ADDIS ABABA UNIVERSITY
SCHOOL OF GRADUATE STUDIES

THE EXTENT, VARIATIONS AND CAUSES OF ROAD TRAFFIC ACCIEDNTS IN BAHIR DAR

BY
YAYEH ADDIS

JUNE,
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ADDIS ABABA

THE EXTENT, VARIATIONS AND CAUSES OF ROAD TRAFFIC ACCIDENTS IN BAHIR DAR

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Approval of Board of Examination

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Chairman, Department Committee	Signature
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Advisor	Signature
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Internal Examiner	Signature
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External Examiner	Signature

Declaration

This 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.

Yayeh Addis

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Confirmation by Advisor

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Name Signature

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CHAPTER 3: GENERAL BACK GROUND OF THE STUDY AREA

LIST OF ACRONYEMS

ANRS	-Amhra National Regional State
BSZ	-Bahir Dar Special Zone
BSZTP	- Bahir Dar Special Zone Traffic Police
BTAC	-Bureau of Transport and Communication
BWUD	- Bureau of Works and Urban Developments
DALYS	-Disability Adjusted Life Year
EMA	-Ethiopian Mapping Agency
FTP	-Federal Traffic Police
GNP	-Gross National Product
GRSP	-Global Road Safety Partner
NUPI	-National Urban Planning Institute
OECD	-Organization of For Economic Cooperation and Development
PIA	-Personal Injury Accident
RTA	- Road Transport Authority
RA	-Road Accident
TRL	- Transport Research Laboratory
UNCHS	-United Nation Center for Human settlement
UNDP	-United Nation Development Program
UNTACDA	-United Nation Transport and Communication Development for Africa
WHO	-World Health Organization

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ABSTRACT

A study was conducted to assess and describe the extent, variations and associated causes of road traffic accidents in Bahir Dar. Based on the understanding and appreciation of the problems, the study has come up with suggestions some remedial measures.

The research was conducted based on the archive of traffic police data between 1995/6 and 2001/02. A questionnaire survey and field observations were also carried out to collect the required data to be preformed as complement to accident analyses in this research. Statistical analysis (Karl Pearson Linear Regression Equation) was used to decide the relationship of dependant and independent variables. A study analyses include comparison of Accident Rates and Densities among different streets of the town.

Results indicate that road traffic accident is a serious problem in the town of Bahir Dar. The numbers have been following an increasing trend throughout the study period and the rate of increase has been rising rapidly due to high population number (increase in road users) and high traffic mixes (increased of wheeled vehicles of all kinds on the town roads).The relationships derived indicates that the increase in vehicles and population will bring an increase in road traffic accidents in the town of Bahir Dar.

Study analyses show that the number and density of road traffic accidents occurring on the main roads were very high with figure ranging 80-90 percent of the total. Mixed allocation of land use type, high volume of traffic flow, poor nature of the road, lack of road facilities, poor traffic management and low level of enforcement contribute to these problems.

In the study, pedestrians are the road users most affected by road accidents. On the average 52 percent of traffic casualties are pedestrians. Passengers, drivers and two-wheeled vehicles riders are also frequently involved in traffic accidents. The risks are higher among males, particularly those who are economically active age group of 18-50 years. The high accident rates of these groups of population are mainly attributed to low level of understanding of traffic rules and low level of observance. All safety measures introduced to protect the road users are disregarded by the large proportion of drivers, pedestrians, school children and cyclists; and that the majority of them have a tendency in complete ignorance of the dangers encountered by traffic accidents.

The study recommends that in striving the road traffic safety improvements in Bahir Dar town needs to adjust human behavior to the environments of the traffic stream and fixed facilities which carry it and would seek to contrive ways and means of better traffic accommodation with planning, education, administration, data capturing, regulation, enforcement, and making capital investments in a new transport facilities and services.

CHAPTER ONE

INTRODUCTION

1.1. The Problem

Transportation is a major generator of employment and plays a vital role in the distribution of essential goods and services from place to place (Herbert, 1979; Meket, 1997). Road transport plays a key role in the national traffic flow of developing countries and accounts for more than 95 percent of inter-urban transport of goods and passengers in different African countries including Ethiopia (UNTACDA, 2000).

Clearly road transport has an important role in economic, social and cultural functioning of cities. But in many cities today it is also generating significant social and economic costs (Shefer, 1997). These costs arise from the external effects of traffic system, particularly accidents, congestion, consumption of public space, air pollution, noise, and disruption of social and economic interaction (Alshuler,1965; Reyonds,1966; Creighton, 1970; Wough, 1990; Rienstra,1996;piet,1997; WHO,2000). These externalities of traffic are especially pertinent in urban areas because here spatial densities are high and the infrastructure networks are most intensively used. For example Barrett (1989) indicated that about 70-80 percent of road accidents of every nation occur in urban areas.

As the number of motor vehicles and vehicle miles of travel increases throughout the world, the exposure of population to traffic accidents also increases. According to TRL(2000)estimates, the number of people killed in road accidents in 1999/2000 was between 750,000 and 880,000 and 23-24 million were injured, about 85 percent of these deaths occurred in the developing countries of Africa, Asia and Latin America.

World Health Organization (2000) statistics reveal that in developing countries road accident is the major factor that brings about death next to those caused by natural factors; one death per annum is recorded for every 50 to 500 motor vehicles, whereas the corresponding range in developed countries is 2000 to5000 motor vehicles.

The total economic costs are also the highest when measured the productivity loss and expenses incurred because of road traffic accidents. TRL (2000) estimated that the social cost of road accident in 1999/2000 was in excess of 500 billion US dollars and the cost in the developing world was estimated to be about 65 million US dollars.

Ethiopia as one of the developing countries has one of the world's worst road accident records as measured by fatality rate of 170 fatalities per10, 000 motor vehicles. Ethiopia currently loses almost 1700 lives each year ; another 7500 are injured, and a further 7783 face property damage only due to accidents (RTA, 2001; FTP, 2002). According to TRL (2000), the average annual cost of road accidents in Ethiopia was about 400 million birr per annum, which accounted for about 0.8-0.9 percent of the GNP. Clearly, these are sums of money that the country can not afford to lose every year.

In Ethiopia there are a few large cities and many small urban centers but because of the concentration of administration, economic activities, population and vehicles in these areas, the proportion of accident occurring in them is very significant. For example, in 1997/98 Addis Ababa accounted for 22 percent of all fatal accidents, 28 percent of serious and 68 percent of slight injuries of the country's total (FTP, 2002).

Being the capital town of the Amhara National Regional State and its role as a cross-flight junction point to Gondar, Lalibela and Axum, have all contributed a lot to Bahir Dar's rapid urbanization. Its location along the main roads, the tourist sites of monasteries within the islands of Lake Tana and Tis Issat Fall of Blue Nile can be considered as additional factors for the growth of the town.

In connection with the above facts road traffic accidents in Bahir Dar have increased over the years in a disturbing rate in terms of both the direct economic loses and the social lives. This observation is supported by Bahir Dar Special Zone Traffic Police (2002/03) accident statistics which shows that 347 accidents occurred in the years between 1995/6 and 2001/02 (gives an average of 49.57RTA/Year), which cost Birr 1,145,065 for property damage accidents only. The number of victims treated in hospital, health center and clinics also show upward trend. Bahir Dar Special Zone Health Department reported that in the last three years (1999/2000-2001/2002) only, 3188 road casualties received medical treatment as in-patients and out-patients.

Several factors contribute to this situation; some are related to the unsatisfactory design and layout of roads, side walks and road furniture. Other problems are related to the poor condition of vehicles that travel on the roads. Most importantly, there is a general trend among drivers and pedestrians of non-compliance with traffic rules and regulations. The situation is further aggravated by deficiency in traffic rules and regulations and a lack of serious enforcement. In the town politicians, government bodies and societies at large know little about the magnitude of road accidents and associated factors. Thus, this study provides an initial indication of road accident problems in Bahir Dar town.

Road accidents and their consequences can not be fully eliminated, but they can be reduced drastically. Reduction in accident rates comes as a result of actions on many fronts, including more disciplining of the drivers and pedestrians, safer vehicles, and safer roads through education, engineering, and enforcement.

Safety can also be enhanced by institutional measures, such as improvement in coordination and integration of safety activities, and safety research and developments. In addressing road safety problems all these measures need to be examined and assessed comprehensively.

1.2. The Objectives

The general objective of the study is to examine the extent and variations of road traffic accidents and to investigate the major causes contributing to road accidents. Based on the analyses, some possible remedial measures for road traffic accidents and other related urban transport problems will be suggested in order to promote smooth mobility and safety.

The specific objectives are:

1. To identify the road traffic accident patterns that exists in Bahir Dar.
2. To assess social and economic costs which have been incurred due to road traffic accidents.
3. To identify the most accident vulnerable class of road users in terms of sex and age groups
4. To examine the spatial and temporal variation of road traffic accidents.
5. To assess accident differences between different means of road transport.
6. To evaluate the existing road traffic management systems, in terms of coordination, manpower distribution and availabilities of resources.
7. To determine the major causes and contributing factors of road accidents with respect to drivers, pedestrians, vehicles and road environments.
8. To identify the level of understanding of pedestrians, drivers, cyclists and school children with regard to traffic rules and regulations.
9. To suggest some possible solutions and counter measures that will contribute to reducing the problems of road accidents.

1.3. Research Questions

1. What are the patterns of road traffic accidents in Bahir Dar?
2. What social and economic costs have been incurred due to traffic accidents?
3. Which class of road users and which age and sex groups of population are highly vulnerable to road accidents?

4. Do traffic accidents vary in time periods and if so, at what times is road accident the highest?
5. Do road accidents vary from location to location and if so, where do accidents usually happen?
6. What types of road transport in the town highly involved traffic accidents?
7. What are the major causes and contributory factors of road traffic accidents?
8. To what extent do pedestrians, drivers and cyclists understand of traffic rules and regulations?
9. How is the level of coordination and integration of stakeholders within their manpower and material availabilities in traffic management of the town?
10. To what extent can traffic accidents be reduced and what are the mechanisms?

1.4. Significance of the Study

This study is mainly concerned with road traffic safety in Bahir Dar. Emphasis is given to studying and measuring the traffic behavior of school children, pedestrians, drivers and cyclists. In addition, problems related to the road environment, condition of vehicles and police enforcement were identified. Therefore, the significance of the study can be stated as follows:

1. Even though the study is carried out for academic purposes and it is confined to a single town, it could be helpful to have a deeper knowledge about the complex problem of urban road transport in general and accidents in particular.
2. The findings obtained from the study would be helpful to gain information and knowledge about the patterns of road accidents in the town, which in turn,

could help to develop countermeasures that could reduce the number and severity of accidents.

2.1. It is important for the police for law enforcement and distribution of man power for surveillance;

2.2. It is important by the government and municipal authorities to determine the need for road improvements, vehicle inspections and to initiate programs for educational and propaganda purposes.

3. It also helps as a source of information for those institutions concerned with road safety management and helps to improve the quality of decision-making in urban road transport safety planning.
4. Finally, it also helps to carry out further research to refine the conceptual and methodology of the present study.

1.5. Limitations of the study

One of the main objectives of this thesis is investigating the extent, causes and possible remedies for road accidents in Bahir Dar. To do such kind of research, one will obviously need to collect primary data through long periods of field researches, needs different technical personnel and adequate budgets. However, due to lack of finance and time constraints, the research focused on selected streets and road users. Moreover, accident reporting lack a significant level of consistency and the statistics obtained is not complete.

1.6. Methodology

1.6.1. Sources of Data

The main types of data used in this thesis are primary and secondary sources. Several techniques were employed to collect primary data. Some of these include: attitudinal surveys involving structured questionnaires, field observations of vehicle flows and real road situations.

In this study, four structured attitudinal type of questionnaires were designed. The first was completed by the pedestrians, the second by children, the third by drivers and the fourth by cyclists.

The questionnaires were designed to allow the researcher to identify the most profound difficulties and traffic safety problems that road users face while moving along and crossing the roads of the town. It is also designed to serve the researcher to identify the level of adherence and understanding of traffic regulations of the individual person being interviewed. In addition, the questionnaires were designed to allow the researcher to provide measures of the traffic experience, perception, attitude as well as stated driving and road crossing behavior of drivers, children, pedestrians and cyclists.

Secondary data for road accidents were obtained from the police accident files of Bahir Dar Special Zone. In order to get further accident information, reports from health centers and

hospital were also collected. Moreover, different books, proceedings, reports, international organization publications, and internet waves have been consulted.

Furthermore, to gate a general picture of road traffic problems, informal interviews were conducted with professionals, policemen, government officials and dwellers. Their opinions have been given great attention in the study.

1.6.2. Sampling Procedure

The study identified three main locations or streets in Bahir Dar town that are characterized by a dense vehicle and pedestrian movement. Pedestrians, school children, drivers and cyclists were randomly selected and interviewed in these areas (see on map3).

In order to select these sample streets and sample populations the researcher first assessed the recorded traffic police accident data and conducted pilot surveys in the town streets for 8 days (Monday to Sunday) in November, 2002.

In respect with the distribution of the number of accidents among main roads and residential streets, the traffic police data of 1995/96-2001/2002 indicates that 85-95 percent of the accidents occurred on these three main roads of the town, namely:

1. St. George church to *Dangela* road
2. St. George church to *Mota* road
3. St. George church to *Gondar* road

These roads usually make up 10 percent of the total road length in the town areas. Comparing the figures on road length and accidents, it turned out that these main roads have 10-15 times more accidents per kilometer than residential area streets.

The personal observation of the researcher during the preliminary survey also identified a complex traffic flow (motor vehicles, cyclists, pedestrians, horse drawn cars and animals) on these streets. These concentrations of traffic in these roads are directly related to the concentration of administrative offices, social services, schools and commercial centers. These high concentrations of activities along the main roads results in a large number of accidents. There fore, accidents on the main roads are critical issues of concern in this study. Thus, pedestrians, drivers, cyclists, and school children were randomly selected and interviewed in these areas.

1.6.3. Sample Size

During the time of preliminary survey in the main streets of the town center(see map 4) the researcher observed 400-500 pedestrians, 100-150 motor vehicles, 200-400 cyclists, 500-600 school children moving and crossing along these line of streets at the identified peak hour of between 5 p.m. and 6 p.m.

From the total population lists above, the researcher believed that if one-fifth of the pedestrians and school children, four-fifth of the drivers, and one-third of the cyclists were taken as a sample from these different sites, it could give us a clear picture of traffic accident

problems in the town. Therefore, in this study a total of 400 respondents were chosen randomly, that is, from pedestrians (90), school children (110), cyclists (100) and motorcar drivers (100) from the three sites and they were interviewed at different times.

Table 1.1 Sample Sizes of Respondents

No.	Location	Sample size				Total
		Pedestrian	Cyclist	Drivers	School Children	
1	**St. George- *Dangela* route**	30	34	34	37	135
2	**St. George- *Mota* route**	30	33	33	37	133
3	**St. George- *Gondar* route**	30	33	33	36	132
Total		**90**	**100**	**100**	**110**	**400**

As Table1.1 shows the number of completed questionnaire forms reached 400. However, after verification of the completed forms and coding and preliminary analysis of the data, 10 forms of the questionnaire for cyclists and 10 forms of the questionnaire for drivers were rejected for incompleteness or misinformation. Thus, the achieved final sample is 90 pedestrians, 90 cyclists, 90 drivers and 110 school children, a total of 380 respondents

Socio-demographic data of the sample respondents is displayed in Table 1.2 below. The table shows that the respondents are mainly males falling within the age group of 20 to 40 years. The level of education for most of the pedestrians is above grade nine, and most of the cyclists and drivers are a high school graduates or above. The majority of the respondents were government employees. From the total questionnaire forms completed by children, 57 (52 percent) were boys and 53 (48 percent) were girls who were mostly below 17 years of age.

1.2 Socio-Demographic Data of the Surveyed Pedestrians, Children, Cyclists and Drivers in Bahir Dar,2002/2003

Socio-Demographic	Response							
	Pedestrian		Cyclist		Drivers		School children	
	No	%	No	%	No	%	No	%
Gender								
• Male	61	77	72	80	86		57	52
• Female	29	23	18	20	4		53	48
Age group								
<17years	8	9	12	13	-	-	101	92
17-22	30	34	25	28	12	13	9	8
23-28	21	23	36	40	46	51	-	-
29-34	17	19	7	8	16	18	-	-
35-40	9	10	5	6	8	9	-	-
41-45	1	1	2	2	4	4	-	-
46+above	4	4	3	3	1	1	-	-
Level of Education								
• Illiterate	2	2	1	1	-	-	-	-
• Reading and witting	1	1	3	3	1	1	-	-
• 1-4 Grade	1	1	6	7	1	1	68	61
• 5-8 Grade	6	7	9	10	21	23	42	38
• 9-12 Grade	39	43	50	56	47	53	-	-
• 12and above	41	45	21	23	20	22	-	-
Employment								
• Government	47	52	16	18	23	26	-	-
• Private sector	21	24	38	42	56	62	-	-
• Unemployed	8	9	18	20	-	-	-	-
• Students	10	11	18	20	3	3	110	100
• Others	4	4	-	-	8	9	-	-

1.6.4. Methods of Data Processing and Analyses

The methodologies employed to analyze the data were both descriptive and inferential statistics. Thus, the organized data were interpreted using descriptive methods in the form of tables, charts, and graphs

.

To identify the most hazardous locations among streets of the town, Accident Density and Accident Rate were calculated. Moreover, to test the magnitude of relationship between dependent variable and independent variables, simple linear regression model is used.

1.7. Definition of Terms

Accident casualty - refers to road crash victims, which include injuries and fatalities.

Accident Density - is the accident size along a particular link or accidents per kilometer.

Accident Frequency - is a measure of the relative magnitude of a specific type of accident in relation to all accidents for a specified time period such as one or three years.

Accident Rate - is a measure of the rate of occurrence of accidents in relation to any one of a number of exposure factors, such as per million vehicles entering or per million km on a study area.

Property Damage - Physical damages of vehicles or properties but not to a person

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

Road Traffic Accident - is defined as a rare, random and multiple factor events always preceded by a situation in which one or more road users have failed to cope with the road and its environment.

Serious Injuries - Injury requiring admission to hospital as an in-patient

Slight Injuries - a traffic casualty, which is minor injury not requiring hospital admission as an in-patient.

Traffic Accident -Are any vehicle accidents occurring on public high way (i.e. originating on, terminating on, or involving a vehicle partially.

1.8. Organization of the Paper

The paper is organized in seven chapters. The preceding chapter is an introductory part, which contain the problems, objectives, the research questions, methodology, limitation of the study and definition of terms. Chapter two highlights review of studies on road traffic accidents. Chapter three elaborates the background of the study area, which discusses physical setting, demographic features and socio-economic characteristics.

Chapter four explains the development of road transports and traffic characteristics of the town. Chapter five contains the extent and variations of road traffic accidents, and the possible causes contributing to road traffic accidents are discusses in chapter six. Finally the conclusion is drawn and some possible remedial measures for accidents are recommended in chapter six.

CHAPTER TWO

REVIEW OF RELATED LITRETURE

2.1. Patterns of Urban Growth and Road Traffic Development

Cities in developing countries are growing rapidly with the increasing of urban population more than 6 percent annually (World Bank, 2000). According to UNDP (2000) evaluation and projection of population growth, in 1950 it was 29 percent and shortly after the year 2001 more than 50 percent of the world's population would be living in urban areas.

Table 2.1: Urban Populations as a Percentage of Total Population, 1950-2010

	1950	1960	1970	1980	1990	2000	2010	Growth Rate 1950-2000	Doubling Time (year) 1950-2000
World Total	29.3	34.2	36.6	39.4	43.1	47.5	52.7	2.7	26
Developed Nations	54.7	61.3	67.5	71.3	73.6	76.3	79.3	1.4	49
Developing Nations	17.3	22.5	25.1	29.2	40,7	40,7	47.2	3.7	19
Africa	14.7	18.4	23.0	27.3	37.3	37.3	43.8	4.4	16
Ethiopia	4.6	6.4	8.6	10.3	14.9	19.9	26.2	5.1	13

Source: 1. UNDP, Human Development Report (2000)
2. CSA (1984, 1994)

Likewise, over the past 50 years, the percentage share of people living in urban areas of Ethiopia has increased almost four times, that is, from 4.6 in 1950 to 19.9 percent in 2000, and will increase to 26.2 percent in the year 2010.

Thus, rapid pace of urbanization associated with high population growth in the town leads to increasing travel demands and the ranges of urban transport (Tesfaye, 1984). The pressure on urban transport systems is increasing in most cities of developing counties not only due to urban population growth, but also the growth of motor vehicle ownership relative to population growth.

Gwallian (1998) noted that an increase in the rate of motorization in developing countries approached to 15-20 percent per annum, in many of them substantially higher rates than urban population growth rates of 3-5 percent per annum. These indicate that the world's vehicle fleet and traffic congestion in developing countries of the world are expanding rapidly.

Table 2.2: Projected Growth of Global Motor Vehicles Fleet by National Income Level (1995-2050)

Year	Low and middle income countries		High Income countries		Total Motor vehicle fleet
	Million	%	Million	%	Million
1995	164	25	487	75	651
2000	209	27	565	73	774
2010	340	31	759	69	1099
2020	555	35	1020	65	1575
2030	905	40	1370	60	2275
2040	1470	44	1840	56	3310
2050	2400	48	2475	52	4975

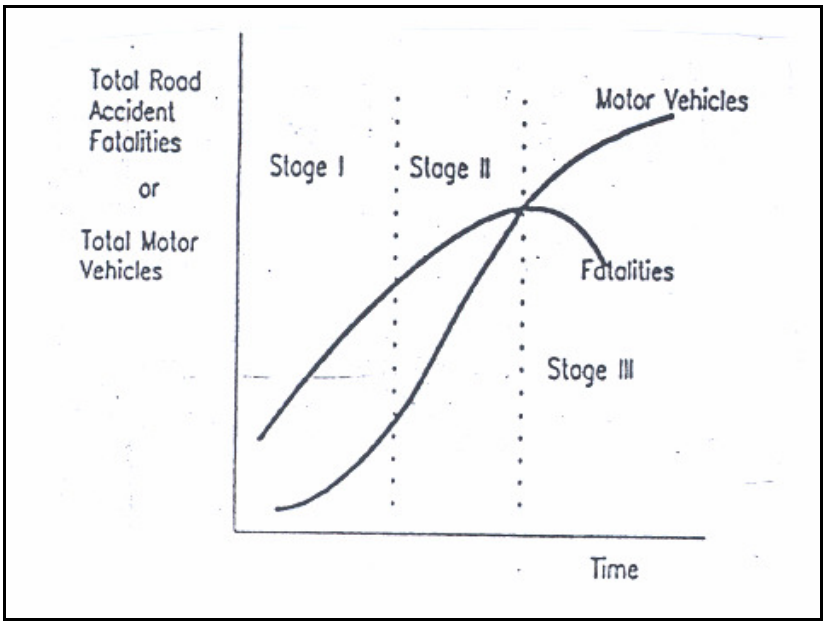
Source: UNCHS (2000) Cited in American Automobile Manufacturers (1996)

Table 2.2 shows the growing share of developing counties in the world's total fleet of motor vehicles. Despite these large increases in vehicle ownership, current per capita vehicle ownership remains low in comparison with that of developed countries

TRL (2000) indicated that in USA, Europe and Japan the ratio was only two to three people per vehicle, but this figure can be as high as 500 to 1000 people per car in countries such as Malawi, Burkina Faso and Ethiopia.

Girma (2000), and Jorgensen (1996), suggested the development of motorization follows a typical trend of the "S" Shaped curve as shown in Figure 2.1 below.

Figure 2.1.Typical Trends for the Development of Motorization and Traffic Fatalities



Source: Girima,(2000)

These two curves in figure 2.1 shows the general relationship between motorization and safety at a given development stage of a country. The first stage represents early motorization from 50 up to 100 vehicles per 1000 inhabitants; the second stage goes up to 300-400 vehicles per 1000 inhabitants, and the third stage is over 400 vehicles per 1000 inhabitants.

Girma (2000) suggested that in the initial stage of motorization the population has little knowledge of how to safely integrate the major traffic into the system. Safety is not considered as a major issue in the design of roads and in vehicles. There is little experience of comprehensive traffic regulation. Road users are also less aware of how to live safely in the road traffic system. During this stage, road accident fatalities rise with the increase in motorization and population. For example, Ethiopia at present is categorized under this stages of development with low level of motorization (2 vehicles per 1000 people).

In the second phase as the traffic hazard increases with high rate of motorization, awareness and concern develops. Improvements in the areas of road and vehicle design as well as influencing human behavior by means such as education, legislation, and enforcement start to be implemented in terms of road safety. This stage of development is characterized by the decrease in the rate of fatalities per vehicle.

In the third phase traffic accidents continue declining within the implementation of the proven safety improvement on black spot road sections, drinking and driving speeding and vehicle safety. This stage is typical to the historical achievements of a number of industrialized countries in the early 1970's.

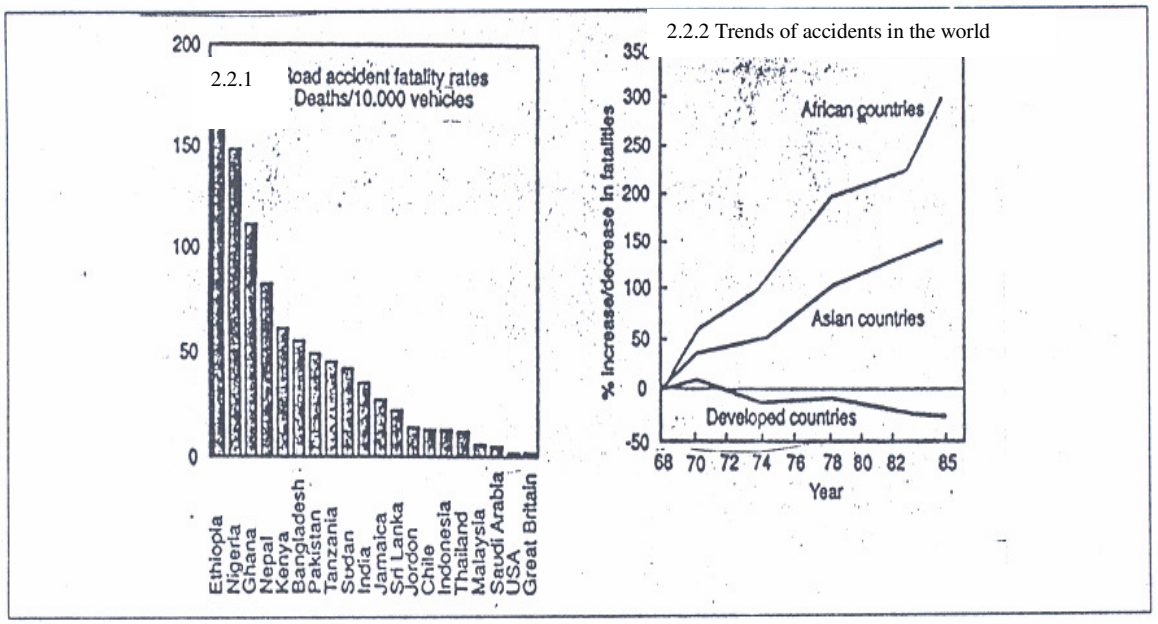
2.2. Extents of Accidents and Road Safety

2.2.1. Global view

As the number of motor vehicles and vehicle mile of travel increases, exposure of population to traffic accidents also increases (TRL, 2000; UNCHS, 2000). This idea is also developed by Garber and Hole (1999) and they indicated that in between 1990 to 1996, with over 500 million cars and trucks in use, more than 500,000 people die each year in motor vehicle accidents and about 15 million are injured.

According to TRL (2000) statistics the number of people killed in road traffic accidents in 1999 was between 750,000 and 880,000 of which 85 percent of the deaths occurred in the developing countries of Africa, Latin America and Asia.

Figure 2.2: World's Road Accidents and Fatality Rates (Deaths per 10,000 Vehicles)



Source: TRL, (20000)

As can be seen form figure 2.2.2, accident occurrence between 1968 and 1985, has increased by more than 200 percent in developing countries, compared to a reversing trend in developed countries. Further analysis of TRL (2000) statistics indicates that fatality rate per vehicle registered in developing countries ranged from 8 to 50 times higher than that the industrialized world.

(Figure 2.2.1)

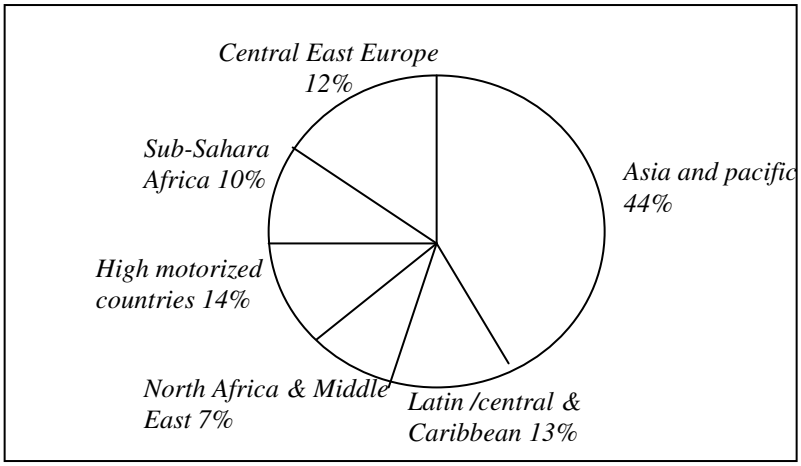
Table 2.3: Percentage Distribution of World's Road Deaths, Motor Vehicles and Population, 1999/2000

Region	Percentage share of		
	Fatalities	Motor vehicles	Population
Sub Saharan Africa	10	4	10
Asian- Pacific	44	16	54
Latin America/Caribbean	13	14	8
Middle East /North Africa	7	2	5
Central and Eastern Europe	12	6	7
Developed World	14	60	15

Source: TRL, (2000).

From the above table 2.3, it can be seen that about 10 percent of global road deaths took place in Sub-Saharan African countries (in which only 4 percent of global vehicles are registered). On the other hand, only 14 percent of road deaths occurred in the entire developed world (North America, Western Europe, Australia and Japans) which contains 60 percent of globally registered vehicles.

Figure 2.3: Global Distributions of Road Accident Deaths



Source: TRL, (2000).

In social health aspects, road accidents will change its rank in the order of disease burden in a short period of time. While it was number nine in 1998, it is expected to be ranked number 3 in the year 2020(see Table 2.4).

Table 2.4: Disease Burden of the World (Daly's Lost) for 10 Leading Causes, in 1998 and 2020

Disease or Injury			
Rank	1998	Rank	2020
1	Lower respiratory infection	1	Ischemic heart disease
2	HIV/AIDS	2	Univocal major depression
3	Prenatal condition	3	Road Traffic Accidents
4	Diarrhea diseases	4	Cerebra vascular disease
5	Univocal Major depression	5	Chronic obstructive pulmonary
6	Ischemic heart disease	6	Lower respiratory infections
7	Cerebra vascular disease	7	Tuberculosis
8	Malaria	8	War
9	Road Traffic Accident	9	Diarrhea disease
10	Chronic obstructive pulmonary disease	10	HIV/AIDS

Source: A 5-Year WHO Strategy for Road Traffic Injury Prevention (2001)

The total economic costs are also highest when we measure the productivity lost and expenses incurred because of road traffic accidents. TRL'S (2000) crude estimates suggested that the annual cost of road accidents in 1999/2000 was about 1% of the GNP in developing countries, 1.5% in transitional countries, and 2% in highly motorized countries.

Table 2.5: Road Accidents Cost by World's Region (US billion dollars), in 1999/2000

Region	Regional GNP (billion dollar)	Estimated Annual Accidents cost	
		% of GNP	Cost(billion)
Africa	370	1.0	3.7
Asia	2,454	1.0	24.5
Latin America	1,890	1.0	18.9
Middle East	495	1.0	7.4
Eastern Europe	659	1.5	9.9
Sub Total	5,615	1.5	64.6
High Motorized Countries	22,665	2.0	453.3
Total	=	=	**517.8**

Source; TRL, (2000)

As it is shown in the above table, the estimated global cost of road accidents was in excess of 500 billion dollars, and the cost in developing countries was estimated to be about 65 billion dollar. These costs include medical treatment, resource cost, property and vehicle damage, administrative costs and non-resource cost estimates of monetary valuation of suffering and bereavement (TRL, 2000).

2.2.2 Road Traffic Accident Situation in Ethiopia

Ethiopia is one of the highest in road accident death rates recorded in the world, over 1700 people being killed annually (Jacobs and Thomas, 2000). Every day, some 5 people have been killed on Ethiopian roads. This death rate has been maintained, and some times exceeded since 1963 when official regulation and figure began (Girma, 2000).

This observation is supported by the National police data (2002/03) which shows that the number of road traffic accidents increased from 6063 in 1993/4 to 12423 in 2001/02, an increase of nearly 104 percent.

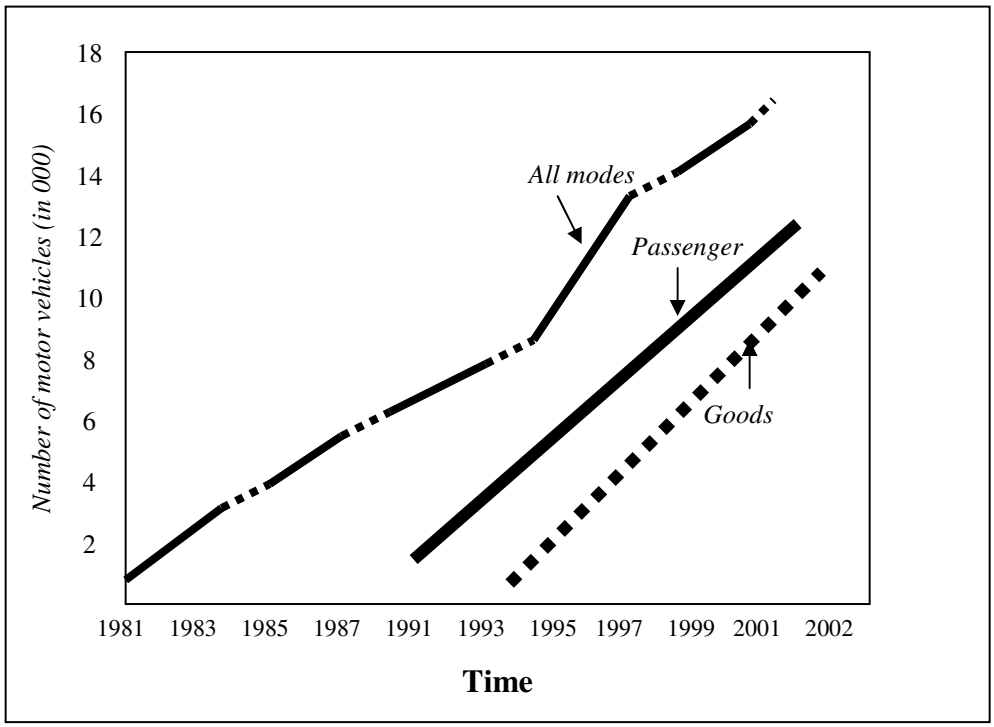
Table 2.6: Trends of Road Accidents in Ethiopia, 1993/4-2001/02

Year / Casualty class	1993/94	199/96	199/96	199/97	199/98	199/99	199/00	200/01	2001/02	% increase 1993-202	Average Annual Increase (%)
Fatal	1077	1254	1335	1314	1313	1283	1274	1261	1327	23.20	2.80
Serious in jury	1100	1403	1568	1618	1762	1642	1771	1697	1712	55.63	6.14
Slight in jury	1180	1263	2044	2044	2444	2173	2120	2134	2196	86.10	8.63
Property Damage	2706	3279	5553	5553	7783	6560	6666	6684	7188	165.63	15.12
Total	**6063**	**7199**	**10500**	**10500**	**13032**	**11658**	**11831**	**11776**	**12423**	**104.89**	**8.17**

Source: Federal Traffic Police (1998, 2002, 200)

As shown in Table 2.5, all accidents have increased over the last ten years, which caused a great loss of human and economic resources in Ethiopia. This problem is worsening from year to year at an alarming rate with the rapid increase of population and the number of vehicles (Girma, 2000).

Figure 2.4: Trends of Motor Vehicle Growth in Ethiopia 1987 to 2002



Source: Girma, (2000)

Despite impressive growth (15 percent per year) in recent years, motor vehicle ownership in Ethiopia remains among the lowest in the world, that is, 2 vehicles per 1000 population (TRL, 2000). This suggests a very low base and therefore a huge potential for continuing rapid motorization in the years to come.

Different studies indicated that road accidents in Ethiopia can be taken as the worst example compared that of other countries of the world (Jacob, 1973, 2000; Tadel, 1989; RTA, 1997; Mathewos, 1999; TRL, 1999).All the writers state that Ethiopia has had relatively high accident records in the world within the average fatality rate of 170 per 10000 vehicles for decades.

Figure 2.5 :Average Fatality Risk

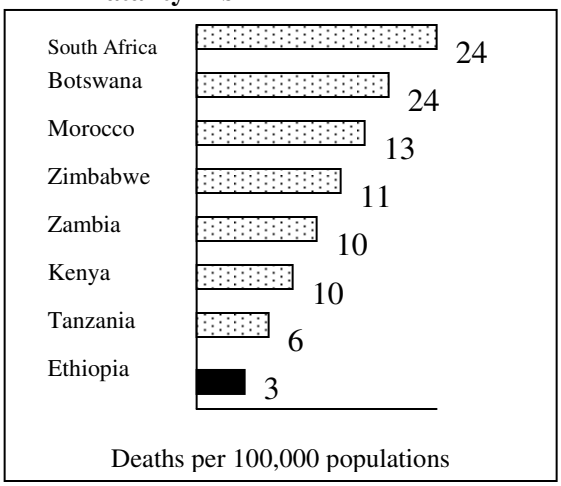
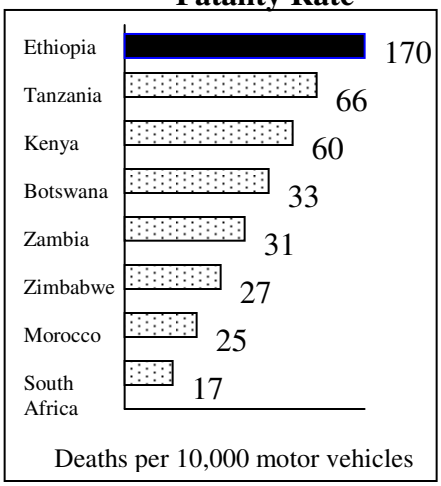


Figure 2.6: Average Fatality Rate



Source: TRL, (2001)

Ethiopia with a very low vehicle ownership has the highest fatality rates per licensed vehicles, (figure 2.6). This shows that Ethiopia is on the extreme high side of the international road safety, which indicating the low level of understanding of the man vehicle -road regulation system (Girma, 2000).

The fatality rate per head of population for Ethiopia in figure 2.5, however, is on the extreme low side; the health risk in Ethiopia does not appear as high as in countries with high vehicle ownership (Girma, 2000). This is because some 85 percent of the Ethiopian population is living in rural areas. In fact, most of them are far from the road infrastructure and the majority of the population is hardly exposed to motor traffic.

The distribution of road traffic accidents between the regional states of Ethiopia varies considerably and which is higher in urbanized regions than elsewhere.

Table 2.7: Regional Road Accidents Distribution of Ethiopia (1997/98-2001/2002)

No	Region	Year						Total	% Share
		1997/98	1998/99	1998/99	1999/2000	2000/01	2000/02		
1	Addis Ababa	8,581	7,345	72903	7293	7203	7622	38044	62.37
2	Oromia	2,033	1,785	1951	2,004	1951	2032	9805	16.07
3	Amhara	919	912	1004	1,040	1,004	973	4,840	7.95
4	SNNPR	610	565	502	287	502	646	2610	4.27
5	Tigray	458	436	529	567	529	542	2532	4.15
6	Afar	244	213	149	196	149	173	875	1.60
7	Somali	203	134	209	132	209	179	857	1.41
8	Harari	135	154	103	107	103	100	599	0.98
9	Gambella	51	28	41	84	41	82	286	0.50
10	Dire Dawa	43	58	48	78	48	37	264	0.43
11	Benishongul	25	28	37	43	37	37	170	0.30
	Total	**13,302**	**11,658**	**11,83**	**11,83**	**11,776**	**12,423**	**60,990**	**100**

Source: Federal Traffic Police Office (2002/03)

As indicated in Table 2.7 the percentage share of road accidents is concentrated in few of the regions. Five regions, Addis Ababa, Oromia, Amhara, SNNPR and Tigray, account for 95 percent of the total accidents in the country.

Road accidents are also higher for different categories of accidents in urban Ethiopia. In1997/98 the urban areas of Ethiopia, in which 14 percent of the country's population lives, in 1997/98 accounted for an over all casualty share of 57 percent. Furthermore, 40 percent of

fatal and 85 percent of the property damage accidents also occurred in the urban areas of the country.

Table 2.8: Urban –Rural Variations of Road Accidents in Ethiopia, 1997/1998

	Percentage share of	
	Urban area	**Rural area**
Population	14.0	84.0
All Road Casualty	57.0	43.0
Fatal only	40.0	60.0
Property Damage accident	85.0	15.0

Source: Computed by the Writer from TRL (2000) Data.

Road accidents are highest in urban areas of Ethiopia because the road infrastructure networks are most intensively used and spatial densities are high (Table 2.8).

2.3. Causes and variation of Road Accidents

Different studies (Davis, 1968; Crighton, 1970; Hutchinson, 1974; Hobbs, 1979; TRL, 2000; Girma, 2000) across a number of countries show that 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 drivers, pedestrians, the vehicles and the roads. The studies also

indicate environmental conditions such as the road surface, weather condition and time of the day are additional factor.

TRL (2000) spot studies of different countries on accident data show that human factors are the sole reason in 65 percent of the cases and contributory cause in 95% More than a quarter of the accidents studied displayed a deficiency in the road environment linked to a driver error. Vehicle defects also contributed to 8 percent of the accidents. Moreover, Saad (1989) described the major accident factors in urban areas of under developing countries (Table 2.9) as follows.

Table 2.9: Major Urban Road Accident Factors in Developing Countries

Major Accident Factors	Estimated % of urban Accident in which the factor plays a part	Estimated % for a particular type of accident
No account taken of pedestrians by drivers	40%	
Lack of pedestrian Facilities (side walks or crossing areas)	40%	60% of pedestrian accidents
Speeding (in relation to urban Environment)	39%	60% of night accident
Lack of safety facilities on large urban arteries	30%	
Dangerous or risky maneuver by a drive	24%	
Lack of experience of driver	20%	
Deteriorated surfacing	20%	
Insufficient public lighting	12%	50% of night accident
Dangerous parking	12%	
vehicle Defect	10%	
vehicle overloading	5%	

Source: United Nation / Institute of Transport, Economics publications (1989)

Hobbs (1979) also indicated that sight distance factors, skidding, signs and marking deficiencies are causal factors most frequently found in urban accidents.

Likewise, in Ethiopia about 90 percent of the total traffic accidents and 87 percent of the injury accidents were caused by human error. The contribution of vehicles and road defect are only 4 and 1 percent, respectively. But Girma (2000) points out road factors are not well identified by the police as the causes of traffic accidents due to the lack of awareness about road and traffic engineering factors and insufficient training in road accident reporting.

Table 2.10: Causes of Road Traffic Accidents (%) as Reported by Traffic Police in Ethiopia (1987/98)

Accident cause	Injury accidents	Total accidents
Driver's error	82	88
Pedestrians error	5	2
Vehicle defect	4	3
Road defect	1	1
Others/unknown	7	6
Total	**100**	**100**

Source: Girma (2000).

There is evidence that pedestrians are the most affected by road traffic accidents. .Between 41 and 75 percent of all road deaths are pedestrians, mostly in urban areas. Passengers and two-wheeled vehicles are also frequently involved in traffic crashes (TRL, 2000).

Table 2.11: Road Accident Fatalities by Road User Category in Ethiopia 1997/98

Casualty class	Fatality	
	Number	% Share
Pedestrian	859	51
Bicyclists	12	1
Motor cyclists	10	1
Drivers	92	5
Passengers	720	43
Total	**1693**	**100**

Source: TRL (2000)

As shown in Table 2.11, vulnerable road users, i.e. pedestrians and passengers, constitute 94 percent of all road fatalities. The pedestrians' casualty involvements are to be even higher in urban areas.

According to Hobbs (1979), Girma (2000), Leshabari, et al (2000) and others road accidents vary as a socio-economic characteristics of a nation (age group, sex, income level, etc). Accidents happen to people from all economic groups but more often to the poor (WHO, 2001). When injured, the poor also have less chance of survival and full recovery. Ethiopia accounted female casualty involvement rate of 23 percent in 1998/99, while males' 77 percent. Thus, road accidents tend to strike males in the prime of life when they are likely to be at the peak of economic and social importance as household.

CHAPTER THREE

GENERAL BACKGROUND OF THE STUDY AREA

3.1. Physical Setting

3.1.1. Location

The town of Bahir Dar is located in the North Western part of Ethiopia at a physical distance of 565 kilometer from Addis Ababa, the capital of Ethiopia. Astronomically, Bahir Dar is located at 11^0 36' north latitude and 37^0 25' east longitudes (EMA, 1988).

The foundation of Bahir Dar dates back to the 14^{th} century associated with the establishment of K*idane Mehret* church near Lake Tana (Seltene, 1988). But the construction of Bahir Dar as a modern town started in 1936 during the Italian occupation (NUPI, 2000).

3.1.2. Area and Structure

Bahir Dar covers a total area of 4520 hectares having a built up area of 2632(BSZ, 2002/03) hectares, which is divided into two Woredas and seventeen Kebeles for the purpose of administration. Out of the total surface area, 17.2 percent is covered by water. The area that is covered by Lake Tana, Abay basin, and River Chambel is 6.3, 3.8 and 1.2 percent

respectively. In the town nearly 17 hectares of ponds and 198 hectares of swamps cover the large areas of different localities (DEVECON, 1999).

Bahir Dar lies on flat topography at the Lake Tana sub-basin. The most geographical structure of the area is Lake Tana depression formed from circular fault which creates a large subsidence. The topography of the town is predominantly flat area with an altitude ranging from 1786 to 1870 meters above sea level. The slope varies from near zero to some 20% in few hillsides, but for the most parts of the town the slope is below 2 percent (DEVECON, 1999).

3.1.3. Land Use Patterns and Master Plan

Pre-twentieth century Bahir Dar was characterized by its function as a caravan stop, administrative center and place of Christian learning and worship. These factors already led to the emergence of a relatively bigger settlement. Christians and Muslims inhabited the town and W*oitos*, landlords and hand crafts partitioned the land of the town among themselves (Seltene, 1988).

Following the advent of the Italians, a marked urbanization and growth of Bahir Dar was achieved. With the Italian invention of 1935, the town started to serve as military camp. As a result the land holding system was changed forcefully and different land use system were implemented, introducing residential and commercial places. The town got municipal status in 1944. In 1950 the town got an *Awraja* status in the Imperial Government administrative structure. A new and better plan was prepared at this time by giving emphasis to opening new

roads, constructing offices, and identifying residential and commercial places (NUPI, 1998). Observing its historic place as a center of the region, the town master plan was prepared in a modern way in 1958, by German consultants and this plan was meant to serve a total of fifty years.

Except for a few alterations, most urban functions and infrastructure, either economic or social projects, had been established according to this master plan. To mention some, the Textile Factory, the Felege Hiwot Hospital, the Bezawit Palace, the main Lake Port, the Hydro Eclectic power generation project on Tiss Abay, the bridge on the Blue Nile River, opening of commercial Bank and others took place in between 1958 and 1963 (NUPI, 1998).

In 1962 the Ministry of Housing and Urban Development made an improvement on the existing master plan, which was functional until 1995. This detailed plan showed the total area and the land use pattern for different services like residential, industrial, commercial, recreational, office use and other areas (BWUD, 1998). In 1994 the total actual land use for the above mentioned purposes reached 1108 hectares.

Table 3.1: Land Use Type and the Percentage Share in the 1962 Master Plan and Detailed Plan of Bahir Dar in 1996

Land use Type	Master Plan Area of 1962		Detail Plan Area of 1996	
	Hectare	%	Hectare	%
Residential	1112	72.6	1782	67.7
Industry	370	2.4	301	11.4
Commercial	154	1.0	35	1.4
Office	264	1.7	189	7.2
Recreation	137	0.9	82	3.1
Transportation &Road	282	1.8	203	7.7
Others	2639	17.2	41	1.5
Total	**4958**	**100**	**2632**	**100**

Source: Socio-Economic Profile Study of Bahir Dar (1998)

The Master plan again was prepared by NUPI in 1996 and has the following main divisions.

Table3.2: Land Use Profile of Bahir Dar in the Revised Master Plan of 1996 by Activities

No	Land use classification	Proposed Future Land use (Hectares)	% share of Built up area
1	**Residential**	897.3	23.2
2	**Administration**	174.6	4.5
3	**Commercial/Trade**	218.4	5.7
4	**Social Services**	448.4	11.7
5	**Manufacturing**	262.6	6.8
6	**Transportation and Road**	472.8	12.8
7	**Recreation**	201.9	5.2
8	**Agriculture**	367.1	9.5
9	**Forest**	472.7	12.2
10	**Special Function**	326.7	8.4

Source: Socio Economy Profile Study Of Bahir Dar (1998)

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The town of Bahir Dar has been restructured in accordance with the proclamation No 43/2000, a proclamation issued to provide for the establishment, reorganization, and definition of power and duties of the municipalities of the Amhara National Regional state. The objective of the reform capacities is to transform the municipality from administrative units into autonomous service delivery units. Therefore, the municipality of Bahir Dar is now an autonomous entity which carries out its functions with principal organs of a municipal council, a standing committee, a mayor, a town manager and deputy manager.

3.2. Demographic Characteristics

3.2.1. Growth of population

At present the town of Bahir Dar is a home to 140,080 residents (CSA, 2002), with 5.4 percent annual average urban population growth, which is one of the highest in the country.

Table 3.3: Growth Trends of Urban Population in Bahir Dar (1965-2002)

Year	Number of Population	Growth Rates (percent)					
		1967	1970	1978	1984	1994	2002
1965	11,990	13.0	13.4	10.7	7.9	7.1	6.9
1967	15,580	-	13.6	10.2	7.3	6.2	6.1
1970	23,400		-	9.0	5.9	5.8	5.4
1978	40,200			-	1.9	4.1	4.0
1984	54,146				-	5.5	5.6
1994	94,235					-	5.4
2002	140,080						-

Source: Compiled From Various CSA Publications and The Result of NUPI (1994) Survey.

As can be seen form Table 3.3, the population of the town has showed a substantial increase during the period between 1965 and 1994. The growth matrix depicted on the same Table shows that the urban population grew, on an average, at an annual rate of 7.1 percent during the period from 1965 to 1994 and 5.5 in between 1994 to 2002 with doubling time of 5.8 years. The town is, in fact, believed to experience significant growth in the coming years due to social and economic pool factors and its higher administrative status.

Table3.4: Projected Urban Population of Bahir Dar (1995-2015)

Year							
Variant	**Urban population Growth Rate**	**1994**	**1995**	**2000**	**2005**	**2010**	**2015**
High	5.6	95000	100,471	132937	175892	232729	298829
Medium	4.5	95000	99,372	12446	155,846	195170	245170
Low	4.0	95000	98,372	120768	147,506	180164	220054

Sour*ce: CSA (1994); NUPI (1998).*

As can be seen from Table 3.4, in 2005, the population of Bahir Dar has been projected to be147, 506 in low variant, with an additional increase of 52,506 people compared to 1994. Such types of population increase and agglomeration usually demand urban governments to have an improved capacity to maintain efficient utilization of road, communication systems, health services, and traffic management systems.

3.2.2. Age-Sex Structure

According to 1994 census, the number of population below 14 and above 65 years of age accounted for 36.61 and 1.5 percent, respectively. From this age structure, 61.82 percent include the active segment of the population. From the total population of the town, 52 percent or 72,436 are females and 48 percent (67644) are males.

3.3. Socio Economic Characteristics

3.3.1. Social Services

The total number of housing unit in 1984 was 9026.The figure in 1989 was 13402. Based on the 1994 National Housing and Population Census Report of Amhara Regions the total number of housing unit in Bahir Dar has grown to 19808. Compared with the 1984 data, 115.2% increment was recorded. The number of households in 1984 was 10291 and this increased to 15,642 and 20, 857 in 1989 and 1994, respectively.

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The town has various educational facilities including institutions of higher education (Bahir Dar University, Blue Nile College and Health Institute). In the area of formal education there are 7 kindergartens, 16 elementary and 3 secondary schools, accessible to about 36,000 enrolled students. Most of existing educational facilities are not properly located. They are located along the main roads. This is a cause for concern with respect to urban traffic accidents and the likely noise pollution in the near future.

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In the town there are about 38 health institutions of these, 19 are privately-owned clinics, one health center, 17 pharmacies (2 governmental and 15 private) and one referral hospital. The health institutions have problems of shortage of skilled manpower and lack of certain necessary medicine. Generally, health service is not satisfactory compared to the total population of the town.

In Bahir Dar there are two main public recreation centers located at the side of Lake Tana administered by the municipal government. The modern recreation service is being provided by Shum Abo Recreation Center. Another recreation service is given by Tana recreation center. There is also a local stadium, a public library and a cinema hall administered by the municipality of the town.

The location of the government institutions are concentrate in the central part of the town. Most of the newly constructed administrative buildings are located along the main road that leads to the airport and Gondar road. There are eleven churches in Bahir Dar, of which five are found along the main roads of the town. All of these churches are found to have problems with respect to their location. Especially St. George church on the immediate side of the main square (that connects the three major roads) has created traffic problems.

3.2.2: Economic Structure

The Bureau of Planning and Economic Development (1999) indicated that 48.8 percent of the households earn less than Birr 4000 per annum and 18.2 percent earned even less than 2000 per annum. According to the Bureau the annual income of Bahir Dar was estimated to be about birr 4000 the majority of the residents are low income earners engaged either in small scale business or in daily labor to meet their basic economic needs.

Based on CSA 1994 survey, some 40 percent of the household heads (of those who are employed) are engaged in government services; around 33 percent are in private businesses

and 27 percent are self-employed. The major economic activities of Bahir Dar include tourism and recreational services, trade, manufacturing activities and informal sector engagements.

Due to the proximity of the town to Lake Tana with its internal historic churches and monasteries and scenic beauties, international and external tourism have developed, which, in turn, has accelerated the growth of the town. For instance 20,100 and 26,440 tourists visited Bahir Dar in 1995 and 1996, respectively (BSZ, 2000). Such development in tourism industry has a forward linkage to stimulate local transport activities.

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A total of 1967 private commercial organizations with a total capital of 12, 182, 029 Birr were registered by the end of 1996 in whole sale, retail and service giving sectors. By the year 2000, those small-scale industries in the town have reached 535 with a total expected capital of 46,011,284 Birr and employees of 4252 workers (BSZ, 2000).

CHAPTER FOUR

PATTERNS OF ROAD TRANSPORT DEVELOPMENT IN BAHIR DAR

4.1. The Road Networks, Type and Length

The present street network in Bahir Dar has its foundations in the *German "Guther"* master plan of the 1960's (BSZ, 2002). Like many other cities in Ethiopia, Bahir Dar has an urban transportation infrastructure that was initially designed for largely non-motorized travel. Only small percentage (about 7 percent) of the town's urbanized land area is devoted to roads. This figure is more or less similar to Addis Ababa and Nazareth, which is about 7 percent and 11 percent, respectively (NUPI, 2002). In 1995, the total length of the town road was 127 km by which 25 km asphalt, 65 km paved and 37 km unclassified in 1995. By June 2002 the total length of asphalt, paved and unclassified road have reached 34.8, 89.1 and 48.5km, respectively.

Table 4.1: Type and Length of Roads in the Town of Bahir Dar over Time

Road Type	**Year**		
	1995	**2000**	**2002**
Asphalt	25	31.8	34.8
Gravel	65	86.35	89.1
Unclassified	37	44.5	48.5
Total	**127**	**162.6**	**172.4**

Source: BSZ, (2002)

In terms of density the networks coverage is estimated at 2 km of roads per 1000 square km or 0.43 km per thousands of population (without considering unclassified roads)(BSZ,2001/02).

Even with the unclassified roads brought into the statistics, the road density still remains well below the national average. The road infrastructure deteriorated seriously over the last few decades. In 2000/01, only 11 percent of asphalt road was in good was in good condition. The rest were either in fair or poor condition (22.6% and 66.4%).

Table 4.2: Conditions of the Road Networks in Bahir Dar, 2000/2001

Road Type	% Share		
	Good	**Fair**	**Damaged**
Asphalt	14.0	16.8	69.2
Gravel	19.5	14.7	65.8
Unclassified (Red ash)	-	20.3	79.7

Source: Bahir Dar Special Zone (2002)

As Table 4.2 shows, most of the roads are still poor and below standard. Due to lack of adequate drainage facilities, the roads are destroyed by flood during the rainy season. Moreover, the roads become muddy and are covered by swampy, which makes traffic movement very difficult.

4.2. Travel Behavior

Bahir Dar is an important example of a class of cities in Ethiopia, which have an extremely high population growth and largely non-motorized transportation system (bicycle, walk, horse-

draw cart), but now it accommodates rapid growth of motorization. While the supply side of Bahir Dar's urban transport has severe constraints, the demand for urban travel has been increasing explosively.

The most obvious causal factor behind the dramatic increase in demand for urban transportation in Bahir Dar is population growth. As indicated before, over the past 10 years the population number has grown by 85 thousand. Population growth generates a direct impact on urban transportation, as more people produce more trips and place a great load of travel on the transport system. The population will continue to grow in the foreseeable future, as the town will continue to create many construction, manufacturing and service jobs that are attractive to the surplus laborers in the rural areas.

The second important causal factor is economic and income growth in Bahir Dar. With high income, more people now travel greater distances to access a wider range of goods and services, more people own bicycles and can afford the commercial and luxury rides on minibuses and taxis. Meanwhile in Bahir Dar economic growth enables an increased number of enterprises and governmental organizations to purchase automobiles and other motor vehicles.

A third factor that induces higher demand for travel in Bahir Dar is urban expansion and land use configuration. The urbanized area of Bahir Dar has greatly expanded over the last 10 years. Between 1990 and 2000 the size of built up areas increase by 4-5 percent. The number

of houses increased from 13402 in 1990, to 19808 in 2000. The combination of these developments has, of course, a strong influence on mobility.

Table 4.3: Average Travel Distance and Time in Bahir Dar

Year	Average Travel Distance	Average Travel Time
1990	1.2km	6 minutes
1995	2.7km	14 minutes
2000	4.3km	20 minutes

Source: Computed by the Writer from Different Transport Study Reports of Bahir Dar.

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If the rising demand of travel is examined more closely, it can be seen that the increase consists of three basic elements. Firstly, the total number of trips per day has been increasing; second, the average travel time and distance have both been increasing (Table 4.3). In the third case, an increasing number of people are shifting from walking to both modes of road transport such as, bicycle, automobile, government owned commuting car, taxi, motor cycle, which all required more road surface area per traveler.

Table 4.4: Mode Shifts and Use of Transport Modes in Bahir Dar as a Function of Time

Modes	% Share of All purpose Trips		
	1990	**1995**	**2000**
Walk	78%	63.3%	52%
Bicycle	14.6%	24.2%	30.3%
Motor vehicle	6.4%	10.4%	17.0%
Others	1.3%	2.0%	0.7%
Total	**100%**	**100%**	**100%**

Source: TACB,(2000); BSZ, (2000/01)

As indicated in Table 4.4, the proportion of people who choose to walk has declined from 78% in 1990 to 52% in 2000. The figure for motorization had a relatively small change; it is apparent that the shift has been mainly towards bicycling. Overall, the usage of personal vehicles and the level of motorization have both increased.

According to the information obtained from the Amhara Region Transport and Communication Bureau (2000), the population movement in the town up to 5 km in all modes of transport reached 45428 people per day, which accounts for 38 percent of the total town's population. The purpose of these travels according to the Bureau is mainly to and from work (10833); other purposes include recreational trip, health and educational trips (33,095) shopping and business activity trips which account for 15000 tripe.

Table 4.5: Total Trip Purpose by Inhabitants of Bahir Dar for Trip up to 5 km in 1999/2000

Tripe Purpose	Number Traveler	% Share
Commuter	10233	22.5
Shopping	1500	3.4
Health service	650	1.4
Schooling	32445	71.4
Recreation and others	600	1.3
Total	**45428**	**100**

Source: *Transport and Communication Bureau (1990) and(2000).*

From the trip purposes indicated in Table 4.5, schooling and commuter are the most important in terms of size. As stated previous (Table 4.4), for all trip purposes walking is an important mode and the role of the bicycle is also significant.

4.3. Volume, Composition and Distribution of Traffic Flow

Driven by rapid urbanization and economic growth, vehicles in Bahir Dar have been increasing in number during recent years. The most direct indicator is traffic volume and its compositions on the street networks.

Between 1990-2000 traffic volume of motorization vehicle on main streets in central district increased by over 40% and that of bicycles by more than 100 percent in a decade. In 2000/2001 there were 371 governmental and non-governmental and private motor vehicles,

which almost tripled the figure obtained in 1990. The number of taxi has been growing faster than other vehicles, but the fastest growing occurred in private automobile, which increased in number from 12 to 68 during 10 years interval.

Table 4.6: Numbers of Wheeled Vehicles in Bahir Dar Municipality, 1990 and 2000

Vehicle Type	Number		Annual% Change	Population		Vehicle per 1000 population	
	1990	2000		1990	2000	1990	2000
A. None-Motorized wheeled vehicles							
◆ **Bicycle**	3778	9383	15.0	-	-	-	-
◆**Horse drawn cart**	570	1005	7.6	-	-	-	-
Sub Total	***3835***	***10388***	***17.0***	***80,020***	***131,000***	***48***	***79***
B..*Motorized wheeled vehicles*							
◆ **Taxi/mini bus**	27	127	37.0	-	-	-	-
◆ **Public bus**	-	1	-	-	-	-	-
◆ **Private car**	12	68	4.6	-	-	-	-
◆ **Office service**	68	158	13.2	-	-	-	-
◆ **Truck**	8	27	1.9	-	-	-	-
Sub Total	**115**	**381**	**23.1**	**80,020**	**131,000**	**1.4**	**3**

Source: 1) Bahr Dar Special Zone,(1998, 2001)
2) Transport and Communication Bureau(1998, 2000)
3) CSA, (1994, 2000)

It is estimated that between 1970 and 1980 there were between 500 and 1000 bicycles in Bahir Dar. This number has grown to 3778 in 1990 to more than 9000 in 2000 years (see Table 4.6). By the year 2003 there are about 12000 bicycles, one for each 13 inhabitants or 2 for each household. In the share of trip per modes of transport the role of bicycle is also significantly increases and public bus transport plays extremely minor role in Bahir Dar.

Table 4.7: Use of Transport Modes in Bahir Dar as Function of Time (in *%*)

Transport Mode	Year	
	1990	**2000**
Walk	78.0	52.0
Bicycle	14.6	30.3
Public Bus	-	0.5
Taxi	3.4	9.7
Office service	2.2	4.4
Private car	0.8	2.1
Motor Bicycle	0.08	0.2
Boot Taxi	0.2	0.8

Source: 1. Different year Annual Reports of Transport and Communication Bureau
2.Bahir Dar Special Zone (2001/02)

In the town there is a complex of different modes of transport. As indicated in Table 4.7 the dominant form of traffic in Bahir Dar is walking which covers 52 percent of the trip, cycling 30.3 percent, services 4.4 percent, private car 2.1 percent and motor bicycle 0.2 percent in 2000. A relevant aspect in the traffic system of Bahir Dar is that bicycle plays an increasing and important role for journey purposes.

Figure 4.1: The Role of Bicycle Transport in Bahir Dar Town

Source: A Photograph Taken by the Writer during the Field Survey (2002/2003)

To sum up, the combination of more or longer trips and mode shifts (as indicated in Table 4.6 and Table 4.7) in Bahir Dar has translated into an explosive increase in travel demand which has been much faster than the expansion of road capatown. Indeed, the speed of increase in travel demand has greatly exceeded what planners expected in the past. The previous master plan of Bahir Dar approved by the National Governments in 1960's greatly under predicted the increase in travel demand of Bahir Dar. First, the planner did not consider the fast growth of population or urbanization; secondly, the planners did not foresee the rapid change in people's income, life style and travel behavior. Therefore, the supply of transportation facilities (such as bus transport, expansion of road, separation of pedestrian or cyclists lane) in

Bahir Dar can no longer meet the demand for travel. If the travel demand continue to increase as the current trends the gap will be enormous, which will consequently cause sever traffic congestion, accidents and decline in the resident's quality of life.

Traffic flow in Bahir Dar is varying in the hours of a day due to socio-economic activities of the society and influence of climatic condition. The writer conducted a study of hourly unclassified traffic flow of motor vehicles at the central junction points of the three main roads for 7 consecutive days (from 21to27, April 2003).

Table 4.8: Average Daily per Hour Motor Vehicle Flow on Main Streets of Bahir Dar, 2002/2003

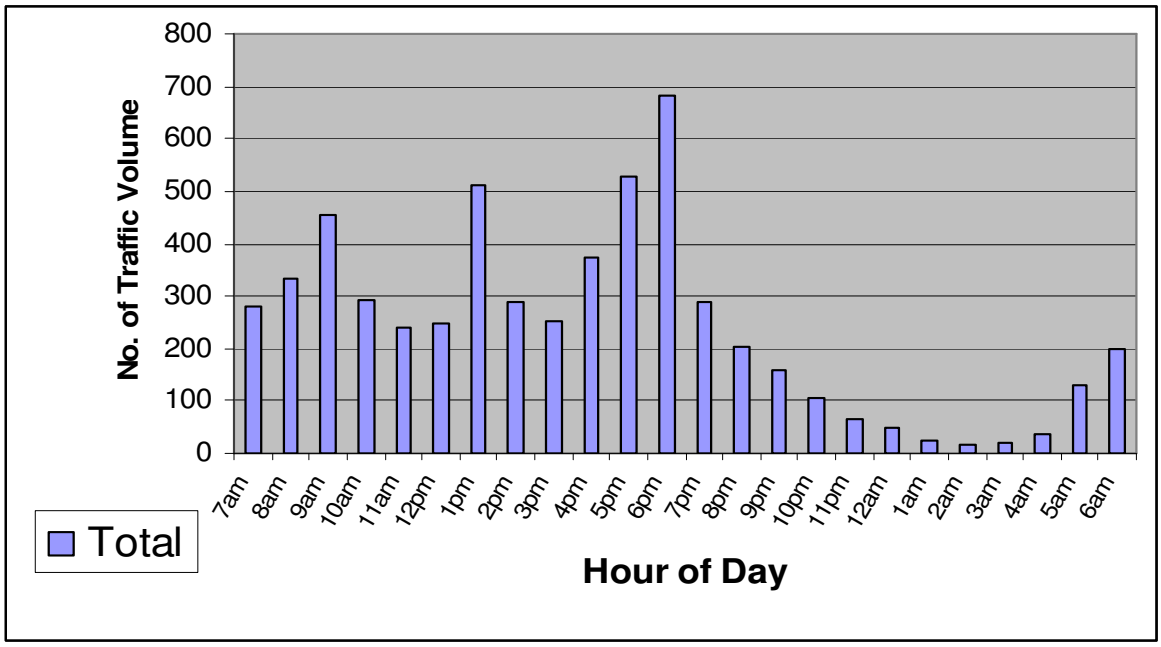
Per hour	Mota gate	Dangela gate	Gondar gate	Total	% share
6 a.m-7 a.m.	118	102	61	281	4.8
7a.m.-8 a.m.	152	88	94	334	5.7
8 a.m.-9 a m.	243	138	73	454	7.8
9a.m.-10 a m.	180	102	83	293	5.0
10a.m-11a m	72	86	82	240	4.1
11am-12noon	94	81	71	246	4.2
12noon-1p.m.	182	178	150	510	8.8
1p.m.-2 p.m.-	99	109	80	288	4.9
2 p.m.-3 p.m.	97	82	72	251	4.3
3 p.m.-4 p.m.	158	127	89	374	6.4
4 p.m.-5 p.m.	256	187	85	528	9.1
5 p.m.-6 p.m.	285	184	214	683	11.8
6 p.m.-7 p.m.	129	103	56	288	4.9
7p.m.-8 p.m.	102	71	31	204	3.5
8 p.m.-9 p.m.	80	56	23	159	2.7
9p.m.p.m-10p m.	62	32	12	106	1.8
10 p.m.- 11 p .m.	46	16	4	66	1.2
11p.m-.12midnig	32	13	2	47	0.8
12midnig-1a.m.	19	7	-	26	0.4
1 a.m.-2a.m.	11	6	-	17	0.1
2 a.m.-3 a.m.	13	6	2	21	0.3
3 a.m.-4 a.m.	12	17	7	36	0.6
4a.m-5 a.m.	56	45	28	129	2.2
5a.m.-6 a.m.	77	81	42	200	3.4
Total	2503	1917	1361	5781	100.0

Source*: Compiled by the Writer During the Field Survey.*

Hourly variations in traffic volume are shown in Table 4.8, where the volume for each hour of the day is represented as the average daily traffic of the week. It can bee seen that there is low traffic volume between 8 a.m. to 5 a.m. and that peak volumes occur between 8 a.m. and 9

a.m. , noon and 1 p.m., and 4 p.m. and 6 p.m. It can bee inferred that work and school trips are primarily responsible for the peaks. When this data were collected on every day of the week, except Sunday the hourly variations were similar to each other. but the actual volumes were not be the same from day to day.

Figure 4.2: Hourly Traffic Variations on the Selected Main Streets of Bahir Dar



Routes of the town do not have equal volume of flow in each hour of a day. Particularly, St .George church to Mota route which is a route influencing by the location of market center and terminals (bus and taxi stations) accounts the highest volume of traffic flow throughout the day

Days of a week also show considerable variations in the volume of traffic flow .To understand "incoming" and "outgoing" flow of traffic volume the writer carried out directional traffic flow study for 7 consecutive days at the three main gates of the town (see Map5).

Table 4.9: Average Daily Incoming and Outgoing Flow of Motor Vehicles at the Main Gates of the Sample Roads of Bahir Dar, 2002/03

MainRoad Gate	Incoming	Outgoing	Total	%
Dangela gate	**702**	**502**	**1204**	**40.2**
Gondar gate	**498**	**480**	**978**	**32.6**
Mota gate	**532**	**281**	**813**	**27.1**
Total	**1732**	**1263**	**2995**	**100.0**

Source Compiled by the writer from field survey.

As Table 4.9 shows, the Bihar Dar- Dangela route is busy with large number of traffic flow (40percent of total), while Bahir Dar - *Mota* gate accommodates relatively low incoming and out going vehicles because of less inter-urban interaction along the Addis Mota –Bahir Dar route.

CHAPTER FIVE

THE EXTENT AND VARIATION OF ROAD TRAFFIC ACCIDENT IN BAHIR DAR

5.1. The Extent and Trends of Accidents

As the a socio-economic status of Ethiopia's regions and towns change, road traffic accidents are bound to increase and assume greater importance as a cause of deaths, injuries and property damage. This observation is supported by Amhara Regional Traffic Police data, which shows that the number of road accidents increased from 446 in 1993/4 to 1040 in 2000/01, an increase of nearly 133 percent at a regional level and the number of accidents grew from 22 to 53, an increase of 140 percent in the town of Bahir Dar.

Table 5.1: The Extent and Trends of Road Accidents in Amhara Region and Bahir Dar Town, 1993/4-2001/01

Year	Amhara Region		Bahir Dar Town	
	Number of accidents	Annual % increase	Number of accidents	Annual % increase
1993/94	446	-	22	-
1994/95	516	15.6	26	18.1
1995/96	748	44.9	27	19.2
1996/97	890	18.9	47	121.2
1997/98	918	3.1	77	-35.6
1998/99	919	0.1	55	63.8
1999/00	912	-0.8	56	-28.6
2000/01	1040	14.0	53	1.8
Total	**6389**	**11.9**	**363**	**19.9**

Source: Amhara Region Traffic Police (2002/03).

Many reasons have been advanced to explain this increase of road traffic accidents in Bahir Dar. One is rapid urbanization with the resultant increase of motorized and non-motorized

vehicles; this mixture of motorized and non motorized vehicles is inherently hazardous under any traffic condition, as shown in Table 5.2 below. The relatively higher speeds of motorized vehicles and the unprotected nature of the bicycle, horse- drawn carts and pedestrians highly aggravate the accident situation of the town.

Table 5.2: Trends of Wheeled Vehicle and Road Accidents in Bahir Dar, 1995/6-2001/02

Year	Registered Wheeled Vehicles					Accidents	
	Bicycle	Horse drawn carts	Motorized Vehicle	Total	Annual rate of increase (%)	No	Annual rate of increase (%)
1995/96	6270	328	867	7467	-	27	-
1996/97	7199	427	896	8522	14.1	47	74.0
1997/98	7996	602	968	9566	12.2	77	38.9
1998/99	8694	875	1135	9077	-5.1	55	-40.0
1999/00	9509	1002	1157	11668	9.0	56	1.7
2000/01	10976	1280	1275	13531	15.9	53	-5.6
2001/02	12971	1427	1246	15644	15.6	32	-65.6

Source: (1) Bahir Dar Municipality (2003).
(2) *Bahir Dar Zone Traffic Police (2003).*
(3) *Western Gojjam Transport and Communication Department (2003).*

As shown in Table 5.2, the rate of increases in the number of accident greatly influences by the rate of increase in the number of vehicles. For example in between 1995/96 and 1996/97 the number of vehicles increases by 14 percent and the number of accidents by 74 percent. On the other hand, in between 1997/8 and 1998/9 the number of vehicles decreases by 5 percent and the number of accidents declined by 40 percent.

A different relationship is observed in the year 1999/2000 to 2002 when the number of vehicles increased by greater than 15 percent while the number of accidents decreased to 65 percent. This is mainly due to considerable under-reporting of the number of accidents.

When one assesses the rate of accidents compared with the numbers of accidents per ten thousand entering motor vehicles in the study area as it is expressed by Garber and Hoel (1999), the number fluctuates between 250 and 800 per 10,000 inspected vehicles.

Table 5.3: Road Accident Rates in Bahir Dar 1995/6-2001/02

Item	Year						
	1995/6	1996/7	1997/8	1998/9	1999/00	2000/01	2001/02
Annual registered motor vehicles	867	896	968	1135	1157	1275	1246
Reported total accidents	27	47	77	55	56	53	32
Accident rate per 10,000 vehicles	311	524	795	485	484	415	257

The trend of road motor accident was up surging till 1997/8, and slightly reduced in the year 2001/02(Table 5.3). The rate in this respect as calculated for Bahir Dar, taking accident per 10000 annually registered vehicles into account remained nearly constant with average rates of 467 over the last seven years. These accidents per vehicle rate are higher in the town when two-wheelers are not counted among the motor vehicles.

As other cities of Ethiopia, the main cause of the high road accident rates of Bahir Dar is high population number (increase in road users) and the other is high traffic volume (increase of wheeled vehicles of all kinds on the town roads). The Karl Pearson Coefficient of Correlation was utilized to compute the relationship between the number of accidents (dependant variable) and the number of population and vehicles (independent variables).

Table 5.4: The Association between Traffic Accidents and Independent Variables

Independent Variable	*Mean*	*Standard Deviation*	*Correlation*	*Significant t. test*	*R*	R^2
Number of population	**119,857**	**2413.6**	**0.813**	**0.002**	**0.813**	**0.656**
Number of vehicles	**899**	**222.3**	**0.842**	**0.001**	**0.842**	**0.708**

The Pearson's Coefficient of Correlation was computed to be 0.81 and 0.84 for the number of population and the number of vehicles suggesting the existence positive association between the number of vehicles, population growth and dependent variable (road traffic accidents).

The coefficient of determination (R^2) was 0.65 percent and 0.70 percent indicating that 65 percent and 70 percent of the variation in the road traffic accident in the town was explained by increasing number of population and vehicle growth, and the remaining 35 percent and 30 percent caused by the other factors.

The Coefficient of Multiple Correlation was computed to be 0.82 and the Coefficient of Determination was 0.68. The value of 0.82 suggests the presence of relatively positive association between the dependent and independent variables. The coefficient of determination confirms that 71 percent of the variations on road traffic accidents were explained by the two independent variables, that is, by the increasing number of vehicles and population growth the remaining 29 percent are caused by other factors.

Table5.5: The Association between Road Traffic Accidents and the Two Independent Variables
(Number of Motor Vehicles and Number of Population)

Model	*R*	*R2*	*Adjusted square*	*Standard Error of the Estimate*	*Change Statistics*	*Significance F-test*
1	**0.825**	**0.68**	**0.71**	**3.1141**	**111.23**	**0.0014**

5.2 Variations of Accidents by Severity Classes, Sex-Age Groups, Road Users and Vehicles Type

5.2.1: Variations of Accidents by Severity Classes

This method involves listing each accident occurring at a site under one of the following severity classes: Fatal (F) Personal Injury (PI), and Property Damage (PD).

In Bahir Dar every year around 10 people are killed and 30 are injured. Of all the reported accidents in 1995/6-2001/02, the average proportion of fatal, serious injury, slight injury and property damage only accidents were 14, 36, 21 and 29 percent, respectively (Table 5.6).

Table 5.6: Reported Road Accidents by Severity Class, 1995/6-2001/02

Severity class	Number of Road Accidents							Total	% share
	1995/6	1996/7	1997/8	1998/9	1999/0	2000/1	2001/2		
Fatal	2	7	7	7	7	10	7	47	13.5
Serious injury	3	21	34	19	20	14	12	123	35.5
Slight injury	4	8	15	18	10	16	5	76	21.9
Property Damage only accident	18	11	21	11	19	13	8	101	29.1
Total	**27**	**47**	**77**	**55**	**56**	**53**	**32**	**347**	**100.0**

Source: BSZTP, (2002/03)

In the period 1995/6-2001/02, the severity index (the proportion of the number of fatal to the total number of injury accidents), as shown in Table 5.7 below varies in the range of 14.2 to 41 percent.

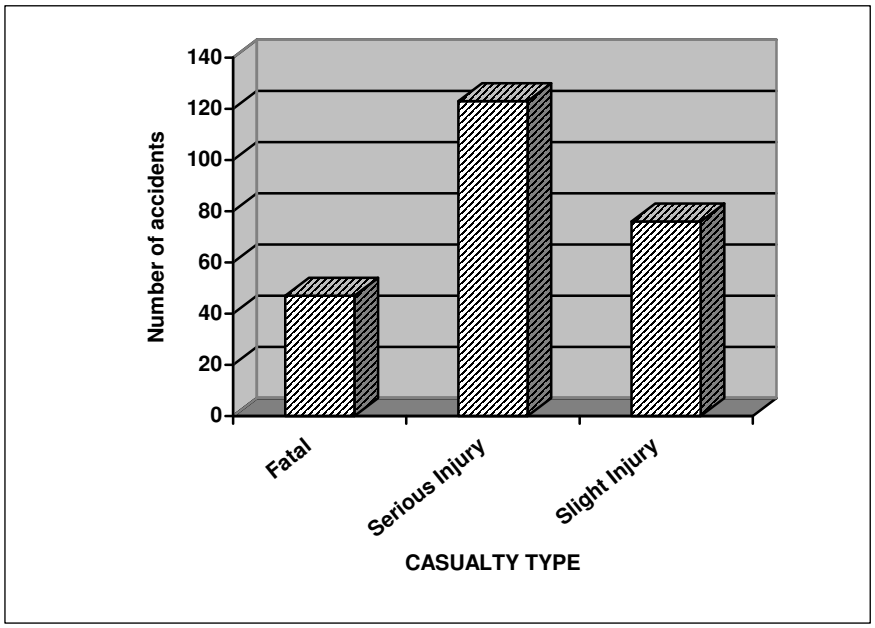
Table 5.7: Numbers and Indexes of Accidents by Type of Casualties, 1995/6-2001/2

Class of Accidents	Year							Total % share	Average annual increase
	1995/6	1996/7	1997/8	1998/9	1999/0	2000/1	2001/2		
Fatal	2	7	7	7	7	10	7	19.1	4.9
Serious Injury	3	21	34	19	20	14	12	50.0	-2.7
Slight Injury	4	8	15	18	10	16	5	30.9	9.1
All PIA	9	36	56	44	37	40	24	100.0	5.6
Severity Index (%)	**28.5**	**24.1**	**14.2**	**18.9**	**23.3**	**33.3**	**41.1**	**-**	**-**

Source: BSZTP,(2002/03).

All casualties have increased by 5.6 percent per year for the last seven years, as shown in Table 5.7 but the greatest increase has been observed with slight injuries. This could be due to an increase in the number of slight injury accidents being reported. Serious injury accidents have decreased slightly (2.7 percent) since 1995/96.

Figure 5.1: Severity of Traffic Casualty in Bahir Dar, 1995/6-2001/02



The other ways of assessing the challenges and seriousness of road accident in the town, according to Girma (2000) , TRL (2001) is to compare the fatality rate (deaths Per 10,000 motor Vehicles) and Fatality risk (deaths per 100,000 Population)

Table 5.8: Fatality Rates and Fatality Risk of Road Accidents in Bahir Dar, 1995/6-2001/02

Year	***Fatality Rate (Death per 10,000 vehicles)***	***Fatality Risk (Death per 100,000 Population)***
1995/96	23	2.0
1996/97	78	6.2
1997/98	78	5.9
1998/99	72	5.6
1999/00	62	5.3
2000/01	79	7.2
2001/02	56	4.9

Source: BSZTP, (2002/03).

Table 5.8 above shows the relative weighting of road accident as a traffic safety risk (fatality rate) and as a personal safety risk (fatality risk).The reported road accident fatalities throughout 1995/6-2001/02 fluctuates between 20and 80 per 10,000 registered vehicles, which is the worst as far as safety is concerned. The fatality risk also ranges from 2 to 8 per 100,000 populations, which is the highest in the country.

Property Damaged Accidents only. The consequences of road traffic accidents have both social and economic impacts. One of the major economic impacts caused by road traffic accidents is damage on property.

Figure 5.2 Damaged on Property Accidents on the Town Roads

Source: A Photograph Taken by the Writer during the Field Survey (2002/2003)

The main cost component in damage to property is the value represented by crashed vehicles. Property damage, however, also includes damage caused to objects inside the vehicles, such as

cargo, and damage to objects outside the vehicles, such as, roadside furniture (sign posts, guardrails, etc.) and fixed property (fences, houses, etc.).

The amount of damage on property usually depends on the number of accidents. The higher the number of road traffic accidents the larger the damage on property.

Table 5.9: Reported Damaged Property Accidents and Estimated Costs in Birr in Bahir Dar

Year	Number of vehicle damaged in accidents	Estimates cost (Birr)
1995/96	22	152,300
1996/97	19	42,820
1997/98	47	155,630
1998/99	34	152,200
1999/00	47	306,600
2000/01	32	126,700
2001/02	17	94,215
Total	**218**	**1,031,465**

Source: BSZTP, (2002/2003).

As can be seen from Table 5.9, the total damage on property accidents only estimated in birr in the years between 1995/6 and 2001/02 was greater than a million birr. Looking at the distribution of wasted property within a year for the last 7 years, one can understand that a picture of huge sum of money is lost each year.

In order to assess the percentage share of annual budgeted loss as a result of road accidents in the town of Bahir Dar, the writer carried out TRLs Regression Equation Models and derived the result as follows.

Log Y= log A + log B ΣX, where

Y= accident cost as a percentage of annual budget allocates

X = amount of budget allocated for the town per annum

The result of this equation is found to be 0.98 percent. This indicates road accidents appeared to cost about 0.98 percent of the town's budget per annum. In other words about one percent of the town wealth was lost as a result of road accidents. This equation has been used to provide an estimate of the town's accident cost as a percentage of total budget allocation per annum. According to the Municipality budget statistics, the average annual budget allocated for the past seven years was about 14 million birr per annum. Thus, the estimated costs of the annual property damage only of road accidents would be reached 0.98 percent (137,200 birr) per annum.

Under-Reporting of Road Accidents: All road accidents, even property damage accidents, are required to be reported. Yet, the traffic police officials of Bahir Dar readily acknowledged during the discussion that not all accidents are reported to them and their statistics greatly underestimates the extent of the true accident situation. To support the idea of under reporting of accidents in the town, the writer designed the questions for pedestrians, drivers and cyclists as follows.

Question	**Pedestrians**		**Drivers**		**Cyclists**	
	Yes	**No**	**Yes**	**No**	**Yes**	**No**
1. Have you faced/ observed traffic accidents in your trip?	77%	33%	83%	17%	54%	46%
2. If your answer is "yes" have the accidents been reported or registered with traffic police?	24%	76%	52%	48%	24%	76%

As shown in the above box, almost 77 percent of pedestrians, 83 percent of drivers and 54 percent of cyclists replied that as they faced or observed accidents while moving in the town. Out of these, only 24 percent of pedestrians 52 percent of drivers and 24 percent of cyclists have reported immediately to the police. This implies that not all road accidents are perceived as crimes and many road users prefer to settle claims immediately and not involve the police.

In addition, the current reporting procedures do not make it easy for road accidents to be reported to the police. Accident investigator traffic police are few in number and they have no mobile patrols. Accordingly, if a party wants to report an accident, they must go to the police station and request it to be reported.

The limited health data available also indicates that official statistics are underestimating road casualty. In this respect, Bahir Dar Special Zone Health Department reported 3188 road casualties receiving medical treatment as out-patients and in-patients at the town hospital, health centers and clinics in the years between 1999/2000 and 2001/02.

Table 5.10: Number of Casualties Treated in the Hospital, Health Center and Clinics by Transport Related Accidents, 1999/2000-20001/02

Age group	Number of treated				% Share
	1999/00	2000/01	2001/02	Total	
1-4	36	48	59	143	4.5
5-14	460	506	539	1505	47.2
15-44	209	262	332	803	25.1
45-44	153	204	252	609	19.1
65+	38	44	46	128	4.0
Total	**896**	**1064**	**1228**	**3188**	**100.0**

Source (1) Felege Hiwot Hospital Statistical Department (2002/03)
(2) *Bahir Dar Special Zone Health Department(2002/03)*

The number of victims treated in the hospital, health center and clinics shows upward trends (Table 5.10). During the last three years (1999/00-2001/02), 3188 casualties were treated for injuries from road accidents in Bahir Dar. This may include other victims of road users outside the town who were registered in the town address during the occurrences of the accidents. However, the total number of registered injuries by the police shows no clear patterns and lacking those cases treated in the hospital, health center and clinics. The most recent police road casualty number for Bahir Dar was only 76 in 1999/00-20001/02 with 46 serious and 30 slight injuries. But the town health department received over 3000 treated road casualty events for the same year. This shows that road injuries reported by the police are 100 times less than what is reported by the Health Department. Therefore, the town administrator, health officials and the police have to regularly address the problem of underreporting of road casualties in the town.

5.2.2. Variations of Traffic Casualties by Sex and Age Groups

In Bahir Dar, the road traffic accident risk for male population is by far higher than that of females. For example in between 1995/6-20001/02 female accidents accounted for only 24.8 percent of the whole casualties.

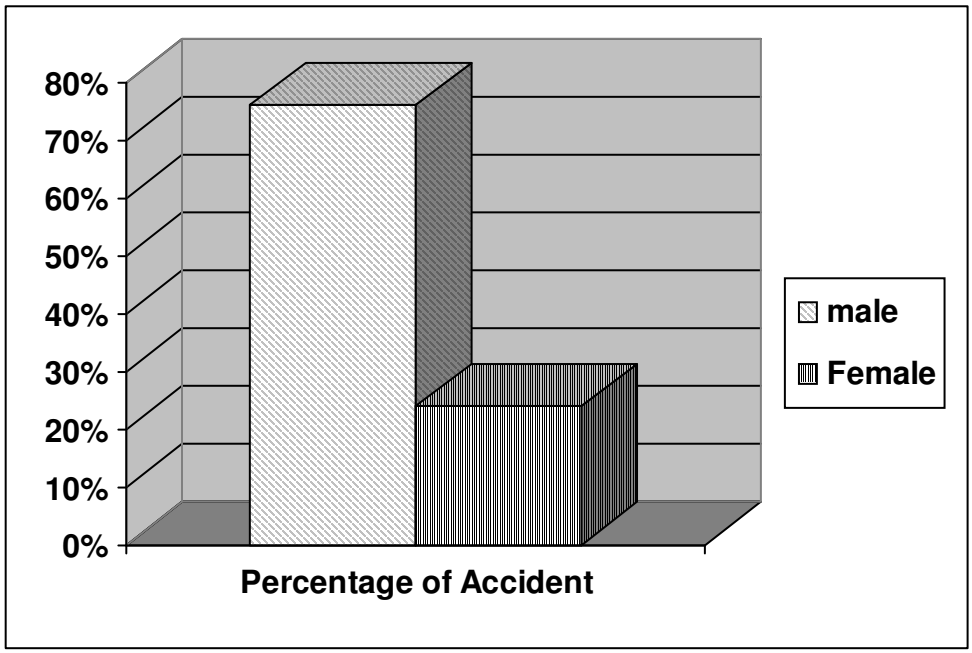
Table 5.11: Distribution of Number of Casualty by Sex Groups, 1995/6-2001/02

Casualty class	**1995/6**		**1996/7**		**1997/8**		**1998/9**		**1999/0**		**2000/01**		**2001/02**	
	M	F	M	F	M	F	M	F	M	F	M	F	M	F
Fatal	3	1	5	2	3	2	5	2	8		8	2	7	1
Serious	2	2	20	4	13	10	13	7	17	5	14	2	11	3
Slight	15	6	18	4	11	2	16	9	12	3	23	6	5	1
Total	**20**	**9**	**43**	**10**	**27**	**14**	**34**	**18**	**35**	**8**	**45**	**10**	**23**	**5**
% Share	**68.9**	**31.1**	**18.1**	**18.9**	**65.8**	**34.2**	**65.4**	**34.6**	**81.4**	**18.6**	**81.8**	**19.2**	**82.1**	**17.9**

Source: BSZTP (2002/2003)

As show in Table 5.11, the risk for females is three to four times lower than for males.

Figure 5.3: Traffic Casualties by Gender



The distribution of road traffic accident victims varies with age, mainly depending on their amount of exposure and degree of safety awareness.

Table 5.12: Number of Road Traffic Casualty at Different Age Groups of Bahir Dar, 1995/6-2001/02

Age group	Casualty	
	No	%
Below 7 years	21	6.3
7-13	28	8.4
14-17	57	17.2
18-30	129	39.0
31-50	72	21.8
above 51	24	7.3
Total	**331**	**100.0**

Source: BSZTP, (2002/2003).

As can be seen in Table 5.12, the road accident risk is very high among the male work- force (18-50 age group), which accounts for 60.8 percent of all casualties in the town.

Figure5.4: The Victim Man in Car Accidents with his Bicycle

Source: Taken from Traffic Police Office during the Field Survey, (2000/03)

5.2.3. Variations of Traffic Casualty by Class of Road Users

As indicated in Table 5.13, 52.3 percent of the reported road traffic accidents are pedestrians, while the average casualties for drivers and passengers are 22.7 and 25.0 percent respectively.

Table5.13: Comparison of Road Accident Casualty by Class of Road User Type, 1995/6-2001/02

Age group	Drivers/Rider	Pedestrians	Passengers	Total
Below 7	-	19	2	21
7-13	-	24	4	28
14-17	17	32	8	57
18-30	35	51	53	129
31-50	20	30	22	72
51 and above	3	17	4	24
Total	**75**	**173**	**83**	**331**
% share	**22.5**	**52.3**	**25.0**	**100.0**

Source: BSZTP, (2002/2003).

The traffic accident casualty patterns of road users in Bahir Dar, however, are quite different from the national average and Addis Ababa. For example, the accident statistics of Ethiopia for the same year show that drivers account for an average of 6 to 7 percent, pedestrians 50.4 percent and passengers 42 percent. In Addis Ababa the percentage of pedestrian and passenger casualty accounts for greater than 90 percent and drivers account for 6 percent. Therefore, the involvement of drivers in any kind of accidents in Bahir Dar is higher than the national average and the town of Addis Ababa. Several factors contribute to this situation; some are related to deficiency in traffic rules and regulations, and lack of serious enforcement and experience. Other problems are related to the poor condition of vehicles that travel on the roads.

5.2.4. Variations of Accidents by Type of Vehicles.

Road traffic accidents vary by type of vehicles with their corresponding compositional structure in the vehicle fleet. In Bahir Dar, this factor is quite relevant. The mixture effects mean that different types of vehicles use the same roads. This leads to high potential risk, especially for non-motorized road users.

Table 5.14: Accidents by Vehicle Types, 1995/6-200102

Type of vehicle	1995/6	1996/7	1997/8	1998/9	1999/00	2001/01	2001/02	Total	%
Pedal cycles	-	2	4	5	2	5		18	5.2
Horse drawn carts	-	-	3	1	2	-	1	7	2.0
Motor cycles	-	-	2	-	-	-	-	2	0.6
Cars	15	25	34	26	31	21	13	165	47.6
Taxi/Minibuses	3	9	13	9	11	7	4	56	16.1
Buses	4	2	7	6	2	5	2	28	8.1
Trucks	4	8	13	8	5	13	11	62	17.7
Undefined	1	1	1	-	3	2	1	9	2.7
Total	**27**	**47**	**77**	**55**	**56**	**53**	**32**	**347**	**100.0**

Source: BSZTP,(2002/03).

As indicated in Table 5.14, 47.6 percent of all accidents are inflicted by private and governmental cars (automobiles, station wagons and pickups). This is followed by trucks, which contribute17.7 percent of accidents. Ranking third are taxis and minibuses, that inflict 16.1of the accidents. Non-motorized vehicles of pedal cycles and horse-drawn carts are also contribute 7.2 percent of accidents in the town.

Figure 5.5: Complex Vehicle collisions on Dangela Route (Truck with Taxi, and Taxi with Bicycle)

Source: A Photograph Taken by the Writer during the Field Survey (2002/03)

By comparing the figures in Table 5.14, it is apparent that there are proportionally fewer bicycles involved in road accidents than may be expected. This is because accidents involving bicycles are more likely to be under-reported.

5.3. Spatial Variation of Road Traffic Accidents

Accidents are usually dispersed in urban areas and their distribution is subject to fluctuation, even if there are places where road traffic accidents occur frequently.

The type of accidents and their configuration highly correlates to the type of routes and the nature of user activities. In a similar pattern, accidents in Bahir Dar are usually highest where

mixed traffic prevails, particularly on main streets of shopping streets, office areas and on older mixed residential roads with narrow rights way, and lowest on well designed roads with light traffics of outer areas of the town (Table 5.15)

Table 5.15: Road Traffic Accidents by Place of Occurrence

Type of Area	1995/6	1996/7	1997/8	1998/9	1999/0	2000/1	2001/2	Total	%
Outer areas of the town	1	1	2	2	0		0	6	1.7
School areas	6	4	7	4	5	6	4	36	10.4
Religion centers	2	2	1	0	3	2	2	12	3.5
Business centers	2	3	17	11	6	14	4	57	16.4
Office areas	13	16	34	18	21	21	10	153	38.3
Residential areas	1	13	17	10	11	6	11	59	17.0
Others	0	2	2	1	2	1	0	8	2.3

Source: BSZTP, (2002/2003).

In respect to the distribution of the number of accidents within injury among main roads and residential streets, the traffic police data of 1995/6-2001/02 documented that over 80 percent of the accidents occur on main roads of the town (refer on map3). These roads make up about 10 percent of the total road length in the town areas. Combining the figures on road length and accidents, it turns out that main roads have 10-15 times more accidents per kilometer than residential area streets.

Table 5.16 Number of Accidents that Occurred at Different Routes of Bahir Dar 1995/6-200/02

Street type	Length	Number of Accident	%
St.GeorgeChurch - *Dangela* gates.	5.4	107	30.8
St.George Church - *Mota* gates	6.2	96	27.6
St.George Church - *Gondar* gates	5.2	84	24.2
Sub Arterial and collector roads	73.2	48	13.9
Local/Residential roads	85.69	12	3.5
Total	**175.7**	**347**	**100.00**

Source: (1) Bahir Dar Municipality, (2002/03)
(2) *Bahir Dar special Zone Traffic Police, (2002/03).*

As stated in Table 5.16, a large proportion of accidents in Bahir Dar are concentrated along the main streets in which 82.6 percent of the total accidents occurred along the three streets. Thus, St. George church to *Dangela* route (30.8 percent), St. George church to *Mota* route (27.6 percent) and St. George church to *Gonda*r route (24.6 percent). The rest of the routes of residential and sub-arterial and collector routes constitute 17.4 percent of the total accidents that occurred in 1995/96 to 2001/02.

Implementation of traffic safety measures must not be based on a personal judgment of where accidents happen and what the cause is. Systematic and regular inventories of traffic accident densities per street type are needed to determine the characteristics of the sections of a road network (which show the highest number of accidents).

$$AD = \frac{TA}{RLK \times TAY}$$

AD = Accident Density

AT = Total Accident along a particular street in this case from St. George church to the periphery of built up area.
RLK = Road length in kilometer
TAY = Total Accident Years.

The average accident density for each sample street in Bahir Dar was calculated to know the accident density and the following average accidents per kilometer per annum have been obtained.

1. **St.George Church to *Dangela gate***

$$AD = \frac{107}{5.4x7} = \frac{107}{37.8}$$

AD = 2.8 Average accidents per km per annum.

2. **St. George church to Mota gate**

$$AD = \frac{96}{6.2x\ 7} = \frac{96}{43.4}$$

AD = 2.2 Average accidents per km per annum.

3. **St. George church to Gondar gate**

$$AD = \frac{84}{5.2x7} = \frac{84}{36.4}$$

AD = 2.0 Average accidents per km per annum.

In a similar pattern the accident densities for collectors and residential routes have been calculated and the results obtained were 0.09 and 0.02, respectively.

To facilitate the comparison of results obtained from the analysis of accidents at a particular location with those of other locations, one or more accident rates could be used. These accident rates are determined on the basis of exposure data, such as traffic volume, and the length of road section being considered. Commonly used rates (based on the measurements and methods of Garber and Hoel) are rate per million of entering vehicles and rate per 100 million vehicle per kilometer as discussed below.

The Rate Per Million of Entering Vehicles (RMEVs) is the number of accidents per million vehicles entering the study location during the study period. It is expressed as

$$RMEV = \frac{A \times 1,000,000}{V}$$

RMEV = Accident Rate per Million Entering Vehicles

A = Total Number of Accidents occurring in 7 years at the location

V = Average Daily Traffic (ADT) x 365

Based on the above formula accidents per million vehicles entering for each main street in the year 2002/03 has been calculated and the following results were obtained.

1. **St. George to Dangela gate**

$$RMEV = \frac{16 \times 100,000}{1204 \times 365} = 36.4 accidents / million entering vehicles.$$

This implies that, the number of all accidents recorded at St. George church to *Dangela* gate for the year 2002/03 was 16, and the average 24 hours volume entering from all directions was 1204 vehicles; thus the accident rate per million entering vehicles in this road accounted for 36.4.

2. St. George church to Mota gate

$$RMEV = \frac{9 \times 1000,000}{813 \times 365} = 30.3 accidents / million entering vehicles$$

3. **St George church to Gondar road**

$$RMEV = \frac{7 \times 1000,000}{978 \times 365} = 19.6 accidents / million entering vehicles.$$

Thus, it should be noted that, St-George church to *Dangela* route has more accident rate per million entering vehicles than *Gondar* and *Mota* roads; this is due to *Dangela* road has more traffic volume than other roads.

5.4 Temporal Variations of Road Accidents

This method categorizes all accidents under different time periods such as hours, days and months to identify whether accident rates are significantly higher during any specific time periods.

5.4.1 Hourly Distribution of Road Traffic Accidents

The difference in the distribution of road traffic accidents observed among the 24 hours of the day or between the day and night time hours were directly related to the difference in the total volume of traffic flow (Table 5.17).

Table 5.17: Distributions of Road Traffic Accidents between the Day and Nighttime Hours

Year	Day time 6a.m.-6 p.m.	Night time 6 p.m-6 a.m.
1995/96	8	19
1996/97	25	22
1997/98	37	40
1998/99	22	33
1999/00	36	20
2000/01	29	24
2001/02	19	13
Total	176	171
% Share	**51**	**49**

Source: BSZTP, (2002/03)

According to Table 5.17, 51 percent of the road traffic accidents in each year occurred in the day time hours. This is due to the highest volume of the daytime traffic flow. But, the highest number of road traffic accidents, that is, 49 percent was observed during the night hours. This may be due to the low densities of traffic volume and thus higher travel speed that prevails during these hours. Higher speeds together with poorer visibilities and alcohol consumption by drivers could help to explain this observed pattern.

If one takes the 24 hours of the day and observes the distribution of road traffic accidents, one definitely gets a different number of accidents in each hour of the day.

Table 5.18: Hourly Distribution of Road Accidents in Bahir Dar, 1995/6-2001/02

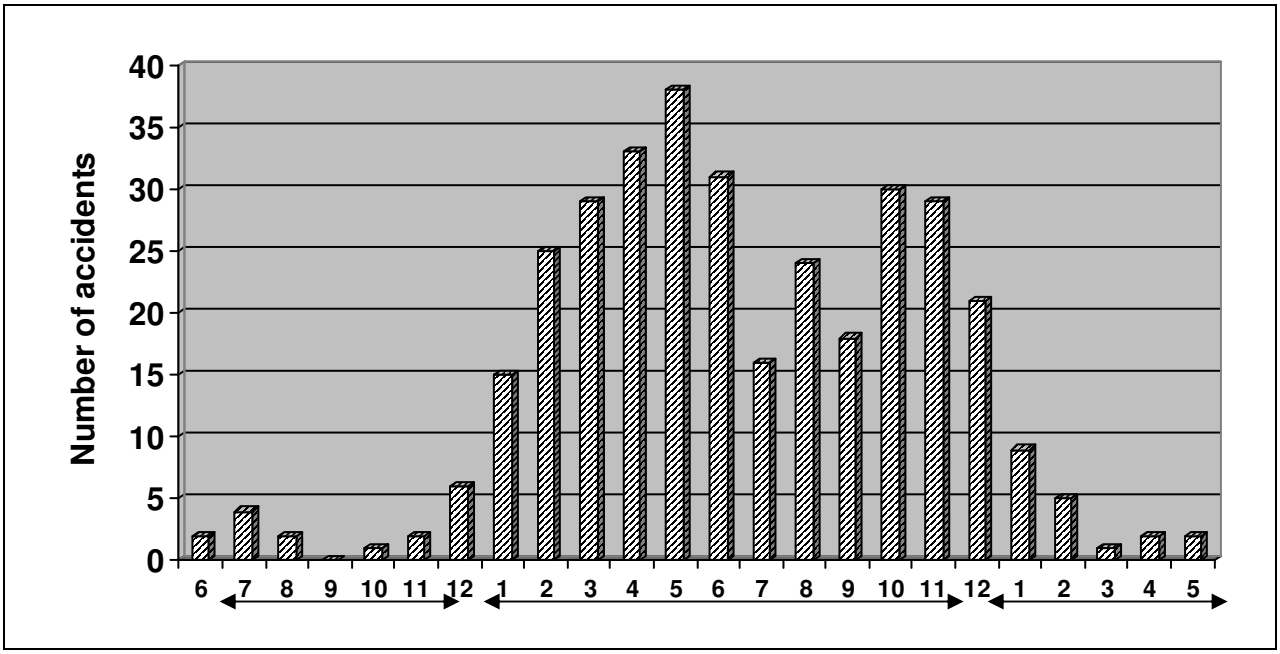
Hours of day	Total Number of Accidents	% Share
6 morning -7 a.m.	2	0.57
7 a.m. - 8 a.m.	4	1.10
8 a.m. - 9 a.m.	2	0.57
9 a.m. - 10 a.m.	0	0.00
10 a.m. -11 a.m.	1	0.28
11am - 12 noon	2	0.57
12 noon -1 p.m.	6	1.72
1 pm - 2 p.m.	15	4.32
2 pm - 3 p.m.	25	7.20
3 p.m. - 4 p.m.	29	8.35
4 p.m. - 5 p.m.	33	9.51
5 p.m. - 6 evening	38	10.95
6 p.m. - 7 p.m.	31	8.93
7 p.m. - 8 p.m.	16	4.61
8 p.m. - 9 p.m.	24	6.91
9 p.m. - 10 p.m.	18	5.18
10 p.m. -11 p.m.	33	8.64
11 p.m. -12 mid night	29	8.35
12 mid night-1a.m.	21	6.05
1 a.m.- 2 a.m.	9	2.59
2 a.m.- 3a.m.	5	1.44
3 a.m.- 4a.m	1	0.28
4 a m- 5a.m	2	0.57
5 a. m - 6morning	2	0.57
Total	**347**	**100.00**

Source BSZTP, (2002/03)

As shown in Table 5.18 the distribution of road traffic accidents throughout the day was not the same. There are hours in which the concentrations of road traffic accidents were relatively high. These hours in Bahir Dar are corresponding to the late after noon and early evening. These hours are usually related to peak hours of motor vehicles, pedestrians and cyclists movement; and these may also be related to the fact that work to home trips are made over much more concentrated period than are the home-to-work trips. Therefore, motorized and non-motorized vehicle conflicts at these times would be significantly giving more potential for accident occurrence.

The percentage shares of the road traffic accidents at different times of the day are also shown in figure 5.3 for week days in 1995/6-2001/02. It can be seen that the number of accidents do not correspond, especially at certain times, with the volume of traffic. Here, too, we can observe a significant decline in the number of accidents during morning peak hours and significant increase in the after noon peak hours.

Figure5.3: Number of traffic Accidents Per Hour in Bahir Dar by Time of Day, 1995/96- 2001/02



As indicated in figure 5.6 the numbers of accidents were highest during the afternoon rush hours from 3 p.m. to 6 p.m. and 10 p.m. to 7 p.m. and 10 to 11 p.m. From 8 a.m. to 9 a.m. in the mornings accidents were much lower compared with the traffic accidents than they are in the after noon and evening. It would be very interesting to know the reason for this. Even though this needs further research to investigate the reason in detail, the discussion with police

officials, drivers, and cyclists as well as in-depth observations by the writer in the research area revealed that the main reasons for more accidents were cyclists and drivers. These groups of people are observed in the worries of the day's work and less attentive to their driving on the home ward journey, and they are more tired in the evening. Some people were also identified as imbibed alcohol in the early evening. Moreover, there are very few parked cars and bicycles obstructing the roads and blocking sight lines in the morning, and in some places there are a lot in the after noon. Besides, it is observed that drivers and cyclists drive faster to home than to work, which enhances further accidents.

5.4.2. Daily Distribution of Road Accidents

The distributions of road traffic accidents throughout the week days also slightly vary.

Table 5.19: Daily Distribution of Road Accidents in Bahir Dar, 1995/6-200/02

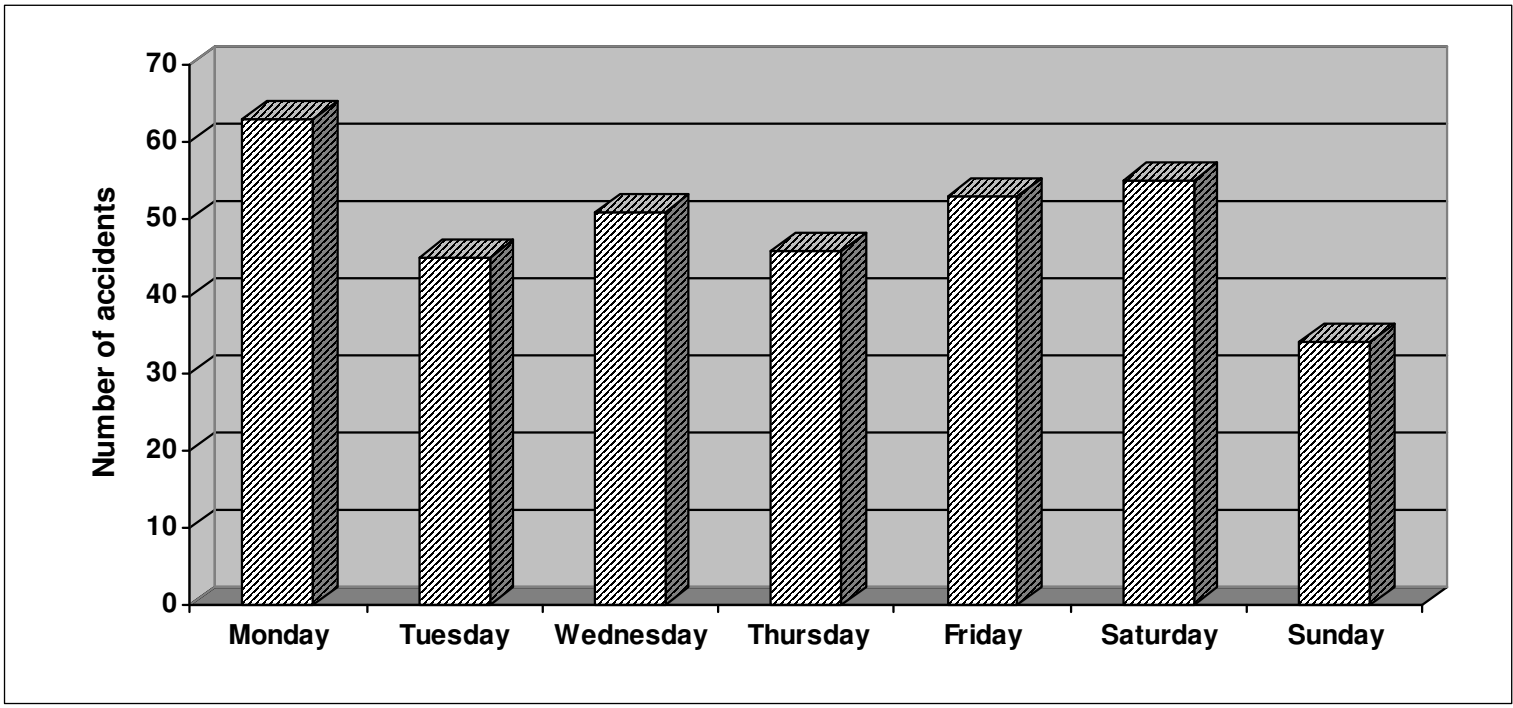
Days	1995/6	1996/7	1997/8	1998/9	1999/0	2000/02	Total	%
Monday	5	6	14	8	13	8	63	18.2
Tuesday	4	6	7	7	9	9	45	13.0
Wednesday	3	6	15	11	7	6	51	14.7
Thursday	8	8	8	7	8	6	46	13.3
Friday	2	4	16	9	6	11	53	15.2
Saturday	2	10	9	9	10	8	55	15.8
Sunday	3	7	8	4	3	5	34	9.8
Total	**27**	**47**	**77**	**55**	**56**	**53**	**347**	**100.0**

Source: BSZTP, (2002/2003).

Based on data given in Table 5.19, on the average there are more than 14 accidents in each day in a year. Except on Sundays road accidents are fairly uniform on other days of the week. In fact, on Mondays, Saturdays and Fridays the occurrence of traffic accidents was relatively

higher than it is on other days. To have a clear picture of road accidents within a day, the following graph may help us for contrasting the situation within a week.

Figure 5.5: Daily Distributions of Road Accidents in Bahir Dar in 1995/6-200/02.



The above figure indicates that Monday is the worst day for accidents. On an average Monday in 1995/6-200/02 there were greater than 60 of accidents.

5.4.3. Monthly Distributions of Road Traffic Accidents

On the basis of the data that are collected for each month of seven consecutive years, one can observe the disparity among months in their total number of road traffic accidents.

Table5.20: Monthly Distribution of Road Traffic Accidents (1995/6-2001/02)

Month	1995/6	1996/7	1997/8	1198/9	1999/0	2000/01	2001/02	Total	%	Seasonal level (%)
September	1	3	7	5	11	4		32	9.2	
October	2	2	5	4	7	4	1	25	7.2	28.6
November	1	3	8	2	-	6	5	25	7.2	
December	3	7	9	7	3	8	4	41	11.8	
January	3	8	4	1	3	9	7	35	10.1	30.2
February	4	6	10	1	2	4	2	29	8.3	
March	4	2	6	8	2	1	2	25	7.2	
April	2	2	6	3	4	1	6	24	6.9	20.7
May	-	4	5	2	6	4	2	23	6.6	
June	3	5	7	12	5	3	2	36	103	
July	3	2	5	8	8	4	-	30	8.6	25.2
August	1	2	5	2	5	5	1	22	6.3	

Source: Bahir Dar Special Zone Traffic Police Department, (2002/2003).

Table 5.20 shows, the variation in the number of road traffic accidents in months. Road accidents are fairly uniformly distributed by month ranging between 6.3 percent in August and 11.8 percent in December, and accidents were relatively higher in the dry months of December, January and February than that of other months. June is also the highest in the summer (wet) season.

CHAPTER SIX

CAUSES CONTRIBUTING TO ROAD TRAFFICACCIDENTS IN BAHIR DAR

6.1. Primary Causes Reported by Police

Accidents commonly have multiple of causes, in that they stem from a number of adverse circumstances. The Ethiopian traffic police are responsible for completing the traffic accident forms. An accident cause code was developed that contains 30 possible causes for accidents categorized under drivers, pedestrians, vehicles and road defects. From analyzing the accidents records of 1995/6- 2001/02 it was found that of all accidents, 72.3 percent were caused by drivers error, 8.4 percent were caused as a result of pedestrians' error, 4.9 percent were caused as a result of vehicle defects and the rest 14.4 percent were caused as a result of others and unknown factors.

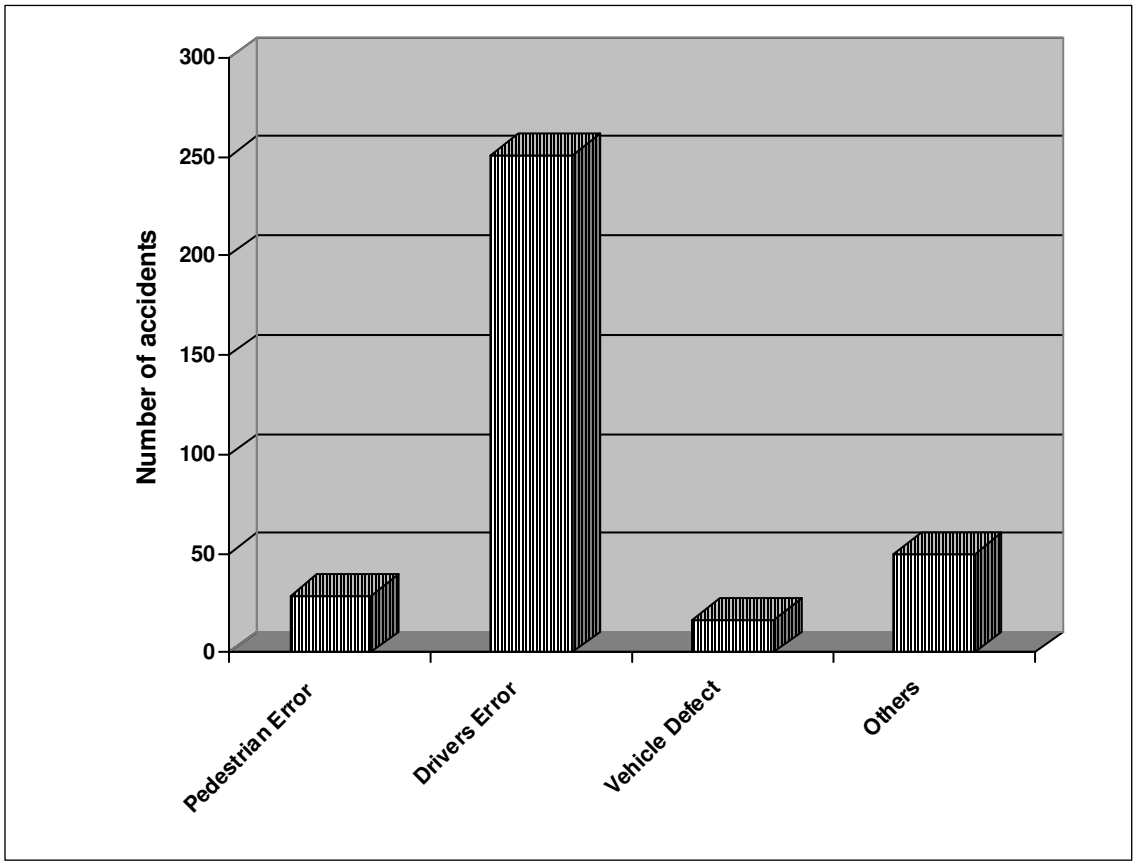
Table 6.1: Causes of Accident as Reported by Traffic Police in Bahir Dar, 1995/6- 2001/02

	Total Accidents	
Accident cause	**Number**	**%**
Driver's error	251	72.3
Pedestrian error	29	8.4
Vehicle defect	17	4.9
Road defect	-	-
Other/unknown	50	14.0
Total	**347**	**100.0**

Source: BSZTP, (2002/03)

As indicated in Table 6.1, more than 80 percent of the total traffic accidents were caused by human error (drivers and pedestrians) and appear to be serious problem as reported by the police. The contribution of vehicle defects to road traffic accidents as identified by the police is only 4.9 percent, which is lower than as one could expect from vehicles accidents. Moreover, the contribution of road factors is not well identified by the police as the causes of traffic accidents. It could be underestimated and unrecorded as it is shown in Table 6.1. Besides, the reports made by the police indicate that a single cause of each accident does not list the multiple factors involved as in on - the – spot of accidents.

Figure 6.1: Main Causes for Accidents in Bahir Dar, 1995/6-2001/03



Analysis of the police statistics show that the main causes for all accidents that are related to drivers error include excessive speeding, failure to give way for vehicles and pedestrians, and improper overtaking. They were considered to be the major error which caused the majority (69.2%) of the accidents in the town. Driving on the wrong side were also the other error, which caused 9 percent of the accidents, and about 7 percent of the accidents were due to too close driving.

Table 6: Detailed Causes for Road Accidents by Type of Drivers Error in Bahir Dar, 1995/6-2001/03

Driver error	Number of Accidents	%
Drink drive	2	0.8
Driving on the wrong side	22	9.8
Failure to give way for vehicle	37	15.2
Failure to give way for pedestrians	26	10.7
Following to close	16	6.7
Improper over taking	24	9.8
Speeding	82	33.6
Improper turning	11	4.5
Not respecting traffic control	2	0.8
Misjudgment during parting	13	5.3
Excess loading	3	1.2
Miscellaneous	6	2.5
Total	**244**	**100.00**

Source: BSZTP, (2002/2003).

The police figure shows that the causes for all pedestrian accidents related to pedestrian' errors, 57 percent is result of pedestrians crossing the road wrongly 37 percent pedestrians stopping, walking or running into roads, 3 percent crossing the road masked by stationery vehicles, and 3 percent were caused as a result of other causes. Environmental conditions such as weather and time of day have important attributable causes for the occurrence of accidents.

In Bahir Dar, accident records contain relatively comprehensive data on the physical condition of roads where accidents have occurred. From the analysis, it is found that in almost all cases, road related elements were in a positive surface condition having no defects.

Table 6.3: Accident Distribution with the surface Condition of the Town

Road surface type	Number of Accidents	% Share
Good Asphalt road	268	77.3
Damaged Asphalt road	6	1.7
Corrugated	68	19.6
Un paved	5	1.4
Total	**347**	**100.0**

Source BSZTP, (2002/03).

As indicated in Table 6.3, 268 (77 percent) accidents were occurred on good-asphalted roads while 68 (19 percent) were on corrugated road surfaces. More over, the records of police traffic data in the town show that 302 (87 percent) of accidents occurred on dry conditions of the road. The main types of road accidents that occur in urban areas related to road layouts are intersections; stretch of roads and along the roads. In the study area 275 (79 percent) of all road accidents have occurred at stretches or along roads while 65 (18.7 percent) of the accidents have occurred at the junctions.

Table 6.4: Distribution of Accidents by Road layouts

Layout at accident site	Number of Accidents	% Share
Cross road	11	3.2
T and Y junctions	54	15.6
Stretched /drive way	275	79.2
Round about	7	2.0
Total at junctions	**65**	**18.7**
Total at non-junctions	**282**	**81.3**

Source: BSZTP,(2002/03).

Table 6.4 also indicates the T- Junction type had 54 (16 percent) of all accident occurrences. This is followed by the 4 arms or cross-junction where 11 (3 percent) of all accidents have occurred. Round type of junction is the most safe in relative terms where only 7 (2 percent) of all accidents have occurred.

6.2. Observed and Questionnaire Surveyed Based Factors that Contribute to Road Traffic Accidents

Accident statistics from the traffic police provide objectives and priority targets for corrective actions. In order to design such action, it is also necessary to identify the main accident generating process, or associations of explanatory factors related to drivers and pedestrian behaviors to vehicles or to the road environment. But police reported accidents in Bahir Dar were often incomplete. That is why field observations were performed as a complement to the analysis of various accidents in the town.

The risk of having accidents were the direct consequences of several factors and elements, such as traffic behavior of drivers, traffic behavior of pedestrians, road environments, vehicle conditions and the availability of comprehensive and adequate legislation and law enforcement .

6.2.1 Traffic Behavior of Drivers.

The police traffic accident statistics in Bahir Dar indicated that drivers' errors are the main causes of the great majority of road accidents in the town. Higher accident occurrences correlated to the drivers can be explained by many factors, including lack of experience, age, and ignorance and inadequate understanding of the value and use of traffic regulations. These are being believed to be the major causes of the higher accident rates by drivers in Bahir Dar.

To achieve the objectives of the study, a questionnaire survey was conducted. The questionnaires were designed to allow the writer to identify the level of adherence and understanding of traffic regulations of the drivers being interviewed, including a series of direct and indirect questions related to traffic regulations and their importance.

In addition to this, questions related to age, level of license, number of years of driving educational level, etc. were also included. Reduced data reveal drivers composition in Table 6.5. From this table the following characteristics can be observed.

Table 6.5: Driver's Composition by Vehicles Registration Categories

Classification	Private car drivers	Commercial car drivers	Governmental car drivers	Total	%
Sex					
. Male	13	48	25	86	95
. Female	4	-	-	4	5
Age group					
. 18-22	2	4	3	9	10
. 23-28	5	23	10	38	42
. 29-34	3	9	5	17	19
. 35-39	3	6	2	11	12
. 40-45	2	3	2	7	8
. 45+over	2	3	3	8	9
Educational level					
. Illiterate	0	0	0	0	0
. Writing & reading	1	0	0	1	1
. 1-4 grade	0	2	0	1	1
. 5-8 grade	4	12	5	21	23
. 9-12 grade	6	31	10	47	53
. 12+ above	6	4	10	20	22
Level of license					
. 2nd	6	2	0	8	9
. 3rd	8	27	18	53	59
. 4th	2	14	5	21	23
. 5th	1	5	2	8	9
Driving Experience					
. 1 year	3	9	3	15	17
. 1-2 years	4	12	7	23	26
. 3-5 years	8	17	11	36	40
. 5-10	1	7	4	12	13
. 10+ above	1	3	-	4	4

Source: Computed by the writer,(2002/03).

As it indicates in Table 6.5, the majority of the drivers are male which accounted for 86 (95 percent) of all the observations in the study area. Thus, most of the drivers (79 percent) are less than 35 years of age. As far as educational status of the respondents is concerned (78 percent) of the drivers are less than 12 grades. It has also been found that most drivers have less than 5 years of driving experiences.

As indicated in Table 6.2, one of the dangerous actions of drivers in Bahir Dar is speeding, which caused the majority of accidents for the last seven years (1995/6-200/02). The speed problem deserves particular attention, which plays a leading part in traffic accidents in the town.

The writer has therefore, attempted to describe speed behavior of the drivers by asking questions such as "what is your normal speed when you drive in the town". A set of choices were given which include: 20km/hr, 20-30 km/hr, 30-40km/hr, 40-50km/hr and above 50 km/hr. For this questions majority of drivers interviewed, 56 (63 percent) declared that they currently drive more than 40 km/hr, which is above the urban speed limits of 30 km/hr stated by the Ethiopian traffic regulation of Negarit Gazeta, 1963. From this, it is possible to conclude that current speeds are high in Bahir Dar which generating high accident risks. This again tells, us that strict speed control system needs to be enforced in the town. But during the field observations by the writer, yet no adequate speed limit signs are installed and posted on the town roads.

Of the drivers' errors indicated in the year 1995/6-2001/02 accident statistics, failure to give the right of way to other road users, are placed in the second places. The Ethiopian traffic regulation

(Negarit Gazeta, 1963) clearly directs a driver of a vehicle where and how he/she should give priority to other road users. For example, a driver of a vehicle approaching a pedestrian zebra crossing is instructed by the law to slow down, and if pedestrians are crossing, to stop his/her vehicle and permit them to cross the road safely.

In attempt to deduce the perceptions of drivers towards pedestrians safety two interrelated questions were introduced to the drivers as follows.

Questions	**Alternative responses**					
	Always		***Sometimes***		***Never***	
	No	%	No	%	No	%
1.*When you drive, have you give way/priorities to pedestrians as required by law?*	63	70	25	28.0	2	3.0
2. How do you rate pedestrians respecting for vehicles in giving priorities where necessary?	**Good**		**Moderate**		**Poor**	
	No	%	No	%	No	%
	3	3	12	13	75	84

As shown on the above box, the majority of drivers interviewed, 63(70 percent) of the total responded that they always give priorities to pedestrians, 25(28 percent some times give priority to pedestrians, and the rest 3 percent never give priorities. For the second question the majority of the surveyed drivers (84 percent) confirms with poor ranking. Thus, the drivers highly criticized pedestrians behavior in applying the laws and rules of traffic. To compare the idea discussed above the writer has prepared other questions to study the behavior of drivers by taking sample pedestrians as presented below.

Questions	**Alternative responses**					
	Always		Sometimes		Never	
	No	%	No	%	No	%
1.Are drivers slow down/stop in pedestrian cross- walks when you are crossing?	10	11	32	35	48	54
2. Crossing roads in Bahir Dar is?	Easy		Difficult			
	No	%	No	%		
	10	11	50	89		

For the first question, 48 (54 percent) of them said “never” and 32 (35 percent) responded as “some times. This shows that few drivers were prepared to stop or even slow down for pedestrians while crossing roads.

In attempt to deduce the perception of pedestrians towards traffic safety in Bahir Dar, a question was asked as to whether crossing the road is easy or difficult. For this question the majority of the surveyed pedestrians, 80(89 percent) indicated that they perceived crossing the roads in Bahir Dar to be difficult. It is generally observed that driver’s behavior towards pedestrians is rather poor; especially they do not respect pedestrians on road crossing i.e. drivers are less likely to stop for them. Therefore, it can be concluded that pedestrians who totally depend on their traffic rights at crossing points can be at great risk.

In addition, there is a lack of appropriate discipline among drivers in the traffic system when overtaking, changing lane, crossing or entering a road. It is common to see a driver almost widely turning the vehicle without giving priority and signs to other road users in the traffic system of the town. There fore, the respect for traffic regulations in the town is very much dependent on the physical presence of traffic police.

Girma (2000) points out that much of the dangerous behavior by drivers could be attributed to lack of knowledge or their general attitude towards road safety. The basic issue of lack of knowledge lies on inadequate driver training and poor evaluation techniques. The existing system for training and examination of new drivers leaves much more to be desired. Drivers were asked questions on what they trust the current driving testing and training procedures.

Questions	Alternative responses			
	Yes		No	
	No	%	No	%
1.Do you have trust on the current driving testing and procedures?	43	47	47	53
2. Have you got additional education or training about road safety by concerned officials?	Yes		Not yet	
	No	%	No	%
	21	23	69	77

For the first question in the above box, 47 (53 percent) of respondents replied that they do not have trusts on the current driving testing and training procedure. Through the expression of the drivers interviewed thus appears a negative image of the existing system for training and examination of drivers. For the second question in the same box, the majority of the surveyed drivers, 69 (77 percent) of the sample drivers replied "not yet". This indicates that large numbers of drivers did not gain additional training and education by concerned bodies after getting their driving license.

Finally looking at the accidental situation from the angle of the driver's age, the result obtained is also quite different. From the police statistics and survey results, young and inexperienced drivers are highly prone to accidents. In Bahir Dar young and n experienced drivers were more than 2 times more dangerous than experienced adult drivers. Due to this facts, the majority of drivers interviewed (83 percent) faced accidents more than one time in their journey on the town roads and 71(79 percent) of all respondents indicated that they convicted by traffic police more than two times as the result of their traffic law violations.

6.2.2. Traffic Behaviors of Pedestrians

The accident statistics of police in Bahir Dar showed that pedestrians are the most vulnerable category of road user in traffic. The high accident risk of pedestrians stems largely from lack of giving priorities to pedestrians by the drivers and the cyclists.

Table6.6: Share of Pedestrian Casualty, 1995/6-2001/02

Year	Total Casualty	Share of pedestrian	
		No	%
1995/6	29	9	31.0
1996/7	52	29	55.7
1997/8	71	41	57.7
1998/9	52	30	57.6
1999/00	45	19	42.2
2000/01	54	22	40.7
2001/02	28	23	82.1
Total	**331**	**173**	**52.2**

Source: BSZTP,(2002/03).

From the Table 6.6, one can see that the percentage of pedestrian casualty as the highest in each year that persons walking are the principal sufferer in road accidents, which accounts for 52 percent of road victims.

As stated pedestrians accidents largely occur due to failure of drivers to give way to pedestrians at road crossing. But a number of accidents can be blamed on the ignorance and lack of attention of some pedestrians. Unlike drivers a considerable section of pedestrians in the town never learn the basic rules of the road safety except through observation. Thus, the following sub sections represent a discussion of the results with 90 pedestrians traffic behavior study under taken in Bahir Dar.

An attempt is made to produce some indicators of the traffic experience of the pedestrians in the town. Traffic experience is considered to be a function of age as well as of traffic exposure. In this study most of the surveyed pedestrians (86 percent) fall with the age group of 20- 40 years, and more than 75 percent of the respondents lived in the town for more than 3 years.

One can look at traffic exposure of pedestrians in terms of the trips they made. To understand the main type of journey purposes perform by the surveyed pedestrian the following questions have been presented.

Question	**Alternative responses**									
Which type of trip propose frequently constitute most of your time?	***Work trip***		***Educational***		***Shopping***		***Recreational***		***Walking***	
	No	%	No	%	No	%	No	%	No	%
	52	58	25	27	43	48	28	31	15	17

As can be shown from the above box, work trip purpose would be perceived as constituting the main part of pedestrian journey, 52 (57 Percent), business/ shopping trip selected (47

percent), and recreational trip accounts (31 percent),while walking for health services constitute small parts of the journey which selected at the fifth level.

In an attempt to deduce the perception of pedestrians towards traffic safety problems in Bahir Dar, a question was asked to the respondents "How do you perceive the level of road traffic accidents in Bahir Dar". The majority of pedestrians (51percent) interviewed agree that the current accident problems are high in Bahir Dar. This shows that the level of perception of the problems experienced by pedestrians in the town is very high. In the same box in column 3,the majority of pedestrians interviewed (61 percent) replied that they faced or observed road traffic accidents more than one times in their trip of the town.

Questions	**Alternative responds**							
	Big problem		**Moderate problem**		**Not a problem**			
1.How you perceived the level of road traffic accidents in your community?	No	%	No	%	No	%		
	46	51	43	48	1	1		
	Yes		**No**					
2.Have you faced/observed traffic accidents in your Journey?	No	%	No	%				
	69	77	21	23				
3.If *you faced/observed accidents, how may times?*	***One***		***Two***		***Three***		***Four***	
	No	%	No	%	No	%	No	%
	14	20	31	45	12	17	12	17

Pedestrians were also asked a question," which types of collision or road accidents were highly prevailing in the town". Alternatives given were:

.Motor vehicle with motor vehicle

- Motor vehicle with bicycle
- Motor vehicle with pedestrian

- Bicycle with bicycle
- Bicycle with pedestrians
- Motor vehicle with static objects
- Bicycle with static objects
- Motor vehicle/ bicycle with animals

The majority of the surveyed pedestrians interviewed (31 percent) replied bicycles with pedestrians, bicycle with bicycle accidents (30 percent) and motor vehicle with bicycle (27 percent).

Observation in Bahir Dar showed that there are notable tendencies of pedestrians towards walking along vehicle roads and with their backs to traffic. When asked to indicate how frequent do a pedestrian has to leave the side walks and walk along roads, 8(9 percent) indicated that they always do this, 52(58 percent) indicated that they some times do this while 16(18 percent) indicated that they rarely do this, others14(16 percent) indicated that they never do this. The demonstrated tendency of pedestrians to leave the sidewalks and walk along the roads increases the risk of a pedestrian being exposed to traffic accidents.

Figure 6.1: Unsafe Crossing of Roads by Pedestrians

Source: A Photograph Taken by the Writer during the Field Survey(2002/03)

Further, pedestrians were asked whether they walk along the roads with their backs to the direction of traffic. Contrary to what has been expected, the majority of the surveyed pedestrians, 72 (80 percent) indicated that they walk with their face to traffic. On the other hand 18(20 percent) indicated that they walk with their back to traffic. However, still, a relatively high number seemed to indicate that they walk along roads with back to traffic which further aggravates the potential risk of being exposed to an accident. The tendency of walking with their back to the traffic, however, is certainly related to a lack of knowledge.

Pedestrians were also asked how much they perceive traffic signs, signals, and road marks when they walk and cross the roads. For this question only 32 (36 percent) of all pedestrians indicated, as they perfectly understood. But the majority of pedestrians, 58 (64 percent) were not clearly aware of the traffic signs and road marks.

Road crossing facilities in the urban area can be categorized into four main types. These are space segregated crossing facilities, time segregated crossing facilities (traffic signals), priority segregated crossing facilities (zebra crossing) and uncontrolled crossing.

Pedestrians were asked questions as to where they would usually cross main roads. Alternatives given were: at traffic light, at junctions, at any point, at mid- block pedestrian crossing away from junctions. For this question the majority of the surveyed pedestrians, 43 (48 percent) have indicated that they would cross roads at any point, 31 (34 percent) at mid block pedestrian crossing away from junctions, 7 (8 percent) at junctions and 9 (10percent) at traffic light. This shows that about 59 (66 percent) of the pedestrians would tend to cross roads

at any of the other unsafe points. This represents a dangerous crossing attitude that might lead to the occurrence of accidents.

In similar conditions the police accident statistics of 1995/6-200/02indicated in Table 6.8 shows the severity of pedestrian accidents by pedestrian activities. Thus, more than 80 percent of the pedestrian accidents occurred when pedestrians were crossing the road or walking along the motor roads, which

substantiate the idea discussed above.

Table 6.7: Accident Severity towards Pedestrians Road Crossing Activities in Bahir Dar, 1995/6-200/02

Pedestrian Activities	**Accident Severity**				
	Fatal	**Serious Injury**	**Slight Injury**	**Total**	**%**
A. Pedestrian on crossing	8	41	23	72	41.3
B. Pedestrian not on crossing					
• *Walking in roads*	16	34	17	67	38.5
• *Playing in roads*	2	6	3	11	6.3
• *On the side walk*	4	6	5	15	8.6
C. **Others**	3	4	2	9	5.3
Total	**33**	**91**	**50**	**174**	**100.0**

Source: BSZT, (2002/03).

As expected, the severity of accidents occurring when pedestrians were crossing was higher. This figure confirms with to the result of the majority of the surveyed pedestrians, (8 9) percent indicated that crossing the roads in Bahir Dar is difficult.

As it has been demonstrated earlier only few drivers are prepared to stop or even slow down for pedestrians while crossing roads. Thus, it could be true that pedestrians who totally depend on their traffic right at crossing points can be at great risk because of drivers being less likely to stop for them.

The pedestrians are also asked a question "which of the driver's error highly aggravated traffic accidents on the town roads".

The questionnaire result for this question revealed that pedestrians in Bahir Dar, 41 (46 percent) of all respondents perceived the high speed of vehicles as the most profound problem that endangers their safety when attempting to cross roads. The results also indicate that 25 (28 percent) of pedestrians perceive non- abidance of drivers to pedestrian's traffic rules as the second serious safety problem encountered while crossing the roads. Limited number of properly designed pedestrian crossing (15 percent), lack of enforcement (3 percent) and others are problems in their order of seriousness.

The rules and regulations recognize the right of pedestrians on the road and restrict drivers to stop upon seeing a pedestrian on the pedestrian crossing. The regulation further provides for penalty against offending motorists. But the respect for traffic regulations and penalties are very much dependent on the physical presence of traffic police along the roads. To understand

the perception of pedestrians towards traffic police efficiency on enforcement the writer interviewed the sample pedestrians as mentioned below:

1.*Are drivers failing to maintain traffic rules and regulations in the presence of traffic police would be penalized for their law offensive*?	**Always**		**Some times**		**Never**	
	No	%	No	%	No	%
	10	11	37	41	43	48
2 *How do you rate the traffic police Commitment to their duties?*	**V. Good**		**Good**		**Poor**	
	No	%	No	%	No	%
	9	10	47	52	34	38

The response of the respondents for the first question, 47 (52 percents) indicated that the presence of penalties for drivers for their law offensive, while, 43 (48 percent) of interviewed pedestrians indicated that they did not see any penalties for law offensive drivers. Concerning the second question in the above box, large number of pedestrians interviewed criticize the current system of penalties taking by traffic police against offending drivers, 34 (38 percent) of all respondents were replied that the traffic police commitment to their duties are poor.

Two interrelated questions were introduced to the pedestrians whether they gained education or not about road safety.

1. Have you ever got education about road safety rules by concerned officials?	**Yes**		**Not yet**	
	No	%	No	%
	45	50	45	50

2. Who is your source of knowledge and experience about road safety rules?	**My self**		**Parents**		**School**		**Traffic police**		**Media**	
	No	%	No	%	No	%	No	%	No	%
	48	53	4	4	14	15	7	8	17	19

For the first question in the above box large proportion of pedestrians, 45 (50 percent) did not get education about road traffic rules by concerned officials. For the second question the majority of pedestrians, 48 (53 percent) have indicated that they have learned how to deal with traffic by themselves and 14 (15 percent) through school. Also 17 (19 percent) have indicated the involvements of media (radio and television), and 23 (26 percent) of pedestrians have also indicated the involvements of traffic police; and the parent involvements accounted only 4 percents. The above responses and result demonstrate the almost non-existence of any systematic official source for providing the necessary education, training and information related to traffic safety. Television and radio both have a wide coverage in town of Bahir Dar. Thus, essential mixed safety message can promote for influencing human behaviors and attitudes. However, their broadcasting of road safety education is still limited and not gained great attention.

School Children Traffic Behavior as Pedestrians: In the town of Bahir Dar children under the age of 15 years are highly vulnerable to road accidents. In these conditions the police accident records of the town in the year between 1995/6- 2001/02 show that accident-involving school children contribute a high percentage of the total accidents (Table 6.9). The following subsection represents a discussion of the result of the school children traffic behaviors study undertaken in Bahir Dar.

Table 6.8: Parentage Shares of School Children Accidents in Bahir Dar Dar,1995/6- 2000/02

Vulnerable Road Users	Injury Type			Total Casualty	%
	Fatal	Serious	Slight		
Students	8	33	16	67	38.7
Workers	4	12	11	27	15.6
Peasants	4	12	7	23	13.3
Unemployed	7	20	11	38	22.0
Unknown	5	9	5	19	10.9
Total	**28**	**86**	**50**	**174**	**100.0**

Source: BSZ TP, (2002/03)

The records in Table 6.8 show that accidents involving school children contribute a high percentage of the total accidents in Bahir Dar. Many factors could be raised to this accidents but the major one is inadequate education and training of children on how to use the road safely. The data obtained from the traffic police indicated that more than 80 percent of injured children were pedestrians and the rest 20 percent were most likely related to cyclists, and more than four- fifth (80 percent) of injured children were in the age groups of 5-14 years. The risk of school pupils being injured in a traffic accident was 50 percent higher during school time than during a similar period when it was not a school day.

The traffic police data also indicated that, quite a high proportion of children (87 percent) accidents occurred at the main roads of the town on their ways to school, and 13 percent of children accidents were occurred around the roads of residential areas.

Further, more the traffic data also reveals that only 8 percent of child accident took place between 7a.m to 8 a.m. when most of children are going to school. On the other hand, most of the children accident (70 percent) took place between 12 noon to 1 p.m. and nearly 22 percent took place after 5 p.m. At these times, traffic is usually congested with adults coming from work at midday and in the evening.

An attempt has been made to establish measures for traffic exposure of school children by preparing a set of inter-related questionnaire.

The first traffic related question was whether the children afraid of or not in afraid of on their way to schools. The result for this question shows that, out of the total 110 respondents, 96 (87 percent) of children stated that they are afraid of traffic on their way to school. The second question stated that “crossing the road is easy or difficult". For this question, 90 (81 percent) children have perceived that crossing the road was difficult and only 19 percent of them have indicated that crossing roads was easy. These responses of school children demonstrate the probable existence of potential problems in the locations of schools and the presence of traffic hazards nearby in front of the schools.

Children were also asked a question as" what type of wheeled vehicle do you often afraid on your way to school" .The alternative given were motor vehicles, bicycles, and horse drawn carts. The majority of the surveyed children, 60 (55 percent) have indicated that they afraid of motor vehicles, 30 (27 percent) bicycles, 8 (7 percent) that horse drawn carts, and the rest 12 (11 percent) were afraid of all. From this one can deduce that motor vehicles traveling at high

speeds were mostly the causes to create fear of school children in Bahir Dar. It is not uncommon to see drivers driving at very high speeds, where there are signs of school children crossing the roads. Insufficient knowledge of safe ways of walking along the streets appears to be one of the contributory factors to road traffic accidents among children of school going age. Thus, 73(65 percent) of interviewed school children did not know the safer way of walking along the streets relative to oncoming vehicles.

The last question forwarded to school children was the identification of different parties towards the teaching of school children on how to deal with traffic sources. The alternatives are: parents, schools, traffic police, radio and television and none of them were allowed to mark more than one choice.

Accordingly, 26 (24 percent) of children were indicated the involvement of traffic, 54 (49 percent) through the involvements of their schools, 15 (14 percent) the involvement of with their parents, 8(7 percent) stated television and radio and the rest 17 (15 percent) of still not taught by any parties about road safety education. Other multiple replies include, 50 (45 percent the involvement of their school traffic and parents, and 15 (14 percent) parents, schools and television.

From the discussion it can be concluded that traffic police, schools and parents together share the responsibility for educating the children on how to deal safely with traffic. However, schoolchildren face problems in terms of parents and school system not providing adequate knowledge on how to safely walk on and across the roads. from school are increasingly susceptible to road traffic accidents.

6.2.3 Traffic Behavior of cyclists

In the town of Bahir Dar the bicycle is a dominant means of transport by far it exceeds the number of passengers' car (in the year 2000: 10976 bicycles and 625 cars). This ratio will continue to exist for decade. An observation also shows that for most of the journey there is a great potential for rapid modal transfers from walking to cycling. But the unhappy feature of the cycle is that a large number of accidents are associated with it.

Based on the police accident records between 1995/6-2001/2, out of 47 people were killed in road accidents, 26(55 percent) were cycle related accidents, and out of 199 people injured, 101(slightly more than 50 percent) were cyclists. If one looks back over the last seven years we find that cyclists accounted for about 18 percent of the total accidents.

Table 6.9: Share of Cycle Related Accidents in Bahir Dar, 1995/6-2002/03

Year	Total No of Accidents	Cyclists related	(%) Share
1995/6	27	5	18.5
1996/7	47	9	19.1
1997/8	77	16	20.7
1998/9	55	10	18.1
1999/0	56	10	17.8
2000/1	53	9	16.9
2001/2	32	6	18.7
Total	347	65	100.00

Source BSZTP, (2002/03).

Table6.9 shows that there are proportionally fewer bicycles involved in road accidents than may be one expected. This is related with under reporting bicycle accidents. But from the above table, even though the percentage of cyclist's accidents is falling, the person-using bicycle as a means of transport is a principal sufferer in road accidents. Higher accident occurrences correlated to cyclists can be explained by many factors including lack of training, age, and inadequate understanding of the value of traffic regulations.

Similar to pedestrians and drivers, a questionnaire survey was conducted for cyclists and asked, as "which type of trip purpose is constitute most of your cycling time?" For this question 47(52 percent) of respond ants replied for all-purpose trips, 26(29 percent) were for work trips, and 10(11 percent) for recreational purposes. Another question asked was whether they had had an accident on their journey of the town roads or not. For this question, 49(55) percent of interviewed cyclists were replied as " yes" answer which means more than half of the cyclists interviewed were faced road traffic related accidents in their journey, of which 75 percent of respondents were indicated that road accidents were not recorded by police.

Cyclists were also asked to mark when and where bicycle accidents frequently happened in the town roads (see the box below)

Question	**Alternative responses**			
1. In which time of a day bicycle accidents are highest?	***Day time***		***Night time***	
	No	%	NO	%
	70	78	20	22
2. In which roads/locations of the town roads bicycle accidents are the highest?	***0n main roads***		***Residential roads***	
	No	%	No	%
	79	88	11	12

For the first question 70 (78 percent) of interviewed cyclists replied that large number of accidents happened during the day time, while, 20(22 percent) indicated at night time

Cyclists were also asked to tick up in rank order as "which type of cycle accidents are most common for collision?" Amongst the cyclists interviewed, falling whilst riding represented most common causes of cycle accidents (34 %) followed by a collision with pedestrians (22 %), collision with bicycles (16 %), collision with motor vehicles (15 %) collision with an object (8 %) collision with horse drawn carts (5 %).

Cyclists were also asked to rank the major problems or factors contributing to cycle accidents in the town as shown in the box below?

Rank	Responses	Number of times selected	%
1	***Absence of segregated lane for bicycles***	19	21.0
2	***Poor road conditions***	17	18.6
3	***Speedy riding***	15	16.6
4	***No priority given by motor car drivers***	13	14.4
5	***Negligence of pedestrians for cyclists***	12	13.3
6	***Lack of enforcements***	8	8.9
7	***Poor condition of bicycle on the road***	6	6.6

As it is shown in the box, out of 90 cyclists interviewed during the traffic survey period, 19(21 percent) of interviewee responded absence of segregated lane for cyclists and other road users, road conditions (18.6 percent), speed riding (16 percent), drivers not giving priorities for cyclists (14.4 percent), negligence of pedestrians (13.3 percent), lack of enforcement (8.9 percent), and poor maintenance of cycles (6.6 percent).

Detailed observation of cyclists by the writer during the study period identified that most bicyclists with pedestrian's accidents happened on off street paths and are caused by the error of bicyclists, because the bicyclists ride too fast and not giving priorities for pedestrians. In addition to this, bicyclists also ride on side walks in a business districts or heavily trafficked pedestrian areas, which highly aggravate the pedestrian / bicyclists accidents with bicycles.

Figure 6.2: Illegal Cycling Behaviors of Riders on the Main Streets of Bahir Dar Town

Source: A Photograph Taken by the Writer during the Field Survey (2002/03)

Cyclists were asked to mark where they thought riding of bicycles is most dangerous. For this question the majority of respondents, 34(38 percent) indicted that large number of accidents frequently happened on crossroads, 32(35 percent) were on the drive way, 21 (23 percent) were at junction roads, the remaining accidents (6%) occurred on traffic light areas. From this, one can conclude that large number of bicycle accidents occur at junctions than straight sections.

Cyclists were asked how much they perceived traffic signs, signals and road marking when they ride along the town streets. For this question, 75(83 percent) cyclists indicated that they perfectly understood the components of road safety, while 15(17 percent) were not clearly aware of the stated road safety elements. The result obtained implies that knowledge of traffic safety elements generally does not have importance for the reduction of accidents among cyclist, because cyclists are notorious for breaking traffic rules in the town streets. In general, 46(51 percent) of the cyclists were not yet gained education about road traffic rules by responsible agencies and majority of the respondents learned how to deal with traffic rules by themselves.

6.2.4 Road Environments

Efficient and economic road transport is largely dependent on road layout. Efficiency can not be achieved if the road user is frequently involved in road accidents, but fortunately those design provisions and frequent maintenance needs to improve traffic flow to reduce accidents. In Bahir Dar, due to lack of training and traffic engineering skills of the traffic police

underestimated the contribution of road environments to traffic accidents. A number of factors can be attributed to these accidents relating to road environments as discussed below.

Condition of road: The existing roads conditions in Bahir Dar are in poor conditions. The basic problem lies in roads that are not planned to fulfill a certain function by following an appropriate standard procedure. Like many other town and cities of Ethiopia Bahir Dar has an urban transportation infrastructure that was initially designed for largely non- motorized travel. Only small percentage (about 6 percent) of the town's urbanized land area is devoted to roads. Still there are no good standards of road design established to suit the fast growing traffic in the town. This resulted in the unjustified traffic congestion and accidents on the road network, which was never designed for the volume and type of traffic.

Figure 6.3: Traffic Accidents on Damaged Routes of the Town

Source: A Photograph Taken by the Writer during the Field Survey, (2002/03)

The flat nature of the land plus the poor drainage facilities on the roads during the rain season creates flood hazards to most of the town streets, which affect smooth mobility. Except very

few arterial, which are asphalt pavements, the roads in Bahir Dar are dominantly unmade roads with little or no improvement at all. The poor conditions of the road networks are mainly due to inadequate maintenance such as, lack of funds to buy equipment and materials, inadequate numbers of trained manpower and lack of maintenance culture. Therefore, the poor nature of the roads in the town can be explained by the amount of money invested for construction and maintenance purpose.

Table 6.10: Length of Road Constructed/ Maintained in Bahir Dar ,1995/6- 2001/02

Type of Road	Length (Km) 1995/96	Length(km) 2001/02	Difference (km)
Asphalt	23.7	33.91	10.2
Gravel	40	56.1	16.1
Unclassified	12	85.6	73.6

Source: Municipality of Bahir Dar (2003).

As shown in Table 6.10, in the last seven years only 10.2 km asphalt roads were constructed and maintained from the already constructed 23.7 km road length.

Traffic Segregation: A traffic engineering principle of overriding importance is the segregation of traffic categories by function and in space and time, for example the segregation of vehicle and pedestrian, of different classes of vehicles and different types and purposes of vehicles movement. But in the study area the traffic flow is too mixed and no distinctions of flow for different modalities are observed. Vehicles are usually parked on pedestrian lanes and pedestrians (including animals) walk in the center of motorways. Heavy trucks also use almost all routes without any restrictions or regulations, which lead into traffic

conflicts between fast moving through traffic, slow moving local traffic and vulnerable pedestrians. The conflicts arising from these inadequacies of traffic segregation give rise to all sorts of traffic accidents.

Figure 6.5: Traffic Conflicts/Mix on the Main Roads of the Town

Source: A Photograph Taken by the Writer during the Field Survey (2002/03).

As indicated in the above Figure 6.5, in Bahir Dar roads, streets and other routes have a multitude of functions in addition to carrying traffic. Here, houses, gardens, landscapes and parking are integrated with movement for car, pedestrians and animals.

Facility on the road: Despite the heavy mix of traffic flow in Bahir Dar, there are no safe pedestrian and vehicular facilities on the road net works. Engineering measures to segregate vehicles and pedestrians or to facilitate safety on shared surfaces such as paved side walks, pedestrian crossings, fences, speed calming facilities, road signs and good street lighting are inadequate or totally absent on the road. The road environment lacks important road safety facilities, which have proper guidance to road users. More over, major inter-urban road, for example roads from Gondar to Addis Ababa passes through Bahir Dar with out by pass for fast moving vehicles (absence of ring roads and speed calming facilities). This apparently adds to the increase in the road traffic accidents in the town. The ability to see ahead and observe potentially conflicting traffic is critical to safe high way operations.

In Bahir Dar sight obstructions on the road observed due to the presence of tall vegetation along the main roadsides and intersections. Footways are obstructed by long trees, sign of advertising, illegal parking, hawkers and traders, encroachments of shop displays, and in some streets foot way dwellers (St. George church to Mota route). Under these conditions, footways are unusable and pedestrians are forced to walk in roadway with both safety and traffic congestion problems.

On road -parking: In Bahir Dar, drives and cyclists normally are forced to park on the road due to the absence of adequate parking lots. On road parking is very much reacted to the frontage land use. Traffic generation characteristics of adjacent land use and absence of access control on street parking is another important factor, which affects traffic safety and

efficiency. To support this idea, the surveyed drivers were asked a question as mentioned below

Question	**On Streets**		**Park area**		**In front of Commercial or office areas**	
1.***Where do you parking your motor car frequently?***	No	%	No	%	No	%
	33	37	20	22	37	41

6.2.5 The Vehicles

The Vehicle with its roadworthiness and its periodic inspection and maintenance are all considered important factors in the safe driving efforts. Occupant protection devices need to be installed and utilized mechanical conditions fuel system integrity type quality, light and breaks all need to meet established standards if they are not contributing to the worsening traffic problems.

Although police as the cause of traffic accidents rarely identifies vehicle defects, the contribution could be quite considerable due to the fact that the condition of vehicles is generally very poor. Most of the vehicles in the fleet are very old with out proper maintenance. Besides many un roadworthy vehicles are on the roads because of the socio- economic situation and lack of enforcement. From the reported driver offences in Bahir Dar in 1995/6-2001/02 one fourth were due to driving unlicensed vehicles, because of that vehicle owners normally don't afford to take their vehicle for over all maintenance.

Table 6.11: Share of Traffic Offences in Driving Unlicensed Motor Vehicles in Bahir Dar, 1995/6-2001/02

Year	Total offences	Unlicensed Vehicles	% Share
1995/6	1744	619	35.4
1996/7	3017	1014	33.6
1997/8	3244	621	19.1
1998/9	2064	549	26.5
1999/00	1822	618	39.9
2000/01	1496	510	34.0
2001/02	2084	413	19.8
Total	**15471**	**4344**	**28.0**

Source: BSZTP, (2002/03).

As can be seen from the Table 6.11 on the average of 28 percent reported offences of Bahir Dar in 1995/6- 2001/02 were due to driving unlicensed vehicles. The regulation of the country states that vehicles should be inspected yearly. It can, there fore, be predicted that the regular testing of vehicle will reduce the number and severity of accidences in which vehicles are involved.

However, poor maintenance cannot be blamed for all defects. The traffic police data of Bahir Dar reported in 1995/6 -2001/02, states that 90.5 percent of accidents contributed by good vehicles.

Table 6.12: Accident Involving in Defective and Non- Defective Vehicles, in 1995/6 - 2001/02

Vehicle Condition	Accidents	
	Number	**%**
Vehicles with defects	33	9.5
Vehicles with no defects	314	90.5
Total	**347**	**100.0**

Source: BSZTP, (2002/03).

From the Table 6.12, more than 90 percent of road accidents in Bahir Dar have been involved vehicles in good condition. In fact, in Bahir Dar a high proportion of the vehicles were found to be defective in some degree but it would be unfair to conclude that defects springing from bad maintenance were responsible for more accidents.

In Bahir Dar, both governmental vehicles and private cars are usually over loaded above their capacity, especially taxi drivers are observing transporting larger number of passenger or overloading above their capacities through out the day.

6.2.5. Legislation and Law Enforcement

Promoting efficient urban traffic system needs an appropriate legislation and law enforcements. Without an appropriate traffic regulation and law enforcement alleviating urban transport problems is impossible. The existing traffic regulations of Ethiopia (Negarit Gazeta, 1963) are very old and without any major appropriate amendments for the last 40 years. The records of the past forty years show that road safety legislation and law enforcement have not

been effective in reducing road accidents, and yet we have a state of affairs where traffic laws are flouted by the vast majority of road users

Table 6.13: Number of Traffic Law Offences by Categories of Vehicle Type in Bahir Dar, 1995/6-2001/02

Year	Road user Categories				
	Motor car Drivers	Cyclists	Horse drawn cart riders	Total Offences	Annual(%) Increase
1995/6	1744	484	147	2375	-
1996/7	3017	552	153	3722	56.7
1997/8	3244	947	189	4380	17.6
1998/9	2064	560	126	2750	37.2
1999/00	1822	227	71	2120	22.9
2000/01	1496	118	37	1651	22.1
2001/02	2084	391	101	2576	56.0
Total	**15471**	**3279**	**824**	**19574**	**8.0**
% Share	**79.0**	**16.7**	**4.2**	**-**	**-**

Source: BSZTP, (2002/03).

As can be seen in Table 6.13, the number of indictable offences committed increase annually at an average rate of 8 percent for the last seven years, of these motor vehicle drivers are the most traffic law breakers in the town, which accounts 15471 (79 percents) both bicycle and horse drawn cart riders in combined contributed 4103 (21 percents) of all offences in the town. It is, there fore, likely that the 1963 road Traffic act of Ethiopia have not played any considerable part in reducing the number of offences and accidents in the town of Bahir Dar.

Bahir Dar town traffic laws and regulations are enforcing by the Bahir Dar Special Zone Traffic Police Section. In order to enforce traffic law effectively, the traffic police should be

organized by efficient staff and equipments. Hence, the manpower, the equipment and training capatown of the office is assessed below to identity the limitations for effective enforcement.

Table 6.14: Existing Staff Profiles of Traffic Police by Educational Level in Bahir Dar, 2002/03

Qualification	No of qualified Staff
BA Degree	-
Diploma	-
Certificate	5
12 grade complete	26
< 12 grade	8
Total	**39**

Source: BSZTP, (2002/03).

The existing staff profile of the office indicates in Table 6.15 is that out of 39 personnel only 5 people is gradated at certificate level, 26 are12 grade completed and the rest 8 are below 12 grade. This shows that the office did not have enough number of qualified personnel with different professional background.

According to the information acquired from the office, all of the traffic police were trained for only 45 days in traffic management system. And 96 percent of the personnel did not gate any additional training in traffic, engineering or related field. From these, we can deduced that the training program is not comprehensive enough to give adequate knowledge about the traffic law, traffic theory, traffic accident investigation and advanced driving inspection. Thus, the

basic education requirement to be a traffic police officer is rather low compared to the level of understanding that the professional demands. In addition to the professional mix and training, the total number of existing staff is only 36 percent of the demand of the office, the gap is about 64 percents

Table 6.15: Existing and Additional Demand of Bahir Dar Traffic Police Personnel 2002/03

Task of Traffic Police	**Existing staff**	**Total demands**	**Gap**	**% of Supply**
Management area	1	5	4	20.0
Investigation area	1	4	3	25.0
Supervisory/control area	13	35	22	62.8
Motorist	1	3	2	33.0
Data encoder	1	3	2	33.0
Others	4	9	5	44.4
Total	**21**	**59**	**38**	**36.2**

Source: BSZTP,(2002/03).

The shortages of man power with the low level of professional mixes have a negative implication in performing the duties and responsibilities of the office the town. Moreover, the traffic police are inadequately equipped to carry out their duties. Roads patrols are ineffective due to insufficient availability of motor vehicles and other enforcement facilities.

Table 6.16: Supply and Demand of Bahir Dar Traffic Police's Equipment, 2002/03

Type of Equipment	Available	Demand	Gap	% Of Supply
Motor cycle	1	3	2	33.3
Radio	2	5	3	40.0
Vehicle	-	2	2	0.0
Ambulance	-	2	2	0.0
Computer	-	2	2	0.0
Others	9	27	18	33.3
Total	**12**	**41**	**29**	**100.0**

Source BSZTP,(2002/03).

As shown in Table 6.16, the existing equipment of traffic police covers only 29 percent of the total demand of the office. The shortage of equipment in addition to the low level of quality and number of the personnel resulted in low enforcement capacity of the office which aggravates the traffic law offences and accidents.

CHAPTER SEVEN

SUMMERY, CONCLUSIONS AND RECOMMENDATIONS

7.1. **Summery and Conclusions**

The results obtained throughout the assessment of the traffic police and field survey data in chapters 5 and 6 indicated that road traffic accident is a serious problem in the town of Bahir Dar. The extent and numbers of road traffic accidents have been following an increasing trend throughout the study period, and the rate of increase has risen rapidly.

The analysis underlined that under-reporting of road traffic accidents assumed to be really bad in the town of Bahir Dar. Traffic police statistics greatly underestimated the true extent of non-fatal accident situations (only fatality accidents are relatively well- reported). In between 1999/2000 and 2001/2002, for example, 3188 road transport related injuries were registered by Bahir Dar Special Zone Health Department. These people received medical treatment as in-patient and outpatient in the town hospital, health center and clinics. But in the same year the traffic police registered and reported only 76 road injury accidents. These are indications that more accidents go unreported, and that the statistics compiled are not always reliable.

It is found that the annual accident rate in Bahir Dar for the last seven years fluctuated between 250 and 800, or remained nearly constant with an average of 467 accidents per 10,000 licensed vehicles. This rate is extremely high on the national road safety scenes which are attributable to high population number (increase in road users) and high traffic mixes

(increase of wheeled vehicles of all kinds on the town roads). In this respect positive relationships between road accident fatalities and the number of vehicles and population were found. The relationships derived constantly indicate that the increase in vehicles and population will bring an increase in traffic accidents and a rise in fatalities.

The severity index was computed as the proportion of the number of fatal accidents to the total number of injury accidents. For Bahir Dar the average number of fatality for the last seven years (1995/6-2001/02) is almost 29 out of 100 injuries, and all traffic casualties have increased by 5.6 percent per year.

The study revealed that the economic costs incurred by road traffic accidents are very high in Bahir Dar. To measure the extent of economic costs incurred by only property damage accidents, a regression equation was computed. The result indicates that road accidents appeared to cost about 0.98 percent of the town's budget per annum. In other word about one percent of the town wealth (137,200 Birr) per annum was lost as a result of road accidents.

In Bahir Dar, pedestrians are the road users most affected by road traffic accidents. Between 52 and 64 percent of all road accidents are pedestrians. Especially, school children under the age of 15 years are highly vulnerable to road accidents. Drivers, passengers and two-wheeled vehicles are also frequently involved in traffic crashes. Results also show that the risks are higher among males, particularly those who are economically active age group of 18-50 years. In between 1995/6 and 2001/02, on the average, males accounted for 75 percent of all casualty cases in the town.

The survey results indicate that, of all road traffic accidents of Bahir Dar, 82 percent were caused by motor vehicles (cars and taxis). The traffic flow is too mixed and no distinction of flow for different modes is observed. Cycles and motor vehicles are usually parked on pedestrian paths, and pedestrians including animals walk in the center of roadways .Moreover, heavy trucks use almost all routes without any restrictions or regulations.

The study revealed that road traffic accidents in Bahir Dar were highest in areas where mixed traffic conditions are observed particularly on the main streets of schools, shopping centers, office areas and on older mixed residential roads with narrow right ways (Dangela, Mota and Gondar roads). These roads constitute 10 percent of the total road length of the town and account for more than 80 percent of the road accidents. Road facilities such as, safety guard police, reflectors, street lighting, appropriated road marking, traffic and direction signs, which improve safety on the road are either insufficient or totally absent in these streets. Absence of adequate sight distance at intersections as a result of tall vegetation also intensifies accidents in the main streets of the town. Poor road maintenance and drainage have also been identified as a crucial problem facing the existing infrastructure to smooth mobility and safety.

In this study the unique characteristics of road traffic accidents identified is that there is a large proportion of road accidents (49 percent) in Bahir Dar during the night hours. The figure is less than 20 percent in Ethiopia in general and Addis Ababa in particular. This large proportion of accidents at night time may be due to the low densities of traffic volume and thus higher travel speed that prevails during these hours. These higher speeds together with

poorer visibilities and alcohol consumption by drivers and cyclists may help to explain this observed pattern.

The peak hour accidents in Bahir Dar also took place between 5 p.m. and 6 p.m. This is observed as these are the hours when the schooling and working time in Bahir Dar ends and vehicle traffic and pedestrian volume are at their highest. Monday represents the day when accidents are more frequent. It was concluded that accidents are also slightly higher during the dry months of December, January and February than in the other months of the year.

According to the police reports and cases analyzed, 80 percent of the total accidents in Bahir Dar were caused by human errors. Of these accidents caused by human errors, drivers were indicated as being responsible causes in about 73 percent of the cases. Speeding and failure to give way for pedestrians and cyclists were the main reported and observed errors of drivers. Especially, motor vehicles are traveling at speeds usually around and over 50 km/h on roads where there are high traffic of pedestrians and cyclists. The behavior of pedestrians is also causing loss of lives and a lot of material damage. People in the town give little attention to traffic because of little experience of a comprehensive traffic regulation and lack of awareness how to act safety in the motor traffic system.

In Bahir Dar, the modes of transport used by low-income groups for the movement of people and goods have lost out competition for policy attention and funding by municipal government bodies. Walking, cycling, and the operation of horse-drawn carts have best suffered from neglect. Horse-drawn carts in the town operate in the hostile road surfaces of local and collector streets with high level of danger and insecurity, especially to women and children.

Furthermore, road safety in Bahir Dar is not seen as the key priority by any specific organization; coordinated and integrated traffic management and enforcement is very poor. The police are inadequately equipped and trained with inadequate manpower and budgeted allocation for remedial work.

In conclusion, the mixed traffic flow in narrow and heavily pedestrians movements, inadequate urban public transport provision, poor standard of vehicle, poor maintenance and development of roads, the negligence of drivers due to lack of adequately training and driver testing, poor traffic control and enforcement which combine increase risk of accidents on roads of Bahir Dar. Low institutional and public awareness of the extent of the destruction of traffic accidents aggravates the situation. So it is self evident from the discussion and analysis made so far that the problem of traffic accident needs to be resolved.

7.2. Recommendations

1. Understand the issue better (Develop reliable accident database): The absence of reliable data on the magnitude and nature of the road traffic accidents is a serious handicap that needs to be overcome as a priority. Under- reporting is significant in Bahir Dar. Official police statistics, the common data sources used, greatly underestimate the true extents of road traffic accidents in the town. Errors in data collecting and coding are also very common. Therefore, to solve these problems traffic safety personnel should be made aware of

the importance of accident data recording and reporting systems. Good data systems should be developed to identify successful and cost effective interventions in road safety works.

2. **Setting urban transport management bodies**: As in the other areas of public work, the urban transport management section is not well-organized in the town of Bahir Dar. Transport-related works are done in a fragmented way. Establishing a road safety unit to implement all programs pertaining to road safety is still not the concern of the municipal government. Only the traffic police department is involved in all activities. Therefore to implement all programs relating to urban transport in general and road safety in particular an urban transport management department should be organized at the town level.

In addition to this the municipal road safety council should be put in place to support and ensure continuity of road traffic safety activities at the town level. Members could be drawn from different sectors such as municipal authorities, transport, education, schools, justice, public health, traffic police, mass media, private companies, road user groups and non-governmental organizations. This council should have support at the highest level in government and should have a legal entity to work with the community. Cooperation between agencies and institutions is vital for future road safety work in the town.

3. Formulating an urban transport policy: To promote and enhance an efficient urban transport system, an appropriate policy and regulatory framework is needed. According to some concerned officials, the traffic law, high way code, legislation and enforcement are not comprehensive enough to encompass all aspects of the urban traffic issues and problems.

These are outdated and not clear, and also fail to cover all the traffic issues related to road users and vehicles that is exist today. Therefore national and regional governments should give a great emphasis to alleviating these problems by formulating a safe transport and traffic management policy. The primary requirement for a sustainable reduction of the accident rate is that road safety should be made a political priority.

4.**Urban and transportation planning related measures**: The solution to the problem of preventing traffic accidents lies mainly in the better planning of cities and the adequate provision of transport infrastructure and facilities. However, this is still difficult to attain in the town of Bahir Dar. As it is mentioned in the discussion, the highest traffic accidents in the past seven years have been registered on the main roads of the town (Dangela, Gondar and Mota routes). Common factors for this are incompatible and mixed allocation of land use types such as residential, schools, commercial, cultural, recreational and office areas. These integrated land uses contribute to the flow of different modes of transport which intensifies traffic conflicts as well as accidents. In addition, the locations of the main entrances of all these institutions are along the main streets which have high traffic loads. Thus, immediate measures should be taken to move the main gates to the back side of the institutions which have low traffic loads. In the long run, mixed allocation of land use types along the main streets should be redesigned and avoided. Activities that are expected to attract heavy traffic should be located on the main roads. On the other hand, activities expected to attract heavy pedestrian walking like schools, market centers and religious institutions should be located on minor roads. Pedestrians and cyclists need routes which are positive, safe, direct accessible and free from barriers. Therefore, main streets in the town should be designed for

low traffic speeds with suitable calm restriction (ideally 20km/hour or less). Crossing police patrols should be located at busy crossing points to assist pedestrians and cyclists to cross these roads.

5. Road and traffic related measures: The prevention and reduction of accidents in the town should be included in the development of new road schemes or improvement or maintenance of existing roads. In Bahir Dar most parts of the accident- prone streets are severely damaged (only 11percent of these roads are in a good condition). Even the newly constructed ring road has been totally damaged without giving any service. Therefore, systematic identification and treatment of hazardous locations can improve road safety substantially. Road safety inspection should be included during the design, constriction and maintenance phase of road projects. It is also important to develop a traffic management strategy on the roads of the town by establishing functional hierarchy of roads and allocating road space to priority users, including bicycles and horse-drawn carts. In Bahir Dar, these factors are quite relevant because the mixture effects of different types of vehicle use on the same road leads to high potential risks especially for non-motorized road users. Thus, the segregation or separation of road user types, such as the construction of bicycle lanes, but also banning vehicles with hazardous freight from the main routes will substantially improve safety. The provision of off-road parking spaces or the establishment of some forms of parking control may reduce conflicts and increase road capacity and safety.

In Bahir Dar foot ways are often obstructed by long trees, signs of advertising, illegal parking, hawkers and traders, encroachment of shop displays, and in some streets foot way dwellers

(.St. George to Mota road). Under these conditions, footways are un-usable and pedestrians are forced to walk in roadways with both safety and traffic congestion problems. There fore, town governments should take enforcement actions against illegal parking on the main roads hazardous and obstructive locations. Tall vegetations at the intersections and junctions should always be cut and equitable policies for relocation of street traders and footway dwellers should also be carried out.

6. Road signs and marking measures: Information for drivers, pedestrians, cyclists and school children is essential for good traffic management. However, in Bahir Dar, it was observed that the number and size of regulatory signs are often inadequate and poorly sited. Road marks are poorly visible at night and unclear even in day time. There are also institutional problems. For example, responsibility for putting marks and signs is not clearly designated to a legal entity in the town. There is no responsible institute or department for designing and supervising signs and marks. It is indisputable that good town-wide signing and road marking can assist development and maintenance of road user behavior and can support enforcement. Therefore, immediate actions should be taken by the town government in arranging effective traffic management agency and in supervising signing and marking measures. Near schools, warning signs for children are needed, and strict speed control systems are need to apply in the town roads.

7. Vehicle related measures: Most of the vehicles in the fleet of Bahir Dar streets are very old with no proper maintenance and enforcement. Especially many un-roads worthy taxis and private cars are operating on the roads of the town because of lack of enforcement.

Despite all these inadequacies, vehicles are over-loaded above their capacity. With bad road conditions of the town these circumstances lead to severe accidents which involve a number of people. Governmental vehicles are also highly involved in road accidents at the night hours due to lack of strict controls on drivers out of working time. Therefore, mandatory regular inspection of all types of vehicles in terms of age, condition and safety features should be carried out constantly. Moreover, strict control and checking of vehicle loads is needed both in the interests of road safety and prevent excessive axle load on pavements.

8. Bicycle related measures: Bicycles are the predominant non-motorized transport mode in the town of Bahir Dar next to walking (accounting for 30 percent of trips), and offer low cost personal mobility assisting lower income groups. However, increasing motorization has increased safety problems for bicycles particularly in mixed traffic heavily used streets and intersections. In the town providing convenient and good quality facilities for cyclists is a low priority. There is a view in some government officials during the discussion that bicycles are considered to impede motor vehicles, and are categorized as the least transport hierarchy. The tendency is, therefore, towards elimination of cyclists rather than provision of good facilities for their use. But bicycles are an efficient mode, suitable for various urban journeys and available to at least most of the social groups of the community. Therefore, bicycles should be treated as an integral part of the traffic management system and strategies should be designed to improve safety by protecting cyclists from conflict with motor vehicles and pedestrians.

Bicycle lanes or tracks should be purposely constructed or created by re-allocating existing road space to provide separate lanes and use local streets with supplementary infrastructure. Clear traffic management rules and measures should be developed on existing roads to assist and control cyclists from road safety problems. It is desirable that cycle traffic be governed by rules intended to promote safety. Some of the common rules strictly adapted are: all cycles should be provided with good brakes and should have night lamps and red reflectors at the rear. Where no separate cycle track are provided, the cyclists shall keep to the extreme right way. Double riding should be controlled and cyclists should not use foot ways of pedestrians.

9. Education and training: Discussions with pedestrians, drivers, cyclists and children about their level of knowledge of the rules and laws of road safety revealed that the majority of these road users did not have education and training. Therefore, road safety education should be given to all classes of the community. All dwellers should be trained to be good road users at all stages of their lives. The training and education system should also start at home from his/her parents. A strong commitment is needed towards road safety education in schools. Since almost all accidents have drivers error as one of the contributory factors there is potential benefit in improving the standards of driving. The driving training program of motor vehicles should be introduced in revised test and with a safety emphasis. Updated training and education is needed for beginners as well as licensed drivers. Media campaigns should concentrate on disseminating knowledge to the public regarding the safe use of the roads, as well as attempting to change unsafe traffic attitudes.

10. Enforcement of traffic regulations: Enforcement measures are fundamental in Bahir Dar town where the drivers and cyclists as well as pedestrians are always reluctant to obey the rules. So, strict and continuous enforcement is one of the key factors that can bring changes to negative traffic attitudes and hence improve the behavior of road users towards a more safe traffic behavior. But traffic growth rate in the town is high and the work load and working practices of traffic police need to keep pace with the changes. Often, working practices are not responsive to the new traffic conditions and fundamental attitudinal changes. The traffic police forces in Bahir Dar are under equipped and not well trained in traffic management. If enforcement of traffic regulations is generally the responsibility of the traffic police, therefore, they are to be well trained and equipped. Training should include how to deal with accident in terms of accident reporting, dealing with patterns, causes and remedial actions. Manpower allocation to traffic police should be sufficient to deal with traffic control as well as enforcement of traffic violations of pedestrians and cyclists.

11. Research related measures: Some parts of the road accident problems are unique to Bahir Dar, such as the heavy accident burden put on cyclists and child pedestrians. But the extent and the effects of road traffic accidents in the town area is usually not known. Therefore, these situations will require research. The research and evaluations should be consequently including studies on the problems of implementing road accident countermeasures.

Finally, the measures which are suggested in this thesis should not necessary have to be treated separately. They should complement each other and work together in a supportive way so as to tackle the particular traffic safety problem in Bahir Dar town.

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Appendix 1.Questionnair Prepared for Sample Population:

Introduction:

A questionnaire is prepared for an academic purpose for the fulfillment of MA Degree in Geography studies. The objective of the study is to assessing the patterns, causes and countermeasures for road traffic accidents in Bahir Dar. Your response is very important for the success of the study. Hence you are requested kindly to give your response by selecting or circling your answer among the alternative choice or by describing your opinion. I would like to thank you for your cooperation.

A. A Questionnaire to be responded by selected pedestrians in Bahir Dar

1. Address (Kebele) ----------
2. Sex----------
3. Age ----------
4. Educational level
   - Illiterate---------- ☐
   - Read and write/informal---------- ☐
   - Primary education (1-8) ---------- ☐
   - Secondary education (9-12) ---------- ☐
   - Above secondary---------- ☐
5. Occupation
   - Private Worker ---------- ☐
   - Unemployed---------- ☐
   - Student---------- ☐
   - Office worker---------- ☐
   - Other (specify) ---------- ☐
6. How long have you been in Bahir Dar?
   - < 1 year---------- ☐
   - 1-2 years ---------- ☐
   - 3-5 years ---------- ☐

6-and above ----------

7. Which type of trip purpose constitutes most of your time?

Work Trip ----------

Educational Trip ----------

Shopping ----------

Recreational ----------

Walking ----------

8. How do you perceive the level of road traffic accident problems in Bahir Dar?

A big problem ----------

A moderate problem ----------

Not a problem ----------

9. Have you faced / observed traffic accidents in your journey?

Yes ----------

No----------

10.If your answer is ''yes '' in question No 9, how many times?

One time ----------

Two times ----------

Three times ----------

Four times----------

11. If your answer "yes" in question no 9 have the accidents been reported or registered with traffic police?

Yes----------

No----------

12. Which types of collision or road accidents were highly prevailing in the town?

Motor vehicle with motor vehicle ---------

Motor vehicle with bicycle ----------

Motor vehicle with pedestrians ----------

Motor vehicle with static object ----------

Bicycle with bicycle ----------

Bicycle with pedestrians ----------

Bicycle with horse drawn carts ----------
Horse drawn cart with pedestrians --------
Others (specify) ----------

13. How frequent do you have to leave sidewalks and walk along roads?

Always----------
Some times--------
Rarely----------
Never do this-------

14. While walking along roads, do you walk with your

Face to the on coming vehicles---------
Back to the on coming vehicles ----------

15. Do you understand traffic signs, signals and road marks while you are moving along streets?

Yes----------
No----------

16. Have you give way / priorities to vehicles as required by law

Always----------
Some times---------
Never----------

17. Where do you usually cross the main roads?

At traffic light----------
At junction----------
At mid-block pedestrian crossing away from junction---
At any point----------

18. Crossing the main roads in the town is:

Difficult----------
Easy----------

19. How do you rate drivers give priorities to pedestrians as required by law.

V. good----------
Good----------
Poor----------
V. Poor----------

20. Rank the following problems in their order of priority in terms of endangering your safety, which

creates by driver's error.

High speed of vehicles---------- ☐

Not give priorities, to pedestrians---------- ☐

Lack of enforcements---------- ☐

Limited number of properly designed pedestrian crossing ------- ☐

Others (specify) ---------- ☐

21. Are drivers failing to maintain traffic rules and regulations in the presence of traffic police would be penalized for their law effective?

Always---------- ☐

Some times---------- ☐

Never---------- ☐

22. How do you rate the traffic police commitment to their duties?

V. good---------- ☐

Good---------- ☐

Poor---------- ☐

23. Have you ever got education about road safety rules by concerned officials?

Yes---------- ☐

Not yet---------- ☐

24. Who is your source of knowledge and experience about road safety rules?

My self ---------- ☐

Parents---------- ☐

Schools---------- ☐

Traffic police--------- ☐

Media---------- ☐

25. Suggest some possible solutions to prevent and reduce road traffic accidents in Bahir Dar?

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_____

_____

B. Questionnaire for School Children Traffic Safety

Please choose an answer and mark it for the following questions.

1. Address (Kebele)
2. Sex
   - Male---------- ☐
   - Female-------- ☐
3. Age ----------
4. Are you afraid of traffic accidents in your way to school?
   - *Yes*---------- ☐
   - *No*---------- ☐
5. Crossing the road is
   - *Difficult*---------- ☐
   - *Easy*---------- ☐
6. What type of wheeled vehicle does you often afraid on your way to school?
   - Motor vehicles ---------- ☐
   - Bicycles---------- ☐
   - Horse drawn carts ---------- ☐
7. Do you recognize the safer way of walking along the streets relative to on coming vehicles?
   - Yes ---------- ☐
   - No---------- ☐
8. Have you got any road safety education by concerned bodies?
   - Yes---------- ☐
   - No---------- ☐
9. Who is the source of your knowledge about road traffic safety rules?
   - Schools---------- ☐
   - Traffic police ---------- ☐
   - Television---------- ☐

C. Questionnaire (to be filled by drivers)

1. Address (Kebele)
2. Sex
3. Age
4. Educational level

   Illiterate---------- ☐

   Read and write / informal ------- ☐

   Primary education (1-8) ---------- ☐

   Secondary education (9-12) ----- ☐

   Above secondary---------- ☐

5. Level of License

   None ---------- ☐

   First level---------- ☐

   Second level------- ☐

   Third level--------- ☐

   Fourth level------- ☐

   Fifth level---------- ☐

6. How long have you been driving in Bahir Dar?

   Less than one year ------- ☐

   1-2 years ---------- ☐

   2-5 years ---------- ☐

   5-10 years ---------- ☐

   >10 years---------- ☐

7. Which type of vehicle do you normally drive?

   Private car---------- ☐

   Commercial car drivers---------- ☐

   Governmental---------- ☐

8. How many years is the vehicle give service in Bahir Dar which you drive?

   < 2 years---------- ☐

   2-5 years---------- ☐

5-10 years---------- ☐
>10 years ---------- ☐

9. Where do you often parking your motorcar?

On street---------- ---------- ☐
Park area ---------- ☐
In front of commercial / office area------- ☐

10. When you drive, what is your normal speed (approximate) in the town?

< 20 km/ hr---------- ☐
20-30 km/hr---------- ☐
30-40 km/hr---------- ☐
40-50 km/hr- ---------- ☐

11. When you drive, have you give way priorities to pedestrians as required by / law?

Always---------- ☐
Some---------- ☐
Never---------- ☐

12. How do you rate pedestrians respect ion for vehicles in giving priorities where necessary?

Good---------- ☐
Moderate------ ☐
Poor---------- ☐

13. How do you perceived the level of road accidents problems in your town?

A big problem ---------- ☐
A moderate problem--------- ☐
Not a problem---------- ☐

14. Are you faced/ observed accidents while driving in the town roads?

Yes---------- ☐
No---------- ☐

15. If you are involved in accidents how many times?

One---------- ☐
Two---------- ☐
Three---------- ☐
Four---------- ☐

16. If you are involved in accidents have it reported or registered with traffic police?

Yes---------- ☐

No---------- ☐

17. How many times you convicted by traffic police for your traffic law-offensives?

One-------- ☐

Two-------- ☐

Three------- ☐

Four----------☐

18. How do you rate the traffic police commitment to their duties?

V. Good---------- ☐

Good ---------- ☐

Poor---------- ☐

V. Poor---------- ☐

19.Do you have a trust on the current driving testing and training procedures?

Yes---------- ☐

No---------- ☐

20.Have you got additional education or training about road safety by concerned bodies?

Yes---------- ☐

Not yet------ ☐

21. Suggest some possible solutions to prevent and reduce road traffic accidents in Bahir Dar?

_____

_____

_____

D. Questionnaire (to be filled by cyclists)

1. Address (Kebele)----------
2. Sex----------
3. Age ----------
4. Educational level----------
5. Occupation ----------
6. How much experience do you have, in total, of riding a bicycle?

   Less than 1 year----------☐

   1- 2years ---------- ☐

   2- 5 years ---------- ☐

   5- 10 years---------- ☐

   More than 10 years---------☐
7. Which type of trip propos constitutes most of your cycling time?

   Work trip ---------- ☐

   Recreational----------☐

   Educational ----------☐

   Shopping----------☐

   All purpose----------☐
8. Had you faced accidents on your journey by riding bicycle?

   Yes---------- ☐

   No---------- ☐
9. If you had faced road accidents how may times?

   One---------- ☐

   Two-------- ☐

   Three------- ☐

   Four--------- ☐
10. Was the accidents you faced reported/ recorder by traffic

    Yes---------- ☐

    No---------- ☐
11. In which time of a day bicycle accidents are highest?

    Daytime---------- ☐

    Nighttime-------- ☐

12. In which roads/ locations of the town roads bicycle accidents are the highest?

    On the main roads---------- ☐

    On the residential roads--------- ☐

13. Rank the following bicycle accidents in their order of priority, which prevail in the town roads?

    Collision with motor vehicles---------- ☐

    Collision with bicycles---------- ☐

    Collision with pedestrians---------- ☐

    Collision with a static object--------- ☐

    Collision with horse drawn carts------- ☐

    Falling while driving---------- ☐

14. Rank the following major causes of s bicycle accidents in their order of priorities.

    Negligence of pedestrians for cyclists---------- ☐

    No priorities given to cyclists by motor car drivers------- ☐

    Absence of segregated lane for bicycles---------- ☐

    Poor road conditions---------- ☐

    Speedy riding---------- ☐

    Poor condition of bicycle on the roads---------- ☐

    Lack of en for cement ---------- ☐

15. Where you thought riding bicycle is more dangerous on the town roads?

    On cross roads---------- ☐

    At traffic light ---------- ☐

    At junction roads---------- ☐

    On the stretched drive way---------- ☐

16. Do you correctly perceive traffic sign, signals and road marks when you riding bicycle along the town streets?

    Yes---------- ☐

    No---------- ☐

17. Have you gained education about road safety by concerned officials?

    Yes---------- ☐

    Not yet---------- ☐

18. Suggest some possible solutions to prevent and reduce road traffic accidents in Bahir Dar?

    1. ----------
    2. ----------