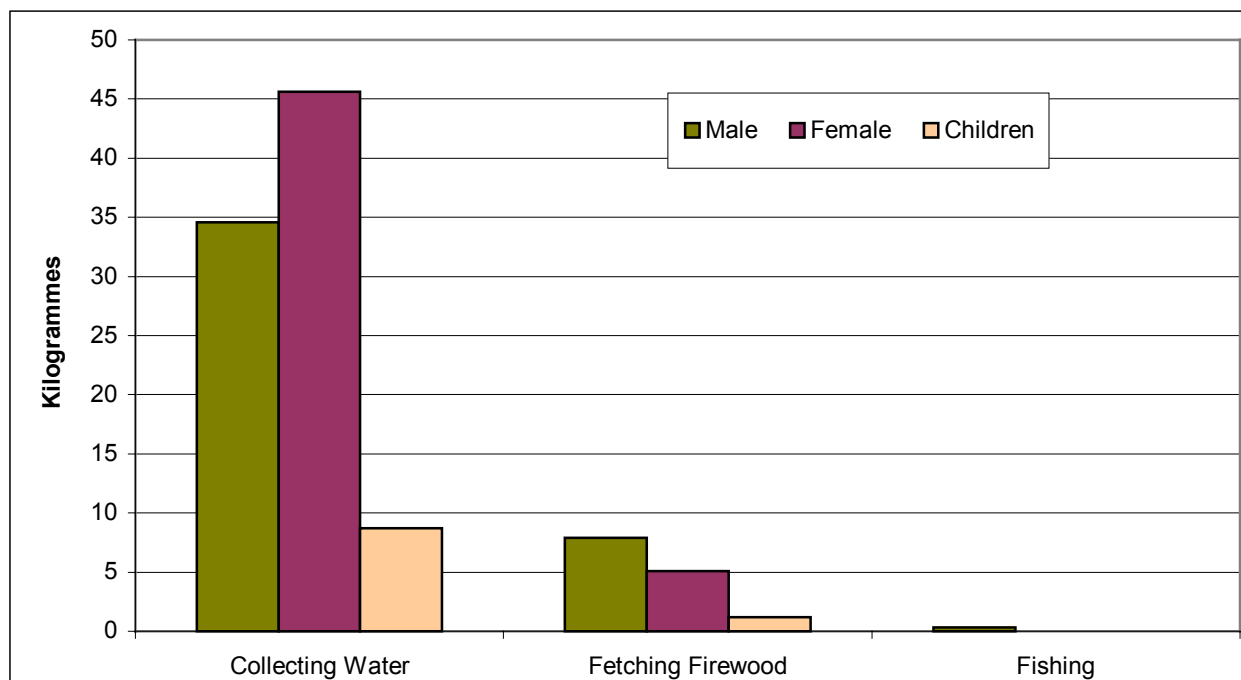


Figure 11: Daily Weight Transported by Gender and Age Group

No	Travel Activity	Daily Weight Transported by Gender and Age Group						Weight Total (kg)
		Male		Female		Children		
		Weight (kg)	%	Weight (kg)	%	Weight (kg)	%	
1	Collecting Water	34.6	38.9	45.6	51.3	8.7	9.8	88.9
2	Fetching Firewood	7.9	55.6	5.1	35.9	1.2	8.5	14.2
3	Fishing	0.3	100	0.0	0	0.0	0	0.3
	Total	42.8	41.4	50.7	49.0	9.9	9.6	103.4

Table 7: Daily Weight Transported by Gender and Age Group

A Peak Snaeng family transports an average of 103kg per day. Women carry most of the daily weight at 49 per cent or 50.7kg, due to the high number of trips to collect water. Men transport 41.4 per cent of the total weight (42.8kg) and children transport the remaining 9.9kg (9.6%), mainly water.

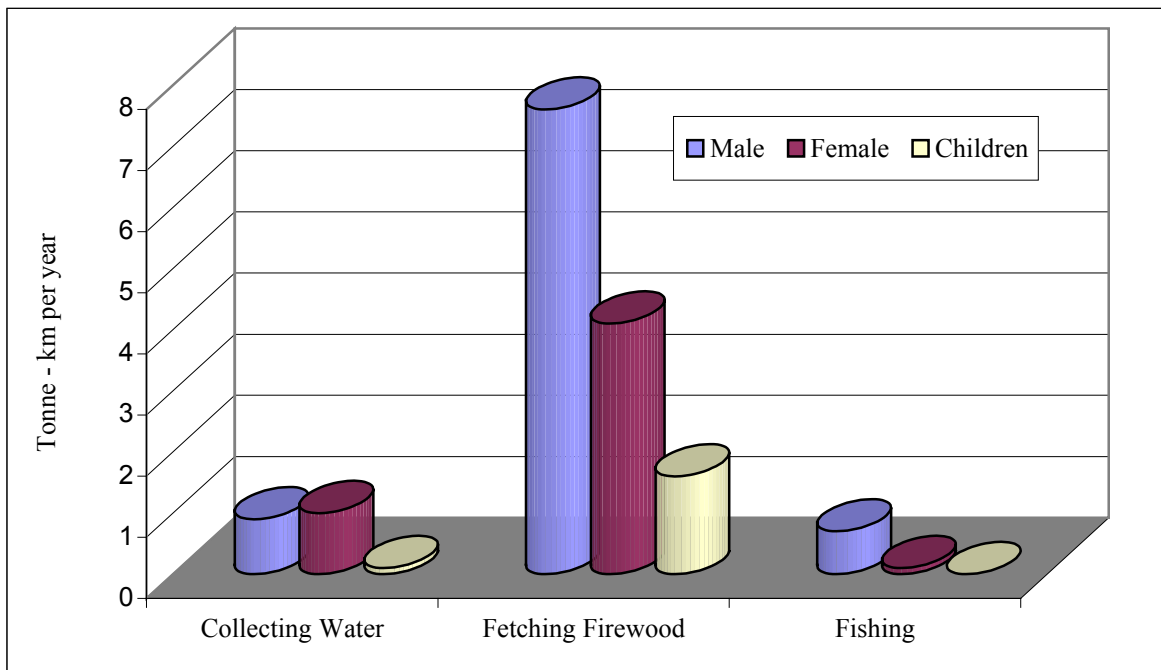


Figure 12: Annual Transport Effort by Gender and Age Group

No	Travel Activity	Annual Transport Effort by Gender and Age Group						Total
		Male		Female		Children		
		Tonne-km	%	Tonne-km	%	Tonne-km	%	
1	Collecting Water	0.9	42.9	1.0	52.4	0.1	4.7	2.0
2	Fetching Firewood	7.6	57.1	4.1	30.8	1.6	12.0	13.3
3	Fishing	0.7	87.5	0.1	12.5	0	0	0.8
	Total	9.2	57.1	5.2	32.3	1.7	10.6	16.1

Table 8: Annual Transport Effort by Gender and Age Group

Combining the distance travelled and the weight transported, men make the largest transport effort. Men account for 57.1 per cent of the total transport effort, while women account for 32.3 per cent. This is mainly because men fetch larger quantities of firewood.

Seasonal Comparison

The time of year affects rural transport patterns. Season has an impact on agricultural activities and micro economic activity and influences travel patterns. Travel times increase and people are forced to change their travel routes and mode of transport.

The graph on the next page shows the different modes of transport used in each season. Transport by foot dominates and increases a little in the wet season.

No	Mode of Transport	Frequency of Use in Dry Season (%)	Frequency of Use in Wet Season (%)	Yearly Frequency of Use (%)
1	On Foot	67.5	73.4	70.3
2	Bicycle	13.4	13.3	13.4
3	Motorbike	1.7	1.4	1.5
4	Oxcart	1.1	1.6	1.4
5	Car	16.3	10.4	13.4
	Total	100	100	100

Table 9: Frequency of Use for Different Transport Modes by Season

Approximately 54.6 per cent of annual trips are made in the dry season and 45.4 per cent in the wet season. In Puok District, dry season travel is 60 per cent and wet season travel is 40 per cent of the annual trips. Trips for water collection mainly account for the differences between the two seasons.

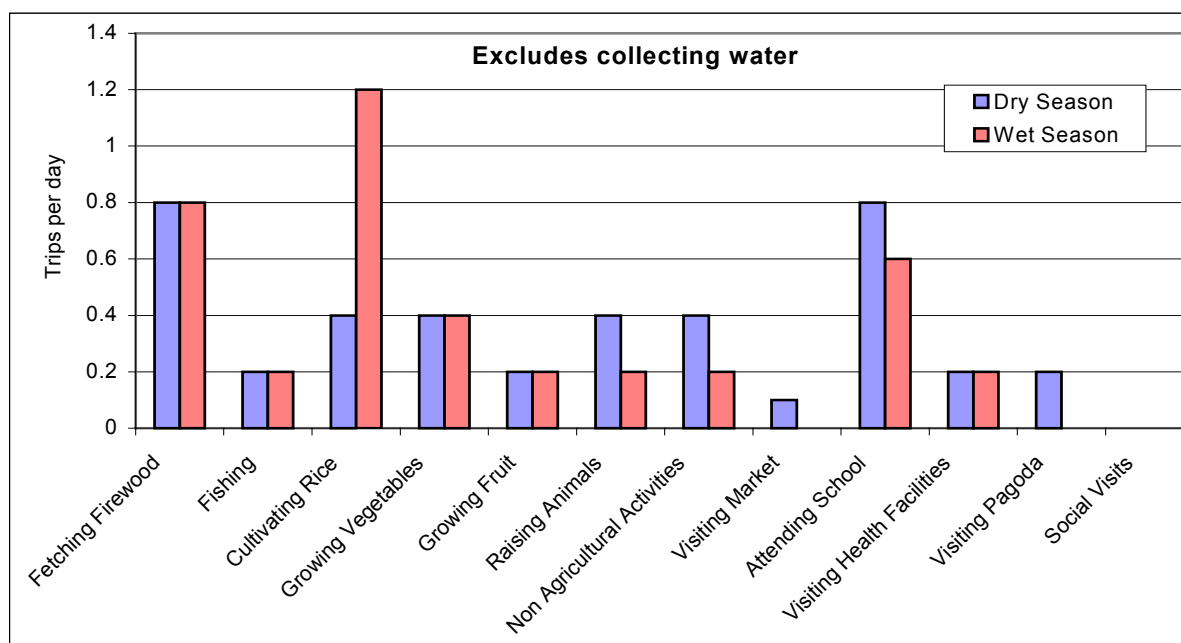


Figure 13: Daily Trip Frequency by Season (Appendix 2, table H)

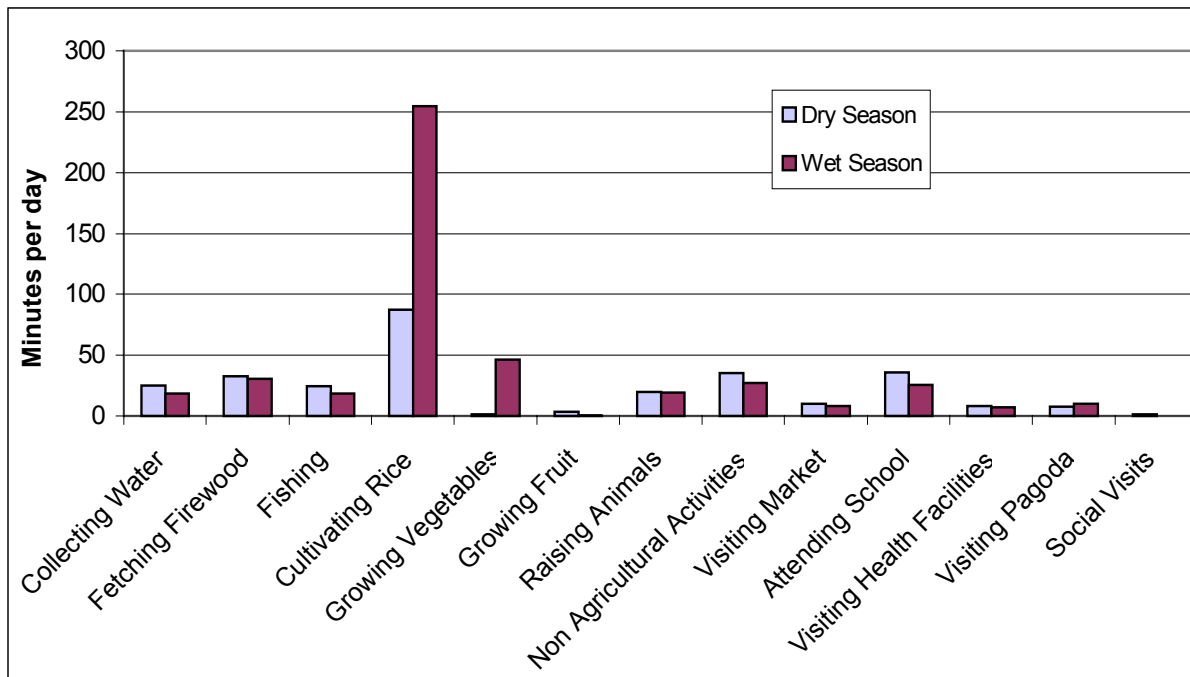


Figure 14: Daily Travel Time by Season (Appendix 2, table I)

Difficult travel conditions and more trips to the distant rice fields mean more time is spent travelling in the wet season. In general, more trips are made in the dry season, but the trips take longer in the wet season. On average, it takes a Peak Snaeng Commune household more than 170 minutes per day to travel to the rice field (longer than the Puok District average of 90 minutes). In the wet season, a family spends 254.5 minutes per day travelling to the rice field (Puok District households spend ‘only’ 138 minutes). In the dry season, this figure is around 88 minutes for a Peak Snaeng Commune family (versus 43 minutes in Puok District).

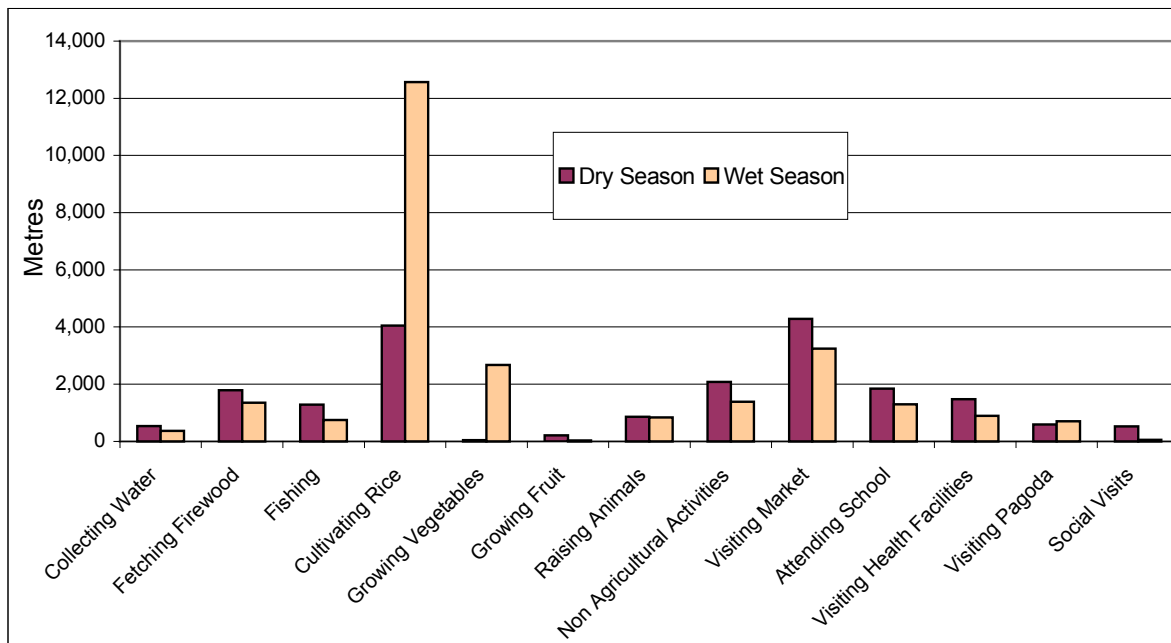


Figure 15: Daily Travel Distance by Season (Appendix 2, table J)

In the dry season, Peak Snaeng Commune households cover 19,564m per day, while in the wet season they travel 26,156m daily. Combining this with the daily trips gives an average trip distance of 1,493m for the dry season and 2,242m for the wet season. Average travel speed is lower in the wet season, about 3.5 kilometres per hour compared with 4.3 kilometres per hour in the dry season. In this case, the average speed for a Peak Snaeng Commune household is higher than for a Puok District household (3 kilometres per hour in the wet season and 3.9 kilometres per hour in the dry season).

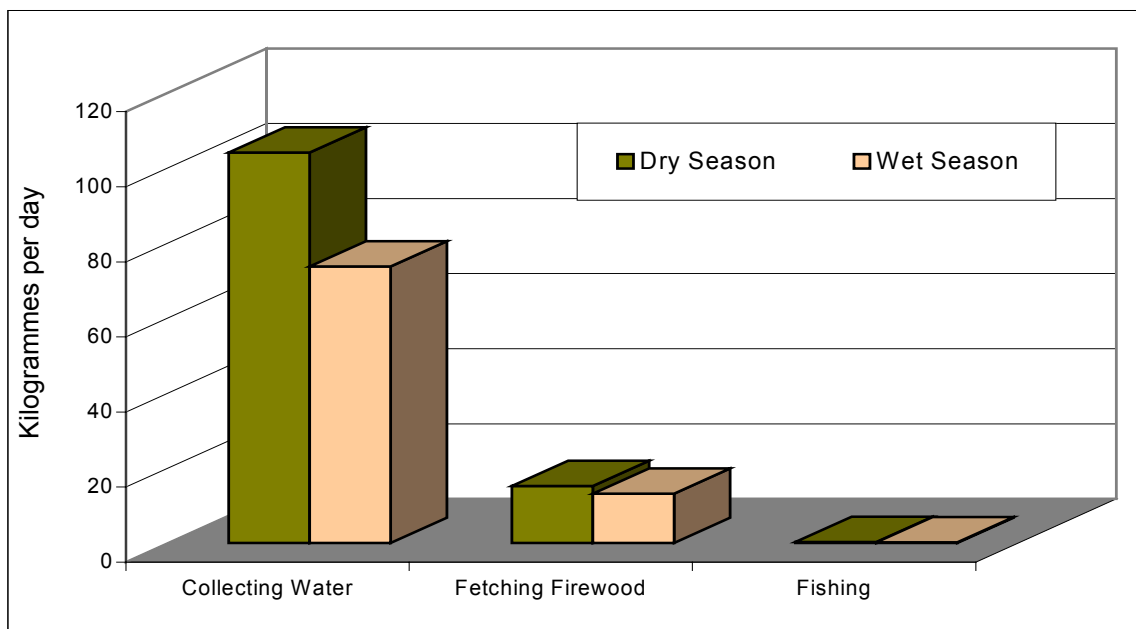


Figure 16: Daily Weight Transported by Season (Appendix 2, table K)

Most weight is transported in the dry season. The weight of water and firewood transported both increases. However, there is little change in the weight of fish transported between the two seasons. In Puok District, there was a slight increase during the wet season.

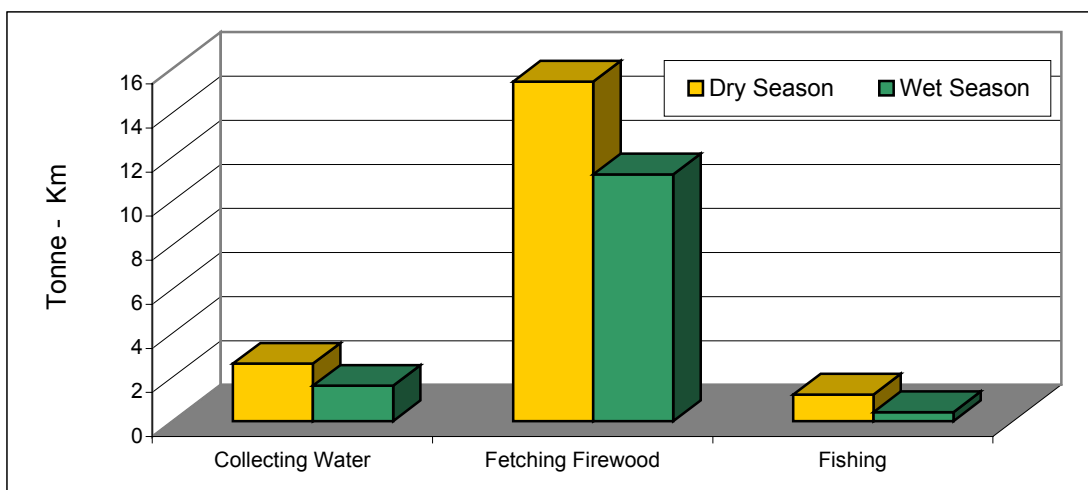


Figure 17: Annual Transport Effort by Season

No	Travel Activity	Transport Effort by Season			
		Dry Season		Wet Season	
		Tonne-km	%	Tonne-km	%
1	Collecting Water	2.6	13.5	1.6	12.1
2	Fetching Firewood	15.4	80.2	11.2	84.9
3	Fishing	1.2	6.3	0.4	3.0
	Total	19.2	100	13.2	100

Table 10: Annual Transport Effort by Season

The greatest transport effort is made fetching firewood. This is true in both seasons. It accounts for 80.2 per cent of the total effort in the dry season and 84.9 per cent in the wet season. Although the amount of firewood carried in the wet season is lower, the longer distance results in a higher transport effort. Collecting water is comparatively low because of the short distances travelled.

Conclusions

Travel and transport are an integral part of human life. In the developed world, trips to obtain necessities like water and fuel have become shorter or have disappeared. Infrastructure and transport modes have evolved, making travel safer, more comfortable and more affordable. This is not the case in large parts of the developing world. In rural areas, where most travel and transport is still on foot, not much has changed.

This is the case in Peak Snaeng Commune, Angkor Thom District, Siem Reap Province. The study found that 70 per cent of all trips in Peak Snaeng Commune were made on foot. In Puok District, trips on foot accounted for about 91 per cent of all trips. In general, travel and transport time took a large part of the day for the families interviewed in Peak Snaeng Commune.

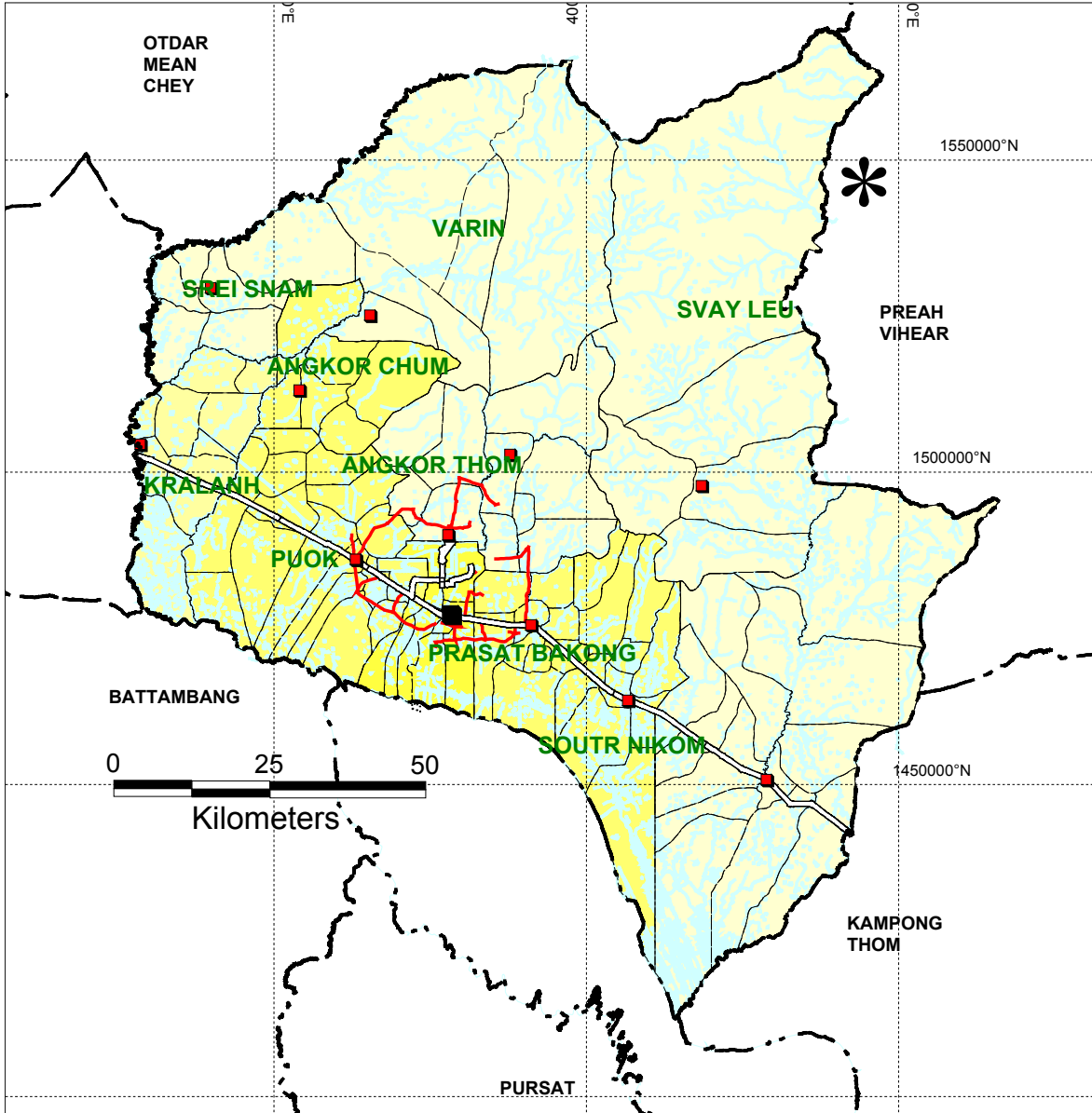
Rural households in Peak Snaeng Commune make an average of 12 trips per day. More than 65 per cent of these trips are for water collection. On a daily basis, families spend around 6 hours 21 minutes travelling and transporting goods, during which they cover approximately 23km on average. Water is most frequently carried, although carrying firewood takes the most energy because of the longer distances involved.

The two stratifications were on gender and on season. The gender comparison showed that the roles of males and females regarding travel and transport were rather balanced. Travel time and travel distances were virtually equal for males and females. However, female household members were making more daily trips while the transport effort of the male members was larger.

In the seasonal trip comparison, there is more travel in the dry season (54.6 %) than in the wet season (45.4 %). This is mainly caused by more water collection trips during the dry season. Therefore, the weight transported is higher in the dry season. Travel time and travel distances increased in the wet season, due to changed RTI conditions.

Appendices

Appendix 1 - Map of Siem Reap Province



Appendix 2 - Additional Tables

No	Main Source of Income	Number of Households	Percentage (%)	Cumulative Percentage (%)
1	Farming	69	93.2	93.2
2	Wage Labour	3	4.1	97.3
3	Other	2	2.7	100.0
4	Total	74	100	100

Table A: Main Source of Income for Surveyed Households

No.	Mode of Transport	Frequency of Use (%)	Cumulative Frequency (%)
1	On Foot	70.3	70.3
2	Bicycle	13.4	83.7
3	Motorised	1.5	85.2
4	Oxcart	1.4	86.6
5	Car	13.4	100.0
	Total	100	100

Table B: Frequency of Use for Different Modes of Transport

No	Travel Activity	Annual Travel Time per Household (minutes)	Daily Travel Time per Household (minutes)	Percentage (%)	Cumulative Percentage (%)
1	Cultivating Rice	61,562	171	44.9	44.9
2	Fetching Firewood	11,389	31.6	8.3	53.2
3	Non Agricultural Activities	11,240	31.2	8.2	61.4
4	Attending School	11,139	30.9	8.1	69.5
5	Growing Vegetables	8,639	24.0	6.3	75.8
6	Collecting Water	7,888	21.9	5.8	81.6
7	Fishing	7,771	21.6	5.7	87.3
8	Raising Animals	7,059	19.6	5.1	92.4
9	Visiting Market	3,332	9.3	2.4	94.8
10	Visiting Pagoda	3,278	9.1	2.4	97.2
11	Visiting Health Facilities	2,813	7.8	2.1	99.3
12	Growing Fruit	730	2.0	0.5	99.8
13	Social Visits	323	0.9	0.2	100
	Total	137,163	381.0	100	100

Table C: Total Annual Household Travel Time

No	Travel Activity	Annual Distance Travelled per Household (metre)	Daily Distance Travelled per Household (metre)	Percentage (%)	Cumulative Percentage (%)
1	Cultivating Rice	2,991,816	8,311	36.4	36.4
2	Visiting Market	1,355,378	3,765	16.5	52.9
3	Non Agricultural Activities	621,893	1,728	7.6	60.5
4	Fetching Firewood	566,589	1,574	6.9	67.4
5	Visiting School	565,739	1,571	6.9	74.3
6	Growing Vegetables	488,340	1,357	5.9	80.2
7	Visiting Health Facilities	424,866	1,180	5.2	85.4
8	Fishing	364,559	1,013	4.4	89.8
9	Raising Animals	305,017	847	3.7	93.5
10	Visiting Pagoda	233,054	647	2.8	96.3
11	Collecting Water	163,171	453	1.9	98.2
	Social Visits	104,878	291	1.3	99.5
13	Growing Fruit	44,294	123	0.5	100
	Total	8,229,594	22,860	100	100

Table D: Annual Distance Travelled per Household

No	Travel Activity	Daily Number of Trips by Gender and Age Group						Trip Total
		Male		Female		Children		
		Number	%	Number	%	Number	%	
1	Collecting Water	2.5	31.7	4.3	54.4	1.1	13.9	7.9
2	Fetching Firewood	0.3	37.5	0.4	50.0	0.1	12.5	0.8
3	Fishing	0.2	100.0	0.0	0	0.0	0	0.2
4	Cultivating Rice	0.3	37.5	0.4	50.0	0.1	12.5	0.8
5	Growing Vegetables	0.1	25.5	0.2	50.0	0.1	25.5	0.4
6	Growing Fruit	0.1	50.0	0.1	50.0	0.0	0.0	0.2
7	Raising Animals	0.2	66.7	0.0	0.0	0.1	33.3	0.3
8	Non Agricultural Activities	0.2	66.7	0.1	33.3	0.0	0.0	0.3
9	Visiting Market	0.0	0.0	0.1	100	0.0	0.0	0.1
10	Attending School	0.0	0.0	0.1	14.3	0.6	85.7	0.7
11	Visiting Health Facilities	0.0	0.0	0.1	50.0	0.1	50.0	0.2
12	Visiting Pagoda	0.0	0.0	0.1	100	0.0	0.0	0.1
13	Social Visits	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Total	3.9	32.5	5.9	49.2	2.2	18.3	12.0

Table E: Daily Trip Frequency by Gender and Age Group

No	Travel Activity	Daily Travel Time by Gender and Age Group						Total Time (minutes)
		Male		Female		Children		
		Time (minutes)	%	Time (minutes)	%	Time (minutes)	%	
1	Collecting Water	7.6	34.7	11.7	53.4	2.6	11.9	21.9
2	Fetching Firewood	12.7	40.2	14.4	45.6	4.5	14.2	31.6
3	Fishing	16.7	77.3	3.6	16.7	1.3	6.0	21.6
4	Cultivating Rice	64.6	37.8	76.9	45.0	29.5	17.2	171.0
5	Growing Vegetables	7.2	30.0	8.2	34.2	8.6	35.8	24.0
6	Growing Fruit	1.2	60.0	0.8	40.0	0.0	0	2.0
7	Raising Animals	8.7	44.4	1.1	5.6	9.8	50.0	19.6
8	Non Agricultural Activities	14.0	44.9	14.0	44.9	3.2	10.2	31.2
9	Visiting Market	4.5	48.4	4.7	50.5	0.1	1.1	9.3
10	Attending School	2.5	8.1	1.0	3.2	27.4	88.7	30.9
11	Visiting Health Facilities	1.7	21.8	3.4	43.6	2.7	34.6	7.8
12	Visiting Pagoda	2.4	26.4	3.1	34.0	3.6	39.6	9.1
13	Social Visits	0.4	44.5	0.3	33.3	0.2	22.2	0.9
	Total	144.2	37.9	143.2	37.6	93.5	24.5	381.0
	Total Time in hours	2hr24mn		2hr23mn		1hr34mn		6hr 21mn

Table F: Daily Travel Time by Gender and Age Group

No	Travel Activity	Daily Travel Distance by Gender and Age Group						Total Distance (metre)
		Male		Female		Children		
		Distance (metre)	%	Distance (metre)	%	Distance (metre)	%	
1	Collecting Water	168	37.1	238	52.6	47	10.3	453
2	Fetching Firewood	660	41.9	695	44.1	219	13.9	1,574
3	Fishing	795	78.6	170	16.7	48	4.7	1,013
4	Cultivating Rice	3,115	37.5	3,825	46.0	1,371	16.5	8,311
5	Growing Vegetables	389	28.7	433	31.9	535	39.4	1,357
6	Growing Fruit	78	63.4	45	36.6	0	0	123
7	Raising Animals	386	45.6	52	6.2	409	48.2	847
8	Non Agricultural Activities	703	40.7	879	50.9	146	8.5	1,728
9	Visiting Market	1,701	45.2	1,989	52.8	75	2.0	3,765
10	Attending School	197	12.6	32	2.0	1,342	85.4	1,571
11	Visiting Health Facilities	392	33.2	561	47.5	227	19.3	1,180
12	Visiting Pagoda	199	30.7	218	33.7	230	35.6	647
13	Social Visits	108	37.0	119	40.9	64	22.1	291
	Total	8,891	38.9	9,256	40.5	4,713	20.6	22,860

Table G: Daily Travel Distance by Gender and Age Group

No	Travel Activity	Daily Number of Trips by Season				Trip Average
		Dry Season		Wet Season		
		Number	%	Number	%	
1	Collecting Water	9.0	57.0	6.8	43.0	7.9
2	Fetching Firewood	0.8	50.0	0.8	50.0	0.8
3	Fishing	0.2	50.0	0.2	50.0	0.2
4	Cultivating Rice	0.4	25.0	1.2	75.0	0.8
5	Growing Vegetables	0.4	50.0	0.4	50.0	0.4
6	Growing Fruit	0.2	50.0	0.2	50.0	0.2
7	Raising Animals	0.4	66.7	0.2	33.3	0.3
8	Non Agricultural Activities	0.4	66.7	0.2	33.3	0.3
9	Visiting Market	0.1	100	0	0	0.1
10	Attending School	0.8	57.1	0.6	42.9	0.7
11	Visiting Health Facilities	0.2	50.0	0.2	50.0	0.2
12	Visiting Pagoda	0.2	100	0	0	0.1
13	Social Visits	0	0	0	0	0
	Total (number/%)	13.1 trips	54.6	10.8 trips	45.4	12.0 trips

Table H: Daily Trip Frequency by Season

No	Travel Activity	Daily Travel Time by Season				Average Travel Time (minutes)
		Dry Season		Wet Season		
		Time (minutes)	%	Time (minutes)	%	
1	Collecting Water	25.2	57.5	18.6	42.5	21.9
2	Fetching Firewood	32.6	51.6	30.7	48.4	31.6
3	Fishing	24.7	57.2	18.5	42.8	21.6
4	Cultivating Rice	87.5	25.6	254.5	74.4	171.0
5	Growing Vegetables	1.6	3.3	46.4	96.7	24.0
6	Growing Fruit	3.4	85.0	0.6	15.0	2.0
7	Raising Animals	19.7	50.3	19.5	49.7	19.6
8	Non Agricultural Activities	35.2	56.4	27.2	43.6	31.2
9	Visiting Market	10.2	54.8	8.3	45.2	9.3
10	Attending School	36.0	58.3	25.8	41.7	30.9
11	Visiting Health Facilities	8.2	52.6	7.4	47.4	7.8
12	Visiting Pagoda	7.8	42.9	10.4	57.1	9.1
13	Social Visits	1.6	88.9	0.2	11.1	0.9
	Total (time/%)	293.7	38.5	468.1	61.5	381.0

Table I: Daily Travel Time by Season

No	Travel Activity	Daily Travel Distance by Season				Average Travel Distance (metre)
		Dry Season		Wet Season		
		Distance (metre)	%	Distance (metre)	%	
1	Collecting Water	540	59.6	366	40.4	453
2	Fetching Firewood	1,792	56.9	1,356	43.1	1,574
3	Fishing	1,280	63.2	746	36.8	1,013
4	Cultivating Rice	4,050	24.4	12,572	75.6	8,311
5	Growing Vegetables	36	1.3	2,678	98.7	1,357
6	Growing Fruit	212	86.5	34	13.5	123
7	Raising Animals	860	50.8	834	49.2	847
8	Non Agricultural Activities	2,074	60.0	1,382	40.0	1,728
9	Visiting Market	4,290	57.0	3,240	43.0	3,765
10	Attending School	1,844	58.7	1,298	41.3	1,571
11	Visiting Health Facilities	1,472	62.4	888	37.6	1,180
12	Visiting Pagoda	588	45.4	706	54.6	647
13	Social Visits	526	90.4	56	9.6	291
	Total (distance/%)	19,564	42.8	26,156	57.2	22,860

Table J: Daily Travel Distance by Season

No	Travel Activities	Weight Transported by Season			
		Dry Season		Wet Season	
		Weight (Kg)	%	Weight (Kg)	%
1	Collecting Water	104.1	87.0	73.7	84.6
2	Fetching Firewood	15.2	12.7	13.2	15.1
3	Fishing	0.3	0.3	0.2	0.2
	Total	119.6	100	87.1	100

Table K: Daily Weight Transported by Season

PART TWO

Vehicular Traffic on National Road 68: *A Baseline Traffic Study between Samraong and O'Smach*

Executive Summary

This research project combines a *Traffic Count* and an *Origin and Destination* study. It was carried out along national road 68 in Oddar Meanchey Province in May 2001. The study was requested by the Ministry of Rural Development (MRD)/Asian Development Bank (ADB) *Project Preparation Technical Assistance* (PPTA No. 3489-CAM) team for the rural development project in Northwest Cambodia.

The actual traffic research was a joint effort between provincial and local Government officials in Oddar Meanchey, the *Benefit Monitoring & Evaluation Unit* of the MRD and the *Socio-economic Team* of the International Labour Organisation (ILO) Upstream project. The objective of the study was to provide baseline traffic data for the MRD/ADB assessment of the importance of national road 68 from Samraong to O'Smach to rural development in Oddar Meanchey.

Traffic count teams were set up in three locations along national road 68 to assess traffic type and volume from six a.m. to six p.m. over a period of seven consecutive days. Origin and destination surveys were conducted at the same locations to gather detailed information about journey types and transport load. The research teams counted 15,781 vehicles passing the survey locations during the one-week survey, an average of 2,254 vehicle movements per day. The most common vehicles were motorbikes and bicycles, which accounted for over 90 per cent of all recorded traffic. Most of this traffic passed the survey locations before 11 a.m. The busiest days were Saturday, Sunday and Monday.

A total of 9,595 road users were interviewed. The majority of these road users originated from Districts within Oddar Meanchey Province (96.5 %). The remaining road users (3.5%) started their journey in Siem Reap, Battambang or Banteay Meanchey Provinces. Within Oddar Meanchey Province, most of the road users started their journey in Samraong District (97.8 %), while 2.2 per cent departed from one of the other three districts (Chong Kal, Banteay Ampil or Anlong Veng). The average time on the road for vehicle drivers interviewed was 84 minutes per one way trip. The trip frequency averaged approximately 2.7 times per day. Handcarts made the shortest trips (approximately 28 minutes), while the average truck trip lasted the longest - about 4.5 hours. The average bicycle trip lasted about 39 minutes, while motorbike trips were significantly longer - around 84 minutes on average.

More than half the vehicles surveyed transported passengers, about one third were empty and the rest transported products. Motorbikes carried 1.7 passengers on average, while bicycles transported approximately 1.3 passengers. When transporting products, the average motorbike load was 24.3 kilograms, for bicycles it was 8.4 kilograms. In trip numbers, the most transported product was fruit, mainly from Thailand. The second most transported product was "Other Household and Capital Goods" and the third most important was the combined category of firewood and charcoal.

Introduction

Since 1999, the ILO Upstream project has been conducting socio-economic studies on rural transport infrastructure planning and investment in Cambodia. These studies aim to measure the potential socio-economic impacts arising from interventions in rural transport infrastructure. They include research on employment generation, markets, water transport, traffic patterns and household travel and transport patterns in rural Cambodia.

In March 2001, the MRD/ADB Project Preparation Technical Assistance (PPTA No. 3489-CAM) team approached the ILO Upstream Project and asked for research assistance for their activities in Oddar Meanchey Province. MRD/ADB recognise that this section of national road 68 from the provincial capital Samraong to O'Smach at the Thai border is important for rural development in the province. Thus, a request was made to undertake a traffic study, similar to that done in Puok District of Siem Reap Province¹⁵, to get baseline data on the traffic characteristics on national road 68.

In late April 2001, initial discussions began with provincial officials and other local stakeholders. Survey locations, recruitment of researchers and other relevant preparations were discussed. Subsequently, 12 local people were trained to count traffic and 24 were trained on origin and destination (O&D) survey methods. A one day pilot was run to test the methodology and for the trainees to gain field experience. On Friday May 4, 2001, the one-week combined traffic count and O&D study started at three locations along national road 68 from Samraong to O'Smach.

This report analyses the traffic count data: it presents the different vehicle types observed, variations in traffic density between the days of the week, the different hours of the day and the differences in traffic characteristics among the survey locations. The O&D survey results are presented indicating types of load, travel times, types of travel etc. The conclusions of the study are presented at the end of the report.

¹⁵ *Traffic Characteristics around Puok Market, Rural Transport Infrastructure Research, Upstream Socio Economic Series Number 1*, by Bas Rozemuller, Sovithea Khun and Yan Samrith, Phnom Penh, February 2000.

Traffic Count

For seven days, the traffic count teams observed all daytime vehicle movements along national road 68 from Samraong to O'Smach. Three survey locations along this road were chosen in consultation with the provincial Government. The survey locations were:

- Location 1 - Kandaek village - a few kilometres Northwest of Samraong
- Location 2 - Khtum village - located approximately at the middle of the section of road
- Location 3 - a roadside survey point just outside O'Smach town

The traffic was divided into ten different vehicle categories, based upon earlier traffic studies in Northwest Cambodia. Table 1 shows these categories.

No.	Vehicle Type
1	Bicycle
2	Motorbike
3	Motor trailer (<i>remorque</i>)
4	Animal drawn cart ¹⁷
5	Car
6	Pickup ¹⁸
7	<i>Koyun</i> ¹⁹
8	Truck
9	Handcart
10	Other

Table 1: Vehicle Categories

Days of the Week

During the week of surveying, the research teams counted 15,781 vehicles passing the roadside survey locations. This amounts to an average traffic flow of about 2,254 vehicles per day. However, there is considerable variation in traffic between the different days of the week, as the next graph shows.

¹⁷ In Cambodia, oxen, horses or water buffaloes pull carts. To simplify coding, the term 'animal drawn cart' is used throughout the report.

¹⁸ The vehicle type pickup includes the *laan koree*, i.e. Korean light truck. The capacity of this vehicle varies from 0.5 to 2 tonnes.

¹⁹ A *koyun* is a local vehicle that uses a single piston engine, usually 8-12 H.P. - *ko* is the Khmer for ox and *yun* means machine (capacity 1-3 tonnes).

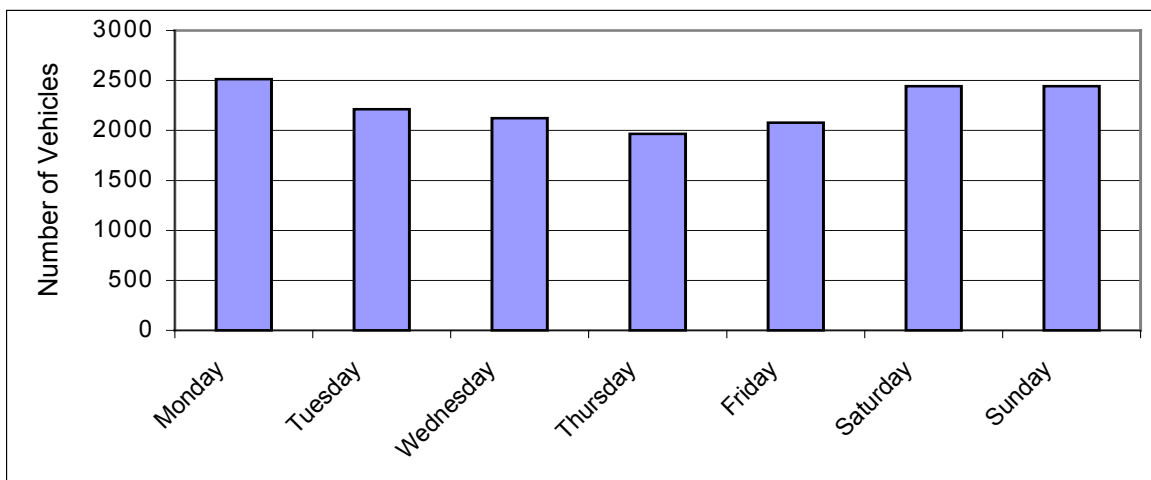


Figure 1: Daily Traffic Density

Saturday, Sunday and Monday were the busiest days. On these days the cross border market in O'Smach is open and many Cambodians travel to the border to trade. Table 2 below shows the comparison of this daily traffic in both directions on the national road.

Day of the Week	National Road 68 Location 1			National Road 68 Location 2			National Road 68 Location 3		
	SR to OS*	OS to SR	Total	SR to OS	OS to SR	Total	SR to OS	OS to SR	Total
Monday	585	684	1,269	406	399	805	205	235	440
Tuesday	555	599	1,154	374	375	749	168	143	311
Wednesday	508	621	1,129	317	369	686	144	164	308
Thursday	487	606	1,093	314	320	634	115	124	239
Friday	542	556	1,098	319	335	654	146	181	327
Saturday	552	573	1,125	379	402	781	326	211	537
Sunday	517	634	1,151	375	391	766	174	351	525
Total	3,746	4,273	8,019	2,484	2,591	5,075	1,278	1,409	2,687

* SR to OS = Samraong to O'Smach, OS to SR= O'Smach to Samraong

Table 2: Daily Traffic Flow

Hours of the Day

Traffic counts were carried out from dawn until dusk. A one-day pilot study was held from five a.m. until seven p.m. to determine the optimum timing for the study. It was found that there was hardly any traffic on the road before six a.m. or after six p.m. The traffic count and the origin and destination research were conducted during these hours.

²⁰ Security concerns may have influenced this pattern. Until recently, the area was a war zone, banditry is still rife and people are concerned about security in the early and late hours.

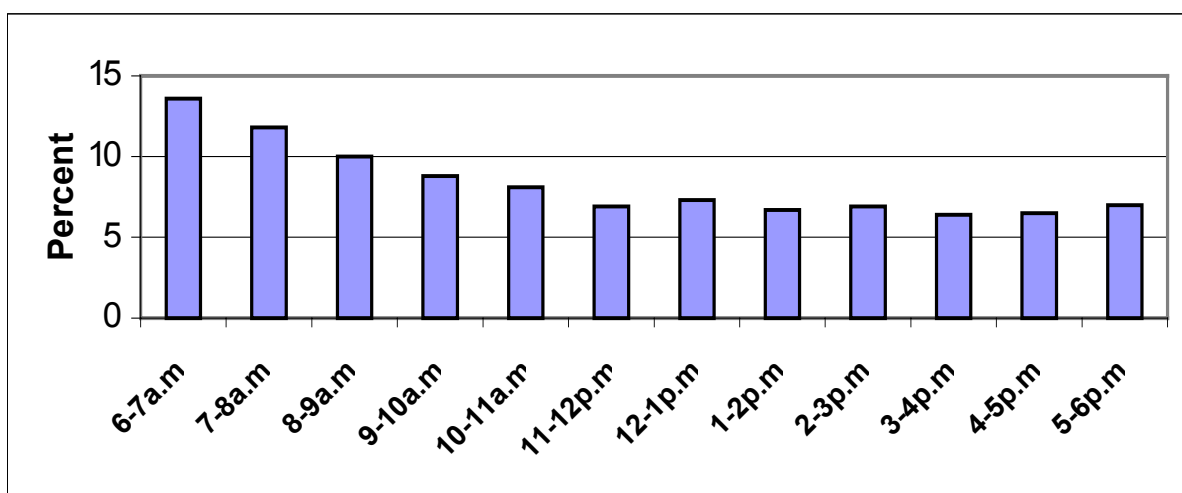


Figure 2: Traffic per Hour

The hour with most traffic is clearly from six a.m. to seven a.m. About 13.6 per cent of the daily traffic passed the observation posts during this hour. In general the roads are significantly more crowded during the morning than in the afternoon. Before 11 a.m., more than 50 per cent of all the observed traffic passed by the observation posts. In the late afternoon, we see another small increase, from four p.m. until six p.m. This pattern is similar to that observed on other roads in Northwest Cambodia.

Hour of the Day	Percentage of Total Traffic	Cumulative Traffic Percentage
6 – 7 a.m.	13.6	13.6
7 – 8 a.m.	11.8	25.4
8 – 9 a.m.	10.0	35.4
9 – 10 a.m.	8.8	44.2
10 – 11 a.m.	8.1	52.3
11 – 12 p.m.	6.9	59.2
12 – 1 p.m.	7.3	66.5
1 – 2 p.m.	6.7	73.2
2 – 3 p.m.	6.9	80.1
3 – 4 p.m.	6.4	86.5
4 – 5 p.m.	6.5	93.0
5 – 6 p.m.	7.0	100

Table 3: Traffic Density by Hour

Traffic Density at Three Different Locations

The three different roadside locations showed quite a different picture of the passing traffic. Location 1 at Kandaek village counted by far the most vehicles during the research period, as the next figure clearly depicts.

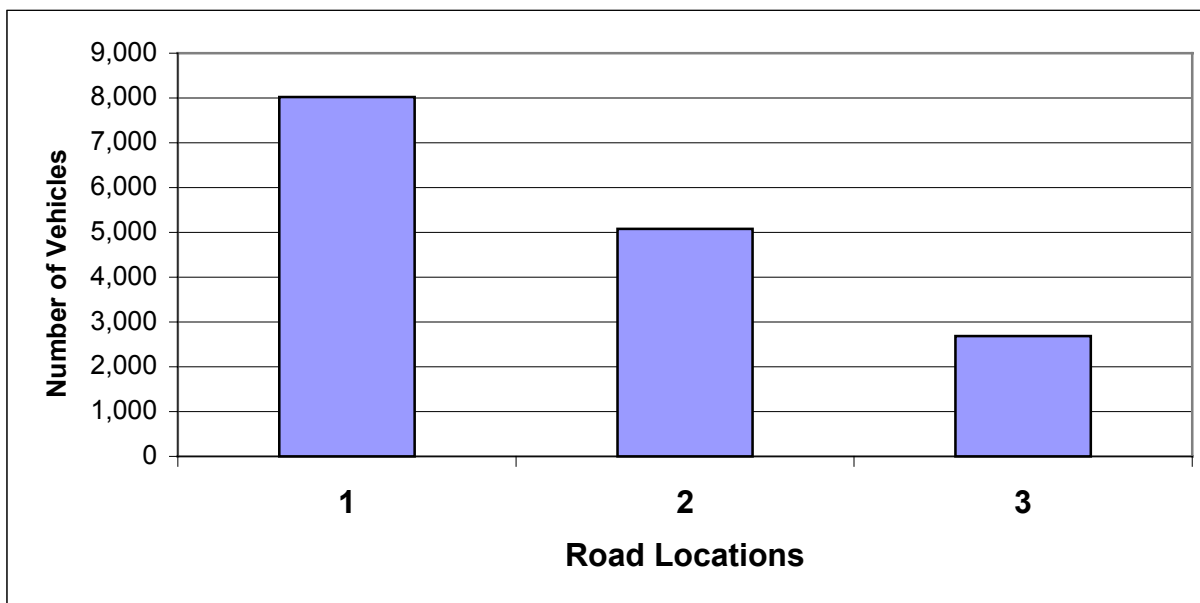


Figure 3: Traffic Volume at Three Traffic Count Locations

Location 3 at O'Smach road observed the lowest volume of traffic and the traffic counted at location 2 at Khtum village fell about midway between the other two locations. It appears that further from the provincial centre of Samraong, fewer vehicles travel along national road 68 towards the Thai border. Table 4 compares the number of vehicles at the three checkpoints in more detail, showing the variation in volumes in different directions during the 12 hours of the traffic count.

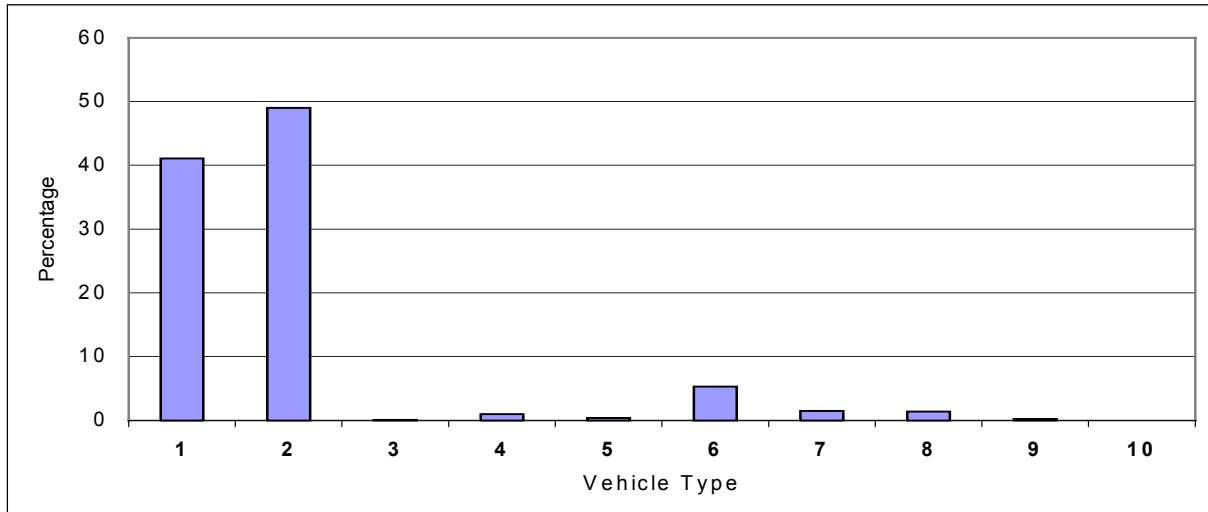
Time	National Road 68 Location 1			National Road 68 Location 2			National Road 68 Location 3		
	SR to OS*	OS to SR	Total	SR to OS	OS to SR	Total	SR to OS	OS to SR	Total
6-7 a.m.	827	471	1298	315	327	642	115	90	205
7-8 a.m.	381	441	822	288	390	678	140	222	362
8-9 a.m.	320	450	770	207	272	479	125	199	324
9-10 a.m.	290	431	721	183	205	388	100	185	285
10-11 a.m.	245	389	634	192	193	385	101	151	252
11-12 p.m.	225	327	552	137	165	302	143	95	238
12-1 p.m.	223	302	525	174	184	358	174	95	269
1-2 p.m.	223	256	479	203	171	374	124	72	196
2-3 p.m.	265	302	567	200	153	353	91	91	182
3-4 p.m.	223	269	492	186	167	353	74	92	166
4-5 p.m.	249	306	555	169	164	333	56	78	134
5-6 p.m.	275	329	604	230	200	430	35	39	74
Total	3,746	4,273	8,019	2,484	2,591	5,075	1,278	1,409	2,687
Aver/day	535	610	1,146	355	370	725	183	150	384

* SR to OS= Samraong to O'Smach, OS to SR= O'Smach to Samraong

Table 4: Traffic Density at the Three Traffic Count Locations

Vehicle Type

Motorbikes and bicycles make up the majority of the traffic observed along national road 68. Together they accounted for more than 90 per cent of all vehicles, with motorbikes a little less than 50 per cent and bicycles slightly more than 40 per cent.



1 = bicycle, 2 = motorbike, 3 = remorque, 4 = Animal drawn cart, 5 = car, 6 = pickup, 7 = koyun, 8 = truck, 9 = handcart, 10 = other

Figure 4: Comparison of All Vehicle Types

The third most common vehicle was the pickup and the fourth was the *koyun*. The next figure shows the eight remaining vehicles, excluding motorbikes and bicycles.

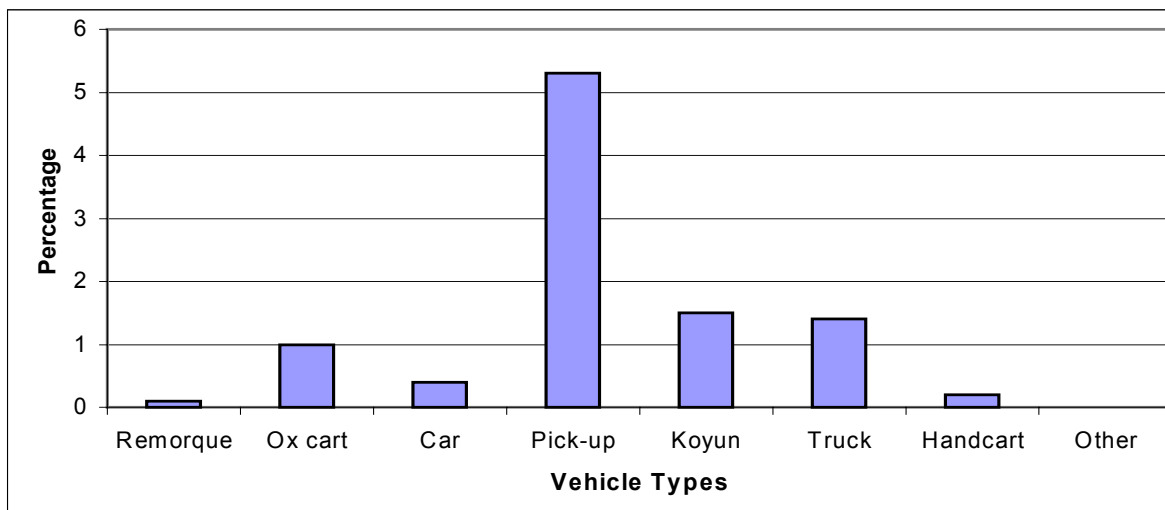


Figure 5: Comparison of Eight Vehicle Types

Table 5 adds the dimension of the locations to the vehicle mode picture. When comparing the three locations it shows that the farther one moves from the provincial centre, the less local (i.e. non-motorised) the traffic becomes, hence the relatively large numbers of motorbikes and pickups at the second and the third locations.

Vehicle Type	National Road 68 Location 1			National Road 68 Location 2			National Road 68 Location 3		
	*SR to OS	OS to SR	Total	SR to OS	OS to SR	Total	SR to OS	OS to SR	Total
1	1,989	2,255	4,244	1,090	1,065	2,155	35	53	88
2	1,501	1,720	3,221	1,146	1,245	2,391	1,014	1,105	2,119
3	5	7	12	3	2	5	3	0	3
4	44	56	100	17	48	65	0	0	0
5	27	6	33	5	8	13	6	9	15
6	100	155	255	138	135	273	137	165	302
7	44	34	78	38	41	79	38	43	81
8	29	40	69	35	38	73	45	34	79
9	7	0	7	12	9	21	0	0	0
10	0	0	0	0	0	0	0	0	0
Total	3,746	4,273	8,019	2,484	2,591	5,075	1,278	1,409	2,687

- SR to OS= Samraong to O'Smach, OS to SR= O'Smach to Samraong

1 = bicycle, 2 =motorbike, 3 = remorque, 4 =Animal drawn cart, 5 = car, 6 = pick-up, 7 = koyun, 8 = truck, 9 = handcart, 10 = other.

Table 5: Vehicle Division at the Three Traffic Count Locations

Origin and Destination Survey

Traffic count studies provide basic information about traffic flows in a certain area, including vehicle types, direction and time of passing. However, observing and counting the passing traffic does not provide information about the origin and destination of the vehicle, trip time and trip frequency or the types and quantity of the vehicle loads.

An *Origin and Destination survey* was carried out to discover this more detailed information. The drivers passing the three traffic count locations were interviewed. The vehicles were stopped for only a few minutes to avoid interfering with the normal traffic movements.

This part of the report will first address some general issues about the vehicular traffic along national road 68, like travel time, frequency, load characteristics, etc. Subsequently, it will focus on the different levels of travel i.e. the differences between provincial, district and commune travel. Finally, it will examine traffic flows at the village level within Samraong commune.

General Characteristics of the Surveyed Traffic

The team interviewed 9,595 road users at the three traffic count locations during the survey. Approximately 61 per cent of the total traffic passing by the survey locations (15,781 vehicles) were interviewed.²¹ The same vehicle classifications were used as in the traffic count study (see Table 1). This section will examine some of the more general travel aspects, like travel time. The next table shows the average travel time per trip for the ten vehicle types involved in the study. It also gives the trip frequency for the different vehicle types.

No.	Type of Vehicle	Average Travel Time/Trip (minutes)	Average Frequency per day (frequency)
1	Bicycle	38.7	2.6
2	Motorbike	84.4	3.0
3	Remorque	59.5	1.3
4	Animal drawn cart	82.3	1.7
5	Car	227.6	1.4
6	Pickup	201.8	1.2
7	<i>Koyun</i>	148.2	1.6
8	Truck	273.7	1.1
9	Handcart	28.3	2.0
10	Other	0.0	0.0
	Average	84.0	2.7

Table 6: Comparison of Travel Time and Frequency

²¹ The relatively low traffic density (compared to the Puok study) made it possible to interview many road users, hence the high sample size.

The average time on the road for the drivers interviewed was about 84 minutes. Road users made 2.7 trips per day on average. Truck drivers spent the most time on the road; their trips lasted approximately 4.5 hours. Their trip frequency was low, a bit more than one trip per day. Handcart trips along national road 68 were the shortest at 28.3 minutes, with a frequency of two trips per day. Motorbikes had the highest trip frequency at three trips per day on average.

Vehicle Load

One of the questions asked during the origin and destination survey was about vehicle load. Vehicles were divided into three categories: empty vehicles, vehicles carrying passengers and vehicles carrying products.²² The products were further subdivided into 19 categories. The next table shows the categories, the product subcategories and their codes.

Code	Classification of Vehicle Load
0	Empty
1	Fresh vegetables
2	Bulbs/roots/pulses/tubers
3	Rice/paddy
4	Other grains
5	Fruit
6	Fresh fish/crustaceans
7	Dried and smoked fish/crustaceans
8	Meat (pork/beef/chicken/duck/bird)
9	Livestock (poultry/pig/cow)
10	Passengers
11	Dried/processed foods (incl. herbs/spices/cooking oils)
12	Beverages
13	Cloth/clothes
14	Other household & capital goods
15	Tobacco
16	Construction materials
17	Firewood/charcoal
18	Fuel
19	Ice
20	Other

Table 7: Categories of Vehicle Load

Of all the vehicles surveyed along national road 68, 32 per cent were empty. Transporting passengers seemed the most important business at 52 per cent of all the vehicles surveyed. The number of vehicles transporting products was approximately 16 per cent.

²² Often, there was no single vehicle load. In those cases, respondents were asked for the most important load.

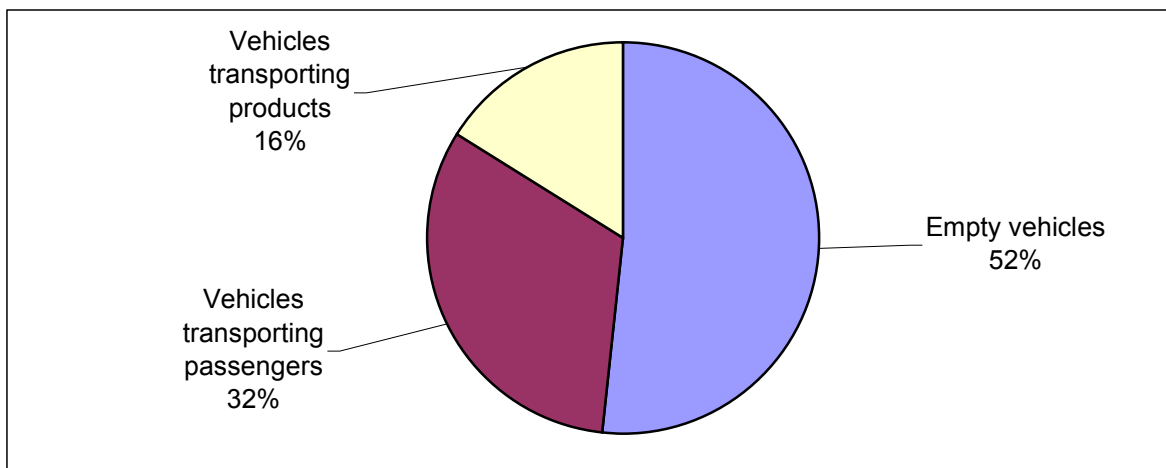


Figure 6: Vehicle Load

Fruit was the most frequently transported product - in vehicle numbers - along national road 68 in Samraong district. As the next table shows, for motorbikes, cars and *koyuns* the most often transported product was fruit, mainly originating from Thailand. The second most transported product was "other household and capital goods" (mainly by *remorque*, pickup and bicycle) and the third was *firewood/charcoal* (mostly by animal drawn cart, bicycle and *koyun*).

No	Vehicle	Product 1	Product 2	Product 3
1	Bicycle	Firewood/charcoal	Other household & capital goods	Rice/paddy
2	Motorbike	Fruit	Rice/paddy	Dried/processed foods
3	Remorque	Other household & capital goods	Fruit	Rice/paddy
4	Animal drawn cart	Firewood/charcoal	Other household & capital goods	Construction materials
5	Car	Fruit	Dried/processed foods.	Other household & capital goods
6	Pickup	Other household & capital goods	Dried/processed foods.	Rice/paddy
7	Koyun	Fruit	Firewood/charcoal	Cloth/clothes
8	Truck	Dried/processed foods.	Construction materials	Firewood/charcoal
9	Handcart	Rice/paddy	Fruit	-

Table 8: Ranking of Products per Vehicle

The quantities transported varied significantly between the vehicle types. This was the case for both product and passenger transport. The average load varied from about 8.4 kilograms for bicycles to 1,485 kilograms for trucks. The next table shows the average load for the nine vehicle types.

No.	Vehicle Type	Average Vehicle Load (Kg)
1	Bicycle	8.4
2	Motorbike	24.3
3	Remorque	39.0
4	Animal drawn cart	98.8
5	Car	766.7
6	Pickup	768.9
7	Koyun	1,484.6
8	Truck	1,484.8
9	Handcart	56.6

Table 9: Average Product Load

For some vehicles, transporting products is only a small part of their business. For *koyuns* and pickups, the majority of their transport involves passengers. The next table presents the average number of passengers carried by each vehicle type.

No.	Vehicle Type	Average Vehicle Load (passengers)
1	Bicycle	1.3
2	Motorbike	1.7
3	Remorque	1.3
4	Animal drawn cart	2.0
5	Car	7.5
6	Pickup	10.5
7	Koyun	12.5
8	Truck	3.8
9	Handcart	0.0

Table 10: Average Passenger Load²³

Traffic along National Road 68

A clear majority of the interviewed road users (96.5%) started their journey in one of the districts within Oddar Meanchey Province. The remaining 3.5 per cent came from other provinces, like Siem Reap, Battambang or Banteay Meanchey. Most of this small proportion came from Kralanh district and Siem Reap town in Siem Reap Province – transporting construction material, processed food and other household goods. The vehicles from Banteay Meanchey and Battambang Province mainly carried rice/paddy, construction material and fruits.

²³ These numbers exclude the drivers of the vehicles.

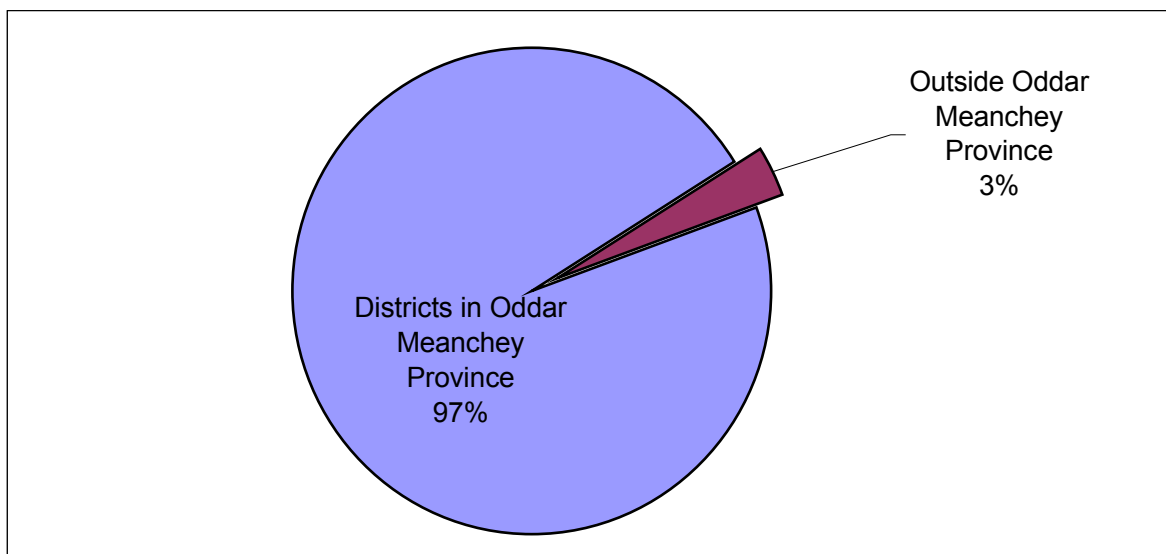


Figure 7: Origin of Interviewed Traffic

Comparing the three locations one can see a difference: Location 1, close to Samraong town has the most local travel (only 3% of traffic from outside Oddar Meanchey Province), while Location 3 in O'Smach has the most regional travel (6% of traffic originates from outside Oddar Meanchey). The table below shows these differences.

Location	Origin in Oddar Meanchey Province (%)	Origin outside Oddar Meanchey Province (%)	Total (%)
Location 1	97.0	3.0	100
Location 2	96.6	3.4	100
Location 3	94.0	6.0	100

Table 11: Vehicle Origin (in and outside of Oddar Meanchey Province)

Within the province, a similar pattern can be discerned: 97.8 per cent of the surveyed traffic originates from a commune within Samraong District. This was expected as all three survey locations were in this district: Kandaek Village is in Samraong Commune, Khtum Village is in Koun Kriel Commune and O'Smach Village is in the recently established O'Smach Commune. The other three districts combined, *Chong Kal*, *Banteay Ampil* and *Anlong Veng* share the remainder of the traffic, totalling 2.2 per cent of the interviewed traffic.

Name of District	National Road 68 Location 1		National Road 68 Location 2		National Road 68 Location 3	
	Number Of Road Users	%	Number Of Road Users	%	Number Of Road Users	%
Samraong	5,848	98.6	2,025	96	1,190	97.5
Chong Kal	33	0.6	76	3.6	20	1.6
Banteay Ampil	27	0.5	7	0.3	9	0.7
Along Veng	23	0.3	2	0.1	2	0.2
Total	5,931	100	2,110	100	1,221	100

Table 12: Comparison of District of Origin

The next level of analysis is the commune level. Within Samraong District, there are five communes: Samraong Commune, Koun Kriel Commune, O'Smach Commune, Bos Sbov Commune and Bansay Reak Commune. The figure below shows the communes of origin for the interviewed road users.

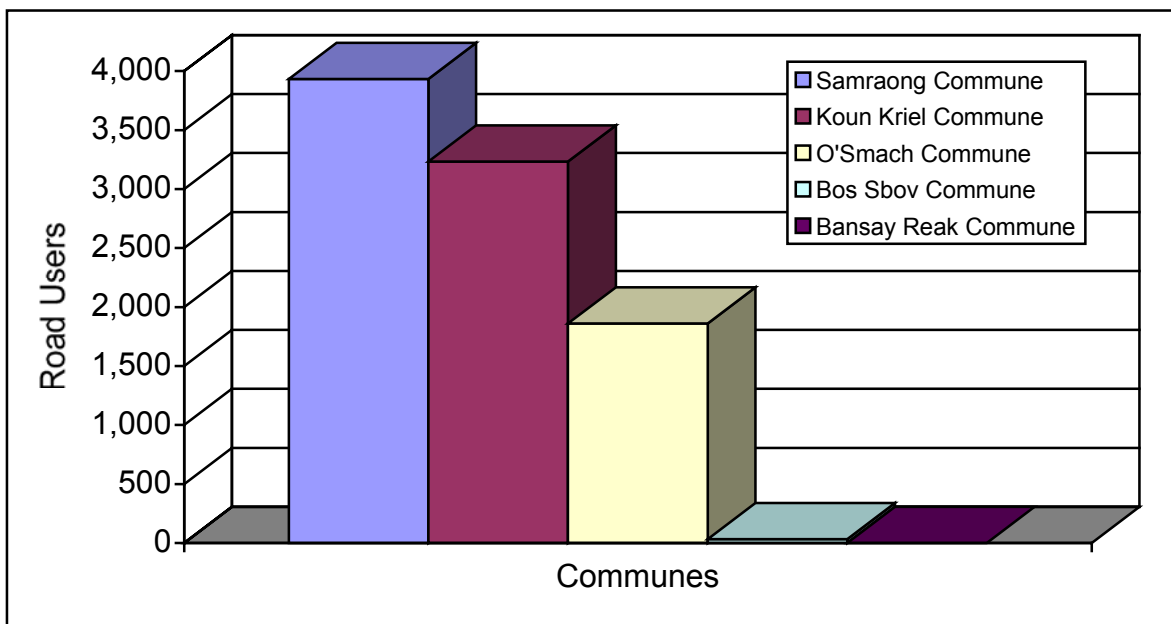


Figure 8: Commune of Origin

Most of the surveyed vehicle operators come from Samraong, Koun Kriel or O'Smach Communes. Table 13 shows the actual numbers and percentages for the three locations in relation to the five communes. The numbers of vehicles originating from Bos Sbov and Bansay Reak Communes are negligible.

Commune	Location 1		Location 2		Location 3		Total	
	<i>Number Of Road Users</i>	%	<i>Number Of Road Users</i>	%	<i>Number Of Road Users</i>	%	<i>Number Of Road Users</i>	%
Samraong	2,785	47.6	809	40.0	339	28.5	3,933	43.4
Koun Kriel	2,437	41.7	613	30.3	184	15.5	3,234	35.7
O'Smach	597	10.2	598	29.5	667	56.0	1,862	20.5
Bos Sbov	28	0.5	5	0.2	0	0.0	33	0.4
Bansay Reak	1	0.0	0	0.0	0	0.0	1	0
Total	5,848	100	2,025	100	1,190	100	9,063	100

Table 13: Comparison of Commune of Origin

The spread of road users by village in Samraong Commune is rather even. As table 14 below shows, most of those surveyed are from Kandaek village, but the differences are small.

Village	Location 1		Location 2		Location 3		Total	
	<i>Number Of Road Users</i>	%	<i>Number Of Road Users</i>	%	<i>Number Of Road Users</i>	%	<i>Number Of Road Users</i>	%
Kandaek	423	15.1	166	21.0	37	11.0	626	16.0
Pul	412	15.0	140	17.0	24	7.0	576	14.6
Chhuk	348	12.4	102	13.0	42	12.0	492	12.5
Ou Ruessei	306	11.0	91	11.0	39	12.0	436	11.1
Phniet	268	9.6	82	10.0	21	6.2	371	9.4
Doun Kaen	265	9.5	69	8.5	19	5.6	353	8.9
Samraong Thmei	256	9.2	58	7.1	86	25.3	400	10.2
Special Settlement ²⁴	254	9.1	54	6.6	41	12.1	349	8.9
Ou Kravan	253	9.1	47	5.8	30	8.8	330	8.4
Total	2,785	100	809	100	339	100	3,933	100

Table 14: Comparison of Village of Origin

²⁴ Every commune in Samraong District has *Special Settlement Areas*, where returnees from refugee camps or former war zones are living.

Conclusions

The most common vehicles on the surveyed section of national road 68 in Oddar Meanchey were *motorbikes and bicycles*, accounting for more than 90 per cent of all vehicles. Motorbikes totalled almost 50 per cent of the passing traffic, while bicycles added up to slightly over 40 per cent. The next most frequent vehicle was the *pickup*, at around five per cent. The other six vehicle types accounted for the remaining five per cent.

The *average daily traffic flow* was about 2,254 vehicles. The busiest hours are between six a.m. and seven a.m. when 13.6 per cent of the daily traffic passed the observation posts. Over 50 per cent of all the observed traffic passed by the observation posts before 11 a.m.

The busiest days are *Saturday, Sunday and Monday*, because the border crossing in O'Smach is open and the border market is operating. However, the difference with the other weekdays was not as significant as expected.

Almost all interviewed road users (96.5%) started their journey in one of *the districts within Oddar Meanchey Province*. The remaining road users (3.5%) originated from places outside the province, like Siem Reap, Battambang or Banteay Meanchey provinces.

About 97.8 per cent of the Oddar Meanchey traffic originated from a commune within *Samraong District*. The remaining 2.2 per cent started their trip in one of the other three districts (Chong Kal, Banteay Ampil or Along Veng).

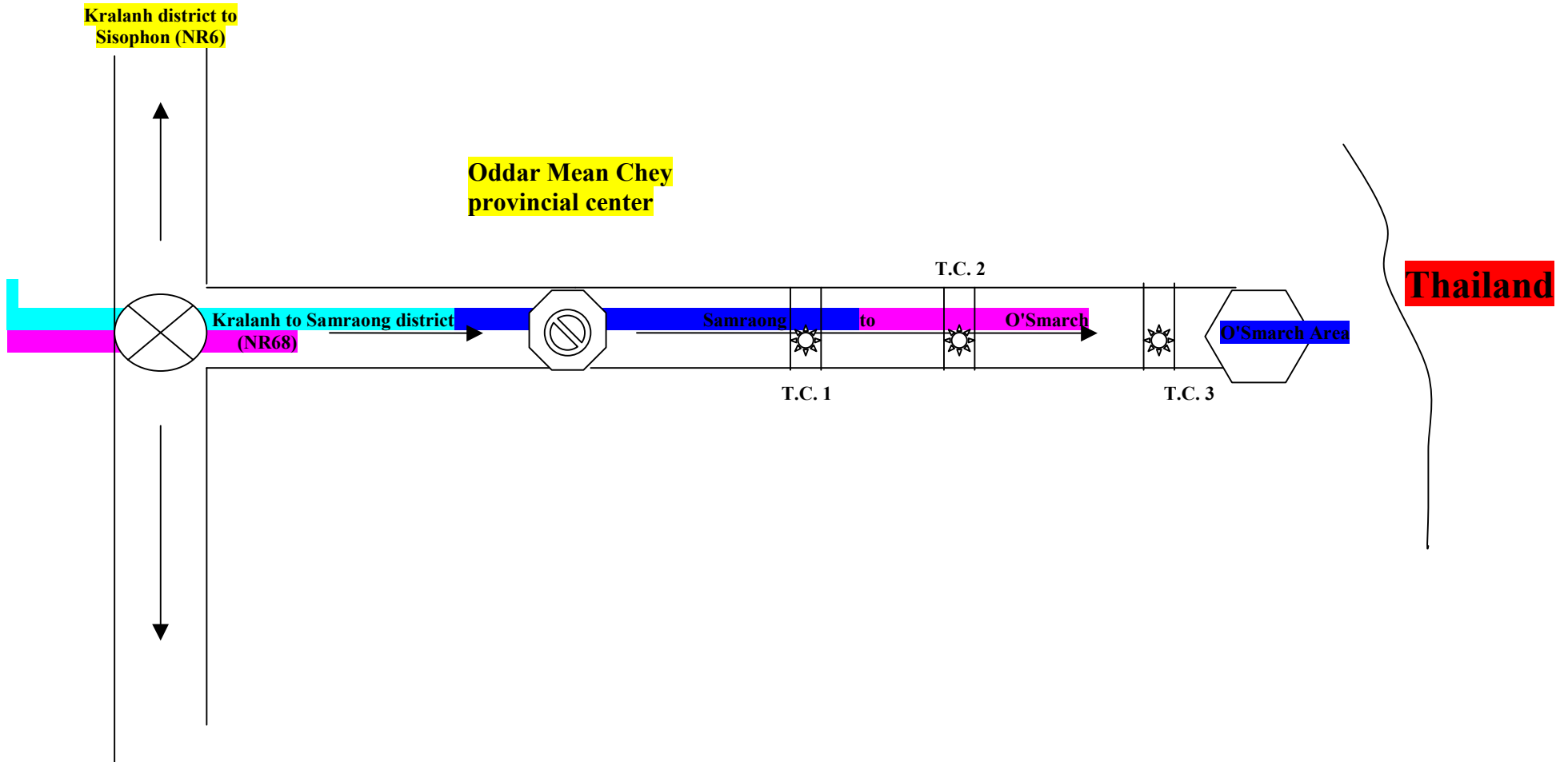
More than half of all the vehicles surveyed transported *passengers*. About one third were *empty* and the rest transported *products*. Motorbikes carried an average of around 1.7 passengers while bicycles transported approximately 1.3 passengers. When transporting products, the average motorbike load was 24.3 kilograms. For bicycles, the average was 8.4 kilograms. Pickups carried an average of 768.9 kilograms of products or 10.5 passengers.

The product most frequently transported - in terms of number of vehicles - was *fruit*, mainly originating from Thailand. The second most transported product was "*Other Household and Capital Goods*" and the third was the combined category of *firewood and charcoal*.

The *average time on the road* for the interviewed vehicle drivers was 84 minutes per one way trip. The *trip frequency* averaged approximately 2.7 times per day. The handcarts spent least time on the road (approximately 28 minutes), while the average truck trip lasted the longest, about 4.5 hours. The bicycle average trip lasted about 39 minutes, while motorbike trips were significantly longer, around 84 minutes on average.

Appendices

Appendix 1: Map of Survey Location in Oddar Mean Chey Province



Appendix 2 – Survey Questionnaires

INTERNATIONAL LABOUR ORGANISATION : UPSTREAM PROJECT CMB/97/MO2/SID
TRAFFIC COUNT SURVEY : SAMROANG TO O'SMARCH

Day of the week:		Date:	
Name of Surveyor:		In or outbound:	
Survey Location:		Sheet Number:	

1-Bicycle														
2- Motorbike														
3- Mototrailer														
4-Ox/bufallo/horsecart														
5-Car														
6- Pick-Up & Light Truck														
7- Koyun														
8-Truck														
9-Handcart														
10-Other														

**INTERNATIONAL LABOUR ORGANISATION: UPSTREAM PROJECT CMB/97/MO2/SID
ORRIGIN AND DETINATION SURVEY: SAMROANG TO O'SMARCH**

Interview sample of passing traffic

Road Side Survey Form

Day of Week :	<input type="text"/>	Time:	<input type="text"/>
Name of Enumerator:	<input type="text"/>	Date:	<input type="text"/>
Location:	<input type="text"/>	In or outbound:	<input type="text"/>
		Sheet Number:	<input type="text"/>

N°	1	2	3	4	5	6	7
	Vehicle Type (Code)	Origin of Vehicle	Destination of Vehicle	Travel Time	Travel Frequency	Type of commodity (Code)	Weight (Kg/Person)
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							

List of Codes Used in O&D Survey

Table A: Classification of Vehicle Types

1. Bicycle
2. Motorbike
3. Mototrailer (Remorque)
4. Ox/buffalo/ horse cart
5. Car
6. Pick-up
7. Koyun
8. Truck
9. Handcart
10. Other

Table B: Classification of Products

1. Fresh Vegetables
2. Bulbs/Roots/Pulses/Tubers
3. Rice/Paddy
4. Other grains
5. Fruits
6. Fresh fish/Crustaceans
7. Dried and smoked fish/Crustaceans
8. Meat (Pork/beef/chicken/duck/bird)
9. Poultry/pig/cow
10. Passengers
11. Dried & Processed foods (including herbs, spices and cooking oils)
12. Beverages
13. Cloth & Clothes
14. Other household & capital goods (including radios and watches)
15. Tobacco
16. Construction materials
17. Firewood/Charcoal
18. Fuel
19. Ice
20. Other

PART THREE
Banteay Srei District Traffic Features:
Research in rural transport

Executive Summary

This study examines rural traffic characteristics around Banteay Srei market, a small market in Banteay Srei District, Siem Reap Province. The results presented here are mainly descriptive and provide an insight into rural travel patterns in Cambodia.

The study combined a traffic count and an Origin and Destination (O&D) survey. Traffic count teams were set up at three locations along roads around the market to assess traffic type and volume. O&D surveys were conducted on road users to gather detailed information about journey type and transport load.

The results from the traffic count show that more than half of the total daily traffic passed the traffic count locations before 11 a.m. However, more than half of the vehicles destined for the market passed the locations before nine a.m.

Three vehicles dominate the roads around Banteay Srei market: bicycles (39.4%), motorbikes (37.8%) and cars (13.1%). The number of cars and pickups (7%) is high compared to other rural transport surveys. Many vehicles travel along these roads to Banteay Srei temple or Phnom Kulen Mountain, both major tourist attractions, which probably explains this difference.

The O&D survey results revealed that the average travel time of the interviewed road users was approximately 75 minutes per trip. On average, they made about one trip per day. Trucks make the longest trips - in terms of time - a bit over two hours per trip. The shortest trips are made by *koyuns* who average approximately 34 minutes per trip. *Koyuns* had the highest average trip frequency at 2.2 trips per day.

Most interviewed road users (97%) originated from a District within Siem Reap Province. Within this Province, more than 70 per cent of the interviewees started their trip in Banteay Srei District, while 27 per cent originated from Siem Reap District. Other road users started their trip in Prasat Bakong, Angkor Thom, Puok or Soutr Nikum Districts.

Of all the surveyed vehicles, about half transported passengers (51.6%), approximately one third were empty (32.2%) and the remaining vehicles transported products (16.2%). Fruit was the most transported product in Banteay Srei District in terms of vehicle numbers. The second most transported product was firewood/charcoal and the third was the subcategory of fresh vegetables.

Introduction

In early 2000, the International Labour Organisation (ILO) Upstream Project expanded infrastructure related planning activities to Banteay Srei and Angkor Thom Districts in Siem Reap Province. Since 1993, the ILO has been building rural roads in Siem Reap and has set up maintenance systems for them based on Labour Based Appropriate Technology (LBAT). To complement the construction and maintenance, an ILO designed planning method – Integrated Rural Accessibility Planning (IRAP) – was introduced and a planning team was established. IRAP is designed to help prioritise Rural Transport Infrastructure (RTI) investments.

In conjunction with the IRAP activities, a series of socio-economic studies commenced. The first study was conducted in 1999 in Puok District, Siem Reap Province. The aim was to gain a detailed profile of the vehicular traffic flow in this important economic District centre.²⁵ The second RTI research study was also carried out in Puok District, exploring the travel and transport patterns of rural households.²⁶

The main objective of this RTI research was to obtain a detailed picture of the flows of vehicular traffic around Banteay Srei market. A similar approach to the first RTI study was taken. To get the necessary data a traffic count study and an Origin and Destination (O&D) survey were carried out. ILO trained teams observed and interviewed road users along the rural road leading to Phnom Kulen and provincial road 67 leading to Banteay Srei market. During the one-day survey, 4,344 vehicle movements were recorded and 1,163 road users were interviewed.

The Banteay Srei traffic study aimed to discover District travel and transport data, like vehicle origin and destination, vehicle load, travel time and frequency. The resulting description of Banteay Srei vehicular traffic flow provides a better understanding of travel patterns in rural Cambodia. It complements the IRAP data gathered in Banteay Srei District and can serve as a baseline study for impact assessments.

²⁵ Upstream Socio Economic Series No. 1: *Traffic Characteristics around Puok Market: Rural Transport Infrastructure Research*, February 2000, ILO/MRD, Phnom Penh, Kingdom of Cambodia.

²⁶ Upstream Socio Economic Series No.3: *Household Travel and Transport Analysis: Rural Transport Infrastructure Research*, September 2000, ILO/MRD, Phnom Penh, Kingdom of Cambodia.

Traffic Count

The District market in Banteay Srei is rather small with only 28 stalls - unlike Puok District market. There is only one road leading to the market - while there are four roads leading to Puok market - which simplified the traffic count.

During the one-day study of the traffic flows around Banteay Srei District centre, the traffic count team observed all vehicle movements at three locations along the roads leading to Banteay Srei market. Two of these locations were on provincial road 67 and one was on a rural road leading to Phnom Kulen. (See map Appendix 1). Based on earlier surveys in rural Cambodia, the team divided the traffic into ten vehicle categories. Table 1 shows these categories.

No.	Vehicle Type
1	Bicycle
2	Motorbike
3	Motor trailer (<i>remorque</i>)
4	Animal drawn cart ²⁷
5	Car
6	Pickup
7	<i>Koyun</i> ²⁸
8	Truck
9	Handcart
10	Other

Table 1: Vehicle Types

From dawn until dusk, 4,344 vehicle movements were counted on these roads.²⁹ On average 334 vehicles passed the locations every hour.

Time of Day

The traffic count commenced at five a.m. and finished at six p.m. Comparing traffic density at different hours of the day shows that the peak hour is from seven to eight a.m. During this hour, 11.5 per cent of the total daily traffic around Banteay Srei market passed the cordon points.

²⁷ In Cambodia, oxen, horses and water buffaloes pull carts. To simplify coding, the term 'animal drawn cart' is used throughout the report.

²⁸ A *koyun* is a locally made vehicle using an irrigation pump engine. *Ko* is the Khmer word for ox and *yun* means machine.

²⁹ During the same time span an average of 65,000 vehicle movements were counted on the roads around Puok market.

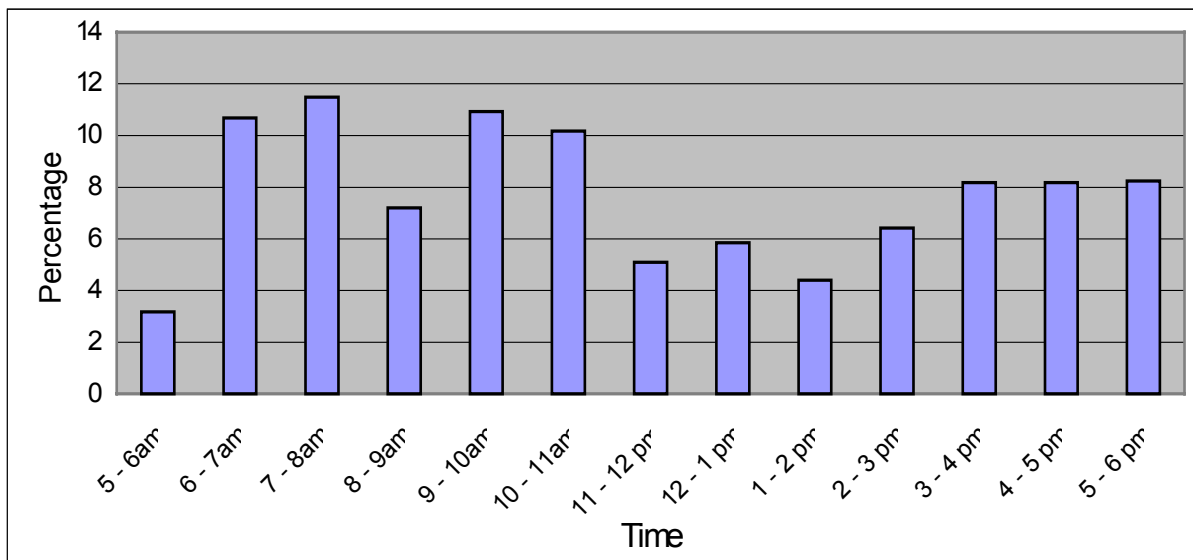


Figure 1: Volume of Traffic per Hour

The roads surveyed were significantly busier during the morning. There is however a revival of traffic intensity in the late afternoon. The figure above shows that on average the hourly frequency of traffic is higher before 11 a.m. The cumulative table below shows this even more clearly. Before 11 a.m., more than half of the total number of vehicles observed passed the traffic count locations.

Hour of the Day	Percentage of Traffic	Cumulative Percentage of Traffic
5 – 6 a.m.	3.2	3.2
6 – 7 a.m.	10.7	13.9
7 – 8 a.m.	11.5	25.4
8 – 9 a.m.	7.2	32.6
9 – 10 a.m.	10.9	43.5
10 – 11 a.m.	10.2	53.7
11 – 12 p.m.	5.1	58.8
12 – 1 p.m.	5.8	64.6
1 – 2 p.m.	4.4	69.0
2 – 3 p.m.	6.4	75.4
3 – 4 p.m.	8.2	83.6
4 – 5 p.m.	8.2	91.8
5 – 6 p.m.	8.2	100

Table 2: Hourly Differences in Traffic Density

Traffic Density

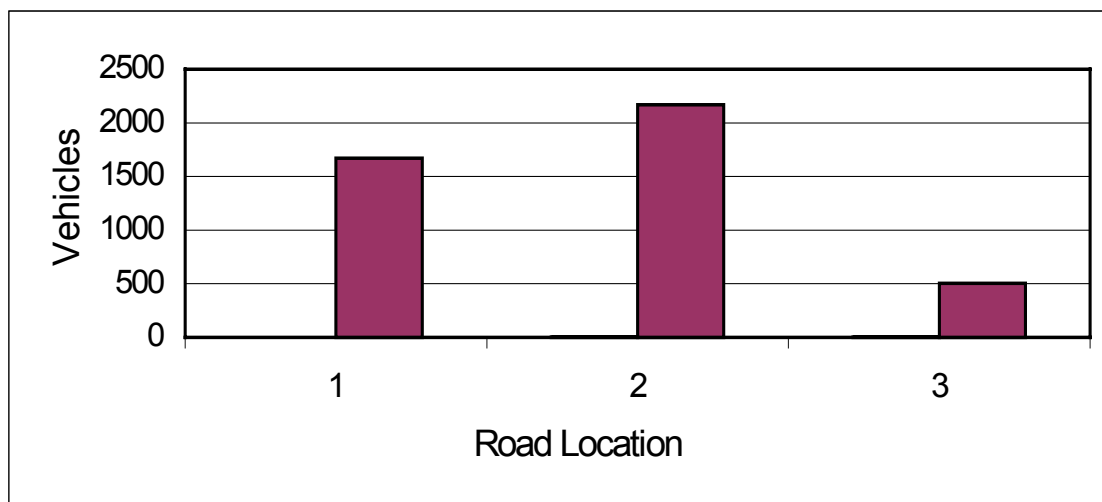


Figure 2: Traffic Volume at Three Observation Posts

The three survey locations show different traffic densities, as figure 2 above illustrates. The busiest location in terms of traffic flow is the cordon point on provincial road 67 north of Banteay Srei market. Table 3 compares the total number of vehicles at the two survey locations on provincial road 67 and the third location on the rural road to Phnom Kulen.

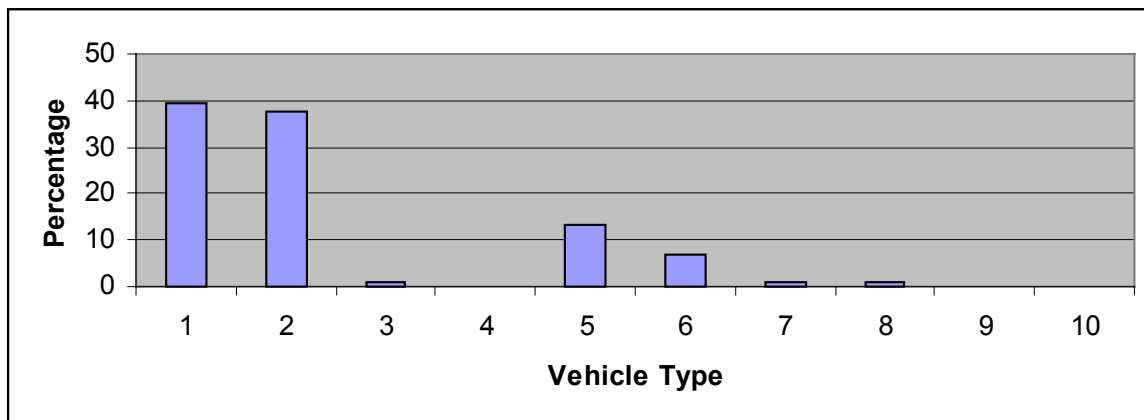
Time	Location 1 (PR 67-1)			Location 2 (PR 67-2)			Location 3 (RR1)		
	in	out	total	in	out	total	in	out	total
5-6 a.m.	22	16	38	35	52	87	5	8	13
6-7 a.m.	128	38	166	93	141	234	57	7	64
7-8 a.m.	119	47	166	106	176	282	42	9	51
8-9 a.m.	56	32	88	74	95	169	46	10	56
9-10 a.m.	163	49	212	78	145	223	27	13	40
10-11 a.m.	107	119	226	119	68	187	18	11	29
11-12 p.m.	21	44	65	91	45	136	6	14	20
12-1 p.m.	42	56	98	80	62	142	8	6	14
1-2 p.m.	23	42	65	63	41	104	9	13	22
2-3 p.m.	71	30	101	68	61	129	26	23	49
3-4 p.m.	84	72	156	87	63	150	21	28	49
4-5 p.m.	66	84	150	103	53	156	12	37	49
5-6 p.m.	61	78	139	120	50	170	16	33	49
Total	963	707	1,670	1,117	1,052	2,169	293	212	505

Table 3: Comparison of Traffic Density at Three Traffic Count Locations

Vehicle Type

Bicycles make up the majority of the traffic observed on the roads around Banteay Srei market. Together with motorbikes, they account for more than 77 per cent of the total vehicles

counted (compared to over 95 per cent in Puok District). The third largest group is cars and the fourth is pickups. Figures 3 and 4 compare the frequency of vehicle types.



1 - Bicycle, 2 - Motorbike, 3 - Remorque, 4 - Animal drawn cart, 5 - Car, 6 - Pickup, 7 - Koyun, 8 - Truck, 9 - Handcart, 10 - Other.

Figure 3: Comparison of All Vehicle Types

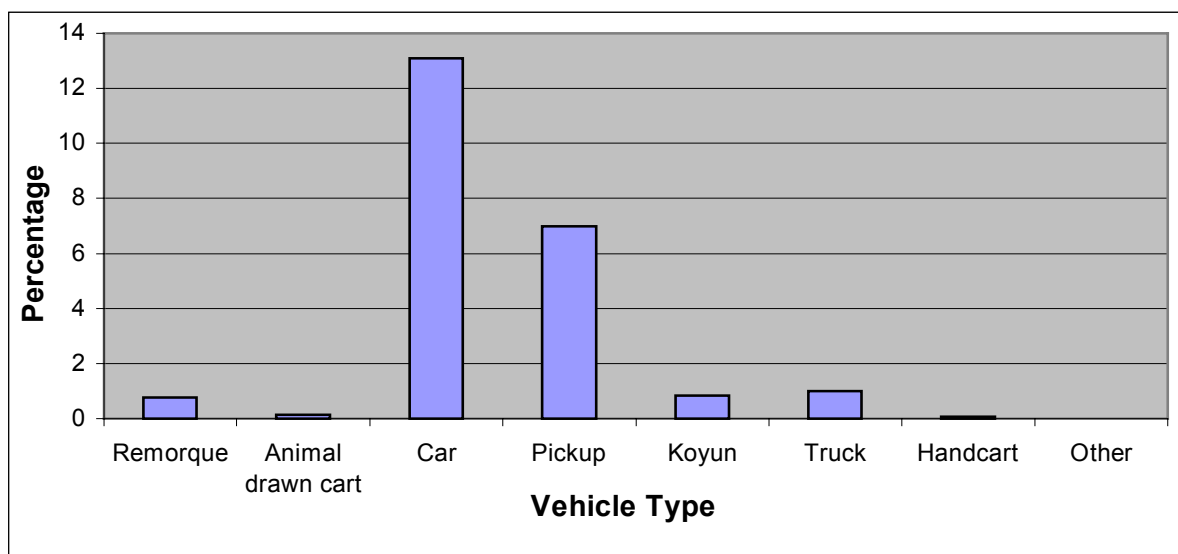


Figure 4: Comparison of Eight Vehicle Types

Vehicle Type	Location 1 (PR 67-1)				Location 2 (PR 67-2)				Location 3 (RR-1)			
	in	out	total	%	in	out	total	%	in	out	total	%
1	352	223	575	34.4	484	466	950	43.8	102	83	185	36.6
2	360	279	639	38.3	420	387	807	37.2	109	85	194	38.4
3	9	6	15	0.9	5	7	12	0.5	4	2	6	1.2
4	0	1	1	0.1	0	0	0	0.0	4	1	5	1.0
5	182	157	339	20.3	89	112	201	9.3	20	9	29	5.7
6	37	22	59	3.5	101	68	169	7.8	52	24	76	15.1
7	6	8	14	0.8	8	9	17	0.8	1	4	5	1.0
8	16	9	25	1.5	10	3	13	0.6	1	4	5	1.0
9	1	2	3	0.2	0	0	0	0.0	0	0	0	0.0
10	0	0	0	0.0	0	0	0	0.0	0	0	0	0.0
Total	963	707	1,670	100	1,117	1,052	2,169	100	293	212	505	100

1 - Bicycle, 2 - Motorbike, 3 - Remorque, 4 - Animal drawn cart, 5 - Car, 6 - Pickup, 7 - Koyun, 8 - Truck, 9 - Handcart, 10 - Other.

Table 4: Vehicle Intensity at Three Locations

Table 4 shows a cross tabulation of vehicle types and survey locations. The modal split is rather similar for the three locations, with around 75 per cent for the combined bicycles and motorbikes. Location 2 has a higher number of bicycles, probably because of its position between the market and the District centre.

The number of cars and pickups passing by the locations is higher than other roadside surveys. This is probably due to tourists visiting the Banteay Srei temples north of the market. This also explains the large number of pickups on the road to Phnom Kulen, another major tourist destination in the area. The next section presenting the results of the Origin and Destination survey will further deal with this topic.

Origin and Destination Survey

Traffic count studies provide basic information about traffic flows in a certain area, including vehicle types, direction and time of passing. However, observing and counting the passing traffic does not provide information about the origin and destination of the vehicle, trip time and trip frequency or the types and quantity of the vehicle loads.

To get this more detailed data, an Origin and Destination (O&D) survey was carried out at the same locations. A sample of the vehicular traffic was stopped and interviewed for a short time (under one minute) to avoid interfering with the normal traffic movements. The results of this survey are presented in this section.

General Characteristics of the Surveyed Traffic

The research teams interviewed 1,163 road users during the one-day O&D survey. From a total daily traffic of 4,344 vehicles, this was a sample size of about 27 per cent. This survey used the same vehicle classifications as the traffic count study (see table 1). The proportions of the different vehicle types interviewed were about equal to the traffic count. The average travel time of all the surveyed vehicle users was approximately 75 minutes, as the next table shows.

No.	Type of Vehicle	Average Travel Time per trip (minutes)	Average Trip Frequency per day
1	Bicycle	61.6	1.2
2	Motorbike	70.3	1.2
3	Remorque	87.1	1.1
4	Animal drawn cart	120.0	1.0
5	Car	89.3	0.8
6	Pickup	118.7	0.9
7	<i>Koyun</i>	34.0	2.2
8	Truck	121.6	1.0
9	Handcart	45.0	1.1
10	Other	0.0	0.0
	Average	75.4	1.1

Table 5: Comparison of Average Travel Times and Frequencies

Trucks made the longest trips in terms of time at around 122 minutes. Koyuns made the shortest average trips at about 34 minutes. Koyuns had the highest trip frequency. On average, a koyun made 2.2 trips per day. The average frequency for all vehicles was about one trip per day, for cars it was even less.³⁰

³⁰ Trip frequency was much lower in Banteay Srei than in Puok - about two trips per day for all vehicles.

One of the items of the O&D questionnaire was the load vehicles were transporting. Loads were divided into the following categories: empty vehicles, vehicles carrying passengers and vehicles carrying products. The products were divided into 19 subcategories. The next table shows these categories, subcategories and their codes.

Code	Classification of Vehicle Load
0	Empty
1	Fresh vegetables
2	Bulbs/roots/pulses/tubers
3	Rice/paddy
4	Other grains
5	Fruit
6	Fresh fish/crustaceans
7	Dried and smoked fish/crustaceans
8	Meat (pork/beef/chicken/duck/bird)
9	Livestock (poultry/pig/cow)
10	Passengers
11	Dried/processed foods (including herbs/spices/cooking oils)
12	Beverages
13	Cloth/clothes
14	Other household and capital goods
15	Tobacco
16	Construction materials
17	Firewood/charcoal
18	Fuel
19	Ice
20	Other

Table 6: Classification of Vehicle Load

The O&D study results show that around half of the vehicles surveyed were transporting passengers (52%), while the number of empty vehicles was about one third of the sample (32%). The number of vehicles carrying products was slightly more than 16 per cent of the total (16%). The quantities transported varied widely between the different vehicle types, both for passengers and products. The average product load ranged from about 22 kilograms for bicycles to about 856 kilograms for trucks. Table 7 shows the average load for the nine selected vehicles.

No.	Vehicle Type	Average Vehicle Load (kg)
1	Bicycle	21.7
2	Motorbike	61.1
3	Remorque	270.6
4	Animal drawn cart ³¹	0.0
5	Car	691.7
6	Pickup	481.0
7	<i>Koyun</i>	187.5
8	Truck	855.7
9	Handcart	115.0

Table 7: Average Vehicle Load (products)

It is important to consider the type of product transported when analysing vehicle loads. The study determined the three products each vehicle type transported most frequently. The next table shows the ranking of the products for each vehicle type.

No.	Vehicle	Product 1	Product 2	Product 3
1	Bicycle	Fruit	Fresh vegetables	Firewood/charcoal
2	Motorbike	Fresh fish/crustaceans	Fruit	Firewood/charcoal
3	Remorque	Fruit	Firewood/charcoal	Rice/paddy
4	Animal drawn cart	-	-	-
5	Car	Construction materials	Other household & capitol goods	-
6	Pickup	Rice/paddy	Firewood/charcoal	Construction materials
7	<i>Koyun</i>	Firewood/charcoal	Construction materials	-
8	Truck	Firewood/charcoal	Construction materials	Other household & capitol goods
9	Handcart	Firewood/charcoal	Fresh vegetables	-

Table 8: Ranking of Products Transported per Vehicle Type

The study found that there were three main subcategories of products transported. Fruit was the most frequently transported product in Banteay Srei District. About 21 per cent of the loaded vehicles surveyed were carrying fruit. The second most transported product was firewood/charcoal (around 17.5%). The third ranked product was the subcategory of fresh vegetables (14.3%).³²

³¹ All the animal drawn carts interviewed were transporting passengers.

³² This ranking is based on the number of vehicles carrying these products, not on the quantity of products transported.

For some vehicles, transporting products is only a small part of their business. For trucks and pickups, the major part of their activity is transporting people. The next table shows the average number of passengers carried for all transport modes.

No.	Vehicle Type	Average Vehicle Load (passengers)
1	Bicycle	1.1
2	Motorbike	1.4
3	Remorque	4.7
4	Animal drawn cart	5.0
5	Car	6.1
6	Pickup	13.4
7	<i>Koyun</i>	5.8
8	Truck	14.7
9	Handcart	0.0

Table 9: Average Vehicle Load (passengers)³³

District Market Traffic Flows

The market in Banteay Srei opens every day at about 6:30 a.m. and usually closes around 5:30 p.m. The first vehicles supplying the market stalls arrive between five and six a.m. The table below shows the number of market bound vehicles surveyed at the two cordon points along provincial road 67.

Time	Number of Vehicles	Percentage of Traffic	Cumulative Percentage
5-6 a.m.	14	5.1	5.1
6-7 a.m.	50	18.1	23.2
7-8 a.m.	60	21.7	44.9
8-9 a.m.	38	13.8	58.7
9-10 a.m.	23	8.3	67.0
10-11 a.m.	12	4.4	71.4
11-12 p.m.	10	3.6	75.0
12-1 p.m.	17	6.2	81.2
1-2 p.m.	10	3.6	84.8
2-3 p.m.	13	4.7	89.5
3-4 p.m.	13	4.7	94.2
4-5 p.m.	12	4.4	98.6
5-6 p.m.	4	1.4	100
Total	276	100	100

Table 10: Market Bound Traffic

³³ These numbers exclude the drivers of the vehicles.

Comparing the table above to the overall traffic count figures presented in table 2 shows that the market bound traffic dominates the early hours. More than half of the traffic destined for the market passed the cordon points before nine a.m. The peak hour for the market is from seven until eight a.m., when 21.7 per cent of the daily vehicles arrive.

Although this survey was more oriented toward transport than market trade, it can give an indication of the quantity of products being transported to Banteay Srei market. Table 11 shows the quantities of each product type passing through to the market, as captured by the research teams.³⁴ As the sample size was approximately 25 per cent of the total traffic, the total products transported to Banteay Srei market could be approximately four times the figures presented in table 11.

No. ³⁵	Type of product	Quantity (kilograms)
1	Fresh vegetables	245
2	Bulbs/roots/pulses/tubers	3
3	Rice/paddy	150
4	Fruits	315
5	Fresh fish/crustaceans	286
6	Dried and smoked fish/crustaceans	30
7	Meat (pork/beef/chicken/duck/bird)	55
8	Beverages ³⁶	40
9	Cloth/clothes	30
10	Tobacco	10
11	Construction materials	200
12	Firewood/charcoal	455
13	Other	10
	Total	1,829

Table 11: Quantities of Products Transported to Market

The traffic flowing to the market mainly comes from three communes in Banteay Srei District - Khnar Sanday, Khun Ream and Preah Dak. People living in communes further away usually visit Siem Reap town markets or other rural markets. The average travel time for surveyed road users originating from one of these communes was 49.8 minutes.

³⁴ These are commodities transported to the market, which does not automatically mean that they are sold at the market.

³⁵ Number 10 was not included because it represents the passengers carried.

³⁶ To simplify comparison kilograms were used instead of litres.

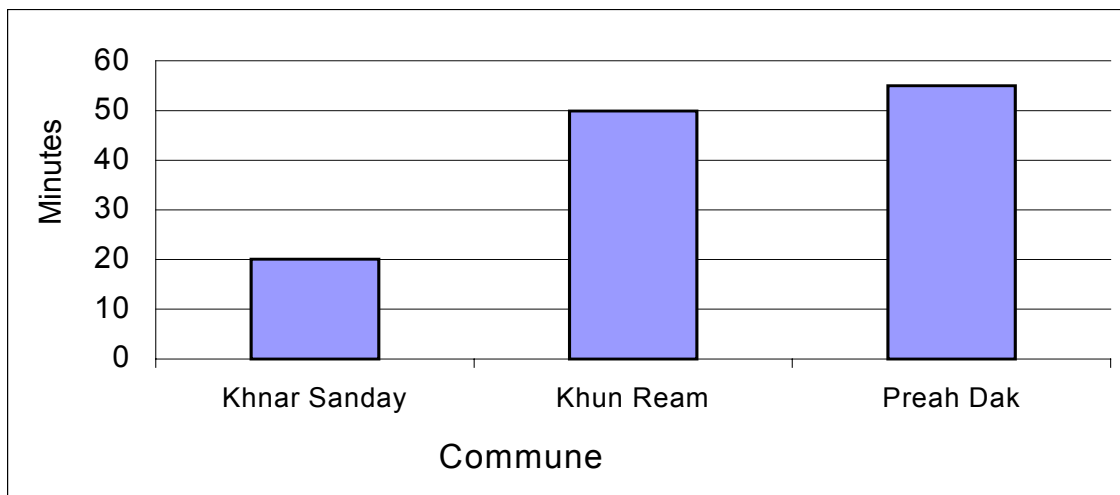


Figure 5: Commune to Market Travel Time

Not surprisingly, Khnar Sanday commune vehicles travelled the shortest time to arrive at the market. Their average travel time is just under 20 minutes. However, vehicles from Preah Dak commune - in the south west of Banteay Srei District - needed nearly one hour to reach Banteay Srei market. The market trips made from Khun Ream commune lasted on average 50 minutes.

No.	Commune	Frequency (trips/day)
1	Khnar Sanday	1.6
2	Preah Dak	1.3
3	Khun Ream	1.1

Table 12: Frequency of Market Visits per Day

People from Khnar Sanday commune visited the market most frequently, on average 1.6 times a day. Interestingly, although the average travel time from Preah Dak commune to Banteay Srei market is longer than from Khun Ream commune, their frequency of market visit is higher at 1.3 versus 1.1 times per day.

Banteay Srei District Travel

During the one-day O&D survey 1,163 road users were interviewed. Only a small percentage originated from outside Siem Reap Province, 35 road users or three per cent of the people surveyed started their trip either in Banteay Meanchey or Odder Meanchey Province. The remaining 97 per cent or 1,128 road users originated from a District within Siem Reap Province. The next table shows the traffic volumes for the different Districts.

No	District	Number of Road Users
1	Banteay Srei	809
2	Siem Reap	308
3	Prasat Bakong	5
4	Angkor Thom	4
5	Puok	1
6	Soutr Nikum	1
	Total	1,128

Table 13: Districts of Origin of Road Users

Table 13 shows that over 70 per cent of the surveyed vehicles originated from a commune within Banteay Srei District. The number of tourists visiting the area explains the relatively high percentage of vehicles from Siem Reap District (27%).

The next level of analysis is that of the communes within Banteay Srei District. The lion's share of the interviewed road users started their journey in Khnar Sanday commune: 77.4 per cent or 626 vehicles originated from one of the villages in Khnar Sanday. This is not surprising, as Khnar Sanday is the commune where the District market and the District centre are located. Table 14 shows the number of road users from the seven communes in Banteay Srei District.

No.	Commune	Number of Road Users	Percentage
1	Khnar Sanday	626	77.4
2	Khun Ream	81	10.1
3	Preah Dak	56	6.9
4	Tbaeng	23	2.8
5	Srei Noy ³⁷	23	2.8
6	Rum Chek	0	0
7	Rum Ta Aek	0	0
	Total	809	100

Table 14: Road Users per Commune in Banteay Srei District

The lowest level of analysis in this transport study is the village level. There are five villages in Khnar Sanday commune - Banteay Srei, Khnar, Thmei, Prei and Sanday. Most of the 626 interviewed Khnar Sanday road users originate from Banteay Srei village, as the next table shows.

³⁷ Srei Noy is a new commune within Banteay Srei District. It was a special resettlement area.

No.	Village	Number of Road Users	Percentage
1	Banteay Srei	507	81.0
2	Khnar	55	8.8
3	Thmei	42	6.7
4	Prei	14	2.2
5	Sanday	8	1.3
	Total	626	100

Table 15: Market Bound Road Users by Village

Conclusions

Three vehicle types dominate the roads around Banteay Srei market: bicycles (39.4%), motorbikes (37.8%) and cars (13.1%). The number of cars and pickups recorded (7%) were high compared to other rural transport surveys. This can be explained by the fact that many cars travel along these roads to Banteay Srei temple or Phnom Kulen Mountain, both major tourist attractions.

More than half of the total daily traffic passed the traffic count locations before 11 a.m. However, more than half of the vehicles destined for the market passed the locations before nine a.m.

The average travel time for the 1,163 interviewed road users was approximately 75 minutes per trip, a trip that they made about once per day. Trucks make the longest trips - in terms of time - lasting about two hours. The shortest trips are made by *koyun* at approximately 34 minutes on average. Their trip frequency, however, was also the highest. On average, they made 2.2 trips per day.

Of all the surveyed vehicles, about half transported passengers (51.6%), approximately one third were empty (32.2%) and the remaining vehicles transported products (16.2%).

Fruit was the most transported product in vehicle numbers in Banteay Srei District. The second most transported product was firewood/charcoal and the third ranked product was the subcategory of fresh vegetables.

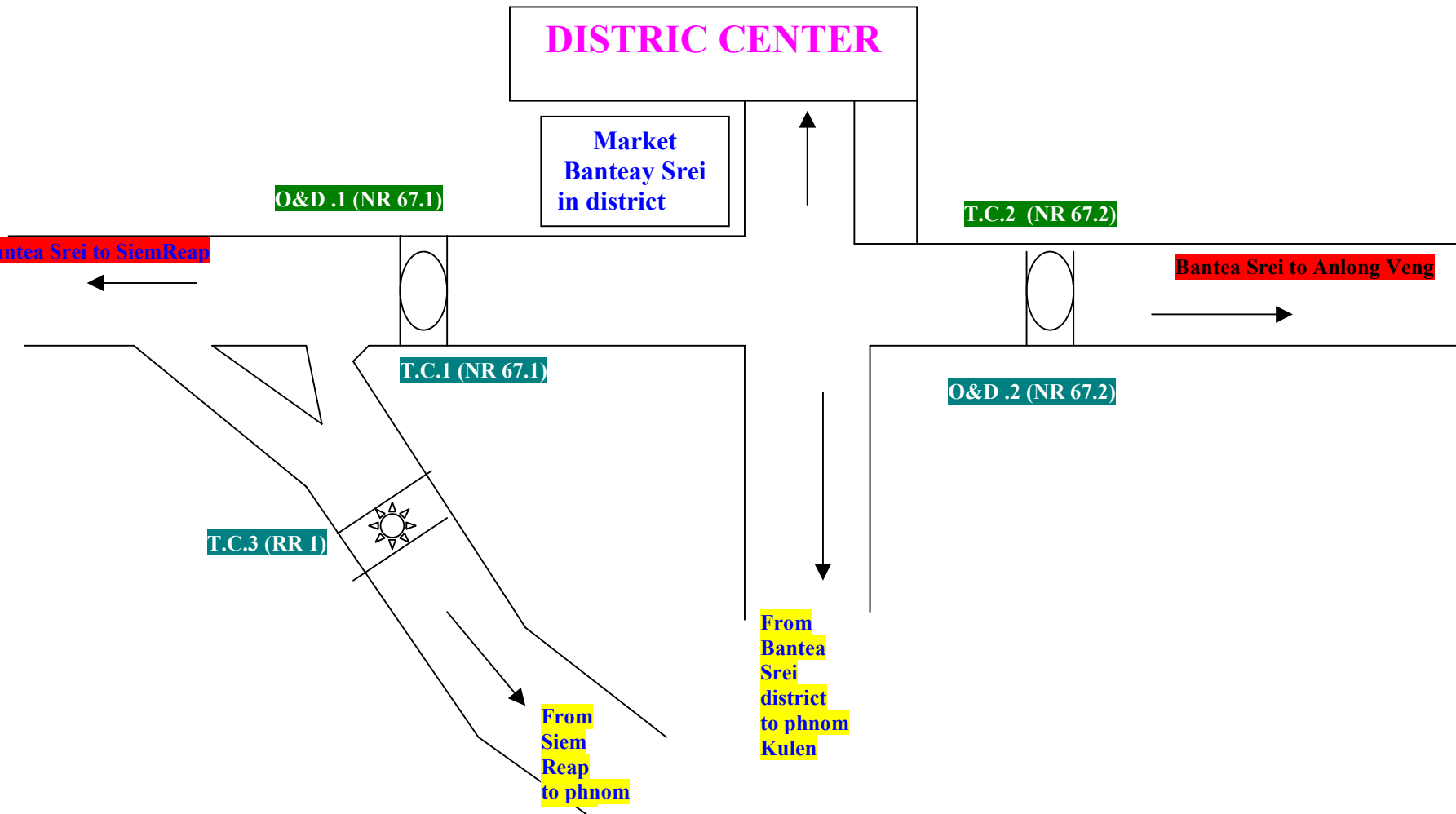
There was a large variation in transport capacity. The average product load ranged from about 22 kilograms for bicycles to about 856 kilograms for trucks. In terms of passengers, the load varied from 1.1 passenger on average per bicycle to an average of 14.7 passengers for trucks.

Most road users interviewed (97%) originated from a District within Siem Reap Province. Within this Province, more than 70 per cent of the interviewees started their trip in Banteay Srei District, while another 27 per cent originated from Siem Reap District. Other road users started their trip in Prasat Bakong, Angkor Thom, Puok or Soutr Nikum Districts.

Khnar Sanday was the most common commune of origin within Banteay Srei District. Other communes of origin were Khun Ream, Preah Dak, Tbaeng and Srei Noy. Obviously, most people travelling on the surveyed roads came from Banteay Srei village (81%). Other villages mentioned were Khnar, Thmei, Prei and Sanday.

Appendices

Appendix 1: Map of survey location Bantea Srei district in Siem Reap province

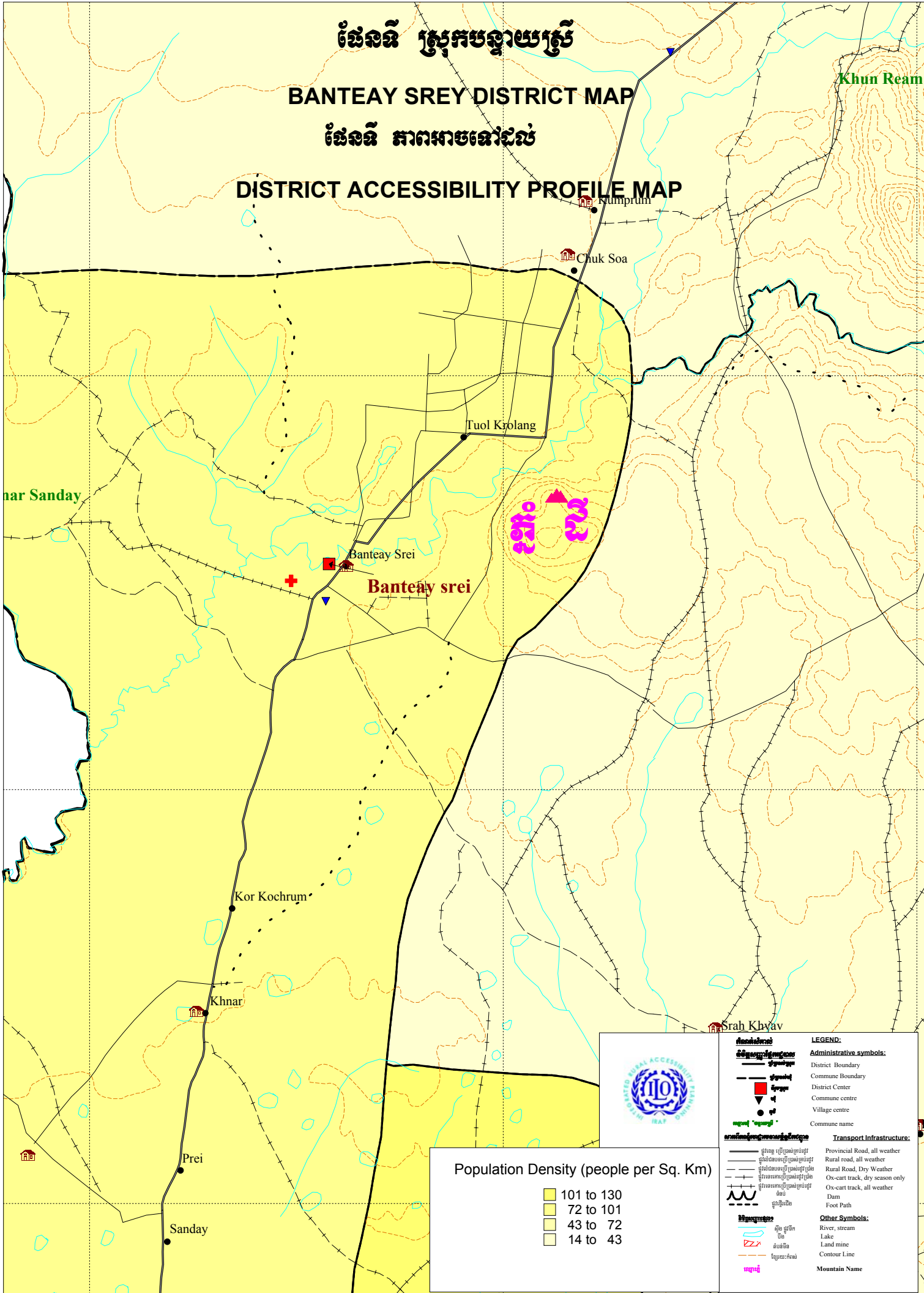


ខេត្ត ក្រចេះ

BANTEAY SREY DISTRICT MAP

ខេត្ត ភាពអាចទៅដល់

DISTRICT ACCESSIBILITY PROFILE MAP



Khun Ream

Khnar Sanday



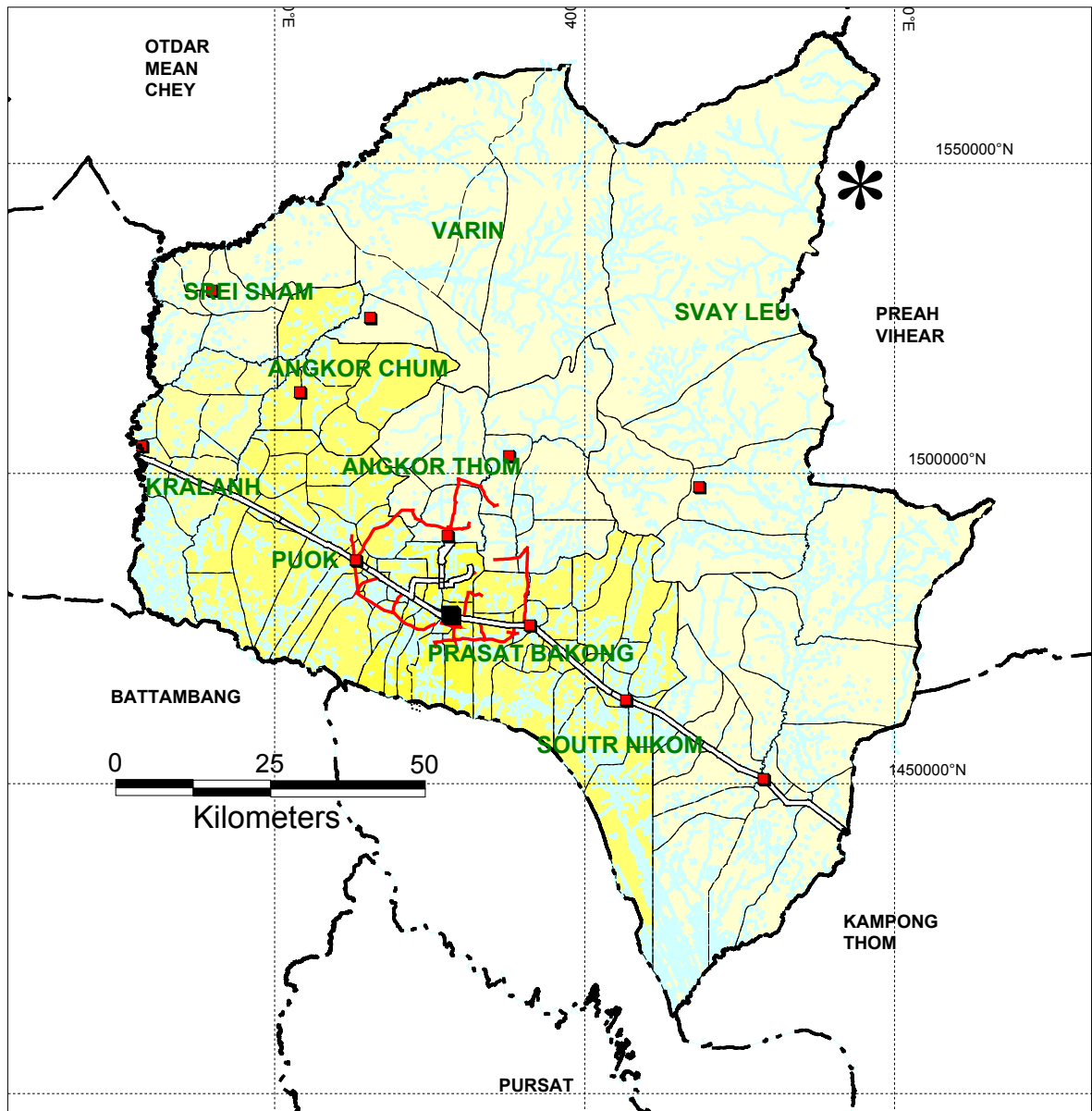
Population Density (people per Sq. Km)

	101 to 130
	72 to 101
	43 to 72
	14 to 43

LEGEND:

	Administrative symbols:
	District Boundary
	Commune Boundary
	District Center
	Commune centre
	Village centre
	Commune name
	Transport Infrastructure:
	Provincial Road, all weather
	Rural road, all weather
	Rural Road, Dry Weather
	Ox-cart track, dry season only
	Ox-cart track, all weather
	Dam
	Foot Path
	Other Symbols:
	River, stream
	Lake
	Land mine
	Contour Line
	Mountain Name

Appendix 3: Map of Siem Reap Province



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