

**ADDIS ABABA UNIVERSITY  
SCHOOL OF GRADUATE STUDIES**

***TAXI TRAFFIC ACCIDENTS IN ADDIS ABABA:  
CAUSES, TEMPORAL AND SPATIAL  
VARIATIONS,  
AND CONSEQUENCES***

**BY**

**Bitew Mebrahtu**

**June ,2002**

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AND CONSEQUENCES***

**A THESIS  
PRESENTED TO  
THE SCHOOL OF GRADUATE STUDIES  
ADDIS ABABA UNIVERSITY**

**In Partial Fulfillment of the Requirements for the Degree of the  
Master of Arts in Human Geography**

**By  
Bitew Mebrahtu**

**June, 2002**

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***DEPARTMENT OF GEOGRAPHY  
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# DECLARATION

The thesis is my original work, has not been presented for a degree in any other university and that all sources of material used for the thesis have been duly acknowledged.

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# Acknowledgments

I would like to express my heart full thanks and gratitude to my advisor professor Mekete Belachew. This paper would not have been completed in its present form, had it not been for his valuable suggestions, comments and constructive criticisms for it.

I wish to express my deep gratitude to Dr. Solomon Mulugeta for his irreplaceable suggestions and comments given during the time of research.

I do not know what to say about Ato Esayiyas Sahlu who sacrificed his precious time and knowledge in the preparation of the maps.

I wish also to express my heart full thanks and gratitude to Dr. Mekonen Disasa, Ato Daniel Tefera and Ato Molla Maru for their professional comments and suggestions.

I am grateful to my colleagues, Ato Daniel Wondium, Ato Girmay Kassay, Ato Kiros Beyene, Ato Haile Mekonen, W/rt Atsede Mekonen Ato Solomon Mengistu, Ato Ayele Shone for their moral and material support.

Also I wish to thank W/rt Netsanet Asmelash, Ato Yared Asmelash and W/ro Roman Abebe, the staff members of the Addis Ababa Traffic Police Traffic Accident Control and Inspection Office Statistics Department and W/rt Mahlet Mussie (who typed the manuscript) and others for their cooperation, material and moral supports during my research work.

At the last but not the least I would like to thank Ato Daniel Tefera and his wife (Saba), Ato Tadesse Gebresellassie and his wife (Sister Mitselale) for every support and my brother Abera Mebrahtu who shouldered all family responsibility during my stay in the University. And thanks to the Tigray Regional State Education Bureau that sponsored my graduate study.

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## Abbreviations and Acronyms

<b>AACA</b>	= Addis Ababa City Authority.
<b>AARA</b>	= Addis Ababa Roads Authority.
<b>AATCB</b>	= Addis Ababa Transport and Communication Bureau
<b>AATPTACIO</b>	= Addis Ababa Traffic Police Traffic Accident Control and Inspection Office
<b>C.S.A.</b>	= Central Statistical Authority
<b>ECA</b>	= Economic Commission for Africa
<b>ECE</b>	= Economic commission for Europe
<b>EMA</b>	= Ethiopian Mapping Authority
<b>ERA</b>	= Ethiopian Roads Authority
<b>ERTA</b>	= Ethiopian Road Transport Authority
<b>ETA</b>	= Ethiopian Telecommunication Agency
<b>GDP</b>	= Gross National Product
<b>GIS</b>	= Geographic Information System
<b>GPS</b>	= Global Positioning System
<b>NGO's</b>	= Non-Government Organizations.
<b>NUPI</b>	= National Urban Planning Institute.
<b>OAU</b>	= Organization of African Unity.
<b>OECD</b>	= Organization of Economic Co-operation and Development
<b>ORAAMP</b>	= Office for the Revision of A.A. Master Plan
<b>PGS</b>	= Pain, Grief and Suffering
<b>PIA</b>	= Personal Injury Accidents
<b>SPSS</b>	= Statistical Information System
<b>TRL</b>	= Transport Research Laboratory
<b>UN</b>	= United Nations

# **Taxi Traffic Accidents in Addis Ababa: Causes, Temporal and Spatial Variations, and Consequences.**

**By Bitew Mebrahtu**

## **Abstract**

*The main objective of the study was to identify the causes and consequences as well as the temporal and spatial variations of taxi traffic accidents in Addis Ababa.*

*The research was based on primary and secondary sources. Three types of questionnaires were distributed to taxi drivers, non-taxi drivers and pedestrians. The Global Positioning System (GPS) instrument was used to locate the major taxi stations and accident-prone areas on maps. Different maps were made using the GIS Arc view. The archives of The Addis Ababa Traffic Police Traffic Accident Control and Inspection Department and the Addis Ababa City Administration Transport and Communication Bureau were used as sources of information.*

*The study considered a number of factors grouped into driver, vehicle, pedestrian, and environmental factors. Also problems associated with the number and facilities of the traffic police department as well as the traffic regulation itself were assessed. The study indicated that the concentration of economic activities and services, negligence of taxi drivers and working for longer hours, older taxi vehicle fleet, and inadequacy of traffic control facilities are among the main causes of taxi traffic accidents. Also the low level knowledge of pedestrians about the traffic rules, the small number of traffic police working for long hours without incentives, inadequate facilities and the lack of enforcing capacity of the traffic regulation itself have also been identified as the main contributing factors to the incidence and magnitude of traffic accident in Addis Ababa.*

*The spatial variation of taxi traffic accidents showed that accidents are highly concentrated along the busiest roads, squares and around schools, government offices worship areas, commercial, recreational as well as dense residential areas. The study also indicated that taxi traffic accidents coincide with peak hours of the day and weekends.*

*On the basis of the findings of the study, it has been recommended that the expansion and improvement of road facility programmes should be supported with prompt remedial measures such as the decentralization of functions, traffic education for children, strict driver training and licensing and public education for pedestrians. Also it recommends the proper management of the available road facilities, and revising of the existing traffic regulation to enhance its enforcing capacity on the offenders.*

# CHAPTER ONE

## INTRODUCTION

Addis Ababa, as a capital city of the Federal Government of Ethiopia, is located almost in the center of the country. The city has a total population of 2,570,000 according to CSA's projected estimate for 2001 based on the 1994 census report for Addis Ababa (C.S.A, 1999). And the largest proportion of the vehicle population in the country is concentrated in AddisAbaba. In the inner area of the city, there is a concentration of government administrative institutions and commercial activities mixed with residences. The city is growing, especially, to the south along Debre Zeit Road according to the Office for the Revision of Addis Ababa Master Plan (ORAAMP) that also stressed that the city had experienced a horizontal growth in unorderly fashion in recent years.

### ***1.1. The Problem***

Since the distribution of the natural resources on the earth's surface is not evenly distributed, there exists scarcity of different commodities in different places. Also there is a difference in specialization in the production of varieties of commodities and services. Because of these conditions and other related motives people exchange what they have produced with what they need irrespective of the distance between them and their partners in trade. Hence, they have to move from place to place to do so. Any movement of people for any purpose using different means is known as transportation. As stated by Bamford and Robinson (1978),

"Transport by definition implies a movement, and every individual from an early age possesses his own "built-in" ability to move, albeit within a limited area". Furthermore, to show the indispensable role of transport they generalized that it is difficult to conceive of a situation where transport does not play a major role in the life of an individual.

Definitions by most scholars concentrate on transport as the movement of people and goods from one place to another. For instance, refer to the works of Goodal (1987), Peters (1982) and Khanna (1986). But according to Mekete (1997), transport also includes movement of information. Likewise, "Transportation is the conveyance of people, goods and information from one place to another or it is the relocation of people, goods and information over space."

It is an accepted fact that of all modes of transportation, road transport is the nearest to people. And its major advantage compared with others is its flexibility, which allows it to operate from door-to-door over short distances at the most competitive prices (Waugh, 1990; Bamford and Robinson, 1978). In Africa over 80% of goods and people are transported by roads (ECA, 1989), and in Ethiopia road transport accounts for over 90% of all the inter-urban freight and passenger movements in the country (Atnafseged, 1996).

Transportation is one of the basic requirements for the proper functioning of societies as its demand is highly related to the movement of people from one place to another. The movement of people according to Bamford and Robinson (1978), as summarized by Mekete (1997) has various purposes. These are:

*Journey to work (movement of persons to their places of work); commercial travel for the sake of business; journeys to school by children and students; Journey for shopping and personal business; journeys for social and entertainment purposes; Journeys to home; and journeys for which there is no specific purpose other than to be with or assist some other person.*

Therefore, transportation has a direct impact on the day-to-day activities of people, especially in large cities where the distance to be traveled is too far to cover on foot or by bicycle within a reasonable time

Cities in the developing nations are not only showing a rapid population growth, but also a change in their residents' way of life. This obviously implies that there is a need for a corresponding expansion of infrastructure and services. But due to inadequate road networks, slow road construction and maintenance, rapid traffic growth, shortage of parking space in the narrow streets, as well as ineffective traffic management and enforcement, there is rapid growth of road traffic accidents. This problem is mainly manifested in most of the capital cities of African nations (Mekete, 1997).

Since every activity of humankind has its own consequences (positive or negative), transport is not an exception to this fact. The constraints associated with transport include the risk of traffic congestion, traffic accident, pollution, noise, and the like (Rallis, 1977).

Road traffic accidents are among the most damaging environmental impacts, which have resulted from transportation development. Road safety, therefore, is a worldwide problem. Each year more than half a million people die in traffic accidents and many more are injured. In this respect, motor vehicles are usually involved. According to the World Bank (1996), even in Shanghai (China), where non-motorized traffic dominates, more than 95% of fatalities and nearly 75% of all registered traffic injuries involve motor vehicles.

In the developing countries, road traffic accident is the major factor that brings about

death next to those caused by natural factors. They do have a great impact on economic and social activities. Road accidents cause all kinds of losses. Other than the loss of life, there is loss of means of transportation and fresh expenditure for purchasing new vehicles or repairing damaged ones. These scarce resources could be used more profitably elsewhere. Generally the losses involved in the developing countries from road accidents are believed, on average, to have reached over 1% of gross national product per year (Adler, 1987). For instance, in Kenya in 1990, it was estimated that traffic accident costs were equivalent to 1.3% of the GDP (World Bank, 1996).

And Ethiopia as one of the developing countries has one of the world's worst road traffic accident records as measured by the rate of fatalities per 10,000 vehicles. It was 180 in 1985/6 (TRL, 1991), 178 in 1996/7 (Girma, 2000), and 155 in 2000 TRL and Ross Silcock, (2000). Road traffic accidents, according to Ethiopian Roads Authority studies, costs the Ethiopian economy between 350-430 million Birr annually, and currently Ethiopia loses almost 1700 lives each year with another 7,500 people reported injured. As these numbers are only those that are reported to the police, the actual number injured in road traffic accidents can be expected to be at least twice as large. About 42% of all the injuries caused by road traffic accidents occur in the city, and over 90% of all injury accidents in Addis Ababa involve pedestrians.

Addis Ababa as a capital city of Ethiopia and a host for many national and international organizations (like the OAU, ECA and many Non-Governmental Organizations (NGO's) and the like) is not only experiencing an ever-increasing growth of population, but also increasing

number of modern vehicles added to the existing old vehicles in the city.

According to ORAAMP (2000),

*The city has been growing rapidly not in orderly fashion but expanding horizontally without planning. Illegal settlements are mushrooming around every corner of the city. This has led to severe shortage of basic services and infrastructures such as access to roads.*

Addis Ababa has a total road length of 1329.5Kms, out of which only 29.7% (395.25Kms) is asphalt road. About 73.5% of the asphalt road is not provided with sidewalks. 72% of the existing roads have width well below the required standard width (ORAAMP, 2000). According to the ORAAMP (2000), about 77% of Ethiopia's vehicle populations are concentrated in Addis Ababa. Moreover, according to the Addis Ababa Transport and Communication Bureau (AATCB), the total number of vehicles in the city is estimated between 100-120 thousand. Again according to ORAAMP (2000), in addition to the city's vehicles about 1360 freight trucks and 240 passenger buses enter the city every day. These make the traffic situation of the city at peak-hours very alarming and they also compete for the available infrastructure.

A remarkable feature in the city's transportation system is the role of public transport where the Anbessa city bus services and the taxi services are the dominant ones. According to the Ethiopian Road Transportation Authority's (ERTA) annual report of 1999/2000, there were about 9952 registered taxis and giving services in Ethiopia during 1998/99. Of which 96% were operating in Addis Ababa, according to the ORAAMP's estimate.

The number of taxis operating in the city is substantially increasing and it is estimated to

be between 10-12,000 or (10%) of the city's vehicle population. The contribution of taxis to the total road traffic accident in Addis Ababa is quite substantial as can be seen from Table 1. On the average taxis contribute about 21% of the total road traffic accidents in the city annually in the specified period, the lowest being 8.1% and the highest 26.5% in 1989/90 and 1996/7. Hence, Addis Ababa like other large cities in developing countries suffers more from road traffic accidents of which the contribution of taxis is between 15.8- 26.5% of the total traffic accident reported to the police since 1990/91.

Hence, Ethiopia in general and Addis Ababa in particular like other developing nations and large cities in the developing countries are suffering from road traffic accident problem that demands an immediate response.

**Table 1: Taxi Traffic Accidents in Addis Ababa (1989/90 -2000/01)**

No	Year	Total No of accidents	Share of Taxis	
			Number	% Of total
1	1989/90	3538	285	8.1
2	1990/91	3159	498	15.8
3	1991/92	3716	682	18.4
4	1992/93	3385	602	17.8
5	1993/94	3005	447	14.9
6	1994/95	3707	683	18.4
7	1995/96	6649	1695	25.5
8	1996/97	6969	1850	26.5
9	1997/98	8585	2036	23.7
10	1998/99	7349	1551	21.1
11	1999/00	7214	1499	20.8
12	2000/01	7279	1501	20.6
13	Total	64,555	13,329	20.6

Source: AATPTACIO's Various Unpublished Monthly Reports.

As we can understand from the experiences of the industrialized nations, complete alleviation of traffic accidents is not possible, but there is a possibility to control and minimize

it. The condition of road traffic accident problem in Addis Ababa particularly that is caused by taxi drivers, demands an immediate response from the government, its organs and other concerned institutions. But not much is known about the problem. Hence, the study concentrates on the causes, contributing factors, temporal and spatial variations, and consequences of taxi traffic accidents in Addis Ababa. It assesses the effects of the problem and seeks solutions to it.

## **1.2. Objectives of the Study**

### **1.2.1. General Objective**

The general objective of the study is to identify the causes and consequences as well as the temporal and spatial variations of taxi traffic accidents in Addis Ababa and arrive at some possible suggestions to alleviate the problem.

### **1.2.2. Specific Objectives**

The specific objectives of the study are to:

1. show the magnitude of taxi traffic accidents such as death, injuries and property damage caused by taxi drivers in the city;
2. understand in detail the characteristics (nature) of taxi traffic accidents;
3. identify the major causes and contributing factors for the incidence (occurrence) of taxi traffic accidents in Addis Ababa; (The characteristics of the drivers, the vehicles, pedestrians and environmental factors that enable to increase the risk of road traffic accidents)
4. identify the relationship between population growth, number of vehicle and taxi traffic

- accidents in the city;
5. identify the temporal (hourly, daily and monthly) and spatial variations of taxi traffic accidents;
  6. identify the consequences of taxi traffic accidents on social and economic conditions in the city;
  7. identify the problems raised in relation to the enforcement (implementation) of traffic law, rules and regulations particularly in relation to taxi drivers;
  8. arrive at some relevant findings that would contribute to minimize road traffic accidents caused by taxis in the city.

### ***1.3. Hypotheses and Research Questions***

#### **1.3.1. Hypotheses**

This study rests mainly on the following major hypotheses.

1. The young taxi drivers are likely to inflict more traffic accidents than the old ones.
2. The less educated taxi drivers are prone to inflict more traffic accidents than the more educated ones.
3. Those taxi drivers with less driving experience have a tendency to cause more traffic accidents than the more experienced ones.
4. Employed taxi drivers cause more traffic accidents than the owners.
5. "Wayalas" turned to taxi drivers commit more traffic accidents than the others.
6. There is a positive relationship between human population growth and taxi traffic accidents.

### **1.3.2. Research Questions**

In addition to the above hypotheses, this study also focuses on the following research questions.

1. What type of traffic accidents do taxi drivers cause?
2. Which type of vehicle defects are causes of taxi traffic accidents?
3. Does pedestrians' knowledge about traffic controls and regulations contribute to the reduction of taxi traffic accidents?
4. Does the taxi drivers' knowledge about the existing traffic regulations contribute to the reduction of traffic accidents?
5. Does the weakness of the existing traffic regulation encourage the taxi drivers to commit more traffic offenses and disobey traffic regulation?
6. Are there problems on the traffic police side, which encourage taxi drivers to commit more traffic offenses?

### **1.4. Significance of the Study**

Road traffic accident problem in Ethiopia, especially in Addis Ababa, is now a major concern of the government, its organs and other institutions concerned with road safety as well as the public in general. As it is stated in the statement of the problem, in recent years over 42% of all injury road traffic accidents in Ethiopia occur in Addis Ababa of which taxis' share ranges between 15-26%. Especially the share of taxis is above 20% since 1995/96. Moreover, due to the scarcity of other alternative public transport services in the city and because of its flexibility, the taxi service will continue to be significant.

With an estimated number of 10-12,000 taxis, and over 110,000 other vehicles in the city as well as the additional freight trucks and passenger buses entering the city every day, if

the intensity of the problem is not controlled and minimized, the road safety problem may become worse.

Therefore, the knowledge of the causes of taxi traffic accidents will be of paramount importance to all those concerned. The findings obtained from the study are expected to provide:

1. helpful information about the taxi traffic accidents in the city
2. information to the governmental institutions and others that are concerned with road traffic safety directly or indirectly and about the accident prone spots in the city.
3. information about the existing problems related to the traffic regulation in the city for the concerned bodies such as the city administration and the traffic police.
4. background information to those scholars who want to conduct future detailed studies on road traffic accidents, road safety and other related issues.

### ***1.5. Delimitation of the Study***

Among the factors that affect the precision of any study, the availability and reliability of the information it employs is very important. This study mainly uses the information collected from the archives of the Addis Ababa Traffic Police Traffic Accident Control and Inspection Office that is available only for 12 years (1989/90- 2000/01). But the detailed analysis of the actual accident data was confined to the 1999/2000 and 2000/01. Information from the archives of the Addis Ababa Transport and Communication Bureau was also collected. The area coverage of the supplementary information collected using questionnaire was confined to the major taxi stations that are found within the territories of the three zones selected for this

purpose.

### **1.6. Limitations of the Study**

The absence of information related to taxis in terms of their number, type, distribution, traffic flow and other related factors, made this study difficult. Also since the available data is more general including vehicles other than taxis, the study has to rely on data from the archives of the traffic police, which are bulky and uneconomical in terms of time and resources. Also it was hard and tiresome to convince the respondents about the aim of the study.

Therefore, shortage of time, absence of recent information and limited cooperation of the government offices such as National Urban Planning Institute (NUPI) were the main problems that the researcher had to face.

### **1.7. Methodology**

This section deals with how the study was conducted, specifically on the method of data collection, sampling techniques and methods of data analysis.

#### **1.7.1. Sources of Data**

In order to achieve the objectives of the study, both primary and secondary data were used. The primary data were obtained from three different questionnaires that were distributed to all taxi drivers, non-taxi drivers and pedestrians who were around and willing to complete the questionnaires. Information was also gathered from officials in the Addis Ababa Transport and Communication Bureau (AATCB), the Addis Ababa Traffic Police Traffic Accident Control and Inspection Office (AATPTACIO), and the Traffic Police men that were on duty.

The secondary data were collected from the AATPTACIO, AATCB, Ethiopian Road Transport Authority (ERTA), and Office for the Revision of the Addis Ababa Master Plan (ORAAMP), Addis Ababa City Administration (AACCA), Ethiopian Roads Authority (ERA) and the Central Statistical Authority (CSA), as well as other relevant published and unpublished information sources.

### **1.7.2. Data Collection Procedure**

Three different questionnaires were prepared and distributed to taxi drivers, non-taxi drivers and pedestrians. These questionnaires were developed based on secondary data obtained from the Traffic Police records and other relevant literature. Different tables were developed to collect data from the archives of AATPTACIO.

Global Positioning System instrument (GPS) was also used to locate major taxi stations and taxi accident-prone areas on maps. Geographic Information System (GIS) data about the roads, Zonal, wereda and kebele boundaries of the city were obtained from the Addis Ababa Administration's GIS Department.

### **1.7.3. Sampling and Sample Size**

#### **1.7.3.1. Area Sampling**

The criteria for selection of the sample areas were the magnitude of taxi traffic accidents. First, based on the frequency of taxi traffic accident statistics collected from the archives of the AATPTACIO within 1999/00 and 2000/01, the six zones of Addis Ababa were arranged in rank order. Second, the two zones ranking first and last were automatically selected on the basis of the principle of purposive sampling. Zone-3 and Zone-6 were selected as the

Zones with the highest and lowest accident areas.

Third, the Zone with the nearest value to the average (mean) of the two extremes was selected as the middle accident-prone area. (Zone1). The logic behind this idea is that when compared the values of the third and fourth ranked Zones with the mean (384), there is no logical gap from the first ranking zone to be considered as a middle value as can be observed from Table 2. Fourth, the major taxi stations found within the selected Zones were used as the sampling areas.

**Table 2: Zonal Distribution of Taxi Traffic Accidents in Addis Ababa (1999/00-2000/01)**

Zone	Taxi traffic accidents		Rank
	Number	% Of total	
1	434	14.60	5
2	527	17.73	4
3	721	24.25	1
4	644	21.66	2
5	600	20.18	3
6	47	1.58	6
<b>Total</b>	<b>2973</b>	<b>100.00</b>	

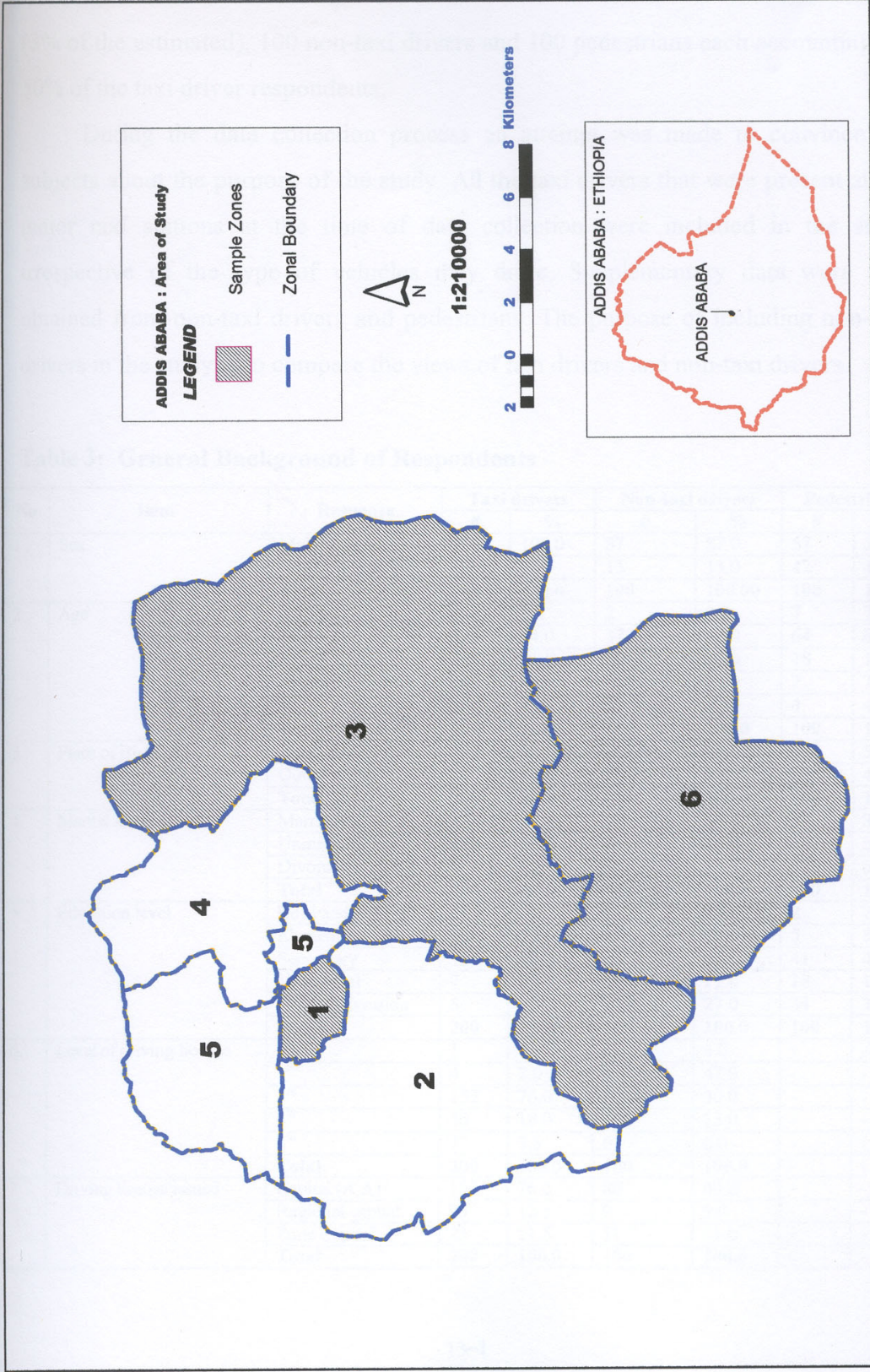
### 1.7.3.2. Sample Size

Based on the data available in Addis Ababa Transport and Communication Bureau and information gathered from taxi drivers as well as the data collected by the researcher, about 60% of the total taxi population were estimated to work in the selected three sample Zones. 400 respondents were accidentally selected: 200 taxi drivers (3% of the estimated), 100 non-taxi drivers and 100 pedestrians. During the data collection process an attempt was made to convince the respondents about the purpose of the study. All the taxi drivers those were present at the major taxi stations at the time of data collection were included in the study irrespective of

the type of vehicles they drive. Supplementary data were also obtained from non-taxi drivers and pedestrians. The purpose of including non-taxi drivers in the study is to compare the views of taxi drivers and non-taxi drivers.

In order to compare taxi and non-taxi drivers in terms of who gives priority for pedestrians (when they cross the road) and assess the knowledge of pedestrians about road crossings as well as traffic regulation, pedestrians that were available around the study area were accidentally selected and included in the sample.

**MAP 1: LOCATION MAP OF SAMPLE ZONES**

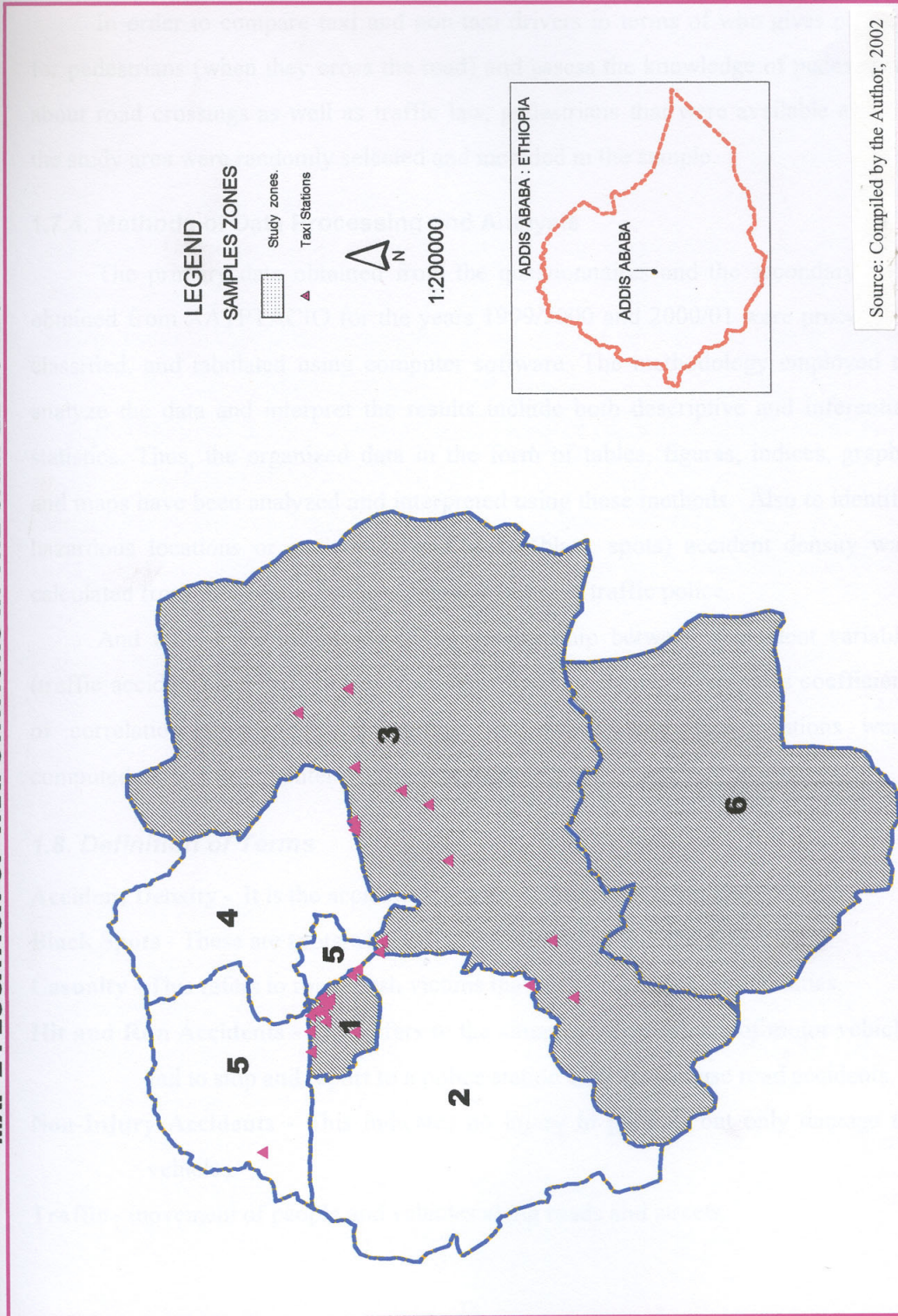


Source : Addis Ababa University Department of Geography, 1999

**Table 3: General Background of Respondents**

	Item	Response	Taxi drivers		Non-taxi drivers		Pedestrians	
			#	%	#	%	#	%
1	Sex	Male	200	100.0	87	87.0	57	57.0
		Female	-	-	13	13.0	42	42.0
		<b>Total</b>	<b>200</b>	<b>100.0</b>	<b>100</b>	<b>100.00</b>	<b>100</b>	<b>100.0</b>
2	Age	≤ 20 years	6	3.0	2	2.0	7	7.0
		21-30	128	64.0	37	37.0	64	64.0
		31-40	42	21.0	29	29.0	18	18.0
		41-50	16	8.0	21	21.0	7	7.0
		≥51	8	4.0	11	11.0	4	4.0
		<b>Total</b>	<b>200</b>	<b>100.00</b>	<b>100</b>	<b>100.0</b>	<b>100</b>	<b>100.0</b>
3	Place of Birth	Addis Ababa	113	56.5	45	45.0	55	55.0
		Out of Addis	87	43.5	55	55.0	45	45.0
		<b>Total</b>	<b>200</b>	<b>100.0</b>	<b>100</b>	<b>100.0</b>	<b>100</b>	<b>100.0</b>
4	Marital status	Married	91	45.5	56	56.0	39	39.0
		Unmarried	108	54.0	43	43.0	55	55.0
		Divorced	1	0.5	1	1.0	6	6.0
		<b>Total</b>	<b>200</b>	<b>200.0</b>	<b>100</b>	<b>100.0</b>	<b>100</b>	<b>100.0</b>
5	Education level	Read and write	2	1.0	8	8.0	2	2.0
		Elementary	47	23.5	12	12.0	5	5.0
		Secondary	139	69.5	41	41.0	41	41.0
		Vocational	7	3.5	12	12.0	18	18.0
		Higher education	5	2.5	27	27.0	34	34.0
		<b>Total</b>	<b>200</b>	<b>100.0</b>	<b>100</b>	<b>100.0</b>	<b>100</b>	<b>100.0</b>
6	Level of driving license	1 <sup>st</sup>	1	0.5	4	4.0	-	-
		2 <sup>nd</sup>	4	2.0	47	47.0	-	-
		3 <sup>rd</sup>	152	76.0	30	30.0	-	-
		4 <sup>th</sup>	36	18.0	13	13.0	-	-
		5 <sup>th</sup>	7	3.5	6	6.0	-	-
		<b>Total</b>	<b>200</b>	<b>100.0</b>	<b>100</b>	<b>100.0</b>	-	-
7	Driving license issued	Capital (A.A)	152	76.0	80	80.0	-	-
		Regional capital	25	12.5	9	9.0	-	-
		Zone Capital	23	11.5	11	11.0	-	-
		<b>Total</b>	<b>200</b>	<b>100.0</b>	<b>100</b>	<b>100.0</b>	-	-

**MAP 2 : LOCATION OF TAXI STATIONS IN THE SAMPLE ZONES**



Source: Compiled by the Author, 2002

#### **1.7.4. Methods of Data Processing and Analysis**

The primary data obtained from the questionnaires and the secondary data obtained from AATPTACIO for the years 1999/2000 and 2000/01 were processed, classified, and tabulated using computer software. The methodology employed to analyze the data and interpret the results include both descriptive and inferential statistics. Thus, the organized data in the form of tables, figures, indices, graphs and maps have been analyzed and interpreted using these methods. Also to identify hazardous locations or accident prone areas (black spots) accident density was calculated and maps were prepared using GIS Arc View 3.2 based on the secondary data obtained from the traffic police.

And to test the magnitude of the relationship between dependent variable (traffic accident by severity levels) and different independent variables, the Karl Pearson's coefficient of correlation, coefficients of multiple correlations, and coefficients of determinations were computed using the computer SPSS programme.

#### **1.8 Organization of the Thesis**

The thesis is organized into nine chapters. The preceding Chapter is an introductory part, which includes the problem, objectives of the study, hypotheses, and research questions, significance, delimitation and limitations of the study as well as methodology and methods of data processing and analysis. Chapter two highlights the related literature on worldwide and Ethiopian perspective. Chapter three discusses the general background of Addis Ababa, while chapter four elaborates on the development of road transport, introduction of taxi service and taxi station distributions in Addis Ababa. Chapter five assesses the overall nature, causes, and the spatial as well as temporal variations of road traffic accidents in Addis Ababa.

Chapter six discusses the nature and causes of taxi traffic accidents in Addis Ababa highlighting driver, vehicle, pedestrian and environmental factors as well as traffic regulation and the traffic police. The spatial and temporal variations as well as casualties by road users are also discussed in this chapter. The major causes or contributing factors are discussed in Chapter seven, whereas the damage and costs to life and property are treated in Chapter eight. Chapter nine is devoted to conclusion and recommendations.

# CHAPTER TWO

## REVIEW OF THE LITERATURE

### *Part One (A Worldwide Perspective)*

Cities in the developing nations show a rapid growth of population, which obviously implies that there is a need for the expansion of infrastructure services for their inhabitants. The rate of urban growth is very high everywhere. The failure to expand the necessary infrastructure like transport to match the growth of population has been a prime cause of misery in the cities of the developing world. Inadequate road networks result in severe congestion as the volume of traffic grows (Devas, 1993). This is because the cost of providing satisfactory urban services such as better transport is enormous and investment is lacking for their expansion.

#### ***2.1. Historical Perspective of Urban Growth***

Urbanization is defined as the process "whereby an increasing proportion of a nation's or region's population live in urban areas" (Waugh, 1990). Even though there is no any global agreement as to what constitutes an "urban area", most nations use population size and percentage of the population engaged in non-agricultural activities according to (UN, 1991). For instance Argentina, Malaysia and Nigeria define urban areas as having 2000, 10000 and 20000 inhabitants respectively (Terence, 1998).

The world is becoming predominantly urban. According to UN (2000), it is expected that during the first years of the 21<sup>st</sup> century for the first time in human history, more than 50% of the world's population will live in urban areas and by 2025 the proportion will be nearing

58%. In 1800, only 3% of the world's population lived in urban areas (Perlman, 1993). According to Waugh (1990), it grew to 29% in 1950, 34% in 1960, and 37% in 1970. In 1980 and in 1990 about 39% and 45% of the world's population lived in urban areas. About 47% of the world's population lived in urban areas in 2000 and by 2007 the world's urban population is expected to equal rural population (UN, 2001).

Also by 2025, only 61% of the population of the developing countries is expected to live in urban areas as compared to 83% in developed countries. This implies that 4.4 billion people will live Source: AATPTACIO's Various Unpublished Monthly Reports in the urban centers of the developing countries, accounting for about 80% of the total urban population in 2025. Urbanization patterns differ markedly between the developed and developing regions. The developing regions are undergoing rapid urbanization but it has slowed down in the developed regions.

The ratio of population growth in urban areas of the developing countries is dramatic as compared to the urban population growth in industrialized nations. From 1950 to 2050, the urban population in the developing nations will increase almost 16 times from under 200 million to 3.15 billion people. That means cities in developing countries are expected to grow by 140,000 people a day in the future (Perlman, 1993). In 1970, about 1.4 billion of the 3.7 billion people in the world lived in urban areas. They were nearly equally divided between the developed and developing nations. (UN, 1992).

According to the United Nations (2001), by 1990 the world's population was about 5.3 billion of which 4.1 billion lived in the developing nations and 1.2 billion in the developed

nations. Approximately 45% (2.4 billion) of the total population of the world lived in urban places of which 1.5 billion lived in developing and 0.9 billion in developed nations. Also the level of urbanization in developed and developing nations was 73% and 37% respectively in 1990. As shown by the United Nations Department of Economics and Social Affairs (1999) estimates, the world's urban population was about 2.8 billion, out of which 1.9 billion were found in the urban areas of developing nations. As a whole, the urban population is growing faster than the world population where the growth rate is 1.2% and 2% per year for the world's total population and world's urban population respectively (UN, 2001). But there is a pronounced variation in the rate of increase for the developing regions. The highest rate of urban growth is found in Africa (3.7% per year) followed by Asia with 2.5% per year. Eastern African region cities are expected to grow by 5% a year between 2000 and 2005 (UN, 2001).

As it is indicated in the urbanization Prospects of 1999 Revision, world level of urbanization will reach 60% by 2030 from 46.6% in 1999. Accordingly the level of urbanization in developing nations will shift from 39.4% in 1999 to 56.2% by 2030, whereas the corresponding change for the developed nations will be from 75.8 to 83.5%.

**Table 4: Percentage of World Populations Living in Urban Areas (1950-2030).**

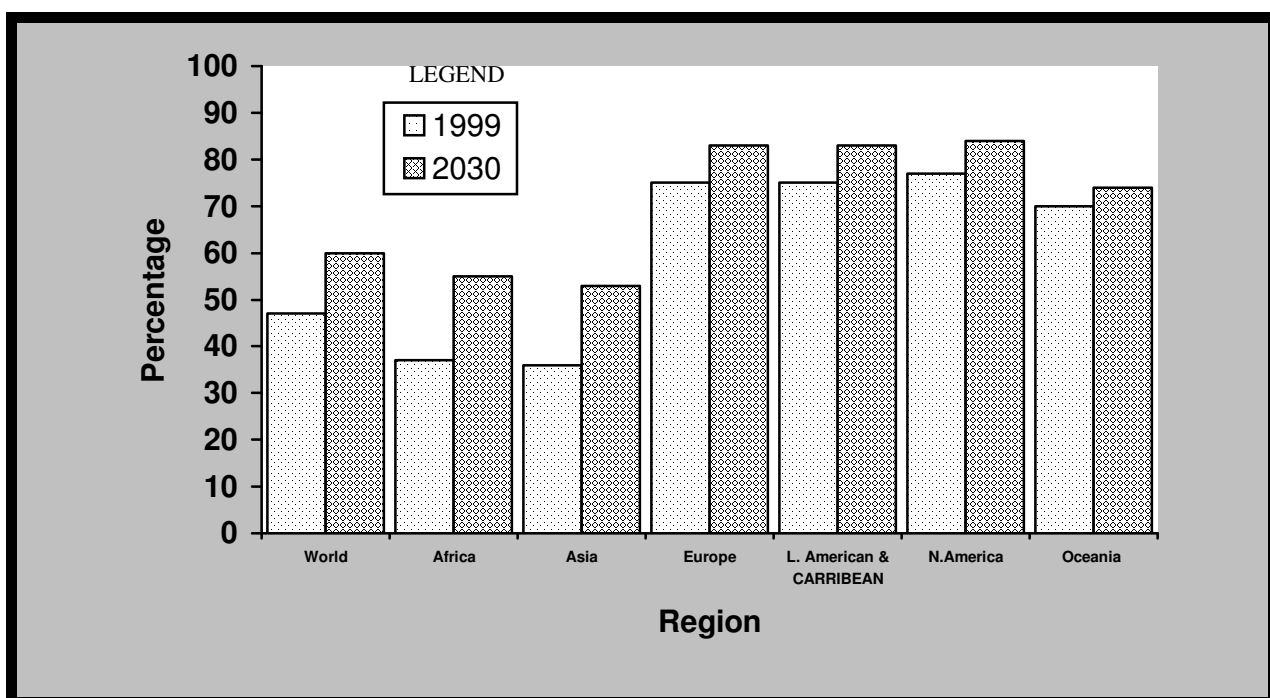
	1950	1960	1970	1980	1990	2000	2010	2020	2025	2030
World total	29.3	34.2	36.6	39.4	43.1	47.5	52.7	58.3	61.1	60.3
Developed Nations	54.7	61.3	67.5	71.3	73.6	76.3	79.3	82.5	84.0	83.5
Developing nations	17.3	22.5	25.1	29.2	34.7	40.7	47.2	53.8	57.0	56.2
Africa										
Ethiopia	4.6	6.4	8.6	10.5	12.3	14.9	19.5	26.2	29.9	35.3

Source: UN (1990- 1999) World Urbanization Prospect Revision

Africa is the least urbanized region with 32% of its population living in urban areas in

1990 (Obudho, 1998). Urbanization estimates indicate that the urban population of Africa is growing 4 times faster than that of the remaining developing regions. In 1990, 15% of the developing nations urban population lived in Africa. And among the regions of Africa, Eastern Africa has the lowest level of urbanization despite the fact that it is one of the most populated regions in Africa (Obudho, 1998).

**Fig. 1 Percentage of World Population Living in Urban Areas, 1999 and 2030**



As indicated in Table 4, the process of urbanization continues at a faster rate in the developing nations of the world than in the developed ones. Accordingly, the urban population of Ethiopia accounts for about 15% currently and it is expected to reach 29.9% and 35.3% in the years 2025 and 2030 respectively.

## 2.2. World Vehicle Population

Today there are 737 million cars worldwide. Among these 70% of them are found in North America, Western Europe and Japan. Approximately 162 million cars (22%) are found in Latin America, Asia and Eastern Europe. The remaining is spread out in the rest of the world. (Deutschland, 2002). In 1950, there were about 53 million cars on the world's roads, and in 1990, the global fleet size rose to 456 million. On the average, the fleet has grown by about 9.5 million automobiles per year over this period. (World Bank, 1995).

The latest estimates of the UN (2001) shows that the share of the world population is 124 vehicles per 1000, but a very wide gap exists among the developed and developing nations in this respect. It is 473 vehicles per 1000 in the developed nations whereas 30 vehicles are available for every 1000 people in the developing nations. Regionally, Northern America, Oceania and Europe rank from first to third with 746, 498 and 341 vehicles per 1000 people respectively. In the case of the developing regions, Africa ranks last with 26 vehicles for every 1000 people as shown in Table 5.

**Table 5: Distribution of World Vehicle Fleet by Region (2001)**

Region	Population in 000	Motor vehicle per 1000 people
World Total	6,134,135	124
Developed nations	1,193,861	473
Developing nations	4,940,274	30
Asia	3,720,705	41
Europe	726,312	343
L. America	526,533	92
N. America	317,068	746
Oceania	30,915	498
Africa	812,603	26
Eastern Africa	256,673	7
Ethiopia	64,459	2

Source: UN (2001) Department of Economic and Social Affairs

Motor vehicles are mainly concentrated in the major urban centers, mainly in big cities, where a variety of activities flourish. This condition imposes a serious problem in the ease of

movement. According to Bamford and Robinson (1978), the complex changes in the economic, social and technological sectors in the urban centers are responsible for urban transport problems. The problem originates from:

1. The absolute growth and changing distribution of population and the consequent increased travel demand. As urban population continues to increase the need for travel also increases because the distance between home and place of work becomes greater.
2. The growth in the number of private cars and freight vehicles leads to tremendous increase in the number of vehicles using the road.
3. The shift of passengers from public transport to the private car which leads to the decline in the use of public transport where public transport has a central role in any efficient urban transport system.

### ***2.3. Road Traffic In Urban Areas***

#### ***2.3.1. What is Traffic or Road Traffic?***

As defined in Webster's Seventh New Collegiate Dictionary "Traffic is pedestrians, animals (whether ridden, driven, herded or led), vehicles and other conveyances, either singly or together while using any road for purpose of travel or locomotion".

And as the Encyclopedia Britannica puts it, "traffic means movement of vehicles, pedestrians and animals on the road or street" (Vol.18), where the main components of traffic are the road, vehicles, pedestrians and animals. Furthermore, "Traffic" is defined in broad sense as "the movement resulting from transport of people along roads, railways, sea lanes, navigable inland water ways and air routes" (Goodall, 1987). And road traffic is a continuous interaction

between the three elements related to traffic itself, and the interaction within the three groups. Namely: man or the human factor, the vehicle and the road or simply the environmental factor (Cantilli, 1987).

Growth in urban areas and in the number of vehicles in many developing countries has led to increased traffic congestion in urban areas and an increase in traffic accident on the road networks, which were never designed for the volumes and types of traffic, which they are now required to carry. In addition, unplanned urban growth has led to incompatible land uses with high levels of pedestrian vehicle conflicts (TRL, 1991).

Hence, providing transport in urban areas is more complex. The main reasons include a high population density, inefficient traffic and pedestrians on one hand and a greater concern for personal safety on the other. According to Thompson (1998), the poor can rarely afford public transport and are more likely to walk or cycle on inadequate and insecure footpaths and tracks. This non-motorized traffic accounts for 80% of journeys in urban areas.

### **2.3.2. Road Network Characteristics**

The structure of the road network in urban areas is usually determined by the existing patterns of layout and density of housing and building characteristics. In high-density urban areas the block building results in a large number of intersections with short distances between them. In urban areas nearly half of the fatal accidents occur at the intersections (Matson, 1955). In such areas different kinds of traffic management systems are installed. The numbers of signal-controlled crossings are normally high. But the road network in rural areas is wide, meshed and has lower density of intersections and less traffic controls (OECD, 1978).

Streets in urban areas are usually edged with sidewalks on both sides of the roadway. Buildings, fences and other vertical objects border the streets in urban areas while in rural areas fields or ditches often flank the roads. As opposed to rural roads urban streets are usually lighted. (OECD, 1978).

### **2.3.3. Road Traffic Factors**

The prominent factors which affect the frequency and severity of road traffic accidents are mainly traffic volume, traffic speed and traffic composition. As the volume of traffic grows the increase of opposing vehicles increases, intervals for passing vehicles are less available, the accidents due to improper passing become frequent, and the frequency of accidents grows approximately in direct proportion to the average volume of traffic volume according to Babkov (1975) cited in Girma (2000). Here again as the volume of traffic increases, the speed of vehicles drops and the main kind of accident becomes a nose-tail collision.

According to Ross Silcock partnership (1991) and Ogden (1996) cited in Girma (2000), greater hazard occurs at higher speeds for the fact that vehicles become less stable and the driver and other road users have less time to react. Hence, as the speed of the vehicle increases the severity of accident increases. The survival rate also decreases as the collision speed of the vehicle increases. And the death risk of pedestrians is much higher than for a vehicle user according to Gunnarsson (1999).

Gunnarsson cited results of studies that indicate that 90% of pedestrians survive at a collision speed of 30km/h, and 40% at 50km/h. Another study made in Norway as summarized by Sakshaug (1989) showed that when the speed limit was lowered from 60 to 50, 70 to 60, and

80 to 60 km/h, serious accidents were reduced by 40-50%. On the other hand, the number of serious accidents increased by about 50% where the speed limit was raised from 80 to 90 km/h.

Another factor, which affects the frequency and severity of road traffic accidents, is composition of traffic. There are different types of vehicles in a traffic stream. And different types of vehicles have different physical, geometric, and performance characteristics. Speed and acceleration can vary greatly from one vehicle type to another. High differential speeds in traffic streams result in more overtaking maneuvers and more probable danger of accidents.

In support of this view, Ogden (1996) showed that the speed differential between heavy and other vehicles is often the basic argument for higher involvement of trucks in accidents. Therefore, speed, volume and composition of traffic are most important factors in accident prevention (safety), which needs more attention.

#### ***2.4. Nature and Cause of Road Traffic Accidents***

Generally speaking, for an effective reduction of road traffic accident rates, a full realization of the problem is required, before effective measures are taken to alleviate the problem. This will be discussed later. First we should define "accident" and "road traffic accident".

##### **2.4.1. What is Road Traffic Accident?**

An "accident is generally an event or happening which is unexpected, undesigned with an element of chance or probability or unfortunate result" and sometimes an "accident" is defined as "the occurrence which usually produces injury, death or property damage"

(Encyclopedia Britannica Vol. 18).

And the definition of road traffic accident is more related with the road traffic, in that road traffic is considered as a system in which the human, the vehicle, and the road interact with each other where the efficiency and safety of road traffic depends on the performance and interaction of these components. The definition by Economic Commission for Europe (ECE), which is widely accepted in most countries of the world, is as follows.

*Road traffic accidents are those which occur or originate on a way or street open to traffic, which resulted in one or more persons being killed or injured and in which at least one moving vehicle was involved. These accidents, therefore, include collisions between vehicles, between vehicles and pedestrians, and between vehicles and animals or fixed obstacles (UN, 1997 Vol. XLII).*

A road accident is defined in Ogden (1996) shortly as

*A rare, random, multiple factor event, always preceded by a situation in which one or more road users have failed to cope with the road and its environment. It is a random event from time and location (space) aspects.*

It is not possible to predict accurately where and when the next road accident will occur. Moreover, there is rarely an accident situation where there is one sole cause of accident. Every accident is a unique event preceded by a chain of unique multiple factors. However, the contribution in each set of circumstances generally falls into the three components of the road traffic system: road, environment deficiencies, vehicle defects, and road user errors.

## **2.4.2. Types and Classification of Road Traffic Accidents**

### **2.4.2.1. Types of Traffic Accidents**

The major traffic accidents that occur on the main highway and streets can be grouped

into motor and non-motor vehicle accidents.

*i. Motor Vehicle Accident:* - which is any motor vehicle accident occurring on the highways and streets involving only one car, more than one car, car-pedestrian and car-bicycle accidents.

*ii. Non-Motor Vehicle Accidents:* - are accidents that involve collision between a pedestrian and a bicycle on a sidewalk (Legault, 1960; TRL, 1995).

#### **2.4.2.2. Road Traffic Accident Classification**

There is no definite and consistent classification method of road traffic accidents worldwide. Some countries keep only simple records classifying accident into total serious (heavy) injuries, and minor (light) injuries or as total injury and property damage only. Also as indicated by Hobbs (1979), the comparison of accident statistics between countries is made difficult because common definitions are not used. For example, death is defined differently in different countries. Death within 30 days in Britain, at the scene in Portugal, within 24 hours in Spain, within 6 days in France, 7 days in Italy and within a year in the USA. Among these, the definition within 30 days is mainly accepted and the case is true in Ethiopia. Therefore, accidents are classified according to the severity of the accident emphasizing whether a person is killed or injured into fatal, serious, and slight and damage only accidents. (See GLOSSORY).

#### **2.4.3. Causes of Road Traffic Accidents**

Every accident is not usually attributable to a single cause but to a chain of unique multiple factors or failures associated with the road and environment deficiencies, vehicle defects, and road user errors. In most cases the traffic police associate traffic accident with a single most important cause on the spot of accident and do not list the multiple factors.

Among the main causes of road traffic accidents, the most important ones as indicated

by Hobbs (1979), Adler (1987), ECA (1989) and Tsumokawo and Hoban (1997) are:

1. driving under the influence of alcohol or/and drug
2. driving recklessly, dangerously or without due regard for other road users and lack of experience.
3. driving above the speed limit- (too fast) and children playing on streets
4. failing to observe traffic signs, misperception and panic reactions from the inexperienced driver
5. negligent pedestrians crossing or walking on the wrong side of the road and rushing into the roadway
6. roads unsuitable for motor vehicles such as narrow road, low quality shoulder surfaces, lack of non-motorized lanes/ paths, undefined crossing sites, dangerous curves, intersections, etc
7. inadequate street illumination, poor visibility, lack of sidewalks, etc
8. lack of proper signs, signals, markings, intersection layout and control
9. mechanical defects of vehicles such as brakes, lights, etc. and congestion.

Most scholars classify these causes into three major classes of error as road user's error, vehicle defects and road condition or environment. Among the most prominent factors, is the human factor of which drivers' errors takes the majority of the blames. Drivers' errors that are hazardous include driving too fast, failing to give way, improper over taking and following too close. All of which could result from aggressive or irresponsible behavior, deficient actions, perceptual errors or impairments. (TRL, 1995).

And vehicle defects, which lead significantly to accidents, are mainly those related to the lack of regular maintenance, of which defective tires and brakes feature most frequently.

In relation to this fact, the main causes of road accidents as identified by the police in some developing countries and the results of an on-the-spot study in the UK is given in Table 6. According to the police, 69-94%, 1-17% and 0-20% of traffic accidents were caused by errors of road users, vehicle defects and road or environmental deficiencies respectively.

Generally, it is known that driver errors, often accompanied by violation of law, are in the chain of events leading to more than 90% of road accidents (Hobbs, 1979).

This fact is also true even in the developed nations. For example, the study by Evans (1991), on two on-the-spot investigations, one in USA and the other one in the UK, in the early 1970s show that road users, vehicles and roads are identified as the sole factor in 57,3, and 2 percent of accidents in the USA. The corresponding values for the UK study are 65,2 and 2 percent. Generally, these studies found that road user errors are responsible for 93-94%, roads and their environments for 28-34%, and vehicles for 8-12% of traffic accidents.

**Table 6: Causes of Road Traffic Accidents (as reported by the police in some developing countries and the UK) (Downing et al., 1991).**

Country	Causes of Accidents (%)			
	Road Users Error	Vehicle Defect	Road Condition or Environment	Others

Afghanistan (1984)	74	17	9	-
Botswana (1982)	94	2	1	3
Cyprus (1982)	94	1	5	-
Ethiopia (1982)	81	5	-	14
India (1980)	80	7	1	12
Iran (1984)	64	16	20	-
Pakistan (1984)	91	4	5	-
Philippines (1984)	85	8	7	-
Malaysia (1985)	87	2	4	7
Zimbabwe (1979)	89	5	1	5
UK (TRRL on-the-spot study 1975)*	95	8	28	-

Source: Girma (2000:42) \* the sum exceeds 100 because of more than one identified causing factor of accidents.

## ***2.5. Major factors Contributing to Road Traffic Accidents***

This section focuses particularly on the identification of the contributory and determinant factors for the problem, among which the most important ones are road users (drivers and pedestrians), vehicles and environmental factors.

### **2.5.1. Road user Factors**

Driving is a skill, which requires training, and experience, and a driver who is in charge of a vehicle should be physically and mentally capable. The basic task of the driver should be determining and maintaining speed and direction in relation to the road by reference to the perceived or expected road characteristics and also a driver should take into account traffic rules (such as observation of signs and signals) and the technical aspect. A driver should also determine and maintain speed and direction in relation to road users. Otherwise the risk of being involved in traffic accident will be much high (OECD, 1978).

Most of the time the major contributing factor in the majority of traffic accidents is the

behavior of a driver. According to the OECD (1978), studies about 80-90% of the road traffic accidents were attributed to the faults of the driver. The common driving errors are lack of observation or ineffectiveness, driving too fast, failure to look, misperception and panic reaction from the inexperienced. This will be severe if the driver is impaired due to alcohol, drugs, illness, fatigue and emotional stress. In the same study, young and inexperienced drivers were found to be more likely to cause traffic accidents than older and experienced drivers. In the USA, the age group 16-24 years contains 22% of the driver population and this group was involved in 35% of fatal and 39% of all injury accidents. And overall accident rates are lowest for those in the age groups 30-60 years (Hobbs, 1979).

In recent studies made by the American Automobile Association (1997), Larson (1997) as cited in Duckes (2001), the majority of aggressive drivers are men between the ages of 18 and 26. This study stressed age as the most important factor in aggressive driving incidents. Again as this study indicates, aggressive driving is increasing (Altman, 1997) resulting in an increase of 7% per year in traffic incidents. For instance, the Department of Transportation (USA) estimated that, in 1996, two-thirds of the 41,907 reported deaths resulting from automobile accidents are attributed to aggressive driving.

In another study as cited in Duckes (2001), a large percentage of cell phones are used while people are driving, and research shows that the use of the phones compromises safety. Redelmeier and Tibshirani (1997) found that the chance of a collision was four times higher when the driver was using the phone. Of particular concern are the consistent findings that drivers talking on the phone think they have more space in front of their car than they really

have, and cell phone users have slower response times (Mcknight and Mcknight, 1997).

The problem of driving while chatting on a mobile phone (cell phone) is also a common problem for Spanish drivers, where the Spanish traffic authorities have decided to strictly enforce the new rules that says "Hang-up and drive" in the Spanish roads (The Economist February 9<sup>th</sup> 2002). According to this magazine, Spain had 314 deaths per one million vehicles and 151 deaths per one million people in 1998. Also considering the seriousness of the traffic accidents caused by the use of a cell phone which distracts drivers while driving, more than 40 countries including Italy, Brazil, Denmark, Portugal, Israel, Japan, Spain and Kenya have issued laws that forbid the use of cell phone while driving (Addis, Vol. 2 No.1, 2002). In Addis Ababa though the traffic problem created as a result of the use of cell phones at present is not much serious, it will be a chronic problem in the near future as the number of people with cell phones is increasing rapidly. Today 32,000 people are in possession of cell phones and there are 40,000 on the waiting list (ETA, 2002).

Pedestrians are the next victims of most road traffic accidents particularly children below the age of 15. They are the most vulnerable to motor vehicle accidents. Because many children, most of the time especially in urban areas of developing countries where there is little availability of playgrounds in their neighbourhood, play around streets or road crossings they are easily exposed to traffic accidents. Cycling also is another cause of accident for children. In Great Britain in 1974 nearly 40% of the fatalities and 25% of those seriously injured were children under 14 and pedestrians aged over 60. Cycling accident is also acute danger to children, particularly in the under 15-age group. Nearly 25% of all cyclists' casualties,

numbering over 20,000 per year, including those slightly injured are from this age group alone (Hobbs 1979).

### **2.5.2. Vehicle Factors**

It is not only the improvement in the standards and design of vehicles that matters, but also adequate maintenance of the vehicle during its working life (Hobbs, 1979). Older vehicles with mechanical defects, and poor maintenance cause higher fatal injuries and property damage. For instance, studies in Britain show that about 20-30 percent of personal injury accidents involve a vehicle having some deficiency (Hobbs, 1979). In most cases, defects associated with the break, tire, light and other mechanical defects are associated with accident. Size difference between colliding vehicles also affects the severity of injury, particularly in cases when heavy vehicles impact light vehicles. As indicated in many studies such as in Garner and Deen (1973), Evans (1991), and Downing et al. (1991), vehicle defects rank after driver and environmental deficiencies as a major cause of road traffic accidents.

### **2.5.3. Environmental Factors**

There is an intimate relationship between defect of roads and road traffic accidents. The design, lighting, and surfacing of roads can affect injury rate and well-designed roads allow greater margins of safety. Many accidents needlessly occur because the facilities provided do not adequately allow for the range of individual requirements of separate groups of road users particularly the pedestrians. (Hobbs, 1979).

In many developing countries due to limited financial resources road construction and maintenance is poor. In addition, roads are not bordered by sidewalks for pedestrians. Both the vehicles and pedestrians are forced to share the available roads or streets, which contributes to high traffic accidents in those countries.

The condition of road surface also contributes to the occurrence of traffic accidents. The theoretical basis is that damaged and uncomfortable road surface is most likely to increase the

probability of incidence of traffic accidents. Road moisture condition is another contributory factor for the incidence of traffic accident. Road surfaces such as dry; wet and muddy have their own contributions to the traffic flow.

The relationships of road width, curvature and straight distance all have particularly marked effects on the occurrence of accidents (Hobbs, 1979). It is on straight and plain roads that traffic accidents occur mostly rather than on others. It is due to the low gradient of these roads that drivers want to drive fast on this section of the road.

The occurrence of an accident is not usually attributable to a single cause but to the combined effects of a number of deficiencies or failures associated with the user, his vehicle and the road layout. Environmental conditions such as weather and time of day will be of influence. Out of the total road accidents (as studies show) about 1%, 2% and 15% occur in a foggy, snowy and rainy weather respectively. Night-time accident rates for unlit streets, are about twice that of day time, and even under average street lighting conditions they are about 50% greater (Hobbs, 1979).

Generally, though traffic accidents are most of the time associated with one sole cause, most of them are attributable to multiple causes. In a study made by the Department of Transportation and Environmental Planning in UK out of 500 road accidents it was found that 77% were attributable to multiple causes and 3% to a single cause.

Environmental/road user factors account for 48.8% followed by environmental/ vehicle road user factors (16.4%), road user factors (12.4%), vehicle/ road user factors (7.2%), environmental factors (5.6%) and environmental/vehicle factors (4.8%).

And in a wider ranging on-the-spot study by TRL, human factors are the sole reason in 65% of the cases and a contributory cause in 95%. About 25% of the accidents studied displayed a deficiency in the road, environment linked to a driver error (Hobbs, 1979).

## ***2.6. Road Accident Risk and Levels of Motorization***

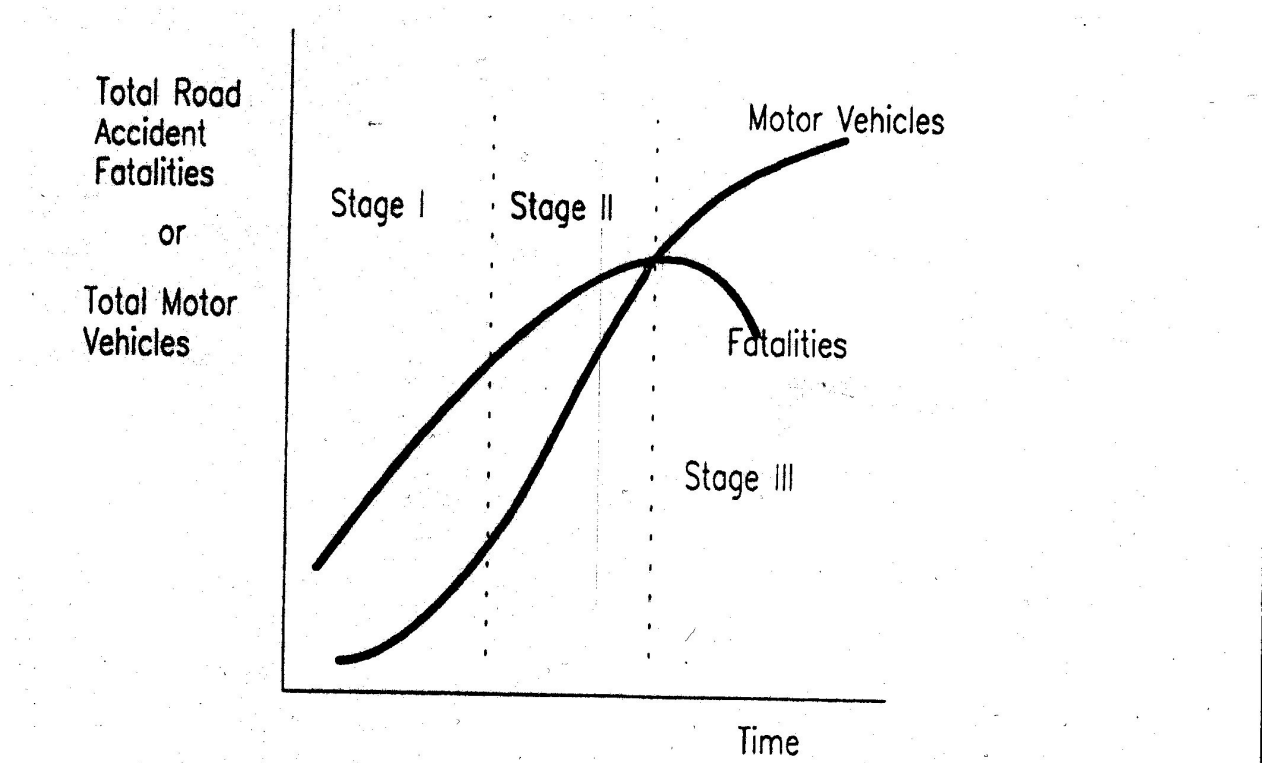
Road accident and the number of vehicles in most cases (other things being constant)

have a direct relationship. When the volume of traffic increases the risk of traffic accident increases. On the basis of the number of vehicles per a given number of people the world nations are at different stages of motorization. As experienced in many developed countries, the development of motorization generally follows a typical trend of S-shaped curve. The overall trend has been characterized into three distinctive stages of development (Jorgensen, 1996), namely: 1. Developing motorization            2. Exploding motorization and

4. Saturation motorization, where levels of road accident fatalities tend to follow a typical trend shown in Figure 2. These two curves in Figure 2 show the general relationship between motorization and safety at a given development stage of a country.

In the initial stage of motorization, the population has little knowledge about road safety and less aware of how to act safely in the motor traffic. During this stage, road accident fatalities rise with the increase in motorization and population. In the second phase, as the traffic hazard increases with high rate of motorization, awareness and concern develops. At this stage there is an increased understanding of the man-vehicle-road-regulation system. This is due to the fact that attention is given to the improvements of road and vehicle design as well as influencing human behavior by means such as education, legislation, and enforcement. This stage is characterized by the decrease in the rate of fatalities per vehicle.

**Fig 2: Typical Trend for the development of Motorization and Traffic Fatalities.**



Source: Girma, (2000:27)

The third phase of development starts when road-traffic fatalities peaks and begins to decline. Here traffic accident fatalities continue declining with the implementation of proven safety improvements on black spot road sections, drinking and driving, speeding and vehicle safety. This is the historical achievement of a number of industrialized nations in the early 1970s (Girma, 2000).

### ***2.7. Spatial and Temporal Variations in Road Traffic Accidents***

A fundamental pre-condition for safe traffic is that the road users have sufficient information about road conditions, traffic characteristics and traffic regulations. The road layout and design should be improved. If it is not the case, traffic accidents will tend to increase. And most road accidents occur in urban areas than in rural.

### **2.7.1. Spatial Distribution of Road Traffic Accidents**

Severe road traffic accidents are associated with those areas, where there is lack of information, overload of information and when the information is difficult to perceive as well as at intersections where traffic is not regulated and with complex geometry (design). Moreover, roads with heavy traffic volumes, with mix of local and through traffic, road users traveling at different speed levels and/or in different directions as well as in busy shopping streets where the high complexity makes it difficult to select sufficient information about the road and the traffic. Most road traffic accidents take place at junctions, on curves, at gaps in dual carriageways, at pedestrian crossings, private driveways and bus stops. Also accidents more likely occur at junctions than elsewhere and in urban areas (Hobbs, 1979).

According to Ogden (1996), for example, in the USA, over 50% of urban and over 33% of rural total reported accidents occur at intersections. The corresponding figures in Australia are 43% and 11%, respectively. Again in the United Kingdom, 60% of all reported accidents are intersection accidents (Jacobs et al., 1986). Therefore, intersections and urban areas especially in the central places of cities are the areas of traffic accident and focus of road safety works. Intersections have different configurations such as the T, X and Y junctions which have different influence on the safety performance of intersections (Ogden, 1996).

### **2.7.2. Temporal Variation of Road Traffic Accidents**

Occurrences of road traffic accidents obviously vary with time. This variation occurs between hours in a day, days in a week, and months in a year closely following the variation of Traffic volume. Even though nighttime driving is normally low, the rate and severity of the accident is higher during the nighttime. According to Hobbs (1979), nighttime accident rates are about 50% greater than daytime accidents.

## **Part Two: An Ethiopian Perspective**

### **2.8 Road Traffic Accident Situation in Ethiopia**

Ethiopia is one of the developing countries with a very low motorization level, 1.7 vehicles per 1000 people in 1996/7 (Girma, 2000), and the most recent data show 2 vehicles per 1000 people in 2001 (UN, 2001). Despite having a very low road network density and vehicle ownership level, Ethiopia has a relatively high accident record. Even though the fatality rate is decreasing, it is still very high compared to the rates of many countries in the world.

According to RTA (1996) cited in Admasu (2001), the years between 1990 to 1995, exhibited a fatality rate of 197 per 10,000 vehicles on the average. It was 178 and 155 per 10,000 vehicles during 1996/7 and 1998/99 respectively. And according to Jacobs (2000) cited in Admasu (2001), the fatality rate is 150 for every 10,000 licensed vehicles in 2000. This could be due to the underreporting of accidents and the problem associated with the inspection of vehicles. The controlling of the not inspected vehicles is loose which leads to the decrease in the number of inspected vehicles (the denominator). Ethiopia's road traffic accident problem has been indicated as the worst example in different papers in comparison with other countries. Jacobs and Sayer (1983), Ross Silcok Partnership (1991), Downing et al. (1991), Jorgensen (1997), TRL and Ross Silcock (2000), Jacobs (2000) and World Bank (2000) and Admasu (2001).

Ethiopia is on the extremely high side of the international road unsafety scene as shown in Table 7 that shows fatalities per vehicle versus vehicle ownership for selected African and

European countries. Accordingly Ethiopia ranks the top in terms of fatalities per 10,000 licensed vehicles but it is at the bottom in terms of fatalities per 100,000 populations as well as vehicle ownership compared even with the nations of Africa found at similar levels of development. In 1989 the fatality rate was 236 but it decreased to 198 fatalities per 10,000 vehicles in 1994.

**Table 7: Fatality Rates and Vehicle Ownership Levels of Some African and Developed Countries.**

Country	Year	Fatalities per 10,000 vehicles	Fatalities per 100,000 population	Vehicles per 10,000 population
Ethiopia	1989	236	3	12
	1994	198	3	16
Uganda	1989	189	5	27
	1994	198	7	36
Kenya	1989	73	9	118
	1994	64	9	120
Botswana	1989	41	19	536
	1993	38	26	722
S. Africa	1989	21	36	1700
	1994	18	25	1336
Norway	1989	1.9	9	3810
	1993	1.4	7	3780
Sweden	1989	2.0	9	4200
	1993	1.6	7	4100
Great Britain	1989	2.3	9	3450
	1992	1.8	8	3620
USA	1989	2.4	18	5758
	1992	2.1	15	5654

Source: Girma (2000:24)

It could be even greater than this figure because there is a problem of under reporting. The problem of under reporting has been indicated in many studies like Tadele (1989) and Girma (2000). For instance, according to a study made by Tadele (1989), about 30% of hospital

treated motor vehicle injuries in Addis Ababa, had no police records, while nearly all police recorded injuries had a hospital record.

### **2.8.1. Casualties by Road Users in Ethiopia**

The knowledge of the causalities by road users helps in how and where to start to solve the problem of personal injuries (Casualties). In the study made by Girma (2000) approximately 56% of the reported traffic accident fatalities are pedestrians (average from 1987/8 to 1996/7) and 45% of non-fatal injuries were pedestrians. In the same study drivers account on the average for 7% of fatal, and 6% of non-fatal road accident injuries.

**Table 8: Comparison of Road Accident Fatalities by Class of Road Users in Selected African Countries.**

Country	Year	Road Accident Fatalities (%)		
		Drivers	Passengers	Pedestrians
Ethiopia	1993/4	6	42	52
Botswana	1994	20	58	23
Kenya	1994	20	37	43
Malawi	1994	10	53	37
S. Africa	1994	27	32	41
Zambia	1994	14	41	46
Zimbabwe	1994	37	22	41

Source: Girma (2000:25)

**There are higher pedestrian fatalities and very low driver fatalities in Ethiopia compared to the above-mentioned countries. But passenger fatalities are moderate relative to the other nations as shown in Table 8.**

### **2.8.2 Accident Reporting in Ethiopia**

The existing system of accident reporting classifies accidents into four accident severity classes

in Ethiopia, namely: fatal, serious injury, slight injury and property damage. But the distinction between serious and slight is not well established where it mainly depends on the personal judgment of the traffic police on the spot.

But the traffic accident casualty pattern in urban areas of Ethiopia is very high even compared with that of other countries. For example, in Addis Ababa, the pedestrian casualties account for 88% and 83% of the fatal and non-fatal injuries (average from 1987/8 to 1996/7) Girma, (2000). But comparing with other studies like in Bombay (Sayer and Palmer, 1997), and Kampala (Oliver, 1995) pedestrian fatalities account for 70% and 61% respectively. Whereas passenger and driver casualties according to Girma, (2000), in Addis Ababa were four and two times less than the national average respectively.

Many countries use the definition of road accident fatality as one in which death occurs within a 30-day period as a result of sustained accident injury (Ogden, 1996) and (Ross Silcock, 2000). In Ethiopia, however, road accident fatality is not clearly and uniformly defined. Accident deaths shown in the accident statistics are mainly on-the-spot deaths. The inclusion of victims who died in hospitals within a short period of time during police investigation is probable. It is quite dependent on the follow up of the investigating policemen. If the victim dies after the preparation of the monthly summary of the accident report, the severity class will most likely remain unchanged. But comparing the reliability of the accident statistics, the fatal accident statistics are more complete and reliable than the non-fatal accident data (Tadele, 1989) due to fatal accident information is needed to enforce the law and carryout prosecutions.

### 2.8.3. Trends in Vehicle Registration in Ethiopia

Though Ethiopia is categorized in the class of countries with the low level of motorization, the trend of vehicle registration in the country is increasing faster and the concentration of these vehicles in few urban areas, where Addis Ababa takes the lion's share, is a typical feature of the nation in terms of vehicle registration and distribution.

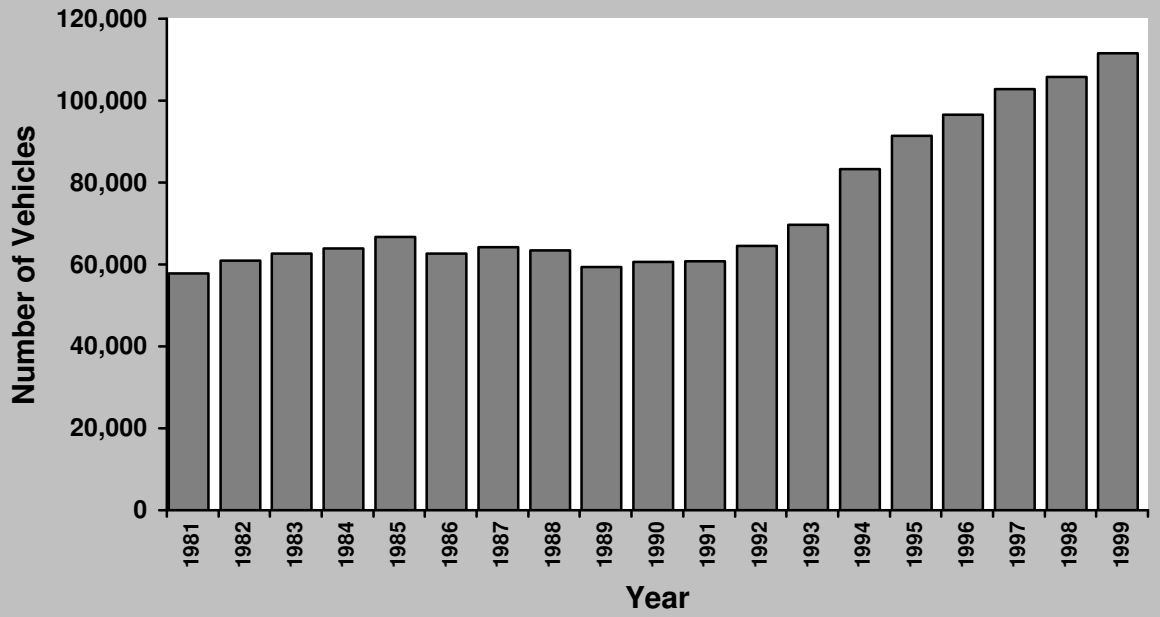
**Table 9: Annually Registered and Inspected Vehicles in Ethiopia (1999/2000)**

Year	Number of Vehicles		
	Taxi	Non-taxi	Total
1981/82	3,290	54,472	57,762
1982/83	3,260	57,692	60,952
1983/84	3,410	59,256	62,666
1984/85	3,435	60,544	63,979
1985/86	4,183	62,458	66,641
1986/87	3,454	59,216	62,670
1987/88	3,530	60,759	64,289
1988/89	2,610	60,766	63,376
1989/90	2,097	57,231	59,328
1990/91	3,811	56,765	60,576
1991/92	4,325	56,444	60,769
1992/93	5,233	59,287	64,520
1993/94	4,869	64,850	69,719
1994/95	6,305	76,974	83,279
1995/96	6,595	84,862	91,457
1996/97	6,524	89,978	96,502
1997/98	9,847	93,033	102,880
1998/99	9,598	96,252	105,850
1999/00	9,964	101,555	111,519

Source: Ethiopia Road Transport Authority (2000/01)

The number and quality of vehicle importation in the country shows significance increase since 1992 where the nation adopts free market economic policy.

**Figure 3: Trends in Vehicle Registration (Ethiopia)**



## CHAPTER THREE

### GENERAL BACKGROUND OF ADDIS ABABA

#### ***3.1. Location and Size***

Addis Ababa is astronomically located at 9<sup>0</sup>02' North latitude and 38<sup>0</sup>42 East longitude. As a capital city of the Federal Government of Ethiopia, it is located almost at the center of the country. The northern boundary runs along the Entoto mountains while its southern boundary runs across a plain land extending towards the Akaki River on to the Debre Zeit road. The eastern limits extend along the road to Debre Berhan and Dessie, while the western boundary runs along mt. Wechecha (EMA, 1988).

The range of altitude is about 600 meters, Entoto area with 2900 meters and the St. Joseph Church with 2300 meters above sea level. Because of this position Addis Ababa ranks the fourth highest capital city in the world and there is a great variation of height within the city, so that much of it is built on the slope (Tesfaye, 1986).

Addis Ababa covers an area of 530.21 square kilometers where about 56% is an urban area inhabited by 98.7% of the city's population whereas the rest 34% is rural area occupied by 1.3% of the city's population (CSA, 1999).

#### ***3.2. Topography and Climate***

The city of Addis Ababa is surrounded from the northwest to the north east by Entoto

Hills (Mekete, 1997) and is endowed with streams and rivers which flow towards the south which includes Kebena, Ginfilla, Bantayiketu, Bule, Akaki and Kechene (ORAAMP, 2000).

The topography of Addis Ababa is not favorable from the transport network development point of view (Tesfaye, 1986). The city's landscape is very sloppy and mostly exposed to flooding. The five streams and rivers, which cross the city from the north to the south, have also a negative impact on the development of the transport sector since the limited resources available do not allow maximum infrastructure development on such difficult terrain. This terrain also creates a difficulty for old vehicles, which are forced to wheel on the ups and downs of the steeper roads such as the Churchill road, and from the Meskal Square to Shiromeda.

Addis Ababa experiences a typical tropical highland climate of moderate temperature due to its high altitude. There is not great difference in the annual average temperature and rainfall of Addis Ababa. It has annual average temperature of 16°C and rainfall of above 1000 m.m. because of its location in the summer and spring maximum rainfall region (CSA, 1999).

### **3.3. Population**

According to the 1994 Central Statistical Authority's Population and Housing Census Analytical report for Addis Ababa, the city had a total population of 2,112,737 of which 1,023,452 are males and 1,089,285 are females with a sex ratio of 94 in 1994.

### 3.3.1. Population Growth

The population of Addis Ababa is growing rapidly. From the year 1961 to 1994, within a time of 33 years, the total population has increased by almost five folds. And even in the recent years, that is between 1984 and 1994 within 10 years the population had doubled.

The population size of Addis Ababa has grown from 443,728 in 1961 2,112,737 in 1994. And according to the CSA's projected estimate the city has 2,570,000 populations in 2001. (CSA, 1999). This increase is due to natural increase and migration towards the city and the addition of the size of the city in recent years. The population of Addis Ababa is projected to reach 2,887,000 and 3,328,000 by the year 2005 and 2010 respectively according to the medium variant estimate (C.S.A, 1999).

**Table 10: Population Growth in Addis Ababa (1961/62 - 2000/01)**

<b>Year</b>	<b>Population Size</b>
1961/62	443,728
1967/68	683,530
1978/79	1,167,315
1984/85	1,423,111
1989/90	1,722,098
1990/91	1,792,599
1991/92	1,865,942
1992/93	1,942,244
1993/94	2,112,737
1994/95	2,157,000
1995/96	2,220,000
1996/97	2,286,000
1997/98	2,354,000
1998/99	2,424,000
1999/00	2,495,000
2000/01	2,570,000

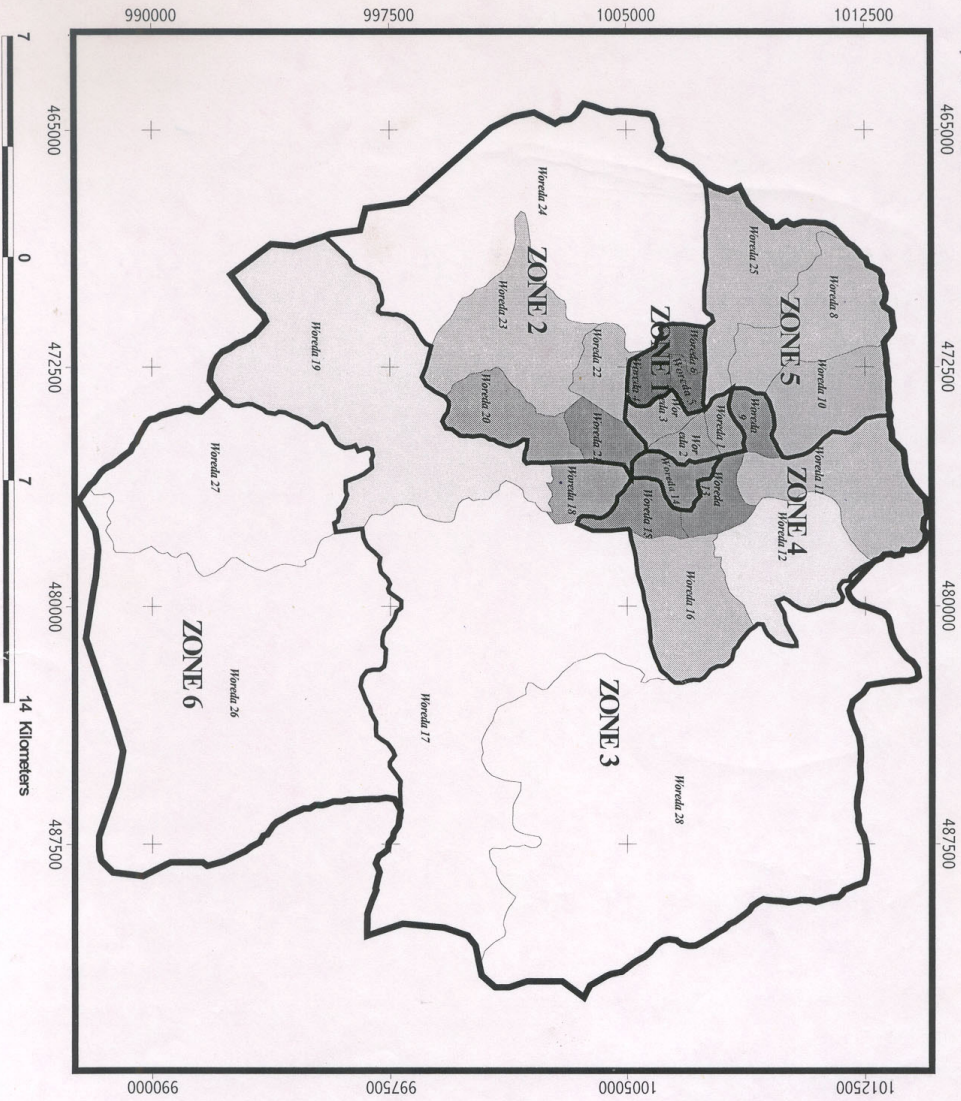
Source: 1 From 1989/90 - 1992/93 CSA (1985) Census Supplement 1, A.A. cited in Mekete

(1997). 2 . The rest CSA (1999) Analytical Report for Addis Ababa

### **3.3.2. Age-sex Structure**

Age-sex structure of a population is one of the factors that affect the number of trips generated per day per person. The age structure of Addis Ababa is typical of neither developed nor developing countries. Because the population structure of the city combines relatively low (32%) of children below age 15 with a very small (3%) of old age people (aged above 64). And the population aged 15-64 constitutes about 65% of the total population. This could be attributed to high in-migration of working age population. (CSA, 1999).

# Map 3. Population and Administrative Map of Addis Ababa



**Legend**

- Region Boundary
- Zone Boundary

**Pop Density (Per/Sqkm)**

	546.894 - 2120.253
	2120.253 - 4352.885
	4352.885 - 6902.929
	6902.929 - 9085.106
	9085.106 - 16493.734
	16493.734 - 24008.43
	24008.43 - 63619.866



Source: Ethio-GIS/CSA, 1994  
UTM GRID: Zone 37

**Table 11: Percentage Distribution of the Addis Ababa's Population by 5-year Age Group (1994)**

Age group	Male	Female	Total
Under-1	1.59	1.45	1.52
1-4	6.80	6.34	6.56
5-9	10.60	10.21	10.40
10-14	13.04	13.40	13.23
15-19	14.38	17.10	15.79
20-24	12.69	13.44	13.08
25-29	9.81	10.10	9.96
30-34	6.84	6.39	6.61
35-39	6.20	6.67	6.44
40-44	4.97	3.77	4.35
45-49	4.12	2.93	3.50
50-54	2.92	2.41	2.66
55-59	1.96	1.58	1.76
60-64	1.52	1.46	1.49
65-69	1.00	0.92	0.96
70 and above	1.46	1.82	1.70
All ages	100.00	100.00	100.00

Source: CSA (1999)

As shown in Table 11 the highest percentage of the population between the age group of 5-30 that account for above 50% are most of the time who make the highest trips per day.

### **3.3.3. Population Distribution**

Addis Ababa has 6 Zones, 28 Weredas and 328 Kebeles of which 305 Kebeles are in the urban part and 23 farmers' association areas in its rural part (CSA, 1999).

As shown in Table 12 and Map 3, there is a disparity in the distribution of population in the six zones. Those zones, which comprise the weredas in the central areas not only have larger population size but also have highest population densities. Whereas those zones that consist the peripheral weredas account less and have lower population densities.

**Table 12: Total Population Size, Urban and Rural of Addis Ababa**

Zones	Total Population	% of total	% of urban	% of Rural	Rank
1	314,565	14.9	15.1	0.0	5
2	472,238	20.2	20.5	0.0	3
3	380,174	18.0	17.4	62.6	4
4	461,313	21.8	22.1	0.0	2
5	434,661	20.6	20.9	0.0	2
6	94,786	4.5	4.0	37.4	6
<b>Total</b>	<b>2,112,737</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>-</b>

Source: CSA (1996)

Furthermore Zone 3 and Zone 6 comprise the total rural population of the city, especially Zone 6 can be designated as the zone where rural population dominates since its share of the urban population is very low. And this entire have its own contribution to the traffic accidents since traffic accidents are mainly associated with the volume of traffic a particular area can have.

## **CHAPTER FOUR**

# **DEVELOPMENT OF ROAD TRANSPORT AND TAXI SERVICES IN ADDIS ABABA**

### ***4.1. Development of Road Transport in Addis Ababa***

Road building in the modern sense began during the period of Tewodros in Ethiopia, which was strategic rather than economic. It was intended to conquer the local kings and bring all the country under his throne (Pankhrust, 1961).

Later, the period of Menelik II had laid down the base for the development of modern means of transport not only in Addis Ababa but also in Ethiopia. The first major constructed road, which linked Addis Ababa and Addis Alem, was constructed during the reign of Menelik II in 1902. The length of this road was about 27 miles. The road was intended to facilitate the transportation of wood for both construction and fuel from Addis Alem to Addis Ababa by gharries (Tesfaye, 1986). The Italian occupation (1936-41) had contributed to the construction of roads in Addis Ababa Pankhurst, (1968) and Tesfaye, (1986), where the first master plan of the town was made and many all weather and asphalt roads were constructed.

The earliest forms of urban transport in Addis Ababa were the "**Gharries**" which came into existence by the order of Menelik II in 1900 (Tesfaye, 1986), and stayed as chief means of transportation unit until they were ordered to leave the city for the near by towns in 1964 (Tayech, 1991). Gharries served the inhabitants of Addis Ababa sufficiently until the population of the city reached about 100,000 in the early 1930's (Gezachew, 1990) and in the early 1950's the number of gharries were about 1093 (Tesfaye, 1986). Then after additional and modern

means of transport necessitated the inhabitants of the city.

#### **4.2. Introduction of Taxi Service to Addis Ababa**

Taxis probably started their services in Addis Ababa in the early 1920s. Ras Hailu of Gojjam brought cars from Europe when he returned from Europe with Teferi Mekonen, who was Regent at that time. Ras Hailu made the cars give services as taxis that were driven by hired drivers (Gezachew, 1996) and these motorized taxis were called "*Kurukur*" (name derived from the sound of the vehicle itself) (Tesfaye, 1986). Kurkur had a carrying capacity of 3 persons. Following the kurukur, "*Seicento*" entered Ethiopia from Italy for use as taxis in Addis. Kurkurs were working around Arat Kilo, Sidist kilo, Piazza, Mercato and Leghar. Other than these places gharries were important means of transport.

After the Italian invasion the number of taxis increased, because taxis and city buses were brought from Italian cities to Ethiopia early in September 1936. By 1938, there were about 500 taxis, 2000 cars, and 3000 lorries in Addis Ababa. And City buses were giving their service around piazza, the railway station, the Addis Alem road, Menelik's old palace and around the foothills of Entoto (Pankhrust, 1961).

Regarding the color of taxis a yellow is a standard color in most nations of the world, but the present day white and blue color of taxis in Addis was fixed in September 1955, which was decided by the Mayor of Addis Ababa city (Addis Zemen/ Amharic Daily/, 1956).

Taxi service was uncontrolled up until 1985. Since then the distribution was controlled and divided into 5 ketenas (Public Transport Corporation, 1989). In these 5 ketenas there were 750 long distance and 2,803 short distance operating taxis, totally 3,553 in Addis Ababa in

1985 working on 64 long distance and 22 short distance lines respectively (Melaku, 1992). But due to the introduction of free market economy in Ethiopia, taxis are free to choose work lines today.

#### **4.3. Trends of Vehicle Population in Addis Ababa**

Although Ethiopia is in the early stages of motorization, the number of cars and length of its roads is small relative to its population size and area respectively; an upward trend in vehicle population is exhibited in its major cities. Addis Ababa has the lion's share of the vehicle population in the country.

**Table 13: Number of Road Motor Vehicles in Addis Ababa: Registered and Inspected (1989/90-2000/01).**

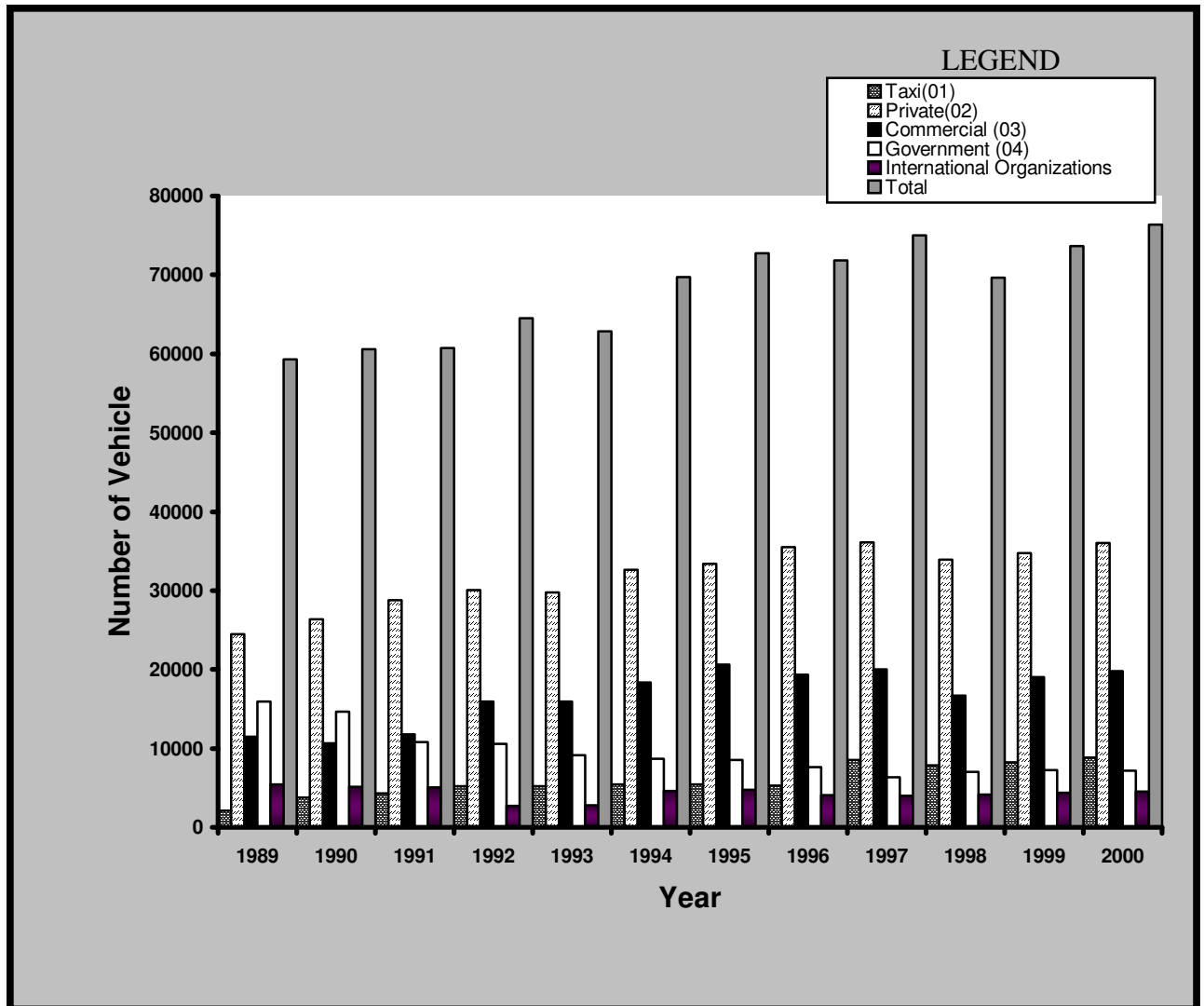
<b>Year</b>	<b>Taxi (01)</b>	<b>Private (02)</b>	<b>Commercial (03)</b>	<b>Government (04)</b>	<b>International organizations</b>	<b>Total</b>
1989/90	2097	24449	11,461	15,906	5,415	59328
1990/91	3811	26351	10,622	14,683	5109	60,576
1991/92	4325	28753	11805	10,800	5086	60769
1992/93	5233	30074	15905	10553	2755	64520
1993/94	5209	29784	15935	9131	2793	62852
1994/95	5442	32648	18377	8690	4578	69735
1995/96	5471	33363	20587	8539	4770	72,730
1996/97	5272	35499	19364	7596	4080	71,811
1997/98	8534	36139	19998	6340	4035	75046
1998/99	7888	33930	16665	6991	4148	69622
1999/00	8266	34730	19025	7270	4362	73,653
2000/01	8847	36047	19770	7192	4547	76,403

Source: Addis Ababa Transport and Communication Bureau. (2001) And Road Transport Authority (1996)

As it can be seen from Table 13 the number of vehicles inspected and registered had increased from almost 59,000 in 1989/90 to 76,000 in 2000/01. Here, what is important is that

the actual number of vehicles is by far greater which is estimated between 100-120 thousands according to the Addis Ababa Transport and Communication Bureau's estimation of 2001/02.

**Fig 4: Trends in Vehicle Registration in Addis Ababa (1989/90-2000/01)**



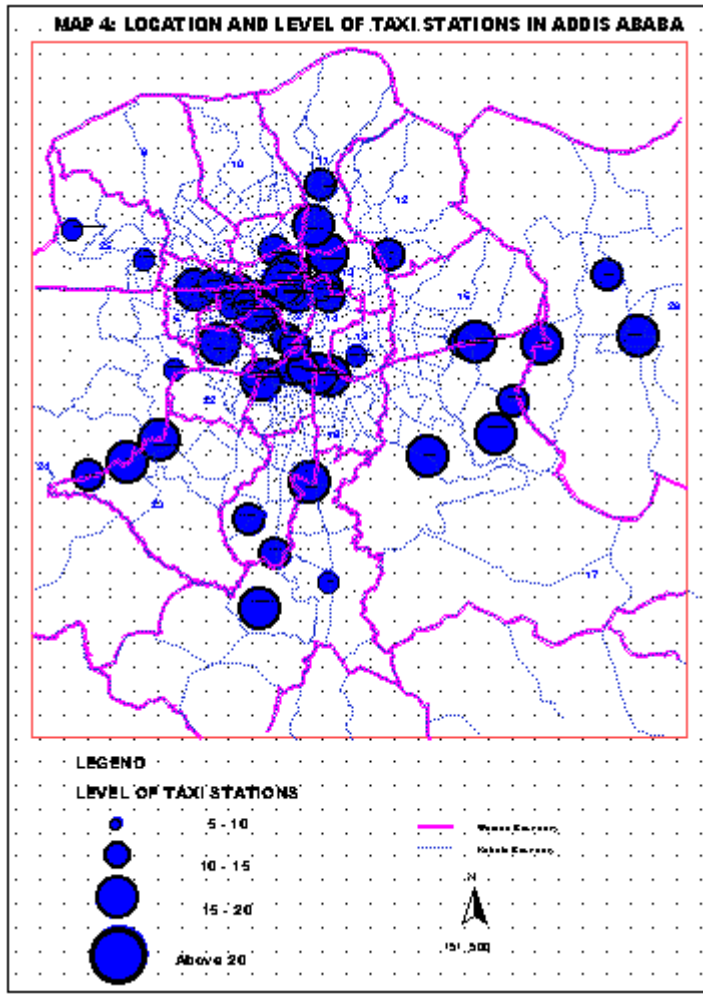
#### ***4.4. The Classification of Taxis and the spatial Distribution of Taxi Stations in Addis Ababa***

Taxis in the city are classified into minibus, small taxi and "Weyeyet" on the basis of the number and arrangement of their seats. Though, the world standard color for taxis is yellow, in Ethiopia the blue and white color is dominant as it was discussed earlier.

The service of the Yellow colored taxis in Addis is confined to or around the Airport and the tourist standard hotels.

Taxi service in the city was controlled in five Ketenas along 64 long and 22 short distance lines since June 1985 until taxis were made free to choose a work line. Today the spatial distribution and concentration of taxi service is determined by economic motives. Taxis are concentrated along the main roads of the city following the concentration of economic activities and services attracting inter woven trips within the central areas of the city and the peripheries.

There are more than 60 major taxi stations around the city as major departure or/ and arrival points which are of different magnitude. Most of them originate and radiate towards the peripheral areas following the major arterial roads in the central parts of the city as shown on Map 4.



## CHAPTER FIVE

# ROAD TRAFFIC ACCIDENTS IN ADDIS ABABA

### ***5.1. Classification of Road Networks***

Due to topography, unplanned expansion of the city and the financial limitation of the city administration, Addis Ababa does not have adequately developed road network. But compared to the other regions of the country the city has relatively developed and interconnected routes. As a capital city of the nation Addis Ababa has a radial pattern of roads that radiate outwards mostly directed to the regional capitals and other larger towns.

Roads are classified on the basis of their location, importance (land use they serve), width and length of the roads, traffic volume, and load transported or tonnage (Khanna and Justo, 1986). Based on the traffic volume (vehicles per hour or day), the Addis Ababa City Planning Division has categorized the roads in the city into:

1. Very heavy traffic (600 vehicles per day)
2. Heavy traffic (250-600 vehicles per day)
3. Medium traffic (70-25 vehicles per day)
4. Light traffic (up to 70 vehicles per day)

Considering the above factors, the roads in Addis Ababa can be classified into three groups as primary, secondary and tertiary roads.

***Primary Roads*** are designed in such a manner to ensure the connection of the principal sectors of the city. They include expressways, arterial streets and sub-arterial streets.

***Secondary Roads*** are intermediate roads that join two primary roads. They include collector and local streets.

***Tertiary Roads*** are "cul-de-sack" or Kebele roads that give door-to-door service connecting residences and various establishments like commercial, recreational, and

administrative, etc. The roads in Addis Ababa are grouped into main and secondary roads in the most recent according to ORAAMP as shown in Table 14 and Map 5.

**Table 14: The Hierarchy of Road Network In Addis Ababa Based on Width. (Actual and future planned)**

Type	Name	Width in meter
Main roads which include	▪ Express way	50
	▪ Urban principal arterial	40
	▪ Urban minor arterial	30
Secondary roads which include	▪ Collectors	20
	▪ Local streets	18
	▪ Pedestrian streets	12
	▪ Bike ways	8

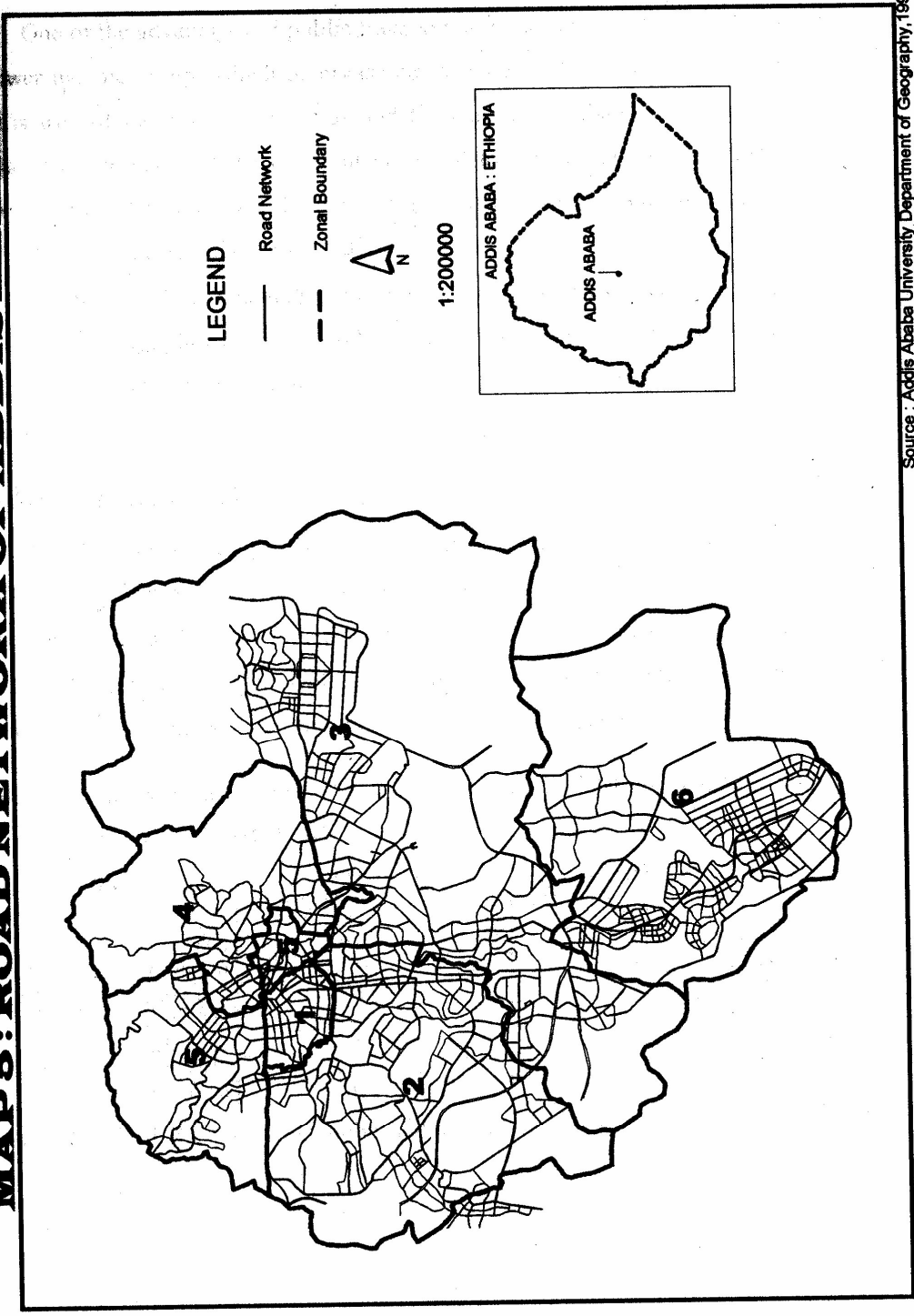
Source: ORAAMP (2000).

What is important here is that the national road network, with radiating roads from Addis Ababa, has a significant impact on the road traffic pressure (traffic congestion) of the city. According to ORAAMP study about 9300 different types of vehicles (average weekly) make outward and inward movement out of which 61% is covered along the Debre Zeit road.

## **5.2. Traffic Characteristics**

A remarkable feature in the city's transportation system is the role of public transport. In the city, next to pedestrian movement, a large proportion of people take city bus to move from one place to another. The two types of public transport services used in the city are the taxi and Anbessa city bus. The number of Anbessa city buses operating is above 450 (2001/02) in 85 lines providing about 40% of the public transport service in the city (ORAAMP, 2000). And the number of taxis in the city is estimated at about 10% of the vehicle population in the city, of which about 60% of them are 5-12 seaters.

**MAP 5: ROAD NETWORK OF ADDIS ABABA**



Source : Addis Ababa University Department of Geography, 1969

One of the advantages of public transport systems is the meeting of the needs of lower income groups which otherwise could not afford the use of other means. This is true of the Anbessa city bus and taxis in Addis Ababa. For instance, as indicated in the study of the different means of transport and their users (NUPI, 1988) cited in Mekete (1997) the percentage is as follows: private cars (7.6), taxis (10), city buses (11.9) and walking (70.5).

About 77% of the country's vehicle population is concentrated within the city and about 1360 freight trucks and 240 passenger buses entering the city every day make the traffic situation of the city at peak hours very alarming. (ORAAMP, 2000)

### **5.3. Road Traffic Accidents**

As it was mentioned in Chapter one, road traffic accident problems are worse in Ethiopia and more severe in Addis Ababa where about 42% of all injury accidents occur in the city. Based on the data available from the Addis Ababa Traffic Police Traffic Accident Control and Inspection Office records from 1993/94 to 2000/01, motor vehicle injury and fatality rates were calculated.

**Table 15: Motor Vehicle Injury and Fatality Rate Per 100,000 Population in Addis Ababa (1993/4-2000/01).**

Year	Population*	Injury rate		Fatality rate	
		Number	Rate	Number	Rate
1993/94	2,112,737	941	44.54	271	12.83
1994/95	2,157,000	957	44.37	255	11.82
1995/96	2,220,000	1682	75.77	286	12.88
1996/97	2,286,000	1601	70.03	264	11.55
1997/98	2,354,000	2014	85.56	283	12.02
1998/99	2,424,000	1879	77.52	280	11.55
1999/00	2,495,000	1873	75.07	300	12.02
2000/01	2,570,000	2100	81.71	267	10.39

Source: AATPTACIO, Various Unpublished Monthly Reports. \*CSA, 1999.

The injury rates vary between 44 per 100,000 populations in 1993/94 to 82 per 100,000 in 2000/01 where it increased by about 83% while fatality rate relatively remained unchanged.

#### **5.4. Trends of Road Traffic Accidents**

The number of people dying and being injured as well as the amount of damaged to property is increasing with minor fluctuations since 1989/90 .As it can be observed from Table 16, there is a steady increase in the number of traffic accidents.

**Table 16: Total Traffic Accidents in Addis Ababa (1989/90-2000/01)**

Year	Accident Severity					
	Fatal	Serious	Slight	Total PIA	Damage	Total
1989/90	194	506	786	1426	2112	3538
1990/91	217	338	842	1987	1172	3159
1991/92	229	400	817	1446	2270	3716
1992/93	238	352	847	1331	2054	3385
1993/94	271	313	581	1165	1840	3005
1994/95	254	311	711	1276	2431	3707
1995/96	284	384	1398	2066	4583	6649
1996/97	280	357	1244	1881	5088	6969
1997/98	265	497	1530	2292	6293	8585
1998/99	287	493	1410	2190	5159	7349
1999/00	301	488	1366	2155	5059	7214
2000/01	267	503	1330	2100	5179	7279
1989/90-2000/01 increase (%)	37.6	-0.6	69.2	47.3	145.2	105.7
Annual average increase (%)	3.1	0.0	5.8	3.9	12.1	8.8
<b>Total</b>	<b>3087</b>	<b>4942</b>	<b>12862</b>	<b>21315</b>	<b>43240</b>	<b>64555</b>

Source: AATPTACIO Various Unpublished Monthly Reports.

During the specified period traffic accidents increased by about 106% with annual average growth rate of 8.8%. The highest growth in traffic accident is exhibited by damage to

property, slight injury and fatal with a percentage change of 145,69 and 38. They have an average annual growth of 12,9 and 3 percent respectively. And the PIA had grown by almost 4% per year.

### ***5.5. Major factors Contributing to road traffic accidents in Addis Ababa***

This section focuses on the identification and analysis of the major factors contributing to the problem among which the most important ones considered are the driver, vehicle, pedestrian, and the environmental factors. The driver factors considered are gender, age, driving experience, level of driving license, and employment. Vehicle factors include types of vehicles, ownership of vehicles, vehicle service years and vehicle defect. And pedestrian factors are treated in terms of occupation and movement. Environmental factors such as road arrangement, road surface, weather as well as time are also considered.

#### **5.5.1. Driver factors**

Most of the time the major contributing factor in the majority of traffic accidents is the behavior of the driver. As it has been discussed world wide studies such as those of the OECD, show that about 80-90% of the road traffic accidents are attributed to the fault of the driver.

The negligence of drivers is the main feature of traffic accident in Addis Ababa. As calculated using the traffic accident data from the traffic police, (1993/94-1999/00) driver faults account for 98% of the causes. Refusing priority to pedestrians (94%) and to other vehicles (16%), driving too close (18%) and inaccurate by pass (14%) respectively which account for about 73% of all cases are the prominent problems. Among these faults of the driver, refusing

priority to pedestrians and driving too fast cause 80, 84 and 89% of the fatal, serious and slight injuries respectively. Drivers in the age group between 18-30 are responsible for 39,36, 27 and 32 percent of the fatal, serious, slight and damage to property respectively during the specified period. Whereas those in the age group 31-50 had contributed 38,38, 27 and 42 percent of the fatal, serious, slight and damage to property respectively. But the contributors of about 21% of the total traffic accidents are the hit and run cases.

Male drivers were responsible for 84,79,60 and 78 percent of the fatal, serious, slight and total traffic accidents respectively. Drivers having driving experience between 2-5, 5-10 and above 10 years are responsible for 22, 20 and 28 percent of the casualties respectively. This condition negates the inverse relationship between driving experience and traffic accident. More than 70% of the traffic accidents in the city are attributed to those drivers having more than 5 years of driving experience. Drivers with the 3<sup>rd</sup>, 2<sup>nd</sup> and 4<sup>th</sup> level of driving licenses account for 33, 16 and 15 percent of the traffic accidents respectively.

The other possible contributory factor for traffic accidents is the relation of the driver and the vehicle he/she drives. About 62% of damage to property, 58% of fatal, 51% of serious and 40% of slight injury accidents and about 57% of the total casualties are caused by employed drivers.

### **5.5.2. Vehicle Factors**

Adequate maintenance of vehicle during its service (working) years is of paramount importance for safe driving. Older vehicles, with mechanical defects and poor maintenance are frequently exposed to accident. The majority of traffic accidents in general are associated with

defects related to brakes, tires, lights and other mechanical defects. But in Addis Ababa, these problems account for the lowest number of accidents. Vehicles with such defects are causes for only 1.3% (N=42,855) of the casualties whereas 78% of the accidents go to vehicles with no defects.

The majority of the traffic accidents are attributed to those maneuvers like going ahead (55%), overtaking (15%), turning (12%), and merging and diverging (10%) respectively. Going ahead (straight forward) maneuvers of vehicles are the causes for 94,92 and 95 percent of fatal, serious and slight injuries respectively in Addis Ababa.

### **5.5.3. Pedestrian Factors**

Movements of pedestrians on roads also contribute to the incidence of traffic accidents, which is magnified at road crossings. In Addis Ababa, 73% of the traffic accidents occur at roads with no way (zebra crossings) for pedestrians and 15% when traveling on both sides of the road in the absence of sidewalks. About 69,74 and 74 percent of the fatal, serious and slight injury accidents had occurred when pedestrians tried to cross roads, which do not have sidewalks for pedestrians.

### **5.5.4. Environmental Factors**

#### **5.5.4.1. Road Factors**

. In Addis Ababa, roads with two-ways and separated by roundabouts have high incidence of traffic accidents. Roads having two-ways accounts for about 60%, 58%, 59%, 40% and 46% of the fatal, serious, slight, property damage and total traffic accidents respectively. And roundabouts accounts for 50%, 38%, 56% and 51% again of the fatal, serious, slight,

damage and total traffic accidents respectively. Moreover, about 96% of all traffic accidents on the above mentioned road arrangements.

Considering the shape of the junctions of roads about 71% of traffic accidents occurred in those straight roads without junctions. Roads with "T" and "+" shaped junctions ranked second and third contributing about 13% and 12% of all the traffic accidents.

In Addis Ababa, 99% of the traffic accidents occur on good asphalt roads. On the other hand, 95% and 94% of these traffic accidents occur on dry surfaces and on straight and plain roads respectively.

#### **5.5.4.2. Weather Conditions**

About 85% of the total traffic accidents and 76% of the fatal accidents occur on good weather conditions of the day and 13% of all accidents occur in cold air conditions. The largest traffic accidents occur during brighter day time (71%) related with the heavy traffic volume.

### ***5.6. Spatial and Temporal Distribution of Road Traffic Accidents and the Number of Casualties in Addis Ababa***

#### **5.6.1. Spatial Distributions of Traffic Accidents**

As it was mentioned in the literature review, people make journeys for different purposes such as for recreation, business, education, and go into working places. Likewise the distribution of traffic accidents in Addis Ababa in relation to land use shows that most accidents (52%) occur around offices followed by market areas (14%), recreational areas and residential areas accounting for 13% each. The highest number of traffic accidents seems as they are

exhibited around offices. But this is attributed to the problem of the traffic police when report. Mostly they refer the prominent or the most known buildings around the accident spot areas for the sake of easy identification.

The distribution of traffic accidents in Addis Ababa at Zonal and Wereda levels shows that there is a disparity among Zones and Weredas. Zones that comprise those Weredas in the central parts of the city account for the largest proportion of traffic accidents. But Zones consisting of peripheral Weredas account for the lowest share.

For instance Zones 3 and 2 account for 25% and 21% of the total accident of the city, while Zone 6 shares only 2.3%. Weredas 21, 17, 18, 19 and 15 together account for 41% of the total, out of which Wereda 21 alone claims more than 10%.

### **5.6.2. Accidents Temporal Variations of Traffic**

**The distribution of traffic accidents caused by road motor vehicles varies from time to time. It varies from hour to hour, day to day and month to month.**

#### **5.6.2.1. Hourly Variations**

Comparing the relationship between the hours of the day and traffic accidents in Addis Ababa, the incidence and intensity of traffic accidents correlate positively with peak-hours. Traffic accidents are higher during the morning peak hour (0800-0900) where offices, schools and commercial centers open and the second higher traffic accidents occur between 1100-1200. This may be due to the intensity of the trips for all purposes and where larger trucks are allowed to enter and leave the city and to perform their job within the city. Also it may be due to the fact

that on Fridays government offices are closed early at 1130,so that civil servants have enough recess time to go home for their lunch and cause higher congestion and the increase in traffic accidents.

**Table 17: Hourly Distribution of Traffic Accidents in Addis Ababa (1999/2000)**

<b>Day Time Hours</b>	<b>Number</b>	<b>Percent</b>	<b>Night Time Hours</b>	<b>Number</b>	<b>Percent</b>
0600-0700	180	2.49	1800-1900	330	4.57
0700-0800	485	6.72	1900-20,00	385	5.33
0800-0900	540	7.48	2000-2100	263	3.64
0900-1000	475	6.58	2100-2200	250	3.46
1000-1100	463	6.41	2200-2300	156	2.16
1100-1200	531	7.35	2300-2400	105	1.45
1200-1300	407	5.64	2400-0100	50	0.69
1300-1400	434	6.05	0100-0200	60	0.83
1400-1500	479	6.63	0200-0300	54	0.75
1500-1600	492	6.81	0300-0400	36	0.50
1600-1700	488	6.76	0400-0500	24	0.33
1700-1800	478	6.62	0500-0600	57	0.79
			<b>Total</b>	<b>7222</b>	<b>100.00</b>

Source: AATPTACIO's Various Unpublished Monthly Reports

About 75% of the traffic accidents occur during the day time hours where the morning and afternoon peak hours have higher and similar share.

### **5.6.2.2. Daily Variations**

The relationship between the days of the week and traffic accidents is shown in Table 18. Accordingly, the incidence of traffic accidents is relatively lower on Sundays. But alarmingly increases on Mondays and the days before the weekend (i.e. Friday and Saturday). Although the major causes are different, the main cause for the high traffic accidents on Saturday is, it is a day that most of the shopping takes place and a day of rest for most civil servants. They often spend the day by visiting parents, friends, families and recreating outside

homes etc. And on Monday, most civil servants, students and other business people restart their work and a high traffic volume revives after Sundays .For example, out of the total traffic accidents about 11% occurred on Sundays and 15% each on Mondays and Saturdays as shown on Table 18.

**Table 18: Days of the Week and Traffic Accidents in Addis Ababa (1996/97)**

Day	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Total
No of Accidents	1287	1240	1296	1172	1305	1288	993	8581
Percent of total	15.0	14.5	15.1	13.7	15.2	15.0	11.6	100.0

Source: AATPTACIO Various Unpublished Monthly Repots

### 5.6.2.3. Monthly Variations

As it can be seen from Table 19 there is no significant disparity among months in their total number of road traffic accidents. But relatively August, January, November, December and October have higher accidents than September and May.

**Table 19: Monthly Distribution of Traffic Accidents in Addis Ababa (1996/97-2000/01)**

Month	1996/97	1997/98	1998/99	1999/00	2000/01	Total	%
September	456	640	594	601	567	2858	7.64
October	498	845	589	636	576	3144	8.41
November	535	840	609	611	627	3222	8.62
December	528	813	644	631	538	3154	8.43
January	657	778	651	673	588	3347	8.95
February	592	745	603	569	565	3074	8.22
March	594	726	565	551	574	3010	8.05
April	593	689	591	557	594	3024	8.09
May	591	581	551	546	639	2908	7.78
June	608	607	627	593	689	3124	8.35
July	604	591	613	530	614	2952	7.89
August	713	730	712	716	708	3577	9.57
<b>Total</b>	<b>6969</b>	<b>8585</b>	<b>7349</b>	<b>7214</b>	<b>7279</b>	<b>37396</b>	<b>100.00</b>

Source: AATPTACIO various unpublished monthly reports.

### 5.6.3. Causalities by Road Users

Road users include drivers, vehicles, pedestrians and passengers. As it is shown in Table

20 pedestrians have the largest share (81%) followed by passengers (15%) and drivers (4%).

**Table 20: Distribution of Road Traffic Accident Casualties by Road Users (1993/94-1999/2000).**

Victim	Accident Severity							
	Fatal		Serious		Slight		Total	
	Number	%	Number	%	Number	%	Number	%
Drivers	83	4.1	189	11.6	220	2.3	492	3.7
Pedestrians	1801	89.0	925	56.7	8117	83.8	10843	81.3
Passengers	139	6.9	517	31.7	1347	13.9	2003	15.0
Sub total	2023	100.00	1631	100.0	9684	100.0	13338	100.0

Source: AATPTACIO Various Unpublished Monthly reports.

### **5.6.3.1. Drivers**

Unlike the driver-caused casualties in developed countries, drivers in Addis Ababa perform better compared to the number of pedestrian and passenger casualties accounting for 4.1, 11.6 and 2.3 percent of fatal, serious and slight injuries respectively.

### **5.6.3.2. Pedestrians and Passengers**

In Addis Ababa, pedestrians are at the top of the traffic accident causality list. Children account for 20% of all casualties and those in the age cohort 18-50 account for 67% of the casualties according to the traffic police reports. In terms of occupation 53,23 and 15 percent of the victims are employed, students and unemployed. And the fit and healthy people registered 97% of the total casualties, as most of the casualties are workers and students.

### **5.6.3.3. Vehicle Types Involved**

Automobiles take the first blame to be followed by taxis accounting for 27.4 and 25 percent of the traffic accidents respectively. Then trucks (22%) are the next followed by station wagons and buses accounting each for 10% in 1997/98.

## **CHAPTER SIX**

### **NATURE OF TAXI TRAFFIC ACCIDENTS IN ADDIS ABABA**

### 6.1. Contribution of Taxis to Traffic Accidents by Severity Levels

The share of taxis from the total vehicle population in Addis Ababa is estimated to be about 10%. However, taxis contribute more to traffic accidents relative to their number.

**Table 21: Accident Involvement of Taxis and Non-Taxis in Addis Ababa**

Year	Accident Severity						Total
	Vehicle	Licensed*	Involved	Fatal	PIA	Damage	
1993/94	Taxi (%)	7.18	10.20	13.28	18.97	12.28	14.88
	Non-Taxi (%)	92.82	4.51	86.72	81.03	87.72	85.12
	<b>Total #</b>	<b>61056</b>	<b>3005</b>	<b>271</b>	<b>1165</b>	<b>1840</b>	<b>3005</b>
1994/95	Taxi (%)	7.80	12.55	19.69	22.26	16.41	18.42
	Non-Taxi (%)	92.20	4.70	80.31	77.74	83.59	81.58
	<b>Total #</b>	<b>69735</b>	<b>3707</b>	<b>254</b>	<b>1276</b>	<b>2431</b>	<b>3707</b>
1995/96	Taxi (%)	7.52	30.98	19.72	25.02	25.70	25.49
	Non-Taxi (%)	92.48	7.37	80.28	74.98	74.30	74.51
	<b>Total #</b>	<b>72730</b>	<b>6649</b>	<b>284</b>	<b>2066</b>	<b>4583</b>	<b>6649</b>
1996/97	Taxi (%)	7.34	35.09	21.07	26.21	26.67	26.55
	Non-Taxi (%)	92.66	7.69	78.93	73.79	73.33	73.45
	<b>Total #</b>	<b>71811</b>	<b>6969</b>	<b>280</b>	<b>1881</b>	<b>5088</b>	<b>6969</b>
1997/98	Taxi (%)	11.37	23.86	14.34	24.39	23.47	23.72
	Non-Taxi (%)	88.63	9.85	85.66	75.61	76.65	76.28
	<b>Total #</b>	<b>75046</b>	<b>8585</b>	<b>265</b>	<b>2292</b>	<b>6293</b>	<b>8585</b>
1998/99	Taxi (%)	11.33	19.66	21.25	25.30	19.33	21.10
	Non-Taxi (%)	88.67	9.39	78.75	74.70	80.67	78.90
	<b>Total #</b>	<b>69622</b>	<b>7349</b>	<b>287</b>	<b>2190</b>	<b>5159</b>	<b>7349</b>
1999/00	Taxi (%)	11.22	18.13	20.60	26.03	18.54	20.78
	Non-Taxi (%)	88.78	8.74	79.40	73.97	81.46	79.22
	<b>Total #</b>	<b>73653</b>	<b>7214</b>	<b>301</b>	<b>2155</b>	<b>5059</b>	<b>7214</b>
2000/01	Taxi (%)	11.58	16.97	21.72	25.24	18.75	20.62
	Non-Taxi (%)	88.42	8.55	78.28	74.76	81.25	79.38
	<b>Total #</b>	<b>76403</b>	<b>7279</b>	<b>267</b>	<b>2100</b>	<b>5179</b>	<b>7279</b>

Source: AATPTACIO Unpublished Monthly Reports.

- AATCB (2001) and vehicle number those only inspected.

Table 21 shows the percentage of taxis and non-taxis involved in road traffic accidents (both injury and non-injury) with their corresponding share in the vehicle-fleet. Comparing the taxis and non-taxis there are fewer non-taxis involved in road traffic accidents than might be expected. Conversely, there are more taxis involved relative to their number. This could be due

in part to the greater annual kilometrage traveled by taxis and driver behavior. And also partly due to the fact that the non-taxi accidents are less reported than taxi accidents. Also since most of taxi drivers in the city are employed drivers it is less likely that they could negotiate and decide the amount to be paid (both sides) to the damage unless the traffic police are involved.

Though the taxis share out of the total vehicle fleet ranges between 7-11% during the specified period, about 10-35% of taxis had been involved in traffic accidents. Between 1993/94- 2000/01 total taxi traffic accidents range between 15-27% and the fatal, PIA and property damage accidents range between 13-22, 19-26 and 12-26 percent respectively.

## ***6.2. Trends of Taxi Traffic Accidents***

As mentioned above the contribution of taxis to the total road traffic accidents is quite significant relative to their numerical share out of the total vehicle-fleet in the city. What about its trend? Is that becoming more severe or not? These two questions are the core questions treated here under. Table 22 shows the distribution of taxi traffic accidents by severity levels. Since 1989/90 there has been an increase in such accidents. This increase continued until 1993/94 with some fluctuations. As of 1997/98 it had decreased by 24% from the peak year (1997/98) and stayed almost constant until 2000/01.

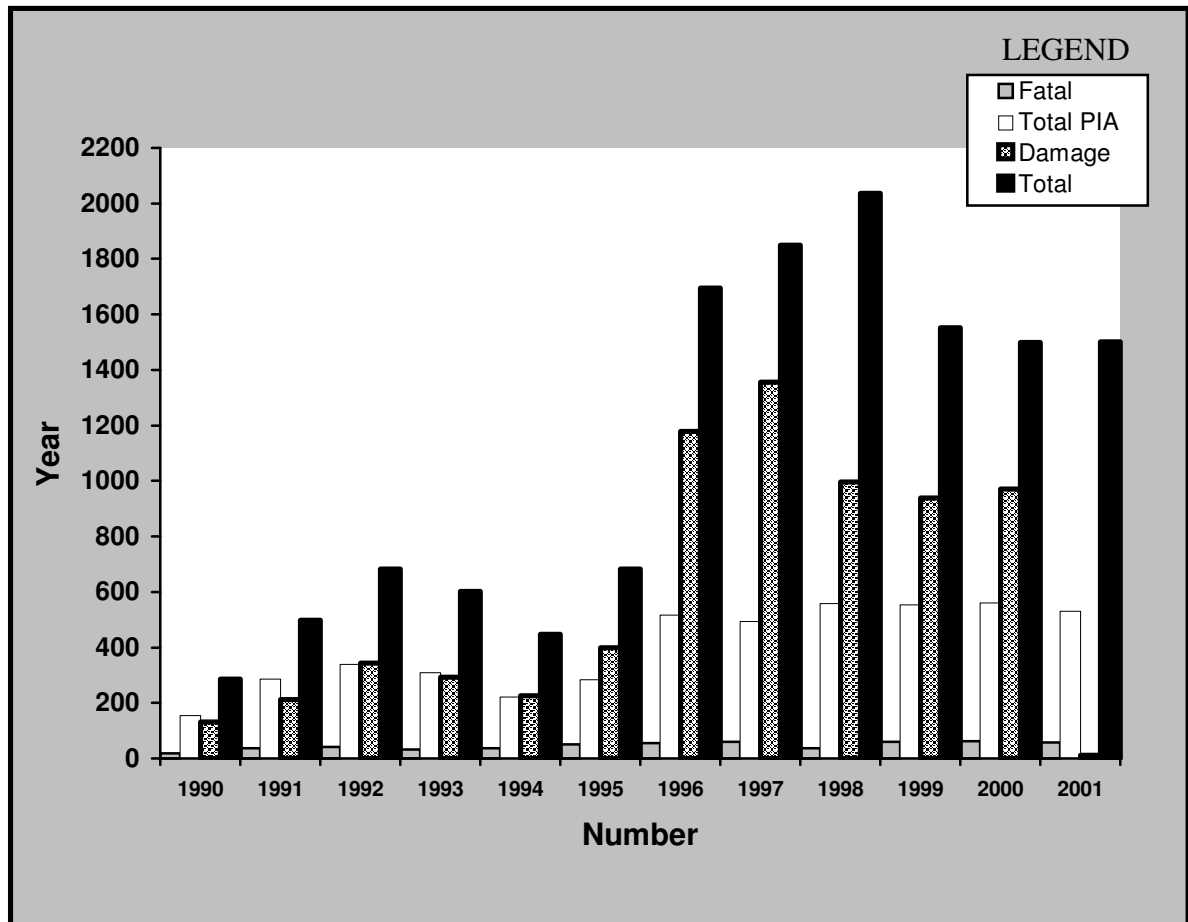
The steady increase from 1989/90 up to 1997/98 was not only exhibited in traffic accidents but also in the overall traffic accidents which forced the city government to issue the new road traffic regulation in 1997/98. Even though it is not significant, the relative decrease in taxi traffic accidents is apparently a result of the new traffic regulation, which raised the fine for every traffic offence. Or it could be due to the under reporting of accidents. Mostly if the two parties solve their problem, the involvement of the traffic police is rare especially depending on the severity level of the accident. Serious care is given for fatal accidents than others and the least care is given for damage to property.

**Table 22: Taxi Traffic Accidents in Addis Ababa (1989/90-2000/01)**

Year	Accident Severity										Total	
	Fatal		Serious		Slight		Total PIA		Damage			
	#	%	#	%	#	%	#	%	#	%	#	%
1989/90	18	3.28	42	4.08	94	2.86	154	3.20	131	1.54	285	2.14
1990/91	36	6.57	50	4.85	199	6.07	286	5.95	212	2.49	498	3.74
1991/92	41	7.48	85	8.25	210	6.40	338	7.03	344	4.04	682	5.12
1992/93	33	6.02	68	6.60	207	6.31	308	6.41	294	3.45	602	4.52
1993/94	36	6.57	56	5.44	127	3.87	221	4.60	226	2.65	447	3.35
1994/95	50	9.12	62	6.02	172	5.24	284	5.91	399	4.68	683	5.12
1995/96	56	10.12	97	9.42	423	12.89	517	10.76	1178	13.82	1695	12.72
1996/97	59	10.77	95	9.22	339	10.33	493	10.26	1357	15.92	1850	13.88
1997/98	38	6.93	113	10.97	408	12.44	559	11.63	1477	17.33	2036	15.27
1998/99	61	11.13	123	11.94	370	11.28	554	11.53	997	11.70	1551	11.64
1999/00	62	11.31	118	11.46	381	11.61	561	11.68	938	11.00	1499	11.25
2000/01	58	10.58	119	11.55	351	10.70	530	11.03	971	11.39	1501	11.26
Total	548	100.00	1030	100.0	3281	100.0	4805	100.00	8524	100.0	13329	100.0

Source: AATPTACIO Various Unpublished Monthly Reports

**Fig. 5: Trends in Taxi Traffic Accidents (1989/90-2000/01)**



Fatality and severity indices were calculated to show the trend in accident severity rates. Fatality index is the proportion of those killed to those that are injured. (Fatal/serious and slight) and severity index is the ratio of the number of fatal and serious injuries to the total number of injuries (Fatal /PIA) (Hobs, 1979 and Girma, 2000).

**Table 23: Fatality and Severity Indices for Taxis (1989/90-2000/01)**

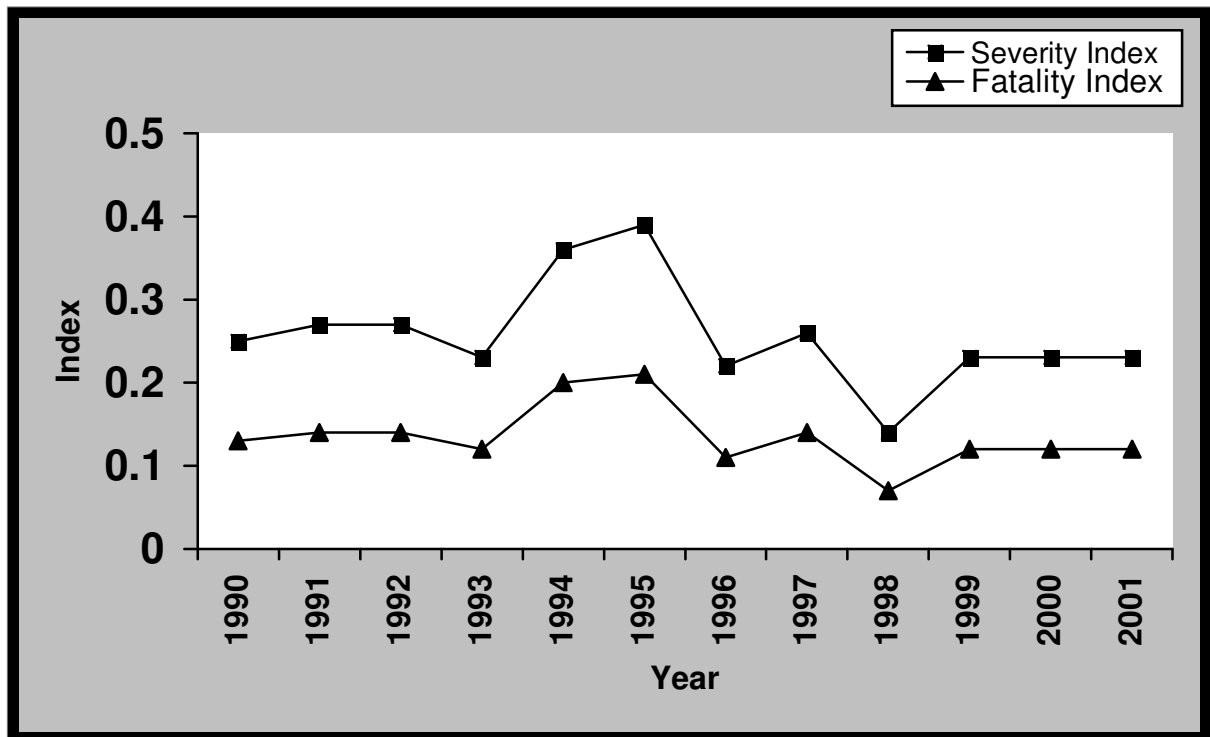
Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Fatality indices	0.13	0.14	0.14	0.12	0.20	0.21	0.11	0.14	0.07	0.12	0.12	0.12
Severity indices	0.12	0.13	0.13	0.11	0.16	0.18	0.11	0.12	0.07	0.11	0.11	0.11

Source: Computed by the Author.

The fatality index and the severity index as shown in Table 23 and Figure 6 vary in the range of 11% to 21% and 7% to 18% respectively. As cited in Girma (2000), Jacobs and Cutting (1986) noted high values of fatality indices up to over 30% in countries with the lowest vehicle ownership level and associated the high values with the considerable under-reporting of non-fatal accidents. The lower indices in 1997/98 show the effect of under reporting of the non-fatal accidents. During 1997/98 due to the issuance of the new traffic regulations a relatively more reporting of traffic accidents are observed which in turn have reduced both indices.

Also Jacobs as cited in Mekky (1984) suggested a severity index of about 7.5% for an average developing country. The higher severity index shows high degree of severity in the taxi traffic accidents in the city, which is above the suggested standard for developing countries.

**Fig. 6: Trends in Fatality and Severity Indices for Taxis (1989/90- 2000/01)**



### **6.3. Factors Affecting Taxi Traffic Accidents**

This section focuses mainly on the identification and analysis of the determinant factors to taxi traffic accidents among which the most important ones are driver behavior, roadworthiness of vehicles, pedestrian behavior and environmental factors. Driver factors are analyzed on the basis of age, education, driving experience, vehicle ownership, terms of employment as well as background of taxi drivers.

Vehicle factors, are analyzed on the basis of vehicle service years (age), vehicle defects and vehicle population, whereas pedestrian characteristics are treated mainly on

pedestrian movement and knowledge about the road traffic law (regulation).

Environmental factors considered are road width and facilities, road arrangement, road site, road junction, road surface and moisture as well as the light and weather conditions. In addition to the above-mentioned factors taxi traffic accidents are also treated in relation to the distribution of economic activities, population size, the traffic law and traffic police problems.

The accident database for taxi traffic accidents created and presented in the following chapters contains all accidents reported by the police between September 1999 and August 2001. A total of 3020 accidents were reported out of which 1963 were injury (114 fatal) and the rest were non-injury accidents.

### 6.3.1. Driver factors

As shown in the review of the related literature most studies show that driver errors are the causes for most of the traffic accidents.

**Table 24: Taxi Traffic Accidents by Driver Errors**

No	Driver error	Accident Severity							
		Fatal		PIA		Damage		Total	
		#	%	#	%	#	%	#	%
1.	Failure to give-way for pedestrians	85	74.85	712	67.36	43	2.19	755	25.00
2	Following too close	-	-	10	0.95	285	14.52	295	9.77
3	Failure to give-way for vehicles	2	1.75	48	4.54	507	25.83	555	18.38
4	Improper Turning	3	2.63	39	3.69	168	8.56	207	6.85
5	Inaccurate overtaking	4	3.51	46	4.35	258	13.14	304	10.07
6	Driving on the wrong side	15	13.16	117	11.07	141	7.18	258	8.54
7	Not respecting Traffic Control	2	1.75	40	3.78	301	15.33	341	11.29
8	Driving under influence *	-	-	17	1.61	102	5.20	119	3.94
9	Miscellaneous	2	1.75	21	1.99	149	7.59	170	5.63
10	Unknown	1	0.88	7	0.66	9	0.46	16	0.53
	<b>Total</b>	<b>114</b>	<b>100.0</b>	<b>1057</b>	<b>100.0</b>	<b>1963</b>	<b>100.0</b>	<b>3020</b>	<b>100.0</b>

- chat, alcohol, etc.

As it can be seen in the above table the most commonly committed errors of drivers include failure to give way for pedestrians and vehicles, not respecting traffic control, inaccurate overtaking and driving too close. These errors account for 75% of the total taxi traffic accidents. Whereas failure to give way for pedestrians and driving on the wrong side are causes for 88% and 78% of the fatal and PIA injuries respectively. Also 90% of injury and 85% of fatal pedestrian accidents as shown in Table 25 were associated with drivers failing to give way for pedestrians. Most of the time it may be due to their negligence and due to the fierce competition they face, they are in hurry, which creates favorable circumstances for the incidence of traffic accidents. Among the collision types, those that cause the highest property damage are side, nose-side, and nose-tail accounting for 87%. These errors of taxi drivers have mainly resulted from the fierce competition for market.

Therefore, as it can be seen from the above discussions driver errors are the causes of most taxi traffic accidents in the city. The assumption here is that these errors are attributed to the age, education level, driving experience, vehicle ownership, terms of employment as well as background of taxi drivers and other related factors.

**Table 25: Distribution of Collision types by Severity Levels**

No	Collision Type	Accident Severity							
		Fatal		PIA		Damage		Total	
		#	%	#	%	#	%	#	%
1.	Head on	1	0.88	13	1.23	100	5.09	113	3.74
2	Nose-tail	-	-	6	0.57	475	24.20	481	15.93
3	Nose-side	1	0.88	11	1.04	530	27.00	541	17.91
4	Side	1	0.88	12	1.14	715	36.42	727	24.07
5	Over turning	4	3.51	18	1.70	3	0.15	21	0.70
6	Pedestrian	97	85.09	950	89.88	45	2.29	995	32.95
7	Passenger falling from vehicle	1	0.88	11	1.04	2	0.10	13	0.43
8	Collision with parked vehicle	-	-	3	0.20	41	2.09	44	1.46
9	Collision with static object	3	2.63	20	1.89	45	2.29	65	2.15
10	Others	6	5.26	13	1.23	7	0.36	20	0.66
	<b>Total</b>	<b>114</b>	<b>100.0</b>	<b>1057</b>	<b>100.0</b>	<b>1963</b>	<b>100.00</b>	<b>3020</b>	<b>100.00</b>

### 6.3.1.1. Age and Education

These variables are treated using both secondary and primary data. With regard to age, it has been found that the young taxi drivers are most likely to inflict more traffic accidents than the old ones. As shown in Table 26, the young that are in the 18-30-age cohort cause about 64% of fatal and 44% of PIA as well as 48% of total taxi traffic accidents. This may be also due in part the dominancy of young age taxi drivers.

**Table 26: Age Ranges of Taxi Drivers Involved in Traffic Accidents**

No	Age	Accident Severity							
		Fatal		PIA		Damage		Total	
		#	%	#	%	#	%	#	%
1.	≤ 18	3	2.63	5	0.47	-	-	5	0.17
2	18-25	44	38.60	297	28.10	586	29.85	883	29.24
3	26-30	29	25.44	173	16.37	407	20.73	580	19.21
4	31-35	12	10.53	70	6.62	163	8.30	233	7.72
5	36-40	10	8.77	46	4.35	124	6.32	170	5.63
6	41-45	7	6.14	30	2.84	98	4.99	128	4.24
7	46-50	2	1.75	20	1.89	71	3.62	91	3.01
8	≥51	1	0.88	25	2.37	72	3.67	97	3.21
9	Hit and Run	6	5.26	390	36.90	442	22.52	832	27.55
	<b>Total</b>	<b>114</b>	<b>100.00</b>	<b>1057</b>	<b>100.00</b>	<b>1963</b>	<b>100.00</b>	<b>3020</b>	<b>100.00</b>

The coefficient of correlation was computed to assess the relationship between the dependent variable (taxi traffic accidents by severity levels) and the driver factors (independent variables) considered as a group. Accordingly the result for age and taxi

traffic accidents is -0.119, ( $P < 0.05$ ) which shows a very weak relationship between age of taxi drivers and taxi traffic accidents. Therefore, the hypothesis, which states as age increases accident decrease, is rejected.

This issue is not supported by the results of the field survey given in Table 27, which compares taxi and non-taxi drivers' age and traffic accidents.

**Table 27: Comparison of Taxi and Non-Taxi Drivers' Age and Traffic Accidents (in Percent)**

No	Age	Accident Severity							
		Fatal		PIA		Damage		Total	
		Taxi	Non-Taxi	Taxi	Non-Taxi	Taxi	Non-Taxi	Taxi	Non-Taxi
1.	20-30	-	2.9	3.8	14.3	62.9	31.4	66.7	45.7
2	31-40	1.9	-	3.8	8.6	9.3	22.9	13.0	31.4
3	41-50	-	-	-	-	14.8	8.6	14.8	8.6
4	> 51	1.9	-	1.9	2.9	3.8	11.4	5.6	14.3
	<b>Total</b>	<b>3.8</b>	<b>2.9</b>	<b>9.5</b>	<b>25.8</b>	<b>90.8</b>	<b>74.3</b>	<b>100.00</b>	<b>100.00</b>

In both cases, 67% of taxi and 46% of non-taxi traffic accidents were committed by drivers in the young age group (20-30). Hence, as the drivers' age increases the incidence of traffic accidents decreases. When education level of taxi drivers is considered, the assumption is that the less educated taxi drivers are prone to inflict more traffic accidents than the more educated ones. As it can be seen from Table 28, those drivers whose education level is below grade 12 cause about 89% of fatal, 58% of PIA, 72% of damage and 67% of total accidents. This may be due to the largest number of taxi drivers with education level below grade 12 as well as their lower level of knowledge to comprehend the traffic regulations.

**Table 28: Education Level of Taxi Drivers Involved in Traffic Accident**

No	Educational level	Accident Severity			
		Fatal	PIA	Damage	Total

		#	%	#	%	#	%	#	%
1.	Adult Education	-	-	3	0.28	11	0.56	13	0.4
2	Elementary	15	13.16	60	5.68	161	8.20	221	7.32
3	Junior Secondary	15	13.16	113	10.69	297	15.13	410	13.58
4	Senior Secondary	72	63.16	441	41.72	945	48.14	1386	45.89
5	Above Secondary	2	1.75	47	4.45	106	5.40	153	5.07
6	Unknown	10	8.77	393	37.18	443	22.57	836	27.68
	<b>Total</b>	<b>114</b>	<b>100.0</b>	<b>1057</b>	<b>100.0</b>	<b>1963</b>	<b>100.0</b>	<b>3020</b>	<b>100.0</b>

The coefficient of correlation for education level and taxi traffic accidents is - 0.186 ( $P < 0.05$ ). This shows a very weak relationship. Therefore, the hypothesis that states as, when the education level of taxi drivers increases the number of accidents decreases is rejected. This is not supported by the field survey results given in Table 29, which compares taxi and non-taxi drivers' educational level and traffic accidents. Those drivers whose educational level is below grade 12 committed about 96% and 60% of taxi and non-taxi traffic accidents, respectively.

**Table 29: Comparison of Taxi and Non-Taxi Drivers' Education Level and Traffic Accidents (in Percent)**

No	Education level	Accident Severity							
		Fatal		PIA		Damage		Total	
		Taxi	non-taxi	taxi	non-taxi	taxi	non-taxi	taxi	non-taxi
1.	Adult education	-	-	-	-	-	2.9	-	2.9
2	Elementary	-	-	1.9	-	38.9	17.1	40.8	17.1
3	High school	3.7	-	7.4	2.9	48.1	37.2	55.5	40.1
4	Vocational	-	-	-	-	1.9	11.4	1.9	11.4
5	Higher education	-	-	-	2.9	1.9	25.7	1.9	28.6
	<b>Total</b>	<b>3.7</b>	<b>-</b>	<b>9.3</b>	<b>5.8</b>	<b>90.8</b>	<b>94.3</b>	<b>100.0</b>	<b>100.0</b>

### 6.3.1.2. Driving experience of taxi drivers

As indicated in the literature review inexperienced drivers commit a large

proportion of traffic accidents. In this respect the formulated hypothesis is that taxi drivers with less driving experience have a tendency to cause more traffic accidents than the more experienced ones. Table 30 shows driving experience of taxi drivers involved in traffic accidents as reported by the police.

**Table 30: Driving Experience of Taxi Drivers Involved in Traffic Accidents**

No	Experience in years	Accident Severity							
		Fatal		PIA		Damage		Total	
		#	%	#	%	#	%	#	%
1.	With no license	3	2.63	8	0.76	6	0.31	14	0.46
2	≤ 1	5	4.39	30	2.84	45	2.29	75	2.48
3	1-2	15	13.16	6	0.57	138	7.03	206	6.82
4	2-5	50	43.86	277	26.21	651	33.16	928	30.73
5	5-10	25	21.93	194	18.35	510	25.98	704	23.31
6	>10	7	6.14	80	7.57	172	8.76	252	8.34
7	Unknown	9	7.89	400	37.84	441	22.47	841	27.85
	<b>Total</b>	<b>114</b>	<b>100.00</b>	<b>1057</b>	<b>100.00</b>	<b>1963</b>	<b>100.00</b>	<b>3020</b>	<b>100.00</b>

As shown in the above table, the less experienced (<5 years) had caused about 64, 36, 42, and 40 percent of the fatal, PIA, damage and total traffic accidents respectively. Had it not been for the considerable size of hit and run cases (unknown) the contribution of the less experienced taxi drivers would have increased even beyond the given proportion.

The coefficient of correlation between driving experience and taxi traffic accidents was also -0.210 which shows again a very weak relationship. Therefore, the hypothesis that states as the driving experience increases taxi traffic accident decreases rejected. But the result of the field survey given in table 31 shows that about 50% of taxi

and 37% of non-taxi traffic accidents are the results of traffic incidents caused by the less experienced drivers.

**Table 31: Comparison of Taxi and Non-Taxi Drivers' Driving Experience and Traffic Accidents (in Percent)**

No	Experience In Years	Accident Severity							
		Fatal		PIA		Damage		Total	
		#	%	#	%	#	%	#	%
1.	<1	-	-	-	-	5.6	5.7	5.6	5.7
2	1-2	-	-	-	2.9	27.8	8.6	27.8	11.5
3	2-5	-	-	1.9	-	14.8	20.0	16.7	20.0
4	5-10	1.9	-	3.8	2.9	18.6	25.7	22.4	28.6
5	> 10	1.9	-	3.8	-	24.0	34.3	27.8	34.3
	<b>Total</b>	<b>3.8</b>	<b>-</b>	<b>9.5</b>	<b>5.8</b>	<b>90.8</b>	<b>94.3</b>	<b>100.0</b>	<b>100.0</b>

### 6.3.1.3. Vehicle Ownership and Terms of Employment

Though there are no available data that show owner and employed taxi drivers in the city, accident data and the field survey data show that employed taxi drivers dominate in number. For instance, out of the total taxi drivers included in the survey questionnaire 79% are employed drivers. In this study we assume that employed taxi drivers cause more traffic accidents than taxi drivers that drive their own taxis. That is not only because of their number but also because of how they handle their jobs and the vehicles.

**Table 32: Taxi Ownership and Traffic Accidents**

No	Ownership	Accident severity							
		Fatal		PIA		Damage		Total	
		#	%	#	%	#	%	#	%
1.	Owner	9	7.89	64	6.05	135	6.88	199	6.59
2	Employed	85	74.56	517	48.91	1285	65.46	1802	59.67
3	Other	12	10.53	64	6.05	100	5.09	164	5.43
4	Unknown	8	7.02	412	38.98	443	22.57	855	28.31
	<b>Total</b>	<b>114</b>	<b>100.00</b>	<b>1057</b>	<b>100.00</b>	<b>1963</b>	<b>100.00</b>	<b>3020</b>	<b>100.00</b>

As indicated in Table 32, about 74% of fatal, 49% of PIA, 65% of damage and 60% of total traffic accidents are caused by employed taxi drivers. If the hit and run

accidents were distributed, the share of employed taxi drivers could most probably greater.

The coefficient of correlation for vehicle ownership and taxi traffic accidents shows -0.040 ( $p < 0.05$ ). Though it is a weak correlation, it shows that employed taxi drivers cause more accidents. This case is supported by the result of the field survey given in Table 33, which shows that about 74% of taxi and 63% of non-taxi traffic accidents are caused by the errors of the employed drivers.

**Table 33: Comparison of Taxi and Non-Taxi Drivers' Vehicle Ownership and Traffic Accidents (in Percent)**

No	Ownership	Accident Severity							
		Fatal		PIA		Damage		Total	
		Taxi	Non-Taxi	Taxi	Non-Taxi	Taxi	Non-Taxi	Taxi	Non-Taxi
1.	Owner	-	-	1.9	2.9	24.1	34.3	26.0	37.2
2	Employed (private)	3.7	-	7.5	-	66.5	-	74.0	-
3	Government employed driver	-	-	-	-	-	20.0	-	20.0
4	Government employed (manager)	-	-	-	2.9	-	25.7	-	28.6
5	Inter city Buses & lorry	-	-	-	-	-	14.3	-	14.3
	<b>Total</b>	<b>3.7</b>	<b>-</b>	<b>9.4</b>	<b>5.8</b>	<b>90.6</b>	<b>94.3</b>	<b>100.0</b>	<b>100.0</b>

Terms of employment have also their own contribution to the prevalence of taxi traffic accidents. About 65% of the employed taxi drivers have employment terms with a fixed amount of money on daily basis. So, the assumption is that in order to get not only that fixed amount but also to get extra income they drive in a hurry and commit more traffic offences than others. The association between traffic accidents and terms of employment of taxi drivers in the field survey shows that about 55.6% and 17% of taxi traffic accidents are attributed to those taxi drivers having a fixed and unfixed terms of

employment respectively. Hence, those who have fixed employment contract are more dangerous ones.

#### 6.31.4. Background of Taxi Drivers

Taxi drivers have different backgrounds before they enter into the taxi driving business. The major groups considered are unemployed, taxi driver's assistant (Weyala) and driver under government and private enterprises. Hence, in terms of discipline (observing the traffic regulations) and driving experience, it is assumed that former "*Weyalas*" who become taxi drivers commit more traffic accidents than the others. Most taxi drivers that were taxi drivers' assistant have bad conduct, are aggressive and reckless drivers. Most people believe that such behavior is mostly associated with the background of the person.

Those who were "*Weyalas*" in the past caused about 28% of taxi traffic accidents. And those taxi drivers that were employed by government and/or private enterprises commit 31.5% taxi traffic accidents.

**Table 34: Background of Taxi Drivers and Taxi Traffic Accidents (in Percent)**

No	Occupational Background	Accident Severity			
		Fatal	PIA	Damage	Total
1.	Jobless and student	-	1.9	16.7	18.6

2	Private business	-		13.0	13.0
3	Mechanic (car related occupation)	-		9.3	9.3
4	Taxi-assistant (Weyala)	1.9	3.8	24.0	27.8
5	Driver in government and private enterprises	1.9	3.8	27.8	31.6
	<b>Total</b>	<b>3.8</b>	<b>9.5</b>	<b>90.8</b>	<b>100.00</b>

The associations between the age, education level, driving experience, vehicle ownership, terms of employment as well as background of taxi drivers have been discussed using the data from the traffic police and field survey. But the effect of each factor is not the same and therefore, it is better to see what percent of the traffic accidents are explained by these factors partly and in combination.

Regression analysis was used to determine the relationship between taxi traffic accidents by severity levels (dependent) and the independent variables considered. Using secondary data, age, driving experience, education level and vehicle ownership were considered with taxi traffic accident severity levels and were calculated stepwise.

**Table 35: The Association between Taxi Traffic Accidents by Severity Levels and four Independent Variables (Driver Factors)**

Model	R	R <sup>2</sup>	Adjusted square	Std-error of the estimate	Change statistics				
					R <sup>2</sup> change	F change	Df <sup>1</sup>	Df <sup>2</sup>	Significance F-change
1	0.210 <sup>a</sup>	0.044	0.044	0.51	0.044	139.062	1	3018	0.000
2	0.446 <sup>b</sup>	0.199	0.198	0.46	0.155	582.695	1	3017	0.000
3	0.49 <sup>c</sup>	0.242	0.241	0.45	0.043	171.821	1	3016	0.000
4	0.493 <sup>d</sup>	0.243	0.242	0.45	0.001	4.585	1	3015	0.032

- a. *Driving experience.* b. *Driving experience, and ownership*  
c. *Driving experience, ownership, and Education level.*  
d. *Driving experience, ownership, education level, and Age*

The result in Table 35 shows that the combined coefficient of multiple correlation

computed is  $R=0.493$  and the coefficient of determination ( $R^2$ ) is 0.243. The coefficient of determination indicates that 24.3% the variation in taxi traffic accidents is explained by the four considered driver factors. Among these factors vehicle ownership explains 15.5% of the variation in accidents whereas, age explains only 0.1% of the variation in the dependent variable. This implies there are other factors that contribute to the incidence of taxi traffic accidents, as they are included in the latter discussions.

### 6.3.2. Vehicle Factors

In this sub-topic the contribution of vehicle factors such as vehicle defect, vehicle service years (age) and vehicle maneuvers and to the incidence of traffic accidents are presented.

#### 6.3.2.1. Vehicle service years and defects

Theoretically the longer the time the vehicle is used, the higher will be the probability of occurrence of mechanical defects to the vehicle, which is involved in accidents. A positive relationship has been observed between vehicle service years and taxi traffic accidents.

**Table 36: Service Years of Taxis Involved in Traffic Accidents**

No	Service in Years	Accident Severity			
		Fatal	PIA	Damage	Total

		#	%	#	%	#	%	#	%
1.	≤1	2	1.75	19	1.80	28	1.43	47	1.56
2	1-2	10	8.77	23	2.18	79	4.02	102	3.38
3	2-5	24	21.05	138	13.06	339	17.27	477	15.79
4	5-10	45	39.47	288	27.25	703	35.81	991	32.81
5	>10	23	20.18	192	18.16	347	17.68	539	17.85
6	Unknown	10	8.77	397	37.56	467	23.79	864	28.61
	<b>Total</b>	<b>114</b>	<b>100.00</b>	<b>1057</b>	<b>100.00</b>	<b>1963</b>	<b>100.00</b>	<b>3020</b>	<b>100.00</b>

As shown in Table 36 there is an increase in taxi traffic accidents with increase in service years of vehicles. Taxis having 5-10 years of service had caused about 39% of fatal and 32% of total taxi traffic accidents followed by those taxis having above 10 years of service accounting for 20% of fatal and 18% of the total taxi traffic accidents.

Out of the 200 taxis included in the field survey only 11.5% were brand new when they entered the taxi service. But this figure is not quite to be accepted in that most of the taxis had in fact were not brand-new since they were being used before. This makes the probability of taxi traffic accident incidence rate higher. But the traffic police accident data shows that 70% of fatal, 68% of serious, 53% of slight, 66% of damage and 64% of total taxi traffic accidents were caused by taxis with no defect. This implies there is a problem in the identification of the defects of the vehicle, where most of the time the driver is blamed as the sole cause. Mechanical, tire, light and break defects account for less than 1% of the accidents. This implies that service year is not the cause of traffic accidents. Or service year does not imply defects in any part of the taxi.

### 6.3.2.2. Vehicle maneuvers (movements of the vehicle at time of accident)

Vehicle maneuvers have also their contributions to the accident rate and severity. As shown in Table 37, the major contributor to taxi traffic accidents is the maneuver of taxis where going ahead accounts for 71, 62, 40 and 48 percent of the fatal, PIA, damage and total taxi traffic accidents, respectively followed by overtaking and U-turning in the case of fatal accidents.

**Table 37: Vehicle Maneuvers and Accident Types**

No	Vehicle maneuver	Accident severity							
		Fatal		PIA		Damage		Total	
		#	%	#	%	#	%	#	%
1.	Merging					6	0.31	6	0.20
2	Diverging					5	0.25	5	0.17
3	Turning Right	4	3.51	35	3.31	85	4.33	120	3.97
4	Turning Left	2	1.75	33	3.12	256	13.04	289	9.57
5	U-Turning	8	7.02	9	0.85	14	0.71	23	0.76
6	Overtaking	17	14.91	270	25.54	502	25.57	772	25.56
7	Going ahead	81	71.05	664	62.82	797	40.60	1461	48.38
8	Reversing	2	1.75	31	2.93	194	9.88	225	7.45
9	Crossings			2	0.19	21	1.07	23	0.76
10	Sudden Start and Stop			4	0.38	64	3.26	68	2.25
11	Others			9	0.85	19	0.97	28	0.93
	<b>Total</b>	<b>114</b>	<b>100.00</b>	<b>1057</b>	<b>100.00</b>	<b>1963</b>	<b>100.00</b>	<b>3020</b>	<b>100.00</b>

In addition to the volume of traffic in the city the errors of drivers committed while overtaking, turning and reversing positions are also important causes. A regression analysis was computed for the vehicle factors to determine their contribution to taxi traffic accidents. The variables considered are vehicle maneuvers, vehicle defect, vehicle

service years and collision type. Each case has 3020 observations. The results are given in Table 38 below.

**Table 38: The Associations between Taxi Traffic Accidents and four Independent Variables /vehicle factors/**

Model	R	R <sup>2</sup>	Adjusted square	Std-error of the estimate	Change statistics				
					R <sup>2</sup> change	F change	Df <sup>1</sup>	Df <sup>2</sup>	Significance F-change
1	0.260 <sup>a</sup>	0.068	0.067	0.34	0.068	219.371	1	3018	0.000
2	0.397 <sup>b</sup>	0.158	0.157	0.33	0.090	321.958	1	3017	0.000
3	0.407 <sup>c</sup>	0.165	0.165	0.32	0.008	28.069	1	3016	0.000
4	0.417 <sup>d</sup>	0.174	0.173	0.32	0.008	30.694	1	3015	0.000

*a. vehicle maneuvers*

*b. vehicle maneuvers and vehicle defect*

*c. vehicle maneuvers, vehicle defect and vehicle service.*

*d. vehicle maneuvers, vehicle defect, vehicle service and collision type*

The combined coefficient of multiple correlations is  $R=0.417$  and the coefficient of determination ( $R^2$ ) is 0.174. Therefore, the vehicle factors considered explain 17.4% of the variation in taxi traffic accidents. However, in terms of their partial contribution, vehicle maneuvers explain 6.8%, vehicle defects 2.2% and vehicle service years and collision type each explain 0.8% of the variation in the dependent variable. This implies that vehicle factors are not significant.

### 6.3.3. Pedestrian Factors

In this section pedestrian movements and knowledge about traffic regulation are presented.

#### 7.3.3.1. Pedestrian Movements

Other than absence of pedestrian crossing facilities and inadequate footpaths (sidewalks) that segregate pedestrians from the motor traffic, movements of pedestrians have also their own contributions to the higher number of pedestrian casualties in Addis Ababa.

**Table 39: Movement of Pedestrian Victims of Taxi Traffic Accidents**

No	Movement	Accident Severity							
		Fatal		PIA		Damage		Total	
		#	%	#	%	#	%	#	%
1.	Crossing out of zebra line	30	27.27	110	50.93	286	43.66	426	43.43
2	Walking of side walks	21	19.09	26	12.04	74	11.30	121	12.33
3	Walking right in absence of side walks	32	29.09	22	10.19	102	15.57	156	15.90
4	Walking left in absence of side walks	5	4.55	24	11.11	93	14.20	122	12.44
5	Walking on the center of roads in the presence of side walks	6	5.45	5	2.31	7	1.07	28	2.85
6	Others	10	9.09	9	4.17	40	6.11	59	6.01
7	Unknown	6	5.45	20	9.26	43	6.56	69	7.03
	<b>Total</b>	<b>110</b>	<b>100.0</b>	<b>216</b>	<b>100.0</b>	<b>655</b>	<b>100.0</b>	<b>981</b>	<b>100.0</b>

Walking right in the absence of sidewalks, crossing the zebra lines and walking on sidewalks are the three accident causes accounting for 29,27 and 19 percent of fatal accidents respectively. In the overall PIA, crossing out of Zebra line accounts for 43% followed by walking on right, left edge of streets in the absence of sidewalks and walking on sidewalks having 16, 12 and 12 percent respectively. Most of the pedestrian movements are the result of scarcity of footpaths and lack of knowledge about the traffic regulation, which lead to inappropriate crossing, and usage of the road.

**6.3.3.2. Pedestrians Knowledge about the Traffic Regulation**

Walking in the middle of the roads in the presence of sidewalks, crossing out of Zebra line and walking to the right in the absence of sidewalks are manifestations of the lack of knowledge of pedestrians about traffic regulations. There is a contradiction that arises between the lack of knowledge of pedestrians about traffic regulations and taxi

drivers, who are in a hurry and in most cases, ignores the pedestrians and try to exploit the opportunity at the expense of the pedestrians' maneuvers. In most cases zebra crossings are not respected in Addis Ababa unless the traffic policemen are around. This problem is also stressed in the studies made by TRL and Ross Silcock (1996).

Pedestrians were asked their knowledge concerning

1. traffic signs and symbols related with pedestrian crossings and Zebra crossings,
2. which side of the street they do prefer most when they walk and cross,
3. who will be responsible if an accident occurs due to their fault.

Their answers are presented and discussed below:

1. What is your knowledge about traffic signs and symbols particularly those related with pedestrian crossings? The responses were: I know most of it (35%), I know enough (40%), I know little (23%), I know nothing (2%).
2. What is a Zebra crossing? The respondents who answered correctly were 61% and 26% answered it partially and 13% gave wrong answer.
3. Around which part of the road do you cross most of the time? The responses were: 75% at the Zebra crossings, 12% at any point of the road section and 6% at road junctions.
4. While you are walking which side of the street do you prefer most of the time? The responses were 81% on the right side, 9% on the left side and 10% did not choose at all.
5. Do you know that those who are victims of an accident due to their faults are

subjected to fine according to the traffic regulations? The responses were, yes (63%) and no (36%).

Accordingly, about 14.7% of the pedestrians lacked the knowledge about the signs and symbols around the pedestrian crossings, about 22.9% of them had doubts about what is a Zebra crossing, about 14.7% crossed the road at any point out of the Zebra crossings and 47.6 of the pedestrians walked on the right side giving their back to the oncoming vehicle and they did not choose appropriate crossings at all. Also 36% of the pedestrians did not know about their responsibilities as pedestrian when they cross the road.

Therefore, in addition to the negligence of taxi drivers, the lack of knowledge of pedestrians about the regulations of the road has its own contribution to the higher involvement of pedestrians in traffic accident as victims in the city. This can be seen in Table 25 where pedestrian collision accounts for 85% of fatal, 90% of PIA and about 33% total taxi traffic accidents in the specified period.

### **6.3.4. Environmental factors**

#### **6.3.4.1. Road Width and Facilities**

There is a close relationship between defects of roads and road traffic accidents. The design, lighting and surfacing of roads can also affect injury rate. Well-designed roads allow greater margins of safety and help minimize the rate of accidents. Many accidents occur due to the inadequacy of facilities for a wider range of individual and group requirements of road users, particularly for pedestrians.

In this study, the road characteristics and arrangement are treated as having a significant contribution to the incidence of traffic accidents. Environmental factors considered include, road width and facilities, road arrangement, road site, shape of road junction, road surface, road moisture, as well as light and weather.

Road width and facilities have their own contribution to the incidence of traffic accidents. Most of the roads in Addis Ababa are narrow except for some arterial roads. The problem of narrowness is aggravated by parking done on either or both sides of the streets. A best example is the Adwa Road from Arat Kilo to Piassa where now it is solved slightly by the introduction of parking meters.

Another important factor is the facilities available on the roads or streets such as paved sidewalks, pedestrian crossings, legible road signs (to direct and warn drivers) street lighting, and traffic light at the major road junctions or intersections. According to the Addis Ababa Roads Authority's 2001/02-second quarterly reports there were only 23 traffic lights that were in a good condition. But this number is not only insignificant, but also most of the time these traffic lights do have technical failure, which leads to traffic chaos especially during the rush hours. This is especially applicable to the Kasanchis Total and Andenet Square traffic lights. In terms of paved sidewalks, about 73.5% of the asphalt road in the city is without sidewalks and the width is below the standard width.

#### **6.3.4.2. Road Arrangement**

Road arrangements have also their contribution to the incidence of traffic accident.

As shown in Table 40 the two-way roads separated by row, edge, barrier wires, and the like and around roundabouts, there is higher incidence of traffic accidents. Hence, above 92% of the fatal, PIA, damage and over all taxi traffic accidents occur on these two types of road arrangements. This may be attributed to the conflict created when vehicles move in opposite directions?

**Table 40: Road Arrangements and Taxi Traffic Accidents**

No	Road Arrangements	Accident Severity							
		Fatal		PIA		Damage		Total	
		#	%	#	%	#	%	#	%
1	One-way	4	3.51	28	2.65	64	3.26	92	3.05
2	Two-way	57	50.00	590	55.82	718	36.5	1307	43.28
3	Roundabouts	48	42.11	392	37.09	1117	56.90	1509	49.97
4	Continuously demarcated lane	4	3.51	35	3.31	46	2.34	81	2.68
5	Interruptedly demarcated lane	1	0.88	12	1.14	18	0.92	30	0.99
	<b>Total</b>	<b>114</b>	<b>100.00</b>	<b>1057</b>	<b>100.00</b>	<b>1963</b>	<b>100.00</b>	<b>3020</b>	<b>100.00</b>

Two-way roads contribute to about 50,56,36 and 43 percent of fatal, PIA, damage and total accidents, respectively whereas roads separated by squares accounted for 42,37, 57 and 50 percent of fatal, PIA, damage and total traffic accidents respectively. The coefficient of correlation determined between road arrangement and taxi traffic accidents is -0.565 ( $p < 0.05$ ) showing that as the number of lanes increases traffic accident increases or the wider the street the greater the chances for accidents.

### 6.3.4.3. Road Gradient

Slope (gradient) and curvature have marked effects on the occurrence of accidents. It is on straight and plain roads that traffic accidents occur more often than on others. On such roads traffic tends to move fast thereby increasing the chances for accidents.

**Table 41: Road Gradient and Taxi Traffic Accidents**

No	Road Site	Accident Severity							
		Fatal		PIA		Damage		Total	
		#	%	#	%	#	%	#	%
1.	Straight and Plain	99	86.84	978	92.53	1864	94.96	2842	94.11
2	Straight and Gentle	-	-	5	0.47	13	0.71	19	0.63
3	Slight Zigzag	2	1.75	10	0.95	6	0.31	16	0.53

4	Highly Zigzag	-	-	3	0.28	3	0.15	6	0.20
5	Hilly	4	3.51	20	1.89	27	1.38	47	1.56
6	Down slope (steeper)	9	7.89	37	3.50	43	2.19	80	2.65
7	Others	-	-	4	0.38	6	0.31	10	0.33
	<b>Total</b>	<b>114</b>	<b>100.00</b>	<b>1057</b>	<b>100.00</b>	<b>1963</b>	<b>100.00</b>	<b>3020</b>	<b>100.0</b>

As shown in table 41, 87% of fatal, 92% of PIA, 95% of damage and 94% of total taxi traffic accidents occurred on straight and plain roads. And steeper slope roads account for 9% of fatal and 3% of total accidents. Even though it is weak, the -0.056 of Pearson coefficient of correlation shows that there is an inverse association between road gradient and taxi traffic accidents. Traffic accidents are higher in straight and plain road surfaces than on steep slopes.

#### 6.3.4.4. Road Junctions intersections

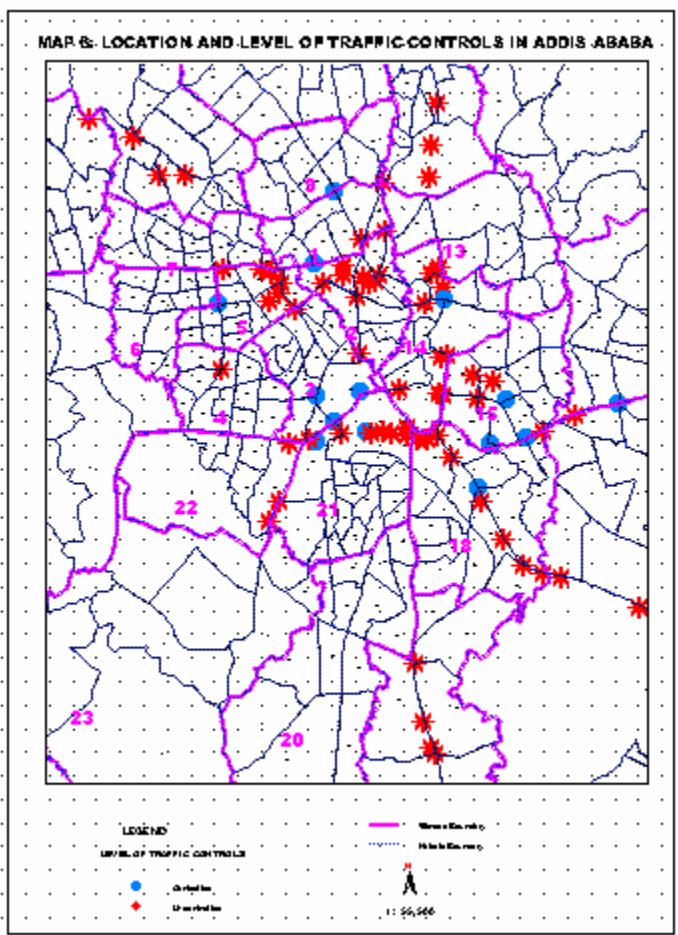
Considering the shape of the road junctions as a cause of traffic accidents, it is possible to assume that those junctions where a larger number of roads converge it is likely that many accidents will happen. In this case, as shown in Table 42, 71% of fatal, 80% of PIA, 67% of damage and 71% of total taxi traffic accidents occur in those roads without junctions.

**Table 42: Shape of Road Junction and Taxi Traffic Accidents**

No	Shape of Junctions	Accident Severity							
		Fatal		PIA		Damage		Total	
		#	%	#	%	#	%	#	%
1.	No junction	81	71.05	850	80.42	1311	66.79	2161	71.56
2	Y	-	-	4	0.38	9	0.46	13	0.43
3	T	23	20.18	121	11.45	303	15.44	424	14.04

4	+	8	7.02	72	6.81	292	14.88	364	12.05
5	O	2	1.75	7	0.66	40	2.04	47	1.56
6	X	-	-	3	0.28	8	0.41	12	0.40
	<b>Total</b>	<b>114</b>	<b>100.00</b>	<b>1057</b>	<b>100.00</b>	<b>1963</b>	<b>100.00</b>	<b>3020</b>	<b>100.0</b>

Roads without junctions do not have most of the time either traffic police or signals (traffic lights), which in turn encourages drivers to drive fast, and this would definitely result in traffic accident especially when someone or something is crossing the road. Roads with "T" and "+" shaped junctions rank second and third contributing about 14% and 12% of total accidents respectively. "T" shaped junctions account for about 20% of fatal and 11% of PIA. In T-shape junctions conflict is not controlled, especially when the junction is at right angle and there is obscurity by static objects (like buildings) not only the probability of traffic accidents is higher but also the nature of the accident is more severe. The coefficient of correlation of -0.255 ( $p < 0.05$ ) between road junction shapes and taxi traffic accidents shows a very weak relationship. Hence accidents are larger in roads without junction than those junctions having more chances of conflict.



### 6.3.4.5. Road Surface and Moisture Conditions

The condition of road surface is also a contributory factor for the incidence of traffic accident. The theoretical basis is that damaged and uncomfortable road surfaces most likely increase the incidence of accident.

**Table 43: Road Surface and Taxi Traffic Accidents**

No	Road Surface	Accident Severity							
		Fatal		PIA		Damage		Total	
		#	%	#	%	#	%	#	%
1.	Good asphalt	92	80.70	831	78.62	1578	80.39	2409	79.77
2	Damaged asphalt	-	-	3	0.28	2	0.10	5	0.17
3	Gravel	2	1.75	3	0.28	3	0.15	6	0.20
4	Dirt	20	17.54	220	20.81	380	19.36	600	19.87
	<b>Total</b>	<b>114</b>	<b>100.00</b>	<b>1057</b>	<b>100.00</b>	<b>1963</b>	<b>100.00</b>	<b>3020</b>	<b>100.0</b>

Contrary to the theoretical explanation about 81% of fatal, 78% of PIA, 80% of damage and 80% of total taxi traffic accidents occur on good asphalt roads. This is attributed to the heavy volume of traffic on asphalted roads and to the tendency to drive too fast on asphalt roads. On the other hand, driving on the damaged asphalt, gravel roads and dirty surfaces forces drivers to take care of their vehicles and drive slowly, which contributes to low traffic incidence.

The coefficient of correlation between road surface and taxi traffic accidents was determined to be -0.203 showing that roads with good surfaces are prone to taxi traffic accidents.

Road moisture condition is another contributory factor to the incidence of traffic accidents. Road conditions such as dry, wet, and muddy contribute to the traffic flow positively or negatively.

**Table 44: Road Moisture Condition and Taxi Traffic Accidents**

No	Moisture Condition	Accident Severity							
		Fatal		PIA		Damage		Total	
		#	%	#	%	#	%	#	%
1.	Dry	100	87.72	999	94.51	1890	96.28	2889	95.66
2	Wet	13	11.40	48	4.54	73	3.72	121	4.01

3	Muddy	1	0.88	7	0.66	-	-	7	0.23
4	Others	-	-	3	0.28	-	-	3	0.10
	<b>Total</b>	<b>114</b>	<b>100.0</b>	<b>1057</b>	<b>100.00</b>	<b>1963</b>	<b>100.0</b>	<b>3020</b>	<b>100.0</b>

Among these road conditions, the largest incidence of taxi traffic accidents is on the dry surface roads accounting for 88% of fatal, 94% of PIA, 96% of damage and 95% of total accidents. And wet surface roads accounted for 11% of fatal accidents. The coefficient of correlation between road moisture and traffic accidents was determined to be -0.039 which shows that more traffic accidents occur on dry surfaces than on wet and muddy ones. This may be because taxi drivers in Addis Ababa are more careful when they drive on wet surfaces.

Therefore, each road factor has its own contribution to the incidence of traffic accidents with different magnitudes. Hence, using the traffic police data a regression analysis was calculated to show the contribution of each factor. The factors considered are road arrangement, moisture, surface and road gradient. The stepwise regression results of those factors that are significant to explain the variations in the dependent variable are shown in Table 45.

**Table 45: Association between Taxi Traffic Accidents and Four Independent Variables (road factors)**

Model	R	R <sup>2</sup>	Adjusted square	Std-error of the estimate	Change statistics				
					R <sup>2</sup> change	F change	Df <sup>1</sup>	Df <sup>2</sup>	Significance F-change
1	0.565 <sup>a</sup>	0.319	0.319	0.54	0.319	1412.471	1	3018	0.000
2	0.630 <sup>b</sup>	0.397	0.397	0.51	0.078	391.134	1	3017	0.000
3	0.633 <sup>c</sup>	0.400	0.400	0.50	0.003	16.936	1	3016	0.000
4	0.634 <sup>d</sup>	0.402	0.401	0.50	0.002	9.056	1	3015	0.003

- a. Road arrangement
- b. Road arrangement and moisture condition
- c. Road arrangement, moisture condition and road surface.
- d. Road arrangement, moisture condition, road surface and road gradient.

The combined coefficient of multiple correlations is 0.634 and the coefficient of determination ( $R^2$ ) is 0.402. Among the road factors that are considered and are significant at ( $P < 0.05$ ) road arrangements explain the highest variations (31.9%) followed by road moisture condition, which explains 7.8% of the variation. Therefore, road factors explain 40.2% of the variation in taxi traffic accidents in Addis Ababa.

### 6.3.4.6. Light and Weather

Environmental conditions also include weather and time of the day. Out of the total road accidents (as studies show) about 1%, 2% and 15% occur in fog, snowy and rainy, conditions respectively. Nighttime accident rates for unlit streets are about twice as those of daytime, and even under average street lighting conditions they are about 50% greater (Hobbs, 1979).

About 65% of fatal, 67% of PIA, 75% of damage and 72% of total taxi traffic accidents occur on bright sunny days followed by 6% of fatal, 12.77% of PIA, 9% of damage and 10% of the total taxi traffic accidents occur during nighttime on streets with good streetlight. (Table 46).

**Table 46: Light Condition and Taxi Traffic Accidents**

No	Light Conditions	Accident Severity							
		Fatal		PIA		Damage		Total	
		#	%	#	%	#	%	#	%
1.	Brighter sun light	74	64.91	714	67.55	1472	74.99	2186	72.38
2	Sun rise	5	4.39	50	4.73	72	3.67	122	4.04

3	Sun set	4	3.51	42	3.97	86	4.38	128	4.24
4	With good street light	7	6.14	135	12.77	174	8.86	309	10.23
5	With dim street light	9	7.89	63	5.96	98	4.99	161	5.33
6	Without street light	15	13.16	53	5.01	61	3.11	114	3.77
	<b>Total</b>	<b>114</b>	<b>100.0</b>	<b>1057</b>	<b>100.00</b>	<b>1963</b>	<b>100.0</b>	<b>3020</b>	<b>100.0</b>

Compared to the lower traffic flow during the nighttime, there is higher and severe taxi traffic accident where about 13% of fatal accidents had occurred during the nighttime.

**Table 47: Weather Conditions and Taxi Traffic Accidents**

No	Weather Condition	Accident Severity							
		Fatal		PIA		Damage		Total	
		#	%	#	%	#	%	#	%
1.	Good Air	87	76.32	922	87.23	1805	91.95	2727	90.30
2	Cloudy	-	-	3	0.28	4	0.20	7	0.23
3	Light rain	2	1.75	5	0.47	7	0.36	12	0.40
4	Heavy rain	3	2.63	4	0.38	3	0.15	7	0.23
5	Hot air	-	-	7	0.66	12	0.61	19	0.63
6	Cold air	22	19.30	116	10.97	132	6.72	248	8.21
	<b>Total</b>	<b>114</b>	<b>100.0</b>	<b>1057</b>	<b>100.0</b>	<b>1963</b>	<b>100.0</b>	<b>3020</b>	<b>100.0</b>

Although unfavorable weather conditions aggravate the incidence of traffic accidents, the highest taxi traffic accidents occur in good air conditions, accounting for 76% of fatal, 87% of PIA, 92% of damaged and 90% of all taxi traffic accidents. But among the unfavourable weather conditions, about 19% of fatal, 11% PIA, 7% of damage and 8% of all traffic accidents occur in cold air condition.

A positive relationship ( $r=0.798$ ) has been obtained between light condition and taxi traffic accidents. Most of the accidents occurred during bright and sunny days and in streets with good streetlights during the nighttime. The association between weather

conditions and taxi traffic accidents was 0.851, which shows that more taxi traffic accidents occur in good weather condition than in unfavorable weather conditions.

**Table 48: Association between Taxi Traffic Accidents and two Independent Variables (weather and light)**

Model	R	R <sup>2</sup>	Adjusted square	Std-error of the estimate	Change statistics				
					R <sup>2</sup> change	F change	Df <sub>1</sub>	Df <sub>2</sub>	Significance F-change
1	0.851 <sup>a</sup>	0.724	0.724	0.30	0.724	7933.040	1	3018	0.000
2	0.907 <sup>b</sup>	0.822	0.822	0.24	0.098	1661.693	1	3017	0.000

*a. Weather condition*

*b. weather condition and light condition.*

To show how these two factors affect taxi traffic accidents a regression analysis was computed and the results are shown in Table 48. The combined coefficient of multiple correlations is R=0.907 and the coefficient of determination (R<sup>2</sup>) is 0.822. Weather conditions explain 72.4% of the occurrence of the accidents whereas light condition explains about 9.8% of the variation.

### **6.3.5. Vehicle and Human Population Growth**

#### **6.3.5.1. Vehicle Population Growth**

The theoretical assumption is that when the number of vehicles increases it results in congestion and higher incidence of traffic accidents. Hence, a positive relationship has been expected between vehicle number and taxi traffic accidents.

In this respect the number of taxi traffic accidents and vehicle population in the city since 1993/94 to 2000/01 were taken to see the association between the dependent

variable (taxi traffic accidents) and independent variable vehicle population.

**Table 49: Taxi Traffic Accidents and Vehicle Population Growth in Addis Ababa (1993/94-2000/01)**

1993/94	Year	1994/95	1995/96	1996/97	1997/98	1998/99	1999/00	2000/01
61056	Vehicle number*	69735	72730	71811	75046	69622	73653	76403
447	Number of accidents	683	1695	1850	2036	1551	1499	1501

\* Source: AATCB (2001/02)

The coefficient of correlation ( $r$ ) was 0.780 and the coefficient of determination ( $r^2$ ) was 0.609. Therefore, taxi vehicle population growth and taxi traffic accidents have a positive association where increase in vehicle number explains 60.9% of the variation in taxi traffic accidents in the city.

### **6.3.5.2. Human Population Growth**

Volumes of traffic accidents include vehicles but also pedestrians, non-motorized traffic and animals. Hence, the larger the number of these traffic elements, the higher will be the conflict on the roads which can lead to higher incidence of traffic accidents.

Likewise, the growth of population in the city has its own contribution to the prevailing taxi traffic accidents especially this leads to the higher number of pedestrians competing for the roads and contributing to the increase of people that use private vehicles. Hence, population growth of the city and taxi traffic accidents shows a positive relationship. The population size in Table 10 and number of taxi accidents in Table 49 were used to see their association.

The coefficient of correlation ( $r$ ) was 0.552 and the coefficient of determination ( $r^2$ ) was 0.304. Therefore, population growth and taxi traffic accidents have a positive association where population growth explains 30.4% of the variation in taxi traffic accidents in the city.

### **6.3.6. Concentration of Economic Activities and Services**

As mentioned earlier, in the central parts of the city, there is a high concentration of government administrative institutions, business and commercial activities mixed with residential uses. The city is also expanding rapidly and horizontally without orderly fashion. These conditions affect the traffic flow in the city. Journeys or trips are made from the peripheral weredas and kebeles to the central weredas and kebeles where there are schools, markets, recreation areas, government offices and hospitals. The problem is aggravated by the absence of alternative roads and the necessary services in the nearby areas. The Mercato market area can best explain this condition. The absence of such type of market area in the other parts of the city.

Government offices such as the city administration are located in the center without any other branch in the other corners of the city, the concentration of the recreation centers like the cinemas and theater halls only in three areas within a shorter distance around Piassa (Cinema Ethiopia, Empire, Hager Fikire and the Addis Ababa Municipality Theatre), Andenet Square (Ambassador and National Theatre) and Merecato (Cinema Ras), the places of worship (churches and mosques) are located mostly around the busiest roads and junctions such as St. Ourael Church, St. Istifanos

Church, St. Gebriel Church, Kidist Sellassie Cathedral, Kidist Mariam Church, Kidus Markos Church, Meskaye Hizunan MedhaneAlem Church, Arada Giorgis church, Kidus Raguel church, Anwar Mosque, Tekele Haimanot church, Lideta Mariam, and Kidus Yohannes Church as well as the concentration of government offices, private businesses, schools and hotels along the busiest main roads make the traffic flow and volume higher, and thus causing the concentration of traffic accidents around these places. (See map 7)

A significant obstacle is also created by street peddlers or hawkers along the main roads mostly in nearby places of worship (especially during monthly ceremonies). And around schools and offices especially at the end of the working days which result in peak hour traffic accidents.

### **6.3.7. Traffic Law and the Traffic Police**

The introduction of the motor vehicle into the country is of a recent history been discussed earlier. The same is true for road traffic regulations. The first comprehensive attempt and systematized legislation concerning road traffic was issued in 1943. Later it was amended and changed by legal notice 2791/1962 Transport Amendment Regulation was issued in 1963 and was also again reinstated by legal notice 335/1968. (AATCB, 1996). Later on due to the higher incidence of road traffic accidents and emergence of new types of traffic offences that are not sanctioned by the existing traffic regulations, the Addis Ababa city Administration was forced to frame and issue new regulations in line with the present conditions in December, 1998. The legislation was deemed necessary

due to: the fact that the level of casualties daily caused by road traffic accident to human life, damage to property and the economy of the city administration at large has reached a serious degree and the gravity and frequency of traffic offences had increased faster, the city council therefore, has issued the new road traffic regulation (AATCB, N. 5/1998).

Hence, in order to make drivers comply with the rules of the traffic, the new traffic legislation had included different types of traffic offences committed and sub-grouped them into six categories of offences on the basis of their severity. The amount of fine imposed by way of punishment, compared with the amount of money fixed as a fine in the previous regulation, shows a 100% increase in most of the cases and in some cases, the increase goes even beyond that. For instance in the 1963 regulations a person who was found intoxicated while driving was fined within 10 to 25 Birr, while the same offense under the present regulation results in a fine of Birr 140. The main objective of any payment of fine is to curb offenses but the present fine is quite high which has resulted in undesirable consequences.

The new road traffic regulation is all encompassing and stricter than its predecessor. However, the number of traffic accidents and offenses committed is high and increasing even without considering the under-reported accident cases. This condition makes the author raise the following questions.

Is there lack of knowledge about the nature of the traffic regulations on the part of drivers?

Are there lacks of resources as well as courage to enforce the regulation on

part of the traffic police?

Does the nature of taxi service encourage disobedience to traffic regulation?

Are there shortcomings in the legislation itself?

Taxi and non-taxi drivers were asked a question regarding their knowledge about the contents of the new road traffic safety regulations issued by the Addis Ababa City Administration Transport and Communication Bureau?

In their response to the question, 42.5% of taxi and 37% of non-taxi drivers indicated that they were well familiar with the contents of the new traffic regulations and 23% of taxi and 35% of non-taxi drivers are fairly familiar. However, 25% of taxi and 18% of non-taxi drivers know little. The remaining 9% of respondents from both groups did not want to say any thing about their knowledge of the matter.

Therefore, about 66% of taxi and 73% of non-taxi drivers have enough knowledge about the contents of the new traffic regulations. They were also asked to rank eleven most frequently committed traffic offences to know how much they know about the prohibited acts by the present traffic regulations indirectly. Among the eleven frequently committed offenses, for instance, the first seven selected are given below in order of their importance.

#### **Taxi Drivers**

1. Parking a vehicle along side another
2. Following too close
3. Speeding
4. Driving while chewing "chat"
5. Not respecting traffic regulation
6. Driving while drunk
7. Not yielding to pedestrians

#### **Non- Taxi Drives**

1. Not yielding to pedestrians
2. Driving while drunk
3. Following too close
4. Speeding
5. Not respecting traffic regulation
6. Driving while chewing "chat"
7. Parking a vehicle along side another

Hence, one can see that though there is little difference on the rankings, both

parties had identified the frequently committed offenses that are responsible

for the higher incidence of traffic accidents in the city. Here taxi drivers are

trying to hide the most common traffic offenses they made deliberately such as carrying excess passengers. So, there is no ground to argue that the law is violated because of lack of knowledge on the part of the drivers.

What about on the side of the traffic police? To manage the traffic flow smoothly and preventing accidents as well as controlling and investigating when occurred is the major duty of the Addis Ababa traffic police accident control and investigation office. Having such a key responsibility the Department lacks the necessary number of personnel and vehicular fleet. According to the Department's annual reports the number of personnel from 1994/95 to 2000/01 did not even reach 500. But in the mid of 2001/02 about 100 traffic police were added to the fleet. And the numbers of motorcycles (including those having many mechanical defects) is about 55, and the number of cars is 3.

Irrespective of all of the problems that it is facing the traffic police Department is doing its best to manage the city's traffic flow. Every traffic policeman is on a permanent duty for a minimum of 13 hours without extra time payments. This often discourages and weakens the traffic police and in so doing leads them to negligence.

Looking at the nature of taxi services, drivers are free to choose their lines of operation; hence there is stiff competition among them. Therefore, they compete with each other to win over the passengers. To beat their competitors, they mostly break the traffic rules; since they behave they cannot earn even the minimum without breaking the rules.

The other important question raised was whether or not there is any shortcoming in the legislation itself? According to the new road traffic regulations the traffic police only give the penalty ticket to the offending driver. Then the driver has to go to the Transport and Communication Bureau for payment. But usually the taxi drivers fail to pay their fines if their traffic offense reached the climax ( $\geq 8$  records). Eventually the offenders are forced to pay the fines. Some of them may be required to retake practical driving examination; and still some others will have their driving licenses.

It is widely known that the offending taxi drivers fail to pay their fines since the traffic police are not empowered to force them pay immediately. For instance according to the AATPTACIO, a certain taxi driver had committed 133 traffic offenses and is expected to pay 42,000 Birr. But there is no legal ground for enforcing, where the new traffic legislation failed.

Both groups of drivers were asked about the number of tickets they received for their traffic violations in the last six months? About 64% of taxi drivers received 1 to 5 tickets, 14% received 6 to 10 tickets, and 8% received 12 to 50 tickets. In the case of

the non-taxi drivers 18% of them received 1 ticket, 10% received 2 tickets and 5% of them received 3 to 7 tickets respectively indicating that their level of offense is lower than those of taxi drivers.

When the author asked the taxi drivers about the number of tickets received for the traffic violations they made and the corresponding punishments (fines), their responses were short "history will pay it". This implies that the fines imposed are beyond their capacity and they will not pay them. Because no one has the ground to enforce them pay unless they go and report to the concerned Department. That is why traffic violations are flourishing in hundreds of thousands every year. For instance in 2000/01 there were 152,616 recorded traffic violations in the city. And the amount of fine that should be paid was 12,394,240 Birr. However, the amount paid is very low.

This situation may lead the drivers and the traffic police to indulge in an illegal activity, namely, bribery. For instance, before the introduction of the new traffic regulations, the amount of money that was imposed, as a fine did not encourage easily corrupt practices, as the fine was not excessive. For example, according to the former traffic regulations, the fine to be paid for loading an extra passenger was Birr 10. But now the reason that is often gives for bribing the traffic policeman is much smaller than the amount required to pay to the government. Therefore, under such circumstances the offending taxi drivers may be encouraged to be engaged in bribery.

After the new traffic regulation has been made practical, however, things have

changed. Many people believe that the amount of fine stated in the new regulation is big enough to allow the traffic police to involve in bribery. It gives much room for bargaining. The increased fine has made involvement in bribery more appealing. For example, under the present traffic law, an individual who has committed the same traffic offense discussed above is obliged to pay Birr 80. But that is only the law in the book. It seems that most taxi drivers would prefer to illegally deal with traffic police rather than simply pay what is stated in the law. Because they may have the advantage in terms of the amount of money they pay and in terms of avoiding the situation of being recorded as traffic law offender. Such bargaining, most often, may end up with drivers paying very lesser amount of money than what the law prescribes. Therefore, many of the respondents believe that this is the prevailing condition.

Generally, in addition to the smaller number of the traffic personnel, the higher fine imposed by the government may create ample opportunity for illegal activities to flourish. It appears that taxi drivers obey the law only when they are sure that they will be detected. The only respect that they accord is not to the law but to the presence of the traffic police. They violate the law as much as possible. For instance, it is becoming a common law (and accepted even by passengers) among taxi drivers, to load extra passengers as they approach peripheral neighbourhoods. The "weyalas" call this phenomenon "Tibeber" meaning, "cooperation". Both types of drivers were asked about their opinions as regards these matters. The questions and their responses were as shown below:

1. How do you compare the fine imposed in the new road traffic regulation with the old one? About 98% of the taxi drivers and 94% of non-taxi drives rated the fine as very high.
2. What kind of measures do you take if you have been caught for violating the rules and when you are sure that the traffic police is going to penalize you? About 16% of taxi drives accepted giving a bribe as their first measure whereas, 60.4% of them considered it to be their second choice after begging. In the case of non-taxi drivers about 10% confirm giving a bribe as their first choice, and 31% as their second choice.
3. A substantial number of drivers complain that traffic policemen treat them improperly. Do you agree with this statement? The response from the taxi drivers is total agreement with a slight difference in its degree where 77% strongly agree, 17 agree and 5% disagree. In case of non-taxi drivers 27% of the respondents marked strongly agree, 43% agree, 22% disagree and 7% strongly disagree.
4. How many of the traffic policemen do you blame for their improper treatment of drivers?

Taxi drivers reported that they blame all (7%), majority of them (56%), few of them (40%) and very few of them (3%) whereas non-taxi drivers responded that they blame all (3%), majority of them (39%), few of them (32%) and very few of them (9%).

5. Answering to the question that targeted the attitude of both groups of respondents on each other, 78% of taxi drives blame the traffic police for their negative

attitude on taxi drivers but 25% of the taxi drivers accept that the traffic police are tired enough to develop a negative attitude towards taxi drivers. In case of non-taxi drivers, 43% of them blame the traffic police for their negative attitude on drivers 51%, blame both parties and 53% of them blame drivers for their failure to respect the traffic law and the traffic police.

6. It is believed that the Addis Ababa traffic police are doing a fair work. Do you agree with this statement? Taxi drivers' response was disagree and strongly disagree with 45.6% each with only 8.7% of them showing agreement. Non-taxi drivers responded with 8% strongly agree, 22% agree, 51% disagree and 18% strongly disagree, respectively.
7. At last both group of drivers were asked to show their agreement of the fair work of both the Addis Ababa Traffic police and the Addis Ababa Transport and Communication Bureau in applying the new road traffic safety regulation to reduce the incidence of traffic accident. About 1%, 8.7%, 46% and 44.36% of taxi drivers responded as strongly agree, agree, disagree and strongly disagree, respectively. Whereas 9%, 19% 56%, and 15% of the non-taxi drivers responded as strongly agree, agree, disagree and strongly disagree, respectively.

Therefore, most of the evidences show that there is a serious problem in the implementation of the new traffic regulation compared with the former. It creates a favorable condition for taxi drivers to commit more traffic offenses and does not force drivers to pay the fine unless they are willing to do so. Another favorable condition that creates opportunity for the misuse of the regulation is the severity of the fine imposed on drivers in general and on taxi drivers in particular. This condition most probably may lead them to bargain with the traffic police to pay lesser than the legally written amount as a bribe. Here the traffic policemen's lower salaries and absence of extra time payments may also create the favorable condition for corruption. Generally it appears that there is a more serious and complicated corruption problem around the taxi drivers, the traffic

police and the Addis Ababa Transport and Communication Bureau employees that handle the renewal of driving licenses and the payment of fines for traffic offenses.

#### **6.4. Temporal Variations of Taxi Traffic Accidents**

Occurrences of road traffic accidents obviously vary with time. It varies between hours in a day, days in a week and months in a year.

##### **6.4.1. Hourly Distribution of Taxi Traffic Accidents**

Because nighttime driving is normally very low, 74.7% of all reported accidents in the specified period occurred during the hours of the daytime. Hourly distribution of taxi traffic accidents is given in table 50. The table shows the coincidence of higher accidents during the morning, noon and afternoon traffic peaks.

There are two peaks during the morning hours (0800-0900 and 1100-1200), one noon peak between 1200-1300 and one after noon peak (1500-1600) having almost equal distributions (7% each on average). There is also a difference in taxi traffic accidents during the day too. About 35.17% (1062) of total accidents occur in the morning and 39.50% (1193) in the afternoon. Even though there is a distribution of accidents during the nighttime due to the nature of taxi service, about 63% of the nighttime accident or 16% (483) of the total taxi traffic accidents occurred within three hours (1800-2100). In the morning, the rush hour traffic is high largely as a result of the absence staggered working hours in Addis Ababa. Public and private sector employees, industrial workers and students leave home at the same. The late

afternoon rush hour is again a phenomenon caused by the return trip of these travelers.

**Table 50: Hourly Distribution of Taxi Traffic Accidents**

Day time hours				Night time Hours			
No	Hour	Number of Accidents		No	Hour	Number of Accident	
		Number	Percent			Number	Percent
1	0600-0700	103	3.41	1	1800-1900	165	5.46
2	0700-0800	177	5.86	2	1900-2000	161	5.33
3	0800-0900	221	7.32	3	2000-2100	157	5.20
4	0900-1000	183	6.06	4	2100-2200	68	2.25
5	1000-1100	164	5.43	5	2200-2300	56	1.85
6	1100-1200	214	7.09	6	2300-2400	42	1.39
7	1200-1300	210	6.95	7	2400-0100	21	0.70
8	1300-1400	200	6.62	8	0100-0200	28	0.93
9	1400-1500	184	6.09	9	0200-0300	13	0.43
10	1500-1600	210	6.95	10	0300-0400	7	0.23
11	1600-1700	188	6.23	11	0400-0500	10	0.33
12	1700-1800	201	6.66	12	0500-0600	37	1.23
	Sub total	2255	74.67		Sub total	765	25.33
<b>Grand Total</b>						<b>3020</b>	<b>100.00</b>

#### 6.4.2. Daily Distribution of Taxi Traffic Accident

The daily distribution of taxi traffic accidents shows no much variation between working days and weekends.

**Table 51: Daily Taxi Traffic Accidents**

No	Day	Accidents Number	Percent
1	Monday	422	13.97
2	Tuesday	386	12.78
3	Wednesday	408	13.51
4	Thursday	452	14.97
5	Friday	446	14.97

6	Saturday	456	15.10
7	Sunday	450	14.90
<b>Total</b>		<b>3020</b>	<b>100.00</b>

Tuesdays have relatively lowest accident record whereas Saturdays have the highest. And we can divide the days of the week into two groups where Mondays, Tuesdays and Wednesdays (the first three working days) as with relatively lower accidents. The next two working days, Saturdays and the weekend have higher taxi traffic accidents. This is attributed to the pattern of movement of the people, where people move to market places, (on Saturdays) recreational areas, asking relatives and other social works most likely using taxis and city buses on Saturdays and Sundays. The trips they make are higher than that of the working days.

However, the pattern of the overall traffic accidents in Addis Ababa as it has been discussed earlier in general is higher during the working days and is lower during the weekends (Sundays) because government and most private business offices are closed. But, Sundays and Saturdays are the busiest days for taxis without any hourly variations that bring taxi traffic accidents to their peak.

### **6.4.3. Monthly Distribution of Taxi Traffic Accidents**

With respect to the seasonal variations of weather conditions, religious and cultural occasions it is expected that there would be monthly variations of traffic accidents. But as shown in Table 52 and Figure 7 there is a fairly uniform distribution ranging from 7.58% (September) to 9.02% (August). Almost 9 months have equal

distributions. Therefore, there is no evidence to suggest that accidents are higher during the rainy months of June, July and August.

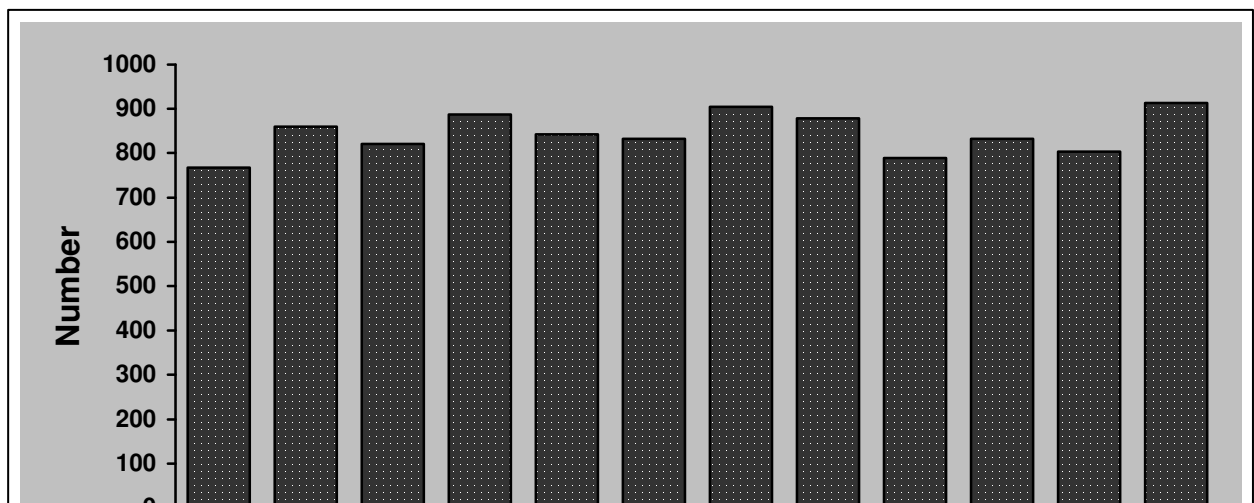
Accidents can occur at any time and at any place. But how frequent do traffic accidents occur varies from time to time and from place to place depending on the intensity of the interaction and places of importance. Hence, analysis of the spatial distribution of taxi traffic accidents in this case helps to identify accident-prone areas (black spots) and to take necessary measures.

**le 52: Monthly Distributions of Taxi Traffic Accidents. (1995/96 -2000/01)**

No	Month	1995/96	1996/97	1997/98	1998/99	1999/00	2000/01	Total	%
1	September	92	109	182	114	135	136	768	7.58
2	October	119	128	241	129	131	112	860	8.49
3	November	122	116	203	123	127	130	821	8.10
4	December	126	155	213	153	124	116	887	8.75
5	January	117	171	166	125	133	131	843	8.32
6	February	176	155	162	137	106	96	832	8.21
7	March	148	174	196	161	116	109	904	8.92
8	April	187	167	144	146	117	117	878	8.67
9	May	155	161	135	108	107	123	789	7.79
10	June	160	154	134	114	129	141	832	8.21
11	July	143	146	118	132	125	140	804	7.94
12	August	150	214	142	109	149	150	914	9.02
	<b>Total</b>	<b>1695</b>	<b>1850</b>	<b>2036</b>	<b>1551</b>	<b>1499</b>	<b>1501</b>	<b>10132</b>	<b>100.00</b>

Source: AATPTACIO Unpublished Monthly Reports

**Figure 7: Trends in Monthly Distributions of Taxi Traffic Accidents (1995/96-2000/01)**



## 6.5 Spatial Distribution of Taxi Traffic Accidents

There is no definite time and place for the incidence of traffic accidents. Road traffic

### 6.5.1. Taxi Traffic Accidents by land use Categories

Urban places have different land uses depending on the kinds of activities people perform in and around. Some of the dominant ones are commercial areas, factories, recreational areas, schools, offices and residential areas. Therefore, in relation to their function, the number of trips made to and out of there varies depending on their size and concentrations. Hence, the distribution of taxi traffic accidents varies from one land use to another as shown in Table 53.

**Table 53: Taxi Traffic Accidents by Land use Categories**

No	Land use	Accident Severity							
		Fatal		PIA		Damage		Total	
		#	%	#	%	#	%	#	%
1.	Around Schools	5	4.39	68	6.43	116	5.91	184	6.09
2	Around Factories	2	1.75	5	0.47	10	0.51	15	0.50
3	Around Worship places	6	5.26	63	5.96	120	6.11	183	6.06
4	Around Market areas	20	17.54	165	15.61	319	16.25	484	16.03

5	Around Recreational areas	9	7.89	147	13.91	249	12.68	396	13.11
6	Around Hospitals	2	1.75	26	2.46	62	3.16	88	2.91
7	Around Offices	50	43.86	434	41.06	912	46.46	1346	44.57
8	Around Residential areas	20	17.54	148	14.10	175	8.92	324	10.72
	<b>Total</b>	<b>114</b>	<b>100.0</b>	<b>1057</b>	<b>100.0</b>	<b>1963</b>	<b>100.0</b>	<b>3020</b>	<b>100.0</b>

The highest taxi traffic accidents occur around offices, market areas, and recreational and residential areas accounting for 44.57%, 16%, 13% and 11%, respectively. Out of the total fatal accidents, office areas take 44% followed by commercial and residential areas having 17.54%. Recreational areas represent 8% of fatal accidents. About 41% of PIA and 46% of property damage accidents had occurred around office areas and about 16% of PIA and property damage around commercial areas. Moreover, recreational areas claim about 14% of PIA and 13% of property damage accidents. This may be attributed to the problem of referencing of the taxi traffic accidents where mostly prominent government offices are taken as a reference.

### **6.5.2. Taxi Traffic Accidents by Zonal, Wereda and Kebele**

There is disparity in the spatial distribution of taxi traffic accidents in Addis Ababa among its zones, weredas and kebeles. Zones comprising weredas with higher population density and concentration of different landuse categories have higher traffic accidents than zones comprising the peripheral weredas having less dense population and

low concentration different landuse categories.

**Table 54: Zonal Distribution of Taxi Traffic Accidents in Addis Ababa (1999/00-2000/01)**

Zone	Weredas included under	Number of Weredas	Taxi Traffic Accidents		Rank
			Number	%	
1	3,4,5,6	4	434	14.60	5
2	20,21,22,23,24	5	527	17.73	4
3	17,18,19,28	4	721	24.25	1
4	1,9,11,12,13,15,16	7	644	21.66	2
5	2,7,8,1,14,25	6	600	20.18	3
6	26,27	2	47	1.58	6
	<b>Total</b>	<b>28</b>	<b>2973</b>	<b>100.00</b>	<b>-</b>

Zone 3,4,5 have about 24, 22, and 20 percent, respectively and account for 60% of the total taxi traffic accidents. The zonal disparity is very high ranging from almost 2% (Zone 6) to 24% (Zone 3). The wereda distribution also follows a similar pattern where those weredas that comprise kebeles located along the major roads and central areas have higher traffic accidents as shown in map 5.

**Table 55: Distribution of Taxi Traffic Accidents on wereda**

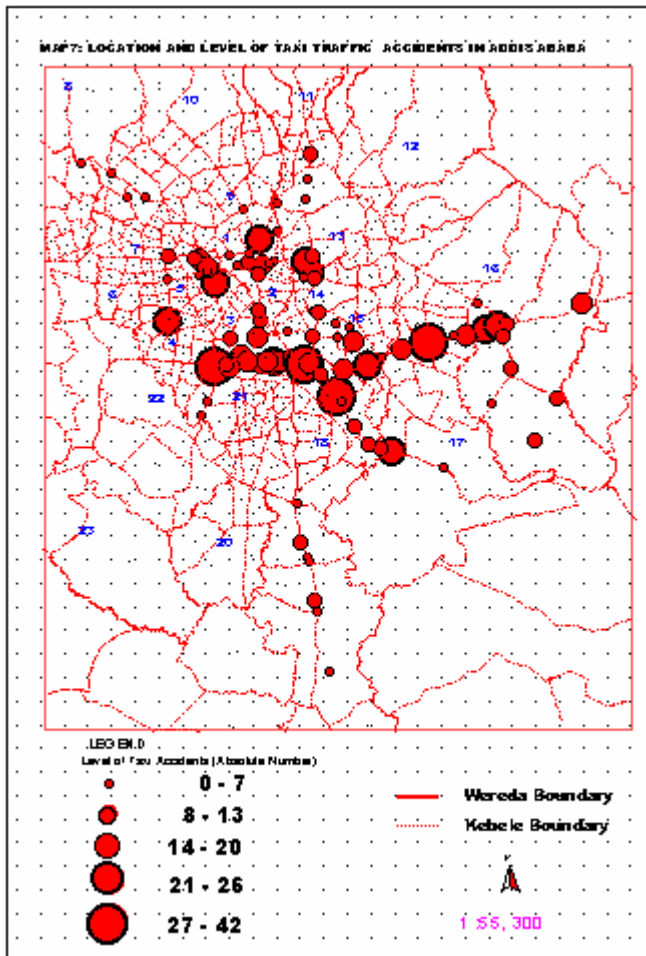
Zone-Total	Wereda	Wereda total	Zonal share (	City share (%)	Rank among all weredas
434(14.60%)	3	147	33.87	4.94	9
	4	90	20.74	3.03	12
	5	161	37.10	5.42	7
	6	36	8.29	1.21	26

527 (17.73%)	20	80	15.18	2.69	15
	21	267	50.66	8.98	2
	22	53	10.06	1.78	20
	23	69	13.09	2.32	17
	24	58	11.01	1.95	19
721(24.25%)	17	296	41.05	9.96	1
	18	236	32.73	7.94	3
	19	136	18.86	4.57	10
	28	53	7.35	1.78	20
664 (21.66%)	1	84	12.65	2.83	13
	9	52	7.83	1.75	22
	11	62	9.34	2.09	18
	12	16	2.41	0.54	27
	13	83	12.50	2.79	14
	15	180	27.11	6.05	5
	16	167	25.15	5.62	6
600 (20.18%)	2	184	30.67	6.19	4
	7	92	15.33	3.09	11
	8	79	13.17	2.66	16
	10	47	7.83	1.58	23
	14	160	26.67	5.38	8
	25	38	6.33	1.28	25
47 (1.58%)	26	8	17.02	0.27	28
	27	39	82.98	1.31	24

Wereda 17, with 10% of the total taxi traffic accidents in the city takes the first rank. This wereda comprises kebeles that include the Bole-Rwanda, Bole Michael, Bole airport, Gerji, Imperial Hotel, AMCE, and the road from Adwa Square up to Urael church (Haile Gebresilasse Road).

Wereda 21, ranks second accounting for almost 9%, and includes kebeles that comprise Senga Tera, Laghar, Stadium and Meskel Square. The third rank is taken by wereda 18, comprising those kebeles starting from Meskel Square up to Wello Sefer through Flamingo, Olympia and Addis Bank as well as the environs of Istifanos church up to Bambis (Urael junction).





Wereda 2, which accounts for 6.19% of the total taxi traffic accidents in the city ranks fourth. It includes those kebeles along the roads that radiate from Menelik II square up to Ras Mekonen bridge, Degouil square, Tewodros square, and from Arada post office through Shoa supermarket up to Somali Tera. In the fifth rank is wereda 15 sharing 6.05% and includes the localities with the prefix Kasanchis: like Kasanchis supermarket, Kasanchis Total, Kasanchis Agip, Kasanchis Meneharia, up to Urael junction and Bambis

bridge (Yordanos Hotel).

The other important weredas accounting for between 5-6% of the total taxi traffic accidents include wereda 16 on the main road from Kokebe Tsibah secondary school up to Lamberat through Megenagna and Ararat Hotel. And Wereda 5 (Merekato) is the next that includes the environs around Tana Gebeya, Cinema Ras, Anwar Mosque, Gojjam Berenda, Autobis Tera (Bus Terminal), Sebategna, Sidamo Tera, Bomb Tera and Berbere Tera.

In general these weredas are found along the major arterial roads where the largest market areas, schools, government offices worship places as well as recreational areas (Cinemas, theatre Halls Hotels, Restaurants Bars, etc) are concentrated along the way which needs taxi services.

This is attributed to the traffic congestion, most of the streets are two-way and are found along the dense population areas where there are numerous out going and in coming trips. The trips are attracted by the concentration of commercial, recreational and governmental offices in addition to the dense residential areas.

About half of the total taxi traffic accidents occurred in these above mentioned accident-prone roads and their environs. This is true also in other African cities. For instance, studies of the OECD (1996) cited in Admasu (2001) showed that a larger proportion of accidents in a given city in Africa are grouped along the main roads. Data from Accra and Douala showed that, an average of 53% of fatal, 71% of serious, 61% of slight injury accidents and 75% of damage accidents occurred on ten roads. Most of these

roads are found around intersections, narrow bridges and busiest roads. And among them the following road segments are the most taxi traffic accident prone listed in order of importance.

1. From Meskel Square to Adwa Square
2. From Mexico square to Meskel square
3. From Arada (Menelik II square) to Amanuel Messalemia
4. From Meskel Square to Bole Airport
5. From Sebategna to Lideta
6. From Mexico through Andenet Square to Kasanchis Supermarket.

Muskaug Richard (1996) cited in Admasu (2001) in his assessment of Road Traffic Accident Situation in Africa, taking the Accra situation as example, he pointed out that 46% of accidents, 41% of fatalities and 39% of injuries occurred on five roads.

Most of the bridges in the city are located on sharp curves, intersection points, on old U-shaped valleys and are narrow without protected paths for pedestrians, which make them death spots. Best examples include, Ras Mekonen Bridge, Habtegiorgis Bridge, Kebena Bridge (to Ferensai and Bella Road), Ginfle Bridge (Arat Kilo) to Kokebtsebah Bridge, Urael Bridge, Bambis Bridge, Somalitera, Lideta (Near Awash Liquor Factory), No. 3 City bus terminal and others. (Map 7)-----

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**Table 56: Distribution of Taxi Traffic Accidents on Kebele Level (1999/00-2000/01)**

No	Zone	Wereda	Kebele	Accidents #	Specific localities included
1	1	3	53	41	General post office, Andnet square and its environs up to Mexico
2	1	3	52	20	Tikur Anbessa Hostpial, Goma Kuteba
3	1	4	27	21	Abenet Hotel and its environs
4	1	5	06	44	Mercato, Raguel church, Anwar Mosque, American Gibi
5	1	5	19	30	Gojjam Berenda and its environs
6	1	5	07	25	Cenima Ras, Tana Gebeya and its environs
7	2	21	01	167	Senga Tera, Lagare, sport commission, Stadium, Lalibela Restaura n t
8	2	21	04	59	Stadium (Eritrean embassy), Meskel square
9	2	22	07	20	Mexico square and its environs
10	3	17	20	49	Bole Rwanda to Bole Air port
11	3	17	24	46	Bole Airport to Megenagna
12	3	17	21	34	Bole to Gerji to AMCE
13	3	17	14	26	Urael /wuha Lemat to Traffic police office (22-Mazoria)
14	3	17	25	24	Lem Hotel to Russia Camp.
15	3	17	23	22	From Traffic Police to Bole Secondary School
16	3	17	17	21	Imperial Hotel and its environs
17	3	18	06	46	Meskel Square
18	3	18	07	34	Istifanos church area
19	3	18	26	25	Flamingo to Olympia Junction.
20	3	18	27	23	Wello- sefer to Addis Bank
21	3	18	18	22	Bambis to Olympia Junciton.
22	3	19	55	41	Gotera to Nefassilk
23	3	19	54	20	Saris Total (Addisu Sefer)
24	3	19	57	20	Kadisco and its environs
25	3	28	02	21	Kotebe, CMC
26	4	1	08	22	Semien Hotel to Menelik II square
27	4	11	17	24	Sidist Kilo to Entoto Vocational School
28	4	15	32	35	Urael and its environs
29	4	15	27	28	Kasanchis Total and its environs
30	4	15	31	26	Menaharia Hotel (Kasanchis) and its environs
31	4	15	30	22	Kasanchis Agip then to Kasanchis Beg Tera-Bambis
32	4	16	12	34	Megenagna to Yeka Micael
33	4	16	22	31	Ararat Hotel to Lambert
34	4	16	08	25	Traffic police office (22-Mazoria) to Piazza Hotel
35	4	16	11	22	Shola and its environs
36	5	2	11	50	Arada post office
37	5	2	12	35	Arada Building and its environs (Piassa)
38	5	2	09	25	Shoa super market to Somali Tera
39	5	2	14	25	Atkilt Tera
40	5	7	34	20	Gojjam Berenda
41	5	8	02	22	Paulos Hospital to Paster
42	5	14	07	47	National Palace and its environs
43	5	14	13	28	Tourist Hotel to Berhanena Selam printing press
44	5	14	25	20	Miazia 27 square and its environs
45	6	27	11	21	Kalit, Crown Hotel

# CHAPTER SEVEN

## MAJOR CAUSES OF TAXI TRAFFIC ACCIDENTS

The major causes and contributing factors of taxi traffic accident have been treated using the traffic accident data from the Traffic Police and the data obtained from the questionnaires. First the driver factors were treated followed by vehicle, pedestrian, environmental and then time factors. A regression analysis and multiple coefficients were used and the coefficient of determination was calculated at significance level of  $p \leq 0.05$  to show how much each variable considered explains the variation in taxi traffic accidents by severity levels in Addis Ababa.

In this chapter, the core idea is to show how much each variable considered explains the variation in accident severity when all variables (independent) that affect or have the contribution to the taxi traffic accidents explain in combination taken at the same-time and computed by stepwise method, under the criteria of probability of a factor to-enter is if  $p \leq 0.05$ , and to remove is if  $p \geq 0.1$ .

Accordingly, the following factors were considered using the accident data obtained from the traffic police.

1. ***Driver factors***- which includes age, driving experience, education level and vehicle ownership
2. ***Vehicle factors*** - which includes service years, defects, vehicle maneuvers and collision type
3. ***Road factors*** - which includes road arrangement, site, surface, junction and road moisture condition.
4. ***Miscellaneous factors*** - which includes light, weather, road users' errors and

location of accidents.

The dependent variable in the model, taxi traffic accidents by severity levels (damage to property 1, slight injury 2, serious injury 3, and total 4) was regressed against a number of major causes and contributing factors of taxi traffic accidents. The incidence and severity of taxi traffic accidents are affected by the following factors.

1. Age ( $X_1$ ), age of taxi drivers in years.
2. Education level ( $X_2$ ) of taxi drivers in grade levels adult education a, elementary 2, junior secondary 3, senior secondary 4 above secondary 5.
3. Driving experience ( $X_3$ ) of taxi drivers in years.
4. Vehicle ownership ( $X_4$ ), owner 1, employed 2, others 3
5. Vehicle service (Age) ( $X_5$ ) in years.
6. Vehicle collision type ( $X_6$ ), Head on 1, Nose-tail 2, Nose-side 3, side 4, Overturning 5, etc
7. Vehicle defect ( $X_7$ ), defect in fire 1, light 2, others 3.
8. Road moisture ( $X_8$ ), Dry, 1 wet 2, muddy 3, others 4.
9. Road Arrangements ( $X_9$ ), one way 1, Two-way 2, roundabouts 3, continuously demarcated lane 4, interrupted demarcated lane 5.
10. Road gradient ( $X_{10}$ ), straight and plain 1, Gentle 2, slight zigzag 3, Hilly Zigzag 4, Hilly 5, steeper 6.
11. Road (junction) shape ( $X_{12}$ ), Good Asphalt 1, Damaged asphalt 2, Gravel 3, Dirt 4.

12. Road (junction) shape ( $X_{12}$ ), No junction 4, Y-junction 2, T-Junction 3, + - junction 4, O-junction 5, K-junction 6.
13. Light condition ( $X_{13}$ ), Righter sunlight 1, sunrise 2, sunsets 3, good streetlight 4, dim streetlights, without streetlight 6.
14. Weather condition ( $X_{14}$ ), Good air 1, cloudy 2, light rain 3, heavy rain 4, Hot air 5, cold air 6.
15. Vehicle maneuvers ( $X_{15}$ ), Merging 1, diverging 2, Turning right 3, Turning left 4, U-turning 5, etc. (Table 37).
16. Land use around the accidents spot ( $X_{16}$ ) around schools 1, factories 2, worship places 3, market areas 4, recreational areas 5, Hospitals 6, offices 7, residence.
17. Driver error ( $X_{17}$ ) error of drivers at time of accident-failure to give way for pedestrians 1, following too close 2, failure to give way for vehicles 3, improper turning 4, etc. (Table 24). Having defined the variables, the author tried to identify major causes of taxi traffic accidents by estimating the Beta coefficient as shown in Table 57.

**Table 57. Model summary of Beta coefficients of taxi traffic accidents (dependent) and 17 independent variables.**

	<i>Variable entered</i>	<i>Standardized Beta coefficient</i>	<i>T- value</i>	<i>Sign.</i>
	<b>Constant</b>		<b>47.798</b>	<b>.000</b>
	X <sub>1</sub>	.826	12.560	.000
	X <sub>17</sub>	-.490	-7.564	.000
	X <sub>3</sub>	-.007	-.136	.892
	X <sub>2</sub>	-.791	-17.942	.000
	X <sub>4</sub>	.286	6.360	.000
	X <sub>5</sub>	-.252	-6.552	.000
	X <sub>6</sub>	-.096	-1.957	.050
	X <sub>7</sub>	.113	3.535	.000
	X <sub>8</sub>	.044	1.684	.092
	X <sub>9</sub>	.071	2.796	.005
	X <sub>10</sub>	.019	.667	.505
	X <sub>11</sub>	-.205	-6.823	.000
	X <sub>12</sub>	.284	7.541	.000
	X <sub>13</sub>	.254	4.374	.000
	X <sub>14</sub>	.014	.616	.538
	X <sub>15</sub>	-.354	-10.244	.000
	X <sub>16</sub>	-.273	-6.861	.000

After the computation of the regression analysis 14 variables were selected that bring a significant effect as shown in Table 58.

**Table 58: The Association between Taxi Traffic Accidents (dependent) and 14 Independent Variables**

Model	R	R <sup>2</sup>	Adjusted R <sup>2</sup>	Std. error of the estimate
1	0.887	0.787	0.786	0.19

Therefore, the coefficient of multiple correlations (R) is 0.887 suggesting a very

strong positive association between the independent variables and the dependent variable (taxi traffic accidents). The coefficient of determination ( $R^2$ ) was determined to be 0.787 implying that about 78.7% of the variation in severity level and incidence of taxi traffic accidents were explained by the independent variables.

In order to show the relative contribution of each variable a stepwise regression analysis was computed and the result is given in Table 59. Among the independent variables, area or location factor stands first which accounted for 57.7% of the variation in severity and incidence of taxi traffic accidents. In other words, the concentration of different economic activities and services (land uses) in fewer areas attracts more trips causing large volume of traffic, which in turn leads to higher incidence of traffic accidents. The second higher (8.6%) contribution for the variation of the dependent variable was made by drivers' age followed by education level with 0.062 (6.2%), vehicle ownership with 0.029 (2.9%) and vehicle service years with 0.008 (0.8%). Road users' errors, road junction, vehicle maneuvers, road moisture condition and road surfaces explain 0.6, 0.5, 0.4, and 0.2 percent respectively and are ranked from 6<sup>th</sup> to 10<sup>th</sup>.

**Table 59: Stepwise Regression Result of Taxi Traffic Accidents and 14 Significant Independent Variables**

Model	R	R <sup>2</sup>	Adjusted square	Std-error of the estimate	Change statistics				
					R <sup>2</sup> change	F change	Df <sub>1</sub>	Df <sup>2</sup>	Significance F-change
1	0.759 <sup>a</sup>	0.577	0.576	0.27	0.577	4109.727	1	3018	0.000
2	0.814 <sup>b</sup>	0.663	0.662	0.24	0.086	768.814	1	3017	0.000
3	0.852 <sup>c</sup>	0.725	0.725	0.22	0.062	685.410	1	3016	0.000
4	0.868 <sup>d</sup>	0.754	0.754	0.21	0.029	356.005	1	3015	0.000
5	0.874 <sup>e</sup>	0.762	0.762	0.21	0.008	102.990	1	3014	0.000
6	0.876 <sup>f</sup>	0.768	0.768	0.20	0.006	74.684	1	3012	0.000
7	0.879 <sup>g</sup>	0.773	0.773	0.20	0.005	67.571	1	3012	0.000
8	0.881 <sup>h</sup>	0.777	0.776	0.20	0.004	53.644	1	3011	0.000
9	0.884 <sup>i</sup>	0.781	0.780	0.20	0.004	53.019	1	3010	0.000
10	0.885 <sup>j</sup>	0.783	0.782	0.20	0.002	29.903	1	3009	0.000
11	0.886 <sup>k</sup>	0.785	0.784	0.20	0.002	28.781	1	3008	0.000
12	0.887 <sup>l</sup>	0.786	0.785	0.19	0.001	11.456	1	3007	0.001
13	0.887 <sup>m</sup>	0.786	0.785	0.19	0.000	6.939	1	3006	0.008
14	0.887 <sup>n</sup>	0.787	0.786	0.19	0.000	3.849	1	3005	0.050

- a. Area (location)                      b. Area and age                      c. Area, age and education  
d. Area, age, education and vehicle ownership  
e. Area, age education vehicle ownership and v. service years.  
f. Area, age education vehicle ownership, v. service years and errors  
g. Area, age education vehicle ownership, v. service years, errors and road junction  
h. Area, age education vehicle ownership, v. service years, errors, road junction and vehicle maneuvers  
i. Area, age education vehicle ownership, v. service years, errors, road junction, vehicle maneuvers and road moisture  
j. Area, age education vehicle ownership, v. service years, errors, road junction, vehicle maneuvers, road moisture and road surfaces  
k. Area, age education vehicle ownership, v. service years, errors, road junction, vehicle maneuvers, road moisture, road surfaces and light  
l. Area, age education vehicle ownership, v. service years, errors, road junction, vehicle maneuvers, road moisture, road surfaces, light and v. defects  
m. Area, age education vehicle ownership, v. service years, errors, road junction, vehicle maneuvers, road moisture, road surfaces, light, v. defects and road arrangements

*n. Area, age education vehicle ownership, v. service years, errors, road junction, vehicle maneuvers, road moisture, road surfaces, light, v. defects, road arrangements and collision*

Moreover, the first 10 variables alone, having a coefficient of multiple correlations (R) 0.885 and the coefficient of determination ( $R^2$ ) of 0.783 explain 78.3% of the variation in severity levels and incidence of taxi traffic accidents. However, among the 14 significant variables spatial variation, age of drivers, education level and vehicle ownership with  $R^2$  of 0.754 take the lion's share explaining 75.4% of the variation in the dependent variable indicating the relative importance of these four factors. Driver factors in general explain 15.6% of the variations in the dependent variable.

Having defined the variables, the author tried to identify major causes of taxi traffic accidents by estimating the Beta coefficient as shown in Table 60.

The dependent variable in the model, taxi traffic accidents by severity levels (damage to property 1, slight injury 2, serious injury 3, and total 4) was regressed against a number of major causes and contributing factors of taxi traffic accidents. The incidence and severity of taxi traffic accidents are affected by the following factors.

1. Age ( $X_1$ ) age of taxi drivers in years.
2. Education level ( $X_2$ ) of taxi drivers in grade levels adult education 1, elementary 2, secondary 3, vocational 4, higher education 5.
3. Marital status ( $X_3$ ), married 1, unmarried 2, Divorced 3.
4. Place of license issued ( $X_4$ ) capital 1, Regional capital 2 zonal capital 3.
5. Driving experience of taxi drivers in years ( $X_5$ )
6. Occupation level ( $X_6$ ), unemployed 1, Driver under government office 2, Taxi drivers assistants 3, driver under private enterprise 4, others 5.
7. Vehicle ownership ( $X_7$ ) , owner 1, employed 2, others 3.
8. Contract Type ( $X_8$ ), fixed 1, unfixed 2, other 3.
9. Pay level ( $X_9$ ) salary of taxi drivers, enough 1, satisfactory 2, small 3.

10. Vehicle Type (X<sub>10</sub>), minibus 1, "wuyeyet" 2, small taxi 3.
11. Weekly rest (X<sub>11</sub>), weekly leave in days. One day 1, two days 2, more than tow days3, No weekly leave 4.
12. Recess time (X<sub>12</sub>), daily rest in hours, Yes 1, No 2, while driving.
13. Use of seat belts a (X<sub>13</sub>), if uses 1, if not 2.
14. Vehicle condition (X<sub>14</sub>), brand new 1, second hand 2, when imported 2, second hand locally 3, no knowledge 4.
15. Working site (X<sub>15</sub>), permanent site 1, No 2.
16. Knowledge of traffic regulation (X<sub>16</sub>). I know most of it 1, enough 2, little 3, No suggestion 4.
17. Length of working hours within a day (X<sub>17</sub>) in hours.

**Table 60. Model summary of the Beta coefficients of taxi traffic accidents (dependent) and 17 independent variables.**

	<i>Variable entered</i>	<i>Standardized Beta coefficient</i>	<i>T- value</i>	<i>Sign.</i>
	<i>Constant</i>		<i>7.881</i>	<i>.000</i>
	X <sub>1</sub>	-.062	-.955	.341
	X <sub>3</sub>	.161	2.913	.004
	X <sub>2</sub>	.157	3.033	.003
	X <sub>4</sub>	.066	1.345	.180
	X <sub>5</sub>	-.369	-6.290	.000
	X <sub>6</sub>	.178	3.452	.001
	X <sub>7</sub>	-.035	-.327	.744
	X <sub>8</sub>	.444	5.777	.000
	X <sub>9</sub>	-.053	-.637	.525
	X <sub>10</sub>	-.069	-1.330	.185
	X <sub>11</sub>	-.152	-2.864	.005
	X <sub>12</sub>	.171	3.528	.001
	X <sub>13</sub>	-.100	-2.050	.042
	X <sub>14</sub>	.245	4.671	.000
	X <sub>15</sub>	-.068	-1.311	.191
	X <sub>16</sub>	.073	1.436	.153
	X <sub>17</sub>	-.014	-.271	.787

Using a questionnaire survey additional data was collected from taxi and non-taxi drivers to show what is really going on in the field and in order to collect other supplementary information about the causes and contributing factors for taxi traffic accidents in the city. The variables considered as major cause and contributing factors include: age, marital status, driving experience, education level, vehicle ownership, drivers' background, terms of employment, pay level, recess time, weekly rest and number of working hours. Also other additional variables identified include knowledge of the traffic law use of seat belt, working site, place of license issued, as well as the condition and type of vehicle they are driving.

After the computation of the regression analysis the combined effect of the considered variables shows a significant association as it is shown in Table 61.

**Table 61: The Association between Taxi Traffic Accidents and 17 Independent Variables**

Model	R	R <sup>2</sup>	Adjusted square	Std. error of the estimate
1	0.730	0.533	0.496	0.4250

The coefficient of multiple correlations (R) is 0.730 and the coefficient of determination (R<sup>2</sup>) 0.533 suggests a positive association between the dependent and independent variables considered. And about 53.3% of the variation in the incidence and severity levels of taxi traffic accidents is explained by these factors and 46.5% by other variables.

To show the relative contribution of each variable, a stepwise regression was computed. Accordingly, driving experience, terms of employment, education level, vehicle condition (age), recess time, weekly rest, marital status and, drivers' background were selected as having relevant contributions to the variation in the incidence and severity levels of taxi traffic accidents at 95% significant level.

According to the results given in Table 61 among the 17 independent variables (most of them are driver factors) eight of them explains 50.8% of the total variations in taxi traffic accident severity and incidence.

Driving experience with a relative contribution 18.6% to the variations in the incidence of taxi traffic accidents ranked first followed by terms of employment, education level and vehicle age, explaining 14.2%, 5.6% and 4.1% of the variations in the dependent variable.

As shown earlier in the case of taxi traffic accident data from the traffic police, driver factors explained only 15.6% of the variations in the dependent variable. However, due to the inclusion of other contributory driver factors in the questionnaire the contribution of driver factors raised 46.7%. That is, 46.7% of the variations in the dependent variable is due to the independent variables considered from the questionnaire. This implies that terms of employment, recess time and weekly rest, marital status and the background of taxi drivers have significant contribution to the incidence of taxi traffic accidents.

**Table 62: Stepwise Regression Result of Taxi Traffic Accidents and Eight Significant Independent Variables**

Model	R	R <sup>2</sup>	Adjusted square	Std-error of the estimate	Change statistics				
					R <sup>2</sup> change	F change	Df <sup>1</sup>	Df <sup>2</sup>	Significance F-change
1	0.432 <sup>a</sup>	0.186	0.186	0.5413	0.186	52.439	1	229	0.000
2	0.573 <sup>b</sup>	0.328	0.322	0.4930	0.142	48.025	1	228	0.000
3	0.620 <sup>c</sup>	0.384	0.376	0.4730	0.056	20.691	1	227	0.000
4	0.652 <sup>d</sup>	0.425	0.415	0.4580	0.041	16.101	1	226	0.000
5	0.671 <sup>e</sup>	0.451	0.439	0.4486	0.026	10.570	1	225	0.001
6	0.687 <sup>f</sup>	0.472	0.458	0.4408	0.021	9.031	1	224	0.003
7	0.698 <sup>g</sup>	0.487	0.471	0.4354	0.015	6.556	1	223	0.011
8	0.713 <sup>h</sup>	0.508	0.491	0.4273	0.021	9.545	1	222	0.002

- a. *Driving experience*
- b. *Driving experience and terms of employment*
- c. *Driving experience, terms of employment and education level*
- d. *Driving experience, terms of employment, education level and vehicle age*
- e. *Driving experience, terms of employment, education level, vehicle age and recess time*
- f. *Driving experience, terms of employment, education level, vehicle age, recess time and weekly rest.*
- g. *Driving experience, terms of employment, education level, vehicle age, recess time, weekly rest and marital status.*
- h. *Driving experience, terms of employment, education level, vehicle age, recess time, weekly rest, marital status and drivers' background.*

Terms of employment, recess time, weekly rest, marital status and background of drivers explain 14.2%, 2.6%, 2.1%, 1.5% and 2.1% of the variation in taxi traffic accident severity and incidence respectively. Taxi drivers whose terms of employment is to bring a fixed amount of money on daily basis commit more traffic offences than those whose terms of employment is to bring what they collect within a day and owner drivers. The logic behind is that the former tries to work for longer hours without any break time and in hurry in order to fetch the fixed amount and get extra money for his pocket. For

instance, about 91% of taxi drivers do not have a recess time (except the time gap where they keep their turn at origin/destination of taxi station) and 75% of them do not have a weekly rest (leave). Considering the length of working hours, 3% of them work for 8 hours, whereas 18.5%, 18.5% and 38.5% of taxi drivers work for 12, 13 and 14 hours a day, respectively. And 17.5% of them work for 15 to 18 hours a day. Also 55% and 26% of taxi drivers were unmarried and were "Weyalas" turned to taxi drivers, respectively. Hence, these drivers are mostly reckless drivers, which contribute more to traffic incidence. They drive having or taken "chat" most of the time which aggravates their recklessness.

The response of pedestrians in the questionnaire also supports the character of taxi drivers in the city. Pedestrians were asked about whether drivers chew "chat" while driving or not. About 92% answered yes and 8% answered no. They were further asked to indicate the type of drivers they saw chewing chat while driving. The responses revealed the following.

- |                                     |  |
|-------------------------------------|--|
| 1. Taxi drivers = 61.5%             | 4. Private organization drivers =14.2% |
| 2. City bus drivers = 2%            | 5. Others =4.1%                        |
| 3.Private automobile drivers =18.2% |  |

Therefore, taxi drivers are at the forefront and the researcher also confirms that most of taxi drivers were chewing "chat" while the questionnaire was administered. This implies that taxi drivers and their assistants impaired by "chat" and other related drinks could commit more traffic offences. This is observed during the after noon hours where more taxi traffic accidents are recorded by the traffic police. In addition to the response of

pedestrians and personal observation of the researcher, authorities from the ERTA, AATCB and Traffic police confirmed that most employed taxi drivers are with a bad conduct and criminal background in that they commit more traffic offences with little respect to the traffic law and the traffic police.

Furthermore, failure to give priority to pedestrians and other vehicles are at the top among the driver errors that cause more traffic accidents. Taxi drivers, non-taxi drivers and pedestrians were asked to select drivers who fail to cede priority while they drive and cross roads? About 39%, 90% and 95% of taxi, non-taxi drivers and pedestrians respectively ranked taxi drivers at the top in their response, which shows the seriousness of the problem and the negligence of taxi drivers. Generally driver errors and factors are the major causes for high taxi traffic incidence, even though the contribution of other factors is considerable too. The three groups of respondents who were asked to rank drivers fault; vehicle problems, pedestrian' fault and road condition as major factors for the incidence of traffic accident in Addis Ababa and their response is shown in Table 63.

**Table 63: Ranked Responses of Respondents to Four Major Causes of Traffic Accidents in Addis Ababa**

No	Cause or error	Responses in Percent of total		
		Pedestrians	Taxi Drivers	Non-Taxi Drivers
1	Driver's fault	51.5	16.5	37.0
2	Poorly maintained vehicle	10.3	8.0	10.0
3	Pedestrian's fault	8.2	23.0	16.0
4	Condition of road	29.9	52.5	37.0
	<b>Total</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>

Although there is throwing of the risk and blaming each other between pedestrians and taxi drivers, the response of non-taxi drivers is fair about the major

causes. Accordingly and as evidenced by the actual data from the traffic police, driver errors are at the top followed by condition of the road, pedestrian's fault and vehicle problems.

Pedestrian faults are in the second place from the human factors, which needs more attention. But all respondents have blamed road condition as a major factor. There is no deny of the road problem but there are other contributing factors to the problem. For example, pedestrians interfere with vehicles not only due to the inadequacy of sidewalks but also due to the selfish use of scarce sidewalks by irresponsible service giving enterprises like Garages, woodworks, metal works, Groceries as well as street peddlers and hawkers. For instance, about 18.2% of pedestrians answered that it is the misuse of sidewalks that forced them to walk on the road to get rid of the overcrowding of the sidewalks. When asked about why do pedestrians walk along the road that is not allowed for pedestrians? About 37.4% of pedestrians responded that it is due to the absence of sidewalks.

## CHAPTER EIGHT

### CONSEQUENCES OF TAXI TRAFFIC ACCIDENTS

Road traffic accidents are causing various human sufferings and imposing financial burdens in many developing countries like Ethiopia. Hence, road traffic accidents are serious problems, which should not be under estimated.

#### ***8.1. Methods of Estimating Road Traffic Accident Costs***

Although calculating road traffic accident costs is not a simple task, various studies on accident costs have identified six different methods. The gross output (or Human capital) approach was suggested and used in Ethiopia in relation to the prevailing conditions in the country. In the gross output method, the cost of a traffic accident involving death or injury is divided into a cost of a loss of current resources and costs due to a loss of future output. Cost of a loss of current resources includes loss of vehicle damage, medical treatment, police and administration costs. While loss of future output is an estimate of the cost to the nation of the person or person's lost out put when killed or seriously injured. All of these costs are considered as "resource" costs and sums to reflect pain, grief and suffering (PGS) and are also considered to be non-resource costs. Non-resource costs are usually expressed as percentages of resource costs of accidents of varying severity (TRL and Ross Silcock, 2000).

As presented in the Ethiopian Road Safety Study by TRL and Ross Silcock (2000), it was suggested to use slightly higher values of PGS than those used in the UK to

estimate road accidents in the mid 1980's. In 1984 it was 40,100 and 10 percent of resource costs used to reflect PGS in the UK for fatal, serious and slight injuries respectively. Accordingly, in Ethiopia at present 50%, 120% and 15% of fatal, serious and slight injury resources costs are used to reflect PGS. In costing road accidents a great deal of information needs to be calculated on social and economic factors and also on the road accidents actually taking place. As explained by TRL and Ross Silcock (2000) if basic information on the cost of damage only accidents can be determined, then a broad estimate of cost of slight, serious and fatal accidents can be obtained by applying ratios derived from other studies.

**Table 64: Ratios of Accident Costs by Type in Different Nations**

<b>Accident Severity</b>	<b>UK 1987</b>	<b>Cyprus 1985</b>	<b>Jordan 1984</b>	<b>Ethiopia 1983</b>	<b>Tanzania 1994</b>	<b>Malawi 1997</b>
Fatal	238	130	64	10	18	9
Serious	9	6.8	3.6	3	4	3.5
Slight	2.2	2.2	1.6	2	4	2
Damage only	1.0	1	1	1	1	1

Source: TRL with Ross Sikock (2000) Technical Appendix VII: 10

According to the study made in Ethiopia by British and American consultants in 1983 on behalf of the Road Transport Authority and the (then) National Road Transport Corporation compared with the recent studies in Malawi and Tanzania suggest that a ratio of about 10:1 (fatal to damage only) for Ethiopia can be taken as reasonable standard and was used for instance in 1998 cost estimation. Based on the information from the Ethiopian insurance corporation of 1990, the average claim for a road accident of about, Birr 8200 was restructured into Birr 10,000 for a serious accident; Birr 6,600 for a slight accident and Birr 3,300 for damage only accident using the ratios of 3:2:1 for serious,

slight and damage only accidents respectively. Also these values set the cost of a fatal accident at Birr 33,000 a ratio of (10:1) and then applying costs for PGS. Therefore, the model that is used today for estimating road accident costs based on insurance companies information and set ratios of accidents by severity is given as follows:

**Table 65: Traffic Accident Costing Model**

<b>Cost in Birr</b>	<b>Fatal</b>	<b>Serious</b>	<b>Slight</b>	<b>Damage only</b>
Resources cost	33,000	10,000	6,600	3300
Sum to reflect PGS	50%	120%	15%	-
Total cost per accident	49,500	22,000	7,600	3300
Number of accidents				
Total cost of accidents				
Grand total cost				

Source: TRL and Ross Silcock (2000) Technical Appendix VII:11

## **8.2. Damage and Costs of Life**

Damage on life is one of the serious problems today resulted from traffic accidents. Not only people lost their life, but also many of them become crippled and their family's sufferings are becoming worse then after. Therefore, increasing number of road traffic accidents means increase of damage on life. As it was discussed, the types of damage on life caused by traffic accidents are grouped into fatal (death), serious and slight injures. The number of damage on life under each category from 1993/94 to 2000/01 is given in Table 64.

**Table 66: Number of Injury Taxi Traffic Accidents by Severity.**

Severity	1993/94	1994/95	1995/96	1996/97	1997/98	1998/99	1999/00	2000/01
Fatal	36	50	56	59	38	61	62	58
Serious injury	58	62	97	95	113	123	118	119
Slight injury	127	172	423	339	408	370	381	351
Total PIA	221	284	517	493	559	554	561	530

Source: AATPTACIO, Unpublished Monthly Reports

Today in Addis Ababa at least one-person dies, and two persons are seriously injured every week and one person gets slight injury everyday as a result of taxi traffic accidents. As shown in Table 65, the total damage on life caused by taxi is increasing especially since 1996/97. Table 65 shows the total cost of damage on life calculated according to the developed model. Each fatal, serious and slight injury costs Birr 49500, 22000 and 76000 respectively.

**Table 67: Total Cost of Damage on Life (in '000)**

No	Year	Accident Severity			
		Fatal	Serious	Slight	Total
1	1993/94	1782	1276	965.2	4023.2
2	1994/95	2475	1364	1307.2	5146.2
3	1995/96	2772	2134	3214.8	8120.8
4	1996/97	2921	2090	2576.4	7587.4
5	1997/98	1881	2486	3100.8	7467.8
6	1998/99	3020	2706	2812.0	8538
7	1999/00	3069	2596	2895.6	8560.6
8	2000/01	2871	2618	2667.6	8156.6

Source: Computed by the Author

Therefore, the cost of damage on life caused by taxi traffic accidents in Addis Ababa is estimated to be a minimum average of 8.07 million Birr per year since 1995/96.

### **8.3. Damage and Costs of Property**

Road traffic accidents are not only causing damage to life and vehicles but also causing a fresh expenditure for repairing the damaged ones and replacing those out of use. The number of damage on property and its cost from 1993/94 to 2000/01 is given in Table 66.

**Table 68: Total Cost of Damage on Property (in '000)**

<b>Year</b>	<b>1993/94</b>	<b>1994/95</b>	<b>1995/96</b>	<b>1996/97</b>	<b>1997/98</b>	<b>1998/99</b>	<b>1999/00</b>	<b>2000/01</b>	<b>Total</b>
Number of Damage only Accidents	226	399	1178	1357	1477	997	938	971	7543
Cost in Birr	745.8	1316.7	3887.4	4478.1	4874.1	3290.1	3095.4	3204.3	24892

Source: Computed by the Author

Hence, the cost of damage to property caused by taxi traffic accidents is substantial, since in 1995/96 about 3.8 million Birr per year is lost due to damage on property. And every week about 19 vehicles get damage in the city only due to taxi traffic accidents. Generally, taxi traffic accidents in Addis Ababa are costing the nation about 12 million Birr every year on a minimum average estimate since 1995/96, which is a huge sum for a developing nation. And this needs serious attention from the government and its organs.

# CHAPTER NINE

## 9.0 CONCLUSION AND RECOMMENDATIONS

### *9.1. Conclusion*

Addis Ababa as a capital city of Ethiopia and a host for many National and International Organizations is experiencing a rapid growth of population. In addition, modern vehicles together with the existing old vehicles are estimated at about 110-120 thousands. And about 1360 freight trucks and 240 passenger busses enter the city everyday after originating from the regional capitals and other important cities and towns. This condition creates an alarming traffic situation especially during the peak hours of the day.

With the increase in the horizontal expansion of the city and lack of parallel alternative roads, lack of appropriate short cuts and/or absence of linkages between radiating or parallel roads; poor surfacing and narrow carriage ways; inadequate sidewalks and traffic control facilities; together with the existing narrow streets and junctions create traffic congestion and jams in the city. However, it is expected that the ring road, which its construction is underway, will not only divert traffic but also it will reduce time and the resource. It will be a shortcut to move from any corner of the city relative to the prevailing condition.

There is a high concentration of government administrative institutions, businesses or commercial activities mixed with residential areas in the central weredas of

the city. Addis Ababa is also characterized by poor traffic control systems and regulations, overcrowded residential patterns (especially in the central weredas and their kebeles), lack of good engineering systems that reduce to the high traffic congestion, absence of road safety organization concerned with coordinating the different offices related with roads and road traffic, and absence of modern road transport regulations and other factors have resulted in a high number of traffic accidents in the city.

In Addis Ababa, taxis provide important public transport service. Taxis account for 10% of the vehicle fleet and 10% of the journeys or trips made in the city. However, taxis are at the forefront of traffic incidence accounting for between 15.6 to 26.5%.

The study considered a number of factors so as to study the major causes and contributing factors. In the study driver, vehicle, pedestrian and environmental factors are treated as separate groups. The other factors included in the study were weather and light conditions, vehicle and human population growth, as well as the number and facilities of the traffic police in the city.

Among the driver factors, vehicle ownership, driving experience, level of education, and age of taxi drivers have been found the major causes of traffic accidents in Addis Ababa. The other contributing factors are terms of employment, recess time and weekly rest, marital status and drivers' background. Those taxi drivers who are young, employed, with less driving experience and less educational level are mainly responsible for the many of traffic accidents in the city. Those taxi drivers with experience as being assistants to other taxi drivers, and those who are unmarried, working for longer hours without recess and weekly leave and with fixed terms of contract have a tendency of committing more traffic accidents than others. On the other hand, most of the taxi

vehicle fleet in the city are quite old and thus are responsible for the incidence of traffic accidents. Among the road factors, road arrangements, moisture, road surfaces and gradients have been identified as important contributing factors to the incidents of traffic accidents. Most taxi traffic accidents occur along two-way lanes and roundabouts; dry, straight and plain, good asphalt roads as well as roads without junctions. However, the T-shaped and cross-shaped junctions are the most dangerous places that invite the worst traffic accidents.

Even though there is incidence of taxi traffic accidents in all weather conditions and throughout the day, the intensity and concentration of traffic accidents is higher during good weather conditions and day time hours.

There is a positive association between the number of vehicle and human population growth as well as concentration of economic activities and services along the main roads of the central weredas and their kebeles on one-hand, and taxi traffic accidents on the other. The concentration of different activities in the center of the city leads to the generation of larger trips, which in turn lead to congestion and traffic accidents. The other contributing factors are low-level knowledge of pedestrians about the traffic rules, which leads to the abuse of even the limited sidewalks by the different groups of the society at different hours.

The small number of traffic police with inadequate supply of the necessary facilities, lack of incentives, and the lack enforcing capacity of the traffic regulations may lead to different forms of corruption. These corruptions seemed to have aggravated the

occurrence of repeated violations of the traffic regulations by taxi drivers that resulted in more traffic accidents.

The temporal analysis of taxi traffic accidents indicated clearly the existence of hourly and daily variations. However, monthly variations are not that much significant. High incidence of taxi traffic accidents coincides with the peak hours of the day. Similarly the spatial variations are observed along the main roads such as Haile Gebresellassie road, Senga Tera- Legahar- Stadium- Meskel Square; around Piassa and its environs, Arat Kilo- National Palace- Meskel Square, Abenet and its environs, Arada Giorgis - Atkilt Tera - Gojjam Berenda- Bus terminal, and around schools, government offices, worship areas, commercial and recreational areas where larger trips are generated there is higher concentration of taxi traffic accidents.

Generally, taxi traffic accidents in Addis Ababa cost the nation about 12 million Birr annually computed using the minimum average estimate since 1995/96. About 75% of the costs were damage to life, and 25% were damage to property. This is a huge sum of money for a developing nation. Therefore, it needs serious attention from the city government and its organs.

## ***9.2. Recommendations***

### **9.2.1. Decentralization of Functions**

Due to the lack of a definite land use policy in the city the concentration of commercial activities, government offices and other services such as schools has encouraged more traffic accidents. Hence, decentralization of functions in the city should

be given priority as well as controlling the improper expansion of the city. Therefore, minimizing the trips generated towards the existing concentrations means reducing congestion and traffic accidents.

### **9.2.2. Traffic Education for Children**

Road safety education should be provided in the schools as a short-term solution. But in the long run, this should be included in the school curricula. This is because most of the traffic accident victims are children.

### **9.2.3. Driver Training and Licensing**

Driver errors are the causes of most taxi traffic accidents. The young, less experienced and with taxi driver assistant background; taxi drivers are responsible for most of the accidents. Therefore, drivers' training and testing should be standardized; a longer minimum time of driving experience should be imposed before a license is issued to a driver. In addition, there should be additional prerequisite criteria for taxi drivers with regard to their background and good behavior, age, driving experience, free from any addiction like chewing chat, alcoholic drinks, free from criminal acts as well as offending violation of traffic regulations.

There should be a restriction for taxi drivers regarding the length of driving hours (working hours) because most taxi drivers are on the road for about 13 to 16 hours a day continuously, which leads to the use of chat as stimulant and that in turn makes them more aggressive drivers.

#### **9.2.4. Public Education for Pedestrians**

Road user education and awareness raising should be given the necessary attention. Pedestrian traffic education should be offered and encouraged through the radio, television, newspapers, magazines, books, films, leaflets and posters as well as giving traffic education around worship places and public gatherings, and the like.

#### **9.2.5. Management of the Existing Facilities**

The misuse of the scarce sidewalks by service giving enterprises such as Garages, Wood and Metal works, Groceries, Restaurants, street peddlers or hawkers, should be controlled. Also parking cars on both or either sides of the road along narrow one-way or two-way streets especially in front of Hotels, Restaurants and supermarkets can be controlled by introducing paid parkings (Parking meters).

The scarcity of traffic signals such as traffic lights and their frequent technical failure creates chaos around squares and junctions leading to the incidence of traffic accidents. Therefore, in addition to the maintenance of the existing ones, the expansion of traffic lights to other accident-prone squares and junctions should receive immediate response.

#### **9.2.6. Traffic Regulations and Enforcement**

To make more effective traffic control, the traffic police should be provided with the necessary facilities, together with reasonable salaries in relation to the prevailing market conditions, and they should be paid for the extra time they are on duty.

On the other hand, the existing traffic regulations that create problems in

controlling and punishing the offenders should be revised without delay. And the higher amount of fine imposed on each offence should be considered in relation to the prevailing side effects it had created. The traffic regulations should encompass regulations regarding the use of cellphones (Mobiles) and seat belts while driving which are some of the main contributory factors as experienced in other developed and developing nations. Especially the traffic accident problems related with the use of cellphones while driving have already started to be manifested in the city. Therefore, prompt corrective measures should be taken. Finally, emphasis must be placed on the alleviation, or avoidance of the prevailing corrupt practices like bribery by taking the necessary measures.

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## ***GLOSSORY***

**Accident Density** - It is the accident size over a black spot or an area.

**Black Spots** - These are spots where road accidents do cluster together

**Casualty** - This refers to road crash victims that include injuries and fatalities.

**Fatal Accident** - This is an accident where at least one person is killed with death occurring within 30 days of the accident.

**Fatality Index** - This is the proportion of the number of persons killed to that of the total of injured persons.

**Fatality Rate** - This is the number of deaths per licensed vehicle.

**Hit and Run Accidents** - This refers to the situation when drivers of motor vehicle fail to stop and report to a police station after they cause road accidents.

**Kebele**- is the lowest administrative unit in Ethiopia.

**Less Educated** - This term includes those people that have not completed secondary school education.

**Less Experienced Driver** - A driver with a driving experience of less than five years.

**Non-Injury Accidents** - This indicates no injury to persons but only damage to vehicles.

**Serious Injury** - This is an accident where there is serious injury or there is a possibility for the injured persons to die.

**Severity Index** - It is the proportion of the number of fatal accidents to the total number of injury accidents.

**Slight Injury** - It is an accident where there are slight injuries to the persons involved like a cut, sprain or bruise.

**Traffic** - movement of people and vehicles along roads and streets.

**Traffic Accident-** It is an accident that occurs owing to the presence of a motor vehicle on a road, where by injury or damage is caused to any person, vehicle, etc.

**Wereda-** is the second higher administrative unit in Ethiopia.

**Woyalas-** Are those people who work as an assistant to a taxi driver.