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**GIS Based Assessment of Road Traffic Accidents in
Adama (Nazerth) City**

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June, 2015

Addis Ababa

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**In Partial Fulfillment of the Requirements for the Degree of Master of Arts
in Geography and Environmental Studies with Specialization in GIS and
Digital Cartography**

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This is certifying that the project prepared by Berhane G/yesus, entitled: GIS Based Assessment of Road Traffic Accident in Adama (Nazerth) City and submitted in fulfillment of the requirements for the Degree of Master of Arts in Geography and environmental Studies with Specialization in GIS and Digital Cartography.

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Table of Contents

Contents	Page
Acknowledgment	i
Table of Contents	ii
List of Figures	v
List of Photos	vi
List of Tables	vii
Abstract	viii
CHAPTER ONE	1
Introduction.....	1
1.1. Statement of the Problem.....	1
1.2. Objectives of the Study	2
1.2.1. General-objective	2
1.2.2. Specific objectives.....	3
1.3. Research Questions	3
1.4. The Scope of the Study	3
1.5. Significance of the Study	3
1.6. Limitations of the Study.....	4
1.7. Organization of the Study	4
1.8. Materials and Methods.....	5
1.8.1. Materials	5
1.8.2. Sampling Procedure	5
1.8.3. Data collection, Processing, Presentation and Analysis.....	6
CHAPTER TWO	7
Review of the Literature	7
2.1. Overview.....	7
2.2. Dynamics of Road Traffic Accidents	8
2.2.1. Globally	8
2.2.2. Africa.....	11
2.2.3. Ethiopia	14
2.2.4. Trend of Road Traffic Accident in Ethiopia.	18
CHAPTER THREE	20

Profile of Adama City	20
3.1. Overview	20
3.2. Location	20
3.3. Climate of Adama(Nazreth).....	22
3.4. Socio-Economic Profile	23
3.4.1. Demography	23
3.4.2. Socio-Economic Aspect	24
3.4.3. Education.....	26
3.4.4. Health	27
3.5. Land Use Patterns and Master Plan	28
3.6. Topography of Adama.	32
3.7. Soil Type in Adama	33
Figure 8 Map of Soil type in Adama.	33
3.8. Road and Transport.....	34
3.8.1. Classification of Roads.....	34
3.8.2. Transportation	35
CHAPTER FOUR.....	37
Analysis of Research Finding	37
4.1. Road Traffic Accident Situation in Adama City.....	37
4.1.1. Estimated Cost of Road Traffic Accident in Adama City 2004/05 to 2013/14	39
4.2. The Temporal Variation of Road Traffic Accidents.....	39
4.2.1. Day and Night Variation.	39
4.2.2. Daily Distribution of Road Traffic Accidents	41
4.2.3. Seasonal Distribution of Road Traffic Accident	42
4.3. The Spatial Variation of Road Traffic Accidents	44
4.3.1. Place of Occurrence.....	44
4.3.2. The Distribution of Hot Spot Areas of Road Traffic Accidents.....	46
4.4. Respondents' Profile	48
4.4.1. Respondents' (officers, pedestrians, police, students and teachers) General Background.	48
4.4.2. Respondents' Related to Road Traffic Accident	50
4.5. Drivers Respondent Related to Road Traffic Accident	52

4.5.1. Profile of the Drivers	53
4.5.2. Drivers' View of Traffic Laws and Regulations	53
4.6. Finding	55
4.7. The Major Causes of Road Traffic Accidents in Adama City.....	56
4.7.1. Drivers' Characteristics	56
4.7.2. Pedestrians' Characteristics.....	57
4.7.3. Vehicle Characteristics	58
4.7.4. Road Environment.....	59
4.8. Traffic Law and Legislation Enforcement	61
4.9. Necessity of Law Intervention.	62
CHAPTER FIVE	66
Summary, Conclusion and Recommendations.	66
5.1. Summary and Conclusion	66
5.2. Recommendations.....	70
Bibliography	71
Appendices.....	74

List of Figures

	Page
Figure 1 Traffic Accident Deaths worldwide by sex and age group -----	9
Figure 2 Traffic Accidents trend in Percent in central part of Ethiopia -----	19
Figure 3 Location of Adama map -----	21
Figure 4 Map of Adama City -----	21
Figure 5 Mean Monthly Distribution of Rain fall in Adama-----	22
Figure 6 Monthly Average Temperature Distribution of Adama-----	22
Figure 7 Contour Elevation Model Map-----	32
Figure 8 Map of Soil Type in Adama-----	33
Figure 9 Graph of RTA in Adama -----	38
Figure 10 Road Traffic Accident Variations in 24 Hours-----	40
Figure 11 Graph of Daily Variation of Road Traffic Accident in Adama-----	42
Figure 12 Graph of Spatial Variation of Road Traffic Accident in Adama-----	43
Figure 13 Map of Spatial Road Traffic Accidental Areas-----	45
Figure 14 Graph of Spatial Variation of Road Traffic Accident in Adama-----	45
Figure 15 Graph of Victims of Road Traffic Accident by age and sex in Adama-----	46
Figure 16 Location Maps of Hot Spot Areas -----	48

List of Photos

Photo 1	Driver who do not wear seat belt in Adama -----	11
Photo 2	Accidents of Vehicles around Kaliti, Addis Ababa -----	18
Photo 3	View of the Adama city entering from Addis Ababa -----	29
Photo 4	Aerial photo of Adama -----	31
Photo 5	Driver's not giving priority to other vehicles and driving along pedestrian walk way-	57
Photo 6	crossing the main road outside of Zebra-Crossing -----	58
Photo 7	Congestion of Bajaj vehicles around commercial center (Nur-gebeya) and Derartu Avenue-----	59
Photo 8	Bicycle with Isuzu vehicle crash along out let to Assela road -----	60
Photo 9	Out let to Harar main road from Adama city -----	61
Photo 10	Road traffic congestion and Lessazfaire traffic police controlling -----	64
Photo 11	Poor maintenance of road out let to Wonji-Shewa -----	68
Photo 12	Bicycle use Derartu Avenue vehicle congestion road -----	69

List of Tables

Table 1 various modes of transport that killed road users -----	10
Table 2 Top 20 nations by road traffic accident -----	12
Table 3 Road traffic safety in African countries -----	13
Table 4 Road traffic safety in Ethiopia -----	15
Table 5 Regional number of traffic accidents -----	16
Table 6 Accidents of main cities in Ethiopia -----	17
Table 7 Population Characteristics in Gender -----	23
Table 8 Number of schools and teachers -----	26
Table 9 Number of students in Adama -----	27
Table 10 Health Information -----	28
Table 11 Health workers and professional-----	28
Table 12 Road types in Adama -----	35
Table 13 Transportation Characteristics in Adama -----	36
Table 14 Road traffic accident situation-----	37
Table 15 Estimated cost of property damage -----	39
Table 16 Road traffic accident variation in 24 hours -----	40
Table 17 Daily variation of road traffic accident -----	41
Table 18 Seasonal variation of road traffic accident -----	43
Table 19 Road traffic accident by place -----	44
Table 20 Road traffic accident victims by age and sex -----	46
Table 21 Accident Spot Areas -----	47

Abstract

Adama (Nazerth) has become one of the traffic accident city in Ethiopia. In the city the numbers of fatalities, injuries, property damage and economic as well as social lose is increasing from time t time.

The aim of the study is t identify and locate accident spot areas, temporal and spatial variation, the incident causes, effects and arrive at effective counter measures that can bring about a behavioral change for road traffic accidents in Adama city.

The methods and procedures used in gathering the study data from the records or reports of traffic police. The primary data collected by questionnaires with close ended and open ended of two types. The first questionnaire is filled by officers, pedestrians, police, students and teachers of section of the population which consist sample of 80 which equally distributed 16 for each category of people. The second questionnaire is filled by the drivers' consists of 60 sample size. The questionnaire filled by automobile, Bajaj, minibus, cyclists, truck and bus drivers randomly distributed. Descriptive analysis of the magnitude and variation of road traffic accidents collected from traffic police records as a form of secondary data. In order to investigate road traffic accident the research employed GIS techniques to identify accident spot areas.

The result of the study revealed that occurrence of road accidents: fatalities, slight and serious injuries and property damage in the city showed an increasing trend. From unevenly distributed 1949 spatially road traffic accidents from the study period 2004/05 to 2013/14, 264 were death, 283 were serious injuries, 359 slight injuries and 1043 were property damage. The communication between traffic police and drivers' seem unfair that one might benefit the other when committing violation of rule and regulation of traffic law rather educational measurement. Most of the drivers did not report an accident for the traffic police to take immediate measure. At the driver side wearing of seat belt, for some consuming alcohol and drug and using mobile phone when driving vehicles are problems identified the role of the pedestrians are also identified particularly when crossing road side in proper way. The study generally comments the way how to minimize road traffic accident with collaboration of government and other stake holders to intervene in the road traffic accident in Adama.

Key Words: Accident Spot areas; Road Network; Road Traffic accident; Road Safety Law and Enforcement.

Acronyms

<i>CAD</i>	<i>Computer Aided Design</i>
<i>CSA</i>	<i>Central Statistics Authority</i>
<i>EC</i>	<i>Ethiopian Calendar</i>
<i>ETB</i>	<i>Ethiopian Birr</i>
<i>ESRI</i>	<i>Environmental Systems Research Institute</i>
<i>GIS</i>	<i>Geographic Information System</i>
<i>GNP</i>	<i>Gross National Product</i>
<i>GPS</i>	<i>Ground Positioning System</i>
<i>KM</i>	<i>Kilo Meter</i>
<i>MADD</i>	<i>Mothers against Drunk Driving</i>
<i>NASA</i>	<i>National Aeronautics and Space Administration</i>
<i>RTA</i>	<i>Road Transport Agency</i>
<i>SD</i>	<i>Standard Deviation</i>
<i>UN</i>	<i>United Nations</i>
<i>WB</i>	<i>World Bank</i>
<i>WHO</i>	<i>World Health Organization</i>

CHAPTER ONE

Introduction

Road traffic accidents- is the tenth leading cause of death globally-now make up a surprisingly significant portion of the worldwide burden of ill-health. An estimated 1.2 million people and killed in road crashes each year, and as 50 million are injured, occupying 30 percent to 70 percent of orthopedic beds in developing countries hospitals. And if present trends continue, road traffic injuries are predicted to be the third leading contributor to the global of disease and injury by 2020(WHO, 2002).

When come to Ethiopia, according to the latest who data published in April 2011-road traffic accident deaths reached 22,786 or 2.77 percent of total deaths. The age adjusted death rate is 37.83 per 100,000 of population ranks Ethiopia number 12 in the world. Road traffic accidents are becoming a major public safety and development obstacle. Pundits said that the current situation necessitates high level of political dedication and immediate action. Various studies have indicated that Ethiopia has one of the highest fatality rates per vehicle in the world. It is in excess of 100 fatalities per 10,000 vehicles. This should be compared with Kenya and United Kingdom, where the figure is about 19 and 2 per 10,000 vehicles respectively. Ethiopia loses about \$65million annually due to traffic accidents. In addition, the victims are mainly public transport travelers in the working age group (18 to 30 years) (Zegabi, East African News January2014).

In this study, the growing problem of road traffic accidents particularly in Adama (Nazreth) with particular reference to the magnitude, risk factors, interventions and research are the major priorities. It is also assessing the traffic crashes, deaths fatal injuries and property damages for the last 10 years traffic accidents and traffic black spot areas will be evaluated. It is also the road situation/status and vehicle types and drivers qualification undertaken.

1.1. Statement of the Problem

There are different modes of transport such as air, water and land transport. Land transport is the second cheapest (after water) mode of transport. Road transport, though it is preferred since it gives door to door service, it is the most vulnerable to traffic accident than any other mode of transport. Today, however, a certain blight or difficulty has settled in the world increasingly, people face difficulties when moving from place to place. Despite the important

positive role the sector, it also is generating social, economical, political and environmental problems (Abraham Mengesha December, 2008).

In, Ethiopia the rate of traffic accidents is very high; because of road transport is the major transportation mechanism along with poor road infrastructure, poor enforcement of traffic laws and other factors. In some regional state main cities of Ethiopia, the road traffic accident seem highest in Bahir Dar then at Mekele, Adama, Harar, Dire Dawa and Addis Ababa respectively(Federal Traffic Police Data2007).

In Adama (Nazareth), the road traffic accident is serious that many people lost their life and injuries a large number of people and damage of properties which has relatively high collision record. Previous studies were shown on the major problems of traffic accidents have resulted from transportation development, road safety, increasing number of modern vehicles added to the existing old vehicles, vehicle traffic congestion, illegal on street parking habit, poor land use, long travel time, illegal way of getting license, less driving experience, human behavior, alcohol consumption (Heidi Worley, version1,2002). There will be a serious gap of adequate and reliable data collection system, particularly in the study of road traffic accident in Adama city (Nazareth). I think there is no road traffic accident written material in Adama city (Nazareth).In this study, road size is not fit with the number of vehicles (Bajaj), bicycles which go on the same road with other heavy trucks/vehicles. Although, using GIS as a tool to analyze road traffic incidents has not received much academic attention because of recent phenomena. It lies in the field crime mapping which is becoming increasingly important. However, there is growing concern of road traffic accident for the city's socio-economic, political and behavioral change towards future development almost free from traffic accident. The impact of road traffic accident associated with its effect on loose of economically productive age group and children future being adult person. The other reason why the problem is of concern is that cost, of damage properties to cover expenses following loss which is hinder the city's development in general and the victim in particular.

1.2. Objectives of the Study

1.2.1. General-objective

The general objective of the research is to identify and locate accident spot areas, temporal and spatial location and the incidence causes, effects and arrive at effective counter measures that can bring about a behavioral change for road traffic accidents in Adama City (Nazareth).

1.2.2. Specific objectives

The Specific Objectives of the Study are:

- To map the spatial and temporal distribution of road traffic accident and accident hot Spots in Adama city.
- To identify major causes of road traffic accidents occurrence in Adama City with respect
- To drivers, pedestrians, vehicles and road environments examine the road policy in relation to use, safety and penalty.

1.3. Research Questions

What are the factors and characters of road traffic accidents in Adama City (Nazareth)?

What type of road transport in the city highly involved in traffic accidents?

Is there a relationship between the road use and the application of traffic regulation in the city?

Why the accident hot spot areas considered as concentration of road traffic accidents?

1.4. The Scope of the Study

The study is confined to one of the major cities of Ethiopia, Adama City (Nazareth) which has a record of high causality rank in the country. Among different factors of accident, such as drivers' factor, pedestrians' factor, mechanical factor of vehicles, road environment, and congestion of small passenger vehicles (Bajaj), Commercial vehicles the most vulnerable and bicycles. The study focused on the major causes and consequences of the spatial and temporal variation of traffic accident in Adama including identification of accident spot areas.

1.5. Significance of the Study

Adama city (Nazareth) is one of the cities which have higher traffic accident characterized by being the junction of four main transport routes that connect to different parts of the country to Addis Ababa, to Djibouti/ Harar, to Wonji and to Arsi-Bale. The city has a big and strategic vision of being/to become a center of trade/commerce and conference for the whole

Ethiopia, and the Oromiya Regional State in particular. Fortunately the city is located at the center and nearby distances of natural tourist attractions, specially natural and historical tourist centers in Oromiya Regional State, South Nation Nationalities and Peoples Regional State, including Afar and Harar Regional State.(Adama City Municipality,2012)

Accordingly, the study is helpful to give insight in to road traffic accident and managing risk exposure with land use planning, designing roads for safety, providing visible, crashworthy, setting road safety rules and improving transport policy. Although it is important to public keeping themselves from traffic accident, Ethiopian road authority to make decision to do a road in safety manner, traffic office/department to concentrate causes and possible measures for accidents to be taken, driver to learn from different mistakes that has done and for researchers for those who are doing on similar topic as possible.

1.6. Limitations of the Study

One of the main objectives of this thesis is investigating the extent, causes and possible remedies for road traffic accidents in Adama (Nazreth).However, the format used by traffic police was not fully appropriate to provide accident data as necessary by age, sex occupation, education level. Apart to this traffic police Commitment to get data on time bounded, Since I am self sponsor lack of financial and time constraints to stay more in the study area, the research focused on selected streets and road users and other group of people officers, police, students and teachers. Moreover, underreporting problem, cooperating to give information such as Adama Transport Agency and lack a significant level of consistency and the statistics obtained is not complete.

1.7. Organization of the Study

The research paper is organized under six chapters with different sub-sections. The preceding Chapter is n introductory part, which includes general back ground of the study, statement of the problem, objectives of the study, research questions, and scope of the study, significance of the study, limitation of the study, def materials and methods and definition of basic terms. Chapter two highlights review of literature 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 Analysis and Research Findings. Chapter five Summery, Conclusion and Recommendations. Finally, Bibliography and Appendices are attached at the end of the text.

1.8. Materials and Methods

1.8.1. Materials

The main sources of data for this study were primary and secondary data. To identify the magnitude of road traffic accident and its effects, primary data were collected from drivers, concern bodies with the help of closed ended and open ended questionnaires prepared for each group. Observation is also part of this study. In order to get ample information about the roads safety problems of the Adama (Nazareth) city, traffic police men and other officials were consulted. It also used gaps to identify and locate accident hot spot areas in the city.

Secondary data was obtained from the Adama City Municipality, Adama Traffic Police Department, Adama Transport Agency, and Adama City Statistics Agency. Moreover, different books, journals of WHO and World Bank, articles and reports publication were also conducted. Furthermore, so as to get a general picture of road safety problems, a good closure was made with internet web sites.

1.8.2. Sampling Procedure

The study identified six accident hot spot areas and four main streets in Adama (Nazareth) city that are characterized by a dense vehicle and pedestrian movement. To get Key information, I select group of people who were met during the time of visits simple randomly selected and questionnaire distributed in these areas. In order to select these sample streets and concern populations the researcher first assessed the recorded road traffic accident by traffic police and conducted pilot surveys in the city for (Monday to Friday) in January, 2015. In respect with the distribution of the number of accidents among main streets, the traffic police data of 2004/2005 to 2013/2014 indicates that above 50 percent of the accidents indicate how many people covered in the survey as shown in the city, namely:

1. From Post Office(Derartu) Avenue to Harar Road Outlet
2. Kebele 04 Bole Road Street
3. From wonji Avenue to Pan-Affric Hotel towards Addis Ababa Outlet
4. Avenue of Saint Marry church
5. From Tikur Abay to Boku Michael Assela Road way
6. Derartu Tulu Avenue Center Part of the City.

1.8.3. Data collection, Processing, Presentation and Analysis.

In order to systematically solve the problems, both the qualitative and quantitative research methodology was used in the survey. The qualitative research methodology has helped the writer to explore the behavior and attitudes of the pedestrians and drivers, while the quantitative research methodology has helped to generate the road accident statistics from the traffic police and part from the respondents. The methodology employed to analyze the data descriptive statistics and parameters. Thus, the organized data classified and tabulated were transferred in to tables, figures, graphs and maps have been analyzed and interpreted using descriptive methods. To test the magnitude of relationship between dependent variable (accident) and independent variable (accident factors), percentage and other accident analysis parameters were also applied.

In this research, using Arc GIS 10.1 software analysis, the available data in AutoCAD format are converted in to ESRI shape files. Before exporting these files to Arc GIS the data was cleaned and topological rules are defined in Auto CAD Map 2010. This could be especially for the road network and the black spot areas to indicate on map. This was also corrected in AutoCAD by taking the paved road as reference. Finally, all shape files are transformed to Ethiopian Coordinate system which is WGS1984 zone 37° N.

CHAPTER TWO

Review of the Literature

2.1. Overview

As the number of motor vehicles and vehicle mile of travel increases, exposure of population to traffic accidents also increases. Road traffic accident is an accident with causal participation of road users in road transport (public roads, paths and squares), its regulation is an important area of traffic civil law. Road safety is complex of factors which ensure the safe situation for the traffic and pedestrians on the roads, preventing from accidents and dangerous situations (WHO, 2002).

According to (Webster's Dictionary, 1976) the term traffic, from the point of view of road transport is defined as the flow of vehicles and pedestrians along a route. The term traffic congestion is also defined as an overgrowing of pedestrians and vehicles along a route.

The term "traffic" can mean movement of people and vehicles on along roads and streets, or air craft's in the sky. However, the actual meaning of traffic usually sights and road markings which are to function in regulating, warning, guiding, and channelizing traffic. The term traffic control refers not only to road, rail, sea and air transportation but also the traffic of shoppers in a supermarket, the flow of paper in large offices and the movement of component on an assembly line (WHO, 2008).

Traffic, traffic congestion and road safety are terms used repeatedly in the assessments of road safety problems. Road safety refers the movement of pedestrians and vehicles along a street over a given area. When the flow of pedestrians and vehicles is not smooth and it is interrupted by accident causalities, most probably triggered by traffic congestion or other factor, then the safe movement will be replaced by traffic accident. Therefore, traffic accident and road safety are said to have an inverse relationship between each other (Adeolalu, A., 1977).

According to (Wikipedia, the free encyclopedia, 1984) the term road traffic laws/regulations are the law which govern road traffic and regulates vehicles in order to facilitate the orderly and timely flow of traffic.

Road safety is a multi-sect oral subject which cannot be delivered by a single agency. In practice, road safety is shared responsibility national, regional and local level. It requires government and non-government agencies and the civil community to foster effective goals.

Government leadership and action is decisive to provide adequate funding, set targets, introduce intervention programmers, delivery to partnerships with all key stakeholders and ensure effective implementation and monitoring arrangements. Road safety laws and regulation are also essential to reduce accidents since they govern road users, by the state policy. The development of road safety policy involves a wide range of participants representing a diverse group of interests such as government legislative bodies like transport, health, education, finance; users citizens, industry, police, non-governmental organizations especially interest groups, professionals, media to formulate road injury prevention policy(European Road Safety Observatory in the year 2006).

2.2. Dynamics of Road Traffic Accidents

2.2.1. Globally

Road traffic accidents-the leading cause of death by injury and tenth-leading cause of death by injury and the tenth-leading cause of all deaths globally- now make up a surprisingly significant portion of the worldwide burden of ill-health. An estimated 1.2 million people are killed in road crash each year, and as 50 million are injured, occupying 30 percent to 70 percent of orthopedic beds in developing countries hospitals. And if the present trends continue, road traffic injuries are predicted to be the third leading contributor to the global burden of disease and injury by 2020. Road traffic accident injuries are predictable and preventable, but good data are important to understand the ways in which road safety interventions and technology can be successful transferred from developed nations where they have proven effective. Awareness of the consequences of road traffic injuries is lagging among policy makers and the general public. What needed is in corporation of comprehensive road safety programs in to national planning in developing countries. In developed countries, road traffic death rates have decreased since the 1960s because of successful interventions such as seat belt safety laws, enforcement of speed limits, warnings about the dangers of mixing alcohol consumption with driving, and safer design and use of roads and vehicles. For example, road traffic fatalities declined by 27 percent in the United States and by 63 percent in Canada from 1975 to 1988. But traffic fatalities increased in developing countries during the same period by 44 percent in Malaysia and 243 percent in china. More than one half of all road traffic deaths globally occur among people ages 15-44 their most productive age group accounts for 60 percent of all daily lost because of road traffic accidents. The costs and consequences of these losses are significant. Three-quarters of all poor families who lost a member to road traffic death reported a decrease in their standard

of living and 61 percent reported they had to borrow money to cover expenses following their loss (Heidi Worley, Version 1, 2002).

According to the World Bank (2012) estimation, road traffic injuries cost 1 percent to 2 percent of the Gross National Product (GNP) of developing countries, or twice the total amount of development aid received worldwide by developing countries. As in developed countries, driver impairment component of road traffic accidents in developing countries. Driving at excess speeds, while under the influence of alcohol or drugs, while sleepy or tired, when visibility is composed, or without protective gear for all vehicle occupants are major factors in crashes, deaths and serious injuries.

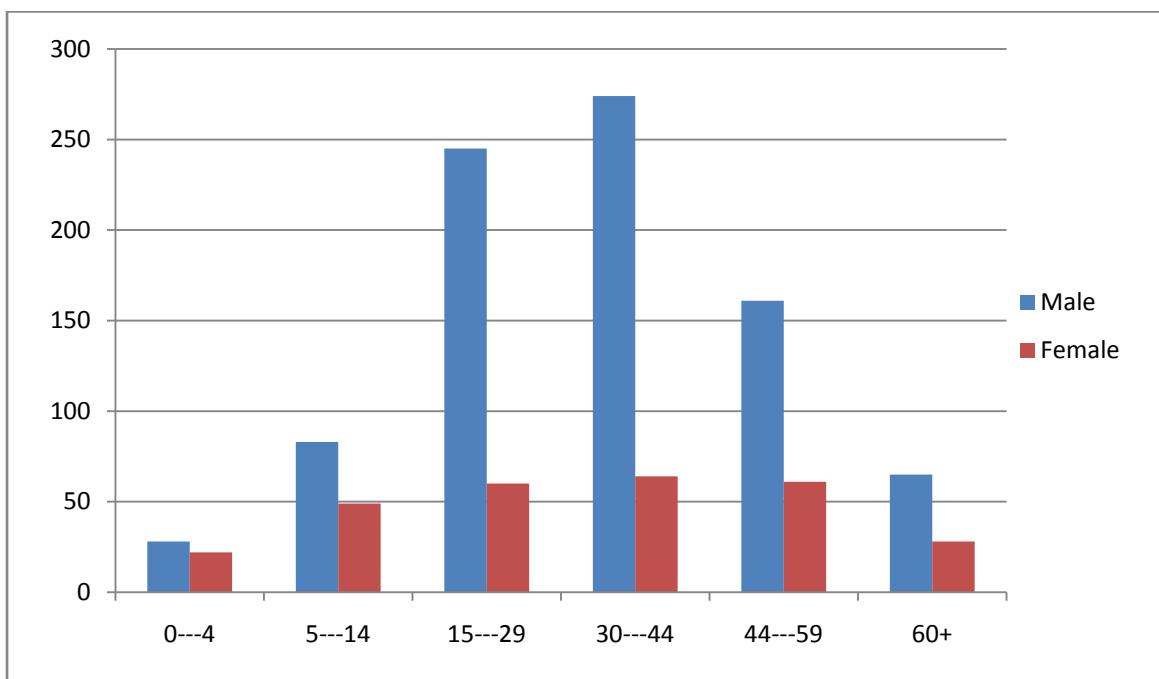


Figure 1 Traffic accident deaths worldwide by sex and age group. *Number of deaths in thousand. Source: WHO, Global Burden of Disease Project, Version 1, 2001

In general, pedestrians, cyclists and moped and motor cycle riders are the most vulnerable road users as well as the heaviest users of roads in poor countries. Most people who use public transportation, bicycles, or mopeds and motor cycles or who habitually walk are poor, illuminating the higher risk bores by those from less privilege. In Asia, for instance, motorized two-and three-wheelers (such as motorized rickshaws) will make up the anticipated growth in numbers of motor vehicles (Dinish Mohan,2002).

Proportion of road users killed in various modes of transport as a percent of all fatalities, selected countries. In general, pedestrians, cyclists, and moped(a motor cycle with a small

engine and has also pedal) and motor cycle riders are the most vulnerable road users as well as the heaviest users of roads in poor countries. Most people who use public transportation, bicycles, or mopeds and motor cycles or who habitually walk are poor, illuminating the higher risk bores by those from less privilege. In Asia, for instance, motorized two-and three-wheelers (such as motorized rick shawls) will make up the anticipated growth in numbers of motor vehicles (Dinish Mohan, 2002).

Table.1 Various mode of transport that killed road users.

Country	Pedestrians	Bicyclists	Motorized vehicles		Others
			Two-wheeled	Four-wheeled	
Thailand	47	6	36	12	-
Malaysia	15	6	57	19	3
United States	13	2	5	79	1

Source: Dinish Moha,2002

Road traffic accidents are one of the significant causes or disability, injury and death in the world. India has the highest road traffic accident rate globally with over 140,000 deaths annually, beating even China. Every hour, nearly 14 lives are lost due to road accidents in India. More than 40% of the deaths are caused by trucks and two-wheelers. Most accidents occur in the afternoons and peak hours (especially in the evening) considered an ‘unsafe’ or dangerous time to be in the road. In 67% of these accidents there is head injury. Most drivers do not wear seat belts or those on two-wheelers do not wear a helmet though it is compulsory in many states of the country, the rules are broken all the time (WHO, 2012).

This Indian condition is also similar to my study area of Adama. Most drivers in Adama do not wear helmet as well as seat belts during my observation and catching in photograph. The accident duration is almost similar that in afternoon time towards night is common.

Photo 1 Driver who do not wear seat belt in Adama.



Source: Photograph, 2015

2.2.2. Africa

According to WHO, 2004 Road traffic accidents kill more people around the world than malaria, and are the leading cause of death for young and youth aged 5 to 29 especially in developing countries.

The Global Status Report Road Safety (2013) has found that the risk of dying as a result of road traffic injury is highest in African region. The African continent recorded an average of 24.1 out of 100,000 populations dying as a result of road crash in a year. The severity of road traffic crashes is likely to be much greater in Africa than any were else, because many vulnerable road users are involved, poor transport conditions such as lack of seat belts, mobile phoning while driving, and hazardous vehicle environments.

The tendency of road traffic accident to cluster or concentrate at spots on road sections usually known as “black spots” or “accident spots” is very common on roads. These spots can be considered as source of spatial information on road accidents. Identification of such spots helps the enforcement arm of the government, in conjunction with the implementing agencies of the government to put remedial measures to alleviate the occurrences of road traffic accidents. However, more precise information needs to improve the road facility so that driving can be dining safety at these spots (Sauna et al., 1996).

The poor reporting system also masked the magnitude of the problem in Africa. The lack of pre-hospital and hospital emergency care after accidents makes the outcome of car accidents in Africa road deaths (48.4 per- 100,000 people), Egypt (41.6), Libya (40.5), Ethiopia (35.0), Sudan (34.7), Guinea-Bissau (34.4), South Africa (33.2) (WHO, 2009).

Road traffic accidents in Africa are expected to rapidly increase over the next four decades, becoming a major public health challenge across the continent. Currently, road traffic accident worldwide is estimated to claim the lives of 1.4 million people per year and injure an additional 20-50 million. By 2050 the international futures for casting model anticipates that global traffic deaths will surpass 3 million people per year. This forecast shows that Africa will be particularly hard hit and will account for over 1 million of these deaths, or 35 percent of the global total. To put this in perspective, by 2050, traffic accidents in Africa will kill almost the same number of people annually as now die from HIV/AIDS in east and Southern Africa combined. And, for every 20 Africans who die in 2050, one will be killed in a traffic accident. However, despite the significant numbers of Africans being injured or killed in this way, road traffic accidents do not receive the same coverage as other public health issues such as HIV/AIDS, tuberculosis and malaria. African countries experience a dramatic increase in the number of vehicles on the road. Very often, such increases in road traffic accident are not matched by adequate improvements in infrastructure and road safety legislation. This results in lag between private expenditure on vehicles and the public expenditure necessary to accommodate increased motorization (African Futures Brief, 2012).

Table2 Top 20 Nations by Road traffic Accident

Rank	Top African, Middle East and Asian Nations by Road Traffic Accident			Remark
	Nations	Reported Number of death	Estimated Death Rate	
1	Eritrea	81	48.4	This figure ranks the countries based on estimated road deaths per 100,000 populations.
2	Cook islands	6	45.0	
3	Egypt	15,983	41.6	
4	Libya	2,138	40.5	
5	Afghanistan	1,179	39.0	
6	Iraq	1,932	38.1	
7	Angola	2,358	37.7	
8	Niger	570	37.7	
9	United-Arab Emirates	1,056	37.1	
10	Gambia	54	36.6	
11	Iran	22,918	35.8	
12	Mauritania	262	35.5	
13	Ethiopia	2,441	35.0	

Source: Allianz/WHO Status Report, 2009.

Different Authors Who Investigated About African Road Traffic Accident Including Ethiopia.

Table 3 Road Traffic Safety in African Countries.

Author	Date	Objective	Methodology	Finding	Key Words
Dr.L.M.Museru	August,2002	To provide information on the type of intervention necessary for various stages and will also show the true burden of injury in Tanzania.	Data sources were police records, medical records, research reports, articles, statistics, abstracts and national news papers.	Drivers' inappropriate behaviors defined by police as reckless or dangerous driving contributed nearly 52% of the different reasons cited as contributory causes.	Road traffic accidents, patterns associated injuries and death.
Dr.GregChen	September,2009	To update the status, trends, causes, existing countermeasure, and issues in traffic safety, facing African countries.	Journals from diverse disciplines, such as traffic safety, injury prevention, medicine, economics, public health and general social science, as well as localized journals in African countries.	Human behavior and incapacitation as a group account for more than 85% of the factors reported by police. Unlike to developed countries.	Traffic safety; Road traffic crashes; Injuries and fatalities; African Countries, contributing factors counter measures; Evaluation.
Wilson Odera	September,2003	To improve the collection and availability of accurate data to help increasing traffic injury as a priority public health problem, raising awareness of policy makers on existing counter measures and mobilizing resources for implementation.	A descriptive analysis of road traffic accidents data using routine police records.	The temporal trends, the spatial distribution between rural and urban, the vehicles such as mostly frequented reported crashes, injury, road severity mostly vehicle pedestrian collisions.	Kenya; Injury; Traffic; Road crashes; Highways.

Source: Journal Articles of Africa, 2002/2003.

In relation to the study area Adama, the authors used secondary data sources especially the police registration of the accidents. What makes different was GPS tool to locate areas and map.

2.2.3. Ethiopia

Ethiopia is one of the worst countries in the world where road transportation kills and injuries are in large number of road users every year. In Ethiopia, traffic police reports are the official sources of data for road-related incidents. In Ethiopia, the rate of road traffic accidents is very high; because of road transport is the major transportation mechanism along with poor road infrastructure, poor enforcement of traffic laws and other factors (WHO, 2009).

In Ethiopia each year more than two thousand people die and ten thousand people injured in road traffic clashes.(Ethiopian Federal Police Report, 2010/2011).

Road traffic accident, the 10th most important killer globally, ranked 13th in Ethiopia (See Table2). According to a study of the Swedish medical university, fatalities related to traffic accident in the country have a proportion of 70 to 100 for every 10,000 vehicles, which means in every 5 accidents kill 1 person on average (WHO Report, 2012).

Like other low income countries, the traffic controlling system is not that much supported by modern technological instruments in Ethiopia. Currently, the country is almost using relatively simple and outdated controlling methods which had been applicable before several decades. It seems that more sophisticated optimization methods are failed for networks. Modern instruments such as traffic speed enforcement hand-held radar and alcohol breath tester, among others, is still not introduced in the country. Of course, according to studies most traffic accidents are the result of speed, lack of road signs and driver's impairment of judgment. Many say that speed, drunk driving and lack of enforcement are said to be the causes of the major failures of the traffic system in Ethiopia. Within a year, over 2,000 people die while over 8,000 are vulnerable to light and heavy injuries are properties worth over 500 million birr get damaged in the country because of road traffic accidents. Most importantly, Oromiya regional state is one of the traffic flow is usually high because of its location obviously vehicles from the 8 states and Dire Dawa City Administration pass through this region to come to the capital city of Addis Ababa (Samuel Taye, 2012).

The Oromiya Regional State is one of the largest states in Ethiopia. This improved road safety policy include the new road safety laws prohibition of cell phone conversation while

behind the wheel, driving without using a seat belt and not using motorcycle helmet and the amendment of an existing road safety laws (excessive speeding, impaired driving with alcohol and chat and unsafe loading) by introducing higher penalty rate including suspension of the driver license. Seat belt wearing, helmet use and phoning while driving were enforced by using a road side random check up on regular bases; however, speed and alcohol were not well enforced due to lack of radar and breath analyzer(Oromiya Regional State Road Transport Regulation No;96/2007).

Ethiopians are more likely to make use of commercial vehicles, minibuses, buses, three tire vehicles (Bajaj) to support mobility needs. Commercial vehicles have a high involvement in crashes, although there is need for exposure data to determine whether they are over-represented. It is also highly likely that these vehicles travel more kilometers per annum which contributes to both a high number of crashes and high rate. The observed trends in Ethiopia road crashes provide guidance on their current road safety problems and the challenges, and point to possible areas of counter measures, policies, and program will need to represent low-cost solutions, green economic constraints with in the country (Australian Road Safety Research, 2013).

Authors who Investigate Road Traffic Accident in Ethiopia

Table 4 Road Traffic Safety in Ethiopia.

Author	Date	Objective	Methodology	Finding	Key words
Demeke Assefa and Gezahegn Tesfaye	2012	To assess the magnitude of trends in and associated factors of Road Traffic Collisions In Central Ethiopia.	Source of data mainly police reports found between Akaki and Adama towns. Both qualitative and quantitative techniques were employed and multivariate analysis used to identify the factors associated with road traffic collisions.	Among the 2,335 collisions, 389(16.7%) resulted in death, 316(13.5%) caused severe injuries, 290(12.4%) caused slight injuries and 1,316(5.4%) caused property damage. These collisions affected about 1,745 individuals while 515(29.5%) people died, 549(31.5%) were severely injured and the remaining 681(39%) were slightly injured. Driving at Midnight, driving above the speed limit, failing to give	Magnitude, Trends Road Traffic Collision, Road Traffic Collisions Fatality.

				priority for other vehicles and pedestrians and vehicular technical problems.	
Guyu Ferede Daie	2013	To clearly identify the location of major road traffic accident black spot areas in Addis Ababa in each sub-city by ranking the total number of road traffic accidents rather than for Addis Ababa as a whole.	Data available from traffic police office of the city by sub-city and frequencies of occurrences of road crashes were used to determine Road Traffic Accident Black Spots by identifying the rank orders of each sub-city.	Ranking the frequency of road car crashes in Addis Ababa varies from one sub-city to the other and provides an insight to local sustainable transport planners especially focusing on those black-spot sites in the city.	Road Traffic Accident Black-Spot, Socio-economic, Impacts, Sub-city, Addis Ababa.
Fesseha Hailu, Mekonnen and Sileshi Teshager	2014	To describe the main causes and consequences of road traffic accidents in the Amhara Region.	Descriptive study employed secondary data. Mortality rate, percentage line and bar graph were used to show the causes and consequences of road traffic accidents.	Almost half (51%) of all crashes involved freight vehicles followed by passenger vehicles which constitute one-third(35%) of all accidents. Passengers accounted for the largest share of road traffic deaths across the region and pedestrians were the main victims in the urban areas.	-

Source: Journals of Road Traffic Accident 2012 to 2014.

Almost many of the author's research source of objective, methodology and the results were similar to the study area Adama and also as part of rationality for the study and may also show gaps of validity that makes differ from those authors could show the accident spot areas using GIS tool such as GPS.

Regional Number of Traffic Accidents by Type of Accident and Victims.

Table 5 Regional Number of traffic Accidents.

*Dire Dawa data not classified by Injury type and property damage.

*Gambella and Somali Regional States did not include because of not data available

Region	Number of Traffic Accidents				
	Death	Serious Injury	Slight Injury	Property damage	Total
Addis Ababa City Adm.	369	1,190	820	9,150	11,529
Afar	45	26	15	71	157
Amhara	504	358	630	1,092	2,584
Benishangul Gumuz	15	26	46	21	108
Dire Dawa City Adm.	21	304	-	-	325
Harari	25	34	74	34	167
Oromiya	893	665	770	1,687	4,015
S.N.N.P.	233	230	265	250	978
Tigray	233	243	97	405	978
Total	2,338	3,076	2,717	12,710	20,841

Source: Adama City Statistics Office, 2011/2012

Road Traffic Accident Causalities in Some Main Cities of Ethiopia. Table 6 Accidents of Main Cities in Ethiopia. *Ranking was done on the total number of Accident performance.

City	Accident Type and Year									Total	Rank
	2008			2009			2010				
	Death	Serious Injury	Slight Injury	Death	Serious Injury	Slight Injury	Death	Serious Injury	Slight Injury		
Addis Ababa	381	594	735	395	727	949	426	901	1012	6120	5
Bahir Dar	29	53	73	35	77	88	46	108	122	631	3
Dire Dawa	18	69	78	21	112	141	24	118	125	706	4
Harar	17	42	71	18	56	132	22	48	112	518	2
Mekele	37	74	25	19	84	76	37	84	79	515	1
Total	482	832	982	488	1056	1386	555	1259	1450	8490	

Source: UN, 2010 and Girmay Giday, 2014



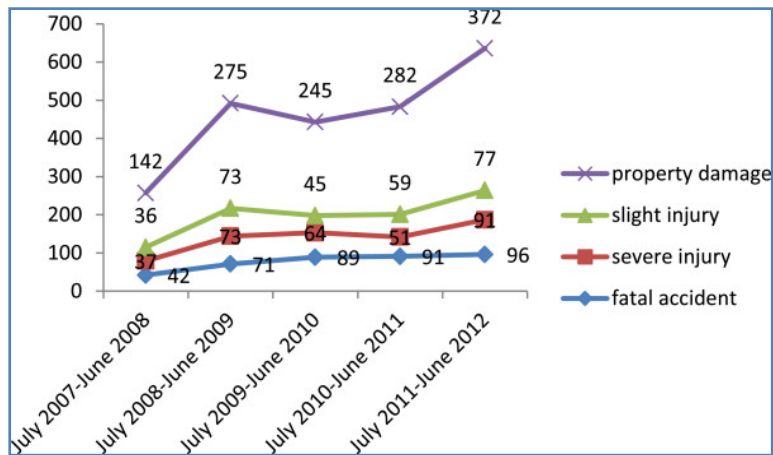
Photo 2 Accidents of Vehicles around Kaliti. Source:T. Kaleab,2014 Africa, Ethiopia.

2.2.4. Trend of Road Traffic Accident in Ethiopia.

Road traffic accidents have been growing in Ethiopia overtime. The figure below shows that accidents are proportional to the number of vehicles operating in each region. Of the total vehicles registered in the country, over half are estimated to be registered in Addis Ababa. As a result, the greater share (about 53.7 percent) of the total traffic accidents happened in the city in 2008/09. Of the total traffic accident-caused deaths in the country for the year 2008/09, Amhara, Oromiya and Addis Ababa have accounted for 27.3, 22.7, and 21.2 percent respectively. This shows that Amhara has taken a disproportionately high share of the total fatalities relative to its low number of vehicles. This entails the need to examine the causes of accidents in the region.

Similarly, the frequency distribution of driver's related characteristics involved in RTCs between Akaki and Adama, central Ethiopia from July 2007 to June 2012, as shown (Figure2) the total of 515 people died in 389 (16.7%) of the collisions, while 549 (31.5%) and 681 (39%) people were severely and slightly injured, respectively. In addition, 316 (13.5%) and 290 (12.4%) of the crashes caused severe and slight injuries, respectively. The remaining collisions brought about only property damage. Among those killed in RTCs, 307 (59.9%) were pedestrians, 145 (28.2%) were passengers, and 63 (12.2%) were drivers. Overall, 1,745 people (183 drivers, 750 passengers, and 812 pedestrians) were affected by the crashes. Over three-quarters of the victims, 1,333 (76.4%), were male (Assefa et al;2014).

Figure 2 Road Traffic Accidents trend in percent central part of Ethiopia



Source: Assefa et al; 2014

CHAPTER THREE

Profile of Adama City

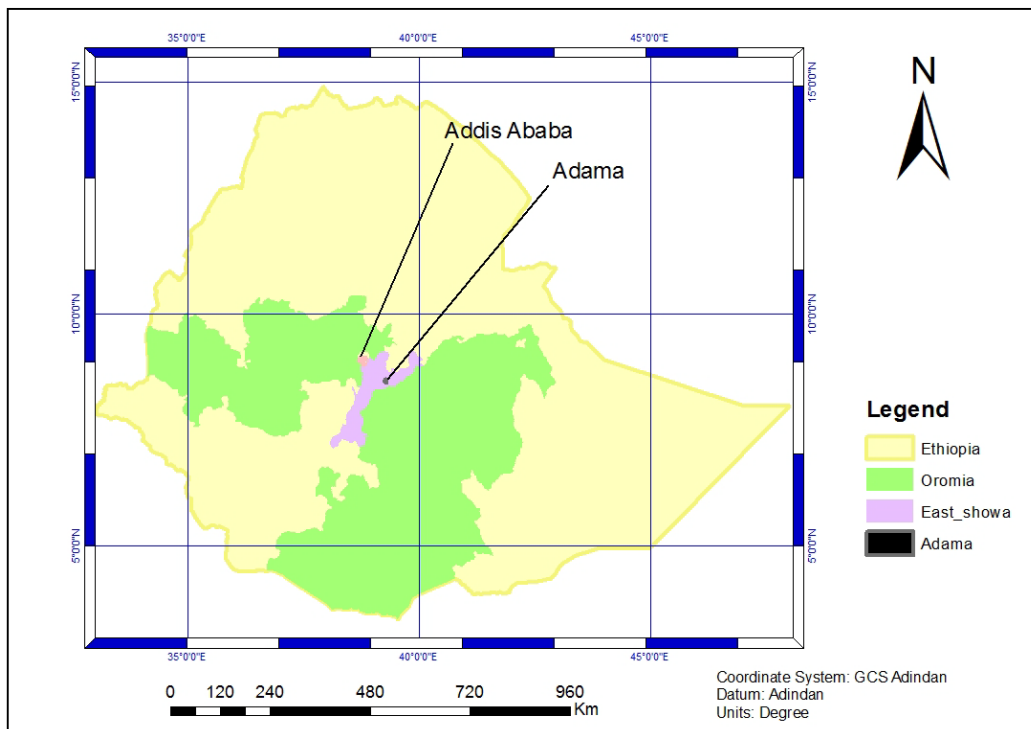
3.1. Overview

Adama (Nazreth) is one of the largest cities of Oromiya and of the country. It is found in the center of Oromiya and the country, at about 100 km south east of Addis Ababa. It was founded in 1924. The City name “Adama” may have been derived from the Oromo word *adaamii*, which means a Cactus or a Cactus-like tree, which grows randomly everywhere, that cry white blood naturally. More specifically, *adaamii* means *Euphorbia Candelabrum*, a tree of the Spurge family, while *hadaamii* would mean Indian fig. Adama is also known as Nazerth which sits between the base of an escarpment to the west, and the Great Rift Valley to the east. Adama (Nazreth) is a busy transportation center. The city is situated along the road that connects Addis Ababa with Dire Dawa. A large number of trucks use the same route to travel to and from the sea ports of Djibouti and Assab (though the latter is not currently used by Ethiopia, following the Ethio-Eritrean war since 1998). Additionally, the Adama Science and Technology University (formerly Adama Technical Teachers college) is located in the city. The Addis Ababa Adama (Nazareth) express way road is the first tall road in the nation that connects Addis Ababa with Adama and also the first express way in Ethiopia and East Africa. The Addis Ababa Djibouti railway line runs through Adama. The city has 14 urban kebeles and 4 rural kebeles. (Wikipedia, the free Encyclopedia, 2012).

3.2. Location

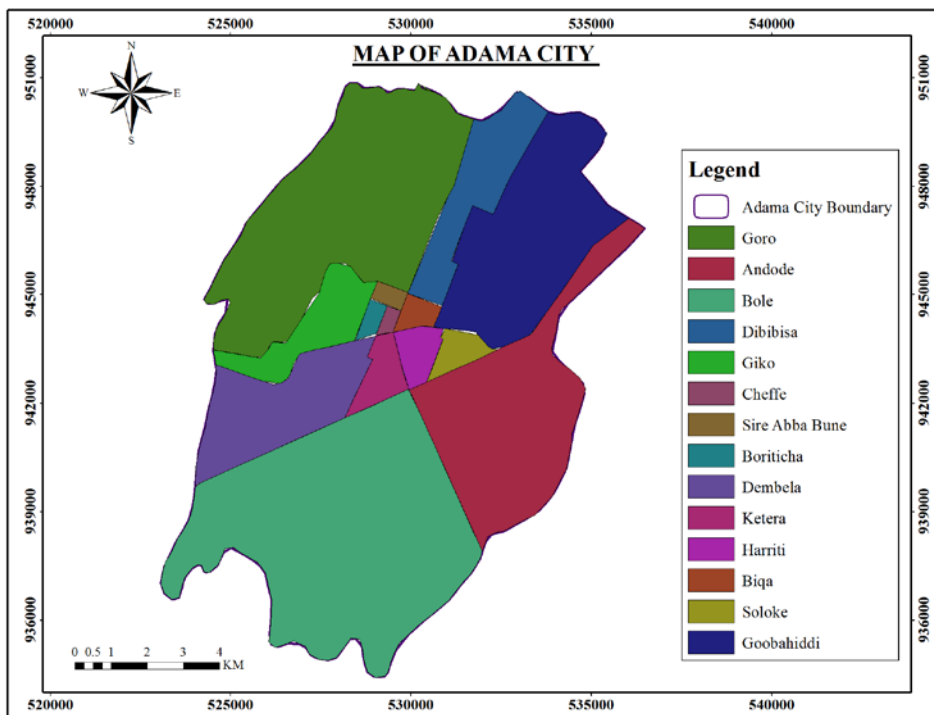
The Absolute location of Adama City (Nazreth) stretches between 8° 33’ to 8° 30’ North latitude and 39° 11’ 57’’ to 39° 21’ 15’’ East longitude. Adama is situated within the Wonji Fault Belt in the main structural of the systems of the Ethiopian Rift Valley. Geological studies indicate that the present physiographic of the area is the result of volcano-tectonic activities occurred in the past and thus the deposition of sediments and largely of fluvial and lacustrine origin. Adama has an elevation 1,712 meters (5,617 ft) above sea level. The time zone is EAT (UTC+3). The city has official area of 16,000 hectares. (Adama City Administration, 2013).

Figure 3 Location of Adama.



Source: Shape File CSA 2012

Figure 4 Map of Adama City.

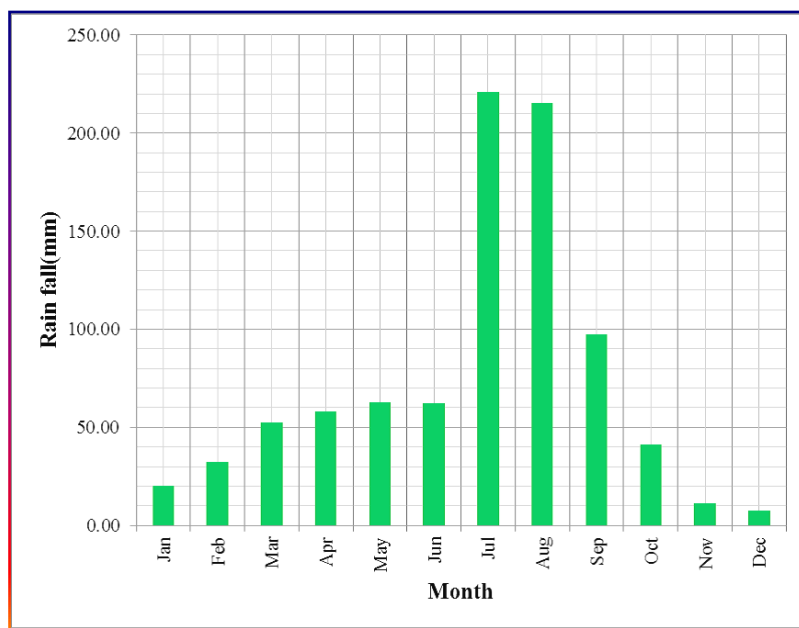


Source : Shape File Adama City Municipality,2012

3.3. Climate of Adama(Nazreth)

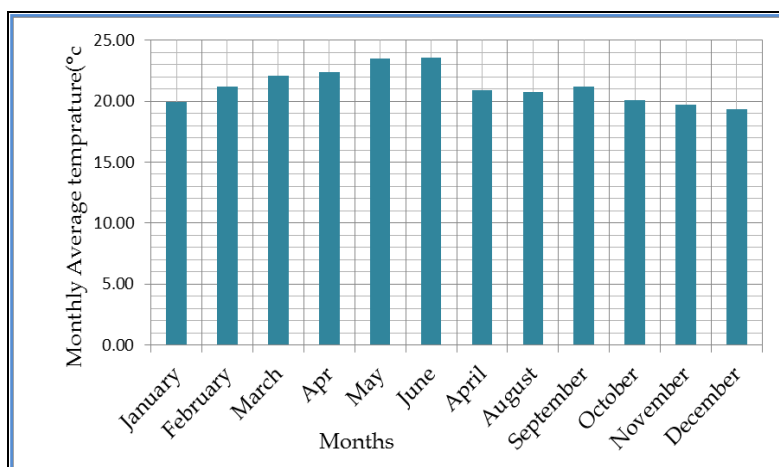
The climate of Adama is tropical. The city has hot and dry weather for the greater part of the winter and warm and sunny in summer. The winter months are much rainier than the summer months in Adama. Thus, the area is generally known for its attractive week ends and summer resort release. Reference to its temperature points that Adama(Nazerth) has a minimum annual temperature falling between 19° and 22° centigrade. The humidity record based on 39 years period(i.e.,1953-1991), points that, the mean annual precipitation of the city was 822.5 mm.(Adama City Administration,2013).

Figure 5 Mean Monthly Rainfall Distribution of Adama.



Source: Adama city Administration, 2013

Figure 6 Monthly Average Temperature Distribution of Adama



. Source: Adama city Administration, 2013

The driest month is December, with 6 mm of rain. Most of the precipitation here falls in August, averaging 210mm. This month is also one of a record of high road traffic accident in Adama. There is a difference of 204mm of precipitation between the driest and wettest months. Throughout the year, temperatures vary by 4.3°centigrade. May and June are the warmest month of the year. The temperature in April averages 22.5° centigrade. December is the coldest month, with temperature averaging 18.2° centigrade.

3.4. Socio-Economic Profile

3.4.1. Demography

The 1994 National Census Reported Adama (Nazreth) city had a total population of 127,842 of whom 61,965 were males and 65,877 were females, with an area of 29.86 square kilometers. Based on the 2007 Census conducted by the Central Statistical agency of Ethiopia (CSA), this city has a total population of 220,212 and increased over the population recorded in the 1994 census, of which 108,872 were men and 111,340 were women? In recent (2012/2013), the Adama City Statistics Bureau made survey and the total populations were 282,976. From this 139,919 were males and 143,057 were females. From 1994 to 2007 Census the growing of population size was 92,370 in percent 92.37. And also from 2007 to 2012/13 the increment of population was 62764 (62.76%). As the statistics show that still the number of urbanization increase time to time as a result, the number of population demand for transportation facility becomes an attainable. See the following table.

Table 7 Population Characteristics by Gender

1994 Census			2007 Census			Percentage Difference (1994-2007)			2012/2013 Survey		
Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total
61965	65877	127842	108872	111340	220212	43.1	40.8	42.9	139919	143057	282976

Source: Adama City Statistics Bureau, 2012.

Population rate had high increment from 1994 Ethiopian Census to the 2007 Census. But from 2007 onwards up to the survey was taken from 2012/ 13, it shows decreasing rate. The rapid urbanization in Adama pressure on urban services and facilities has become a serious

problem. Road traffics are not matched by adequate improvements in infrastructure and road safety legislation. This exposed to high risk for traffic accident of the urban population. He accident data shows that 68 percent of personnel injury accidents in our country involve pedestrians' (T.Kaleab,2014).Here in Adama also true. Students participated in some towns to educate pedestrians' to take proper precautions to avoid road accidents. Such activity has to be encouraged in Adama also to minimize the problem. Road user education and awareness rising is an important part of any road safety strategy like the urban population has become increasing from time to time.

3.4.2. Socio-Economic Aspect

Adama (Nazerth) is an economic center for trade and products that are paid for by ways that radiate from it and the necessary transaction involved in this exchange are proved by it. Economically, the city has been serving as a major focal point for trade and small scale industries. The major business sectors in Adama (Nazareth) are hotels, trade and industry. The city is pulling migrants, who came following the trade route in search of jobs and livelihood. The city is an important center of distribution of goods that are manufactured locally by various industries in the city and its suburbs. It is still a relay point for goods produced and manufactured in the country and imported from abroad to the small towns and rural areas in the region. As a result, it seems the two primary market places namely “Gimb Gebeya” and “Arada” are characterized by whole sale trade side by side the retail for the city dwellers (Adama City Administration, 2012).

Adama (Nazerth) due to its location route on the Sodore hot water spring resort which is 27 Km away from Adama on the Assela road. Similarly, a place where “Garagadi” also known for its natural stem and hot springs is located 12Kms from Adama. Boku is another attraction located at the south west edge of the city, about 2 km from the taxi stop. It is known for its high temperature steams springing from sloppy land. In a nut shell, Adama, is a growing capital and its strategic importance as an intersection point between economically important regions. It has always been full of travelers. Recently, Adama has also become famous for its meat trade-which attracts visitors from Addis Ababa which flock in every week end. Thus, there are a lot of hotels, big and small, restaurants, bars and cafes and the majority of population gets its livelihood from sundry commercial activities and services. There are also factory and office workers whose number is increasing lately. As the study will show, the

nature of economic activities has contributed immensely to the existing form of the city and its social composition (Addis Mebratu, 2006).

Trade and Industry, Adama has one industrial zone with adequate site and service, whereas small sized industries have been scattered all over the city. There are about 25 large and medium scale manufacturing industries in the city. With regard to composition and diversity of the sub-sector, it is dominated by food industries (47.6% of total) showing the response of investors to available agricultural raw materials. The second dominant manufacturing type is manufacture of machineries and equipments with 23.8% share. Industries targeting irrigation, housing, education, health, etc, are scanty. Moreover, it is characterized by dominance of public light and consumer goods industries, meaning; only 3.7% are privately owned. 4.8% are heavy, and 9.5% are producer goods industries. As far as performance of the sector is concerned, it employs limited number of persons (that is 3783 or 0.83% of the total labor forces). But it is created significant share of the local gross domestic product 44% or 299.5 million Ethiopian Birr. A larger proportion of trade activities in Adama go to trade of consumption and imported goods, which has strong implication on meager capital accumulation and foreign exchange reserve. Trade of fuels is the dominant trade type with 68.7% of total capital of wholesale traders. Other important trade activities such as trade of machineries and equipments, health, education, etc are scanty. The service sector, on the other hand, is dominated by hotels followed by bars and restaurant. Half of the total wholesalers are owned in partnership and additional 20.2% are owned in proprietorship. Besides, 90.2% of total service trade is owned by sole proprietorship share companies, private limited companies, and cooperatives are insignificant (Adama City Administration, 2005).

Concerning the investment procedure for big investments like manufacturing industries is very prompt and attractive. The city Administration has already prepared and distributed to a number of manufacturing industries more than 100 hectares of land in the last three years. The current industrial zone land price is as low as 0.80 cents per M². Adama (Nazerth) has become a favorite place for private investment as well as the foreign Ethiopian citizens. The main reason for such attraction of private investment is the availability of market, infrastructure, and cheap labor force in the city. The investment opportunities in and around the city are: Manufacturing and storage, Hotels and Tourism, Social Service Provision (Education and Health facilities), Real-estate development and Urban Agriculture (Adama City Administration, 2005).

3.4.3. Education

Concentration of schools (both government and private) is also another factor that increases the size of teachers, librarians and students in the city. Higher education-Institutions are also available in Adama (Nazerth) which have increased the demand for urban transport. As a result, the number of employed teachers and students has their own impact on the flow of traffic situation that influenced the traffic movement from home to school and back to home. The two tables show the number of teachers and students at different level of grades.

Table 8 Number of schools and teachers.

Category	School Types		Number of teachers in government schools			Number of teachers in Private school		
	Government	Private	Male	Female	Total	Male	Female	Total
Elementary and Junior School Including Kindergarten (1-8)	26	80	279	418	697	215	265	480
Secondary School (9-10)	6	16	234	99	333	188	240	428
Preparatory School (11-12)	2	2	133	31	164	128	137	265
College	1	3	-	-	-	-	-	-
University	2	1	-	-	-	-	-	-
Total	38	102	646	548	1194	531	642	1173

Source: Adama City Education Department 2014/15.

Table 9 Number of Students' in Adama.

Category	School Types	Number of Students		
		Male	Female	Total
Primary and junior including Kindergarten (1-8)	Government	15539	19719	35258
	Private	12980	12106	25086
Secondary School (9-10)	Government	4321	4927	9248
	Private	3011	3686	6697
Preparatory School (11-12)	Government	1414	1980	3394
	Private	1302	1023	2325

Source: Adama city Education Department 2014/15.

3.4.4. Health

An employment opportunity is created by the health sector in the Adama City is identified as one factor that increases the demand of transport. In the year 2014/2015 there is 1 government hospital and 2 private hospitals. There are also 6 health centers and 110 private owned clinics. The following table shows the number of health professional in the city that has increased the number of urban dwellers, there by the demand of urban transport.

Table 10 Health Information.

Category	Number	Number of Health Workers					
		Extension Nurses	Midwifery	Health Officers	Laboratory Technicians	Pharmacy	Supportive Staff
Health Center	6	93	28	26	39	29	50

Source: Adama City Health Department, 2014/15.

Table 11 Health Workers and Professionals.

Category	Numbers	Number of Health Workers and Professionals						Radiography
		Medical Doctors	Nurses	Midwifery	Health officers	Laboratory Technicians	Pharmacy	
Government Hospital	1	165	108	20	4	18	18	-
Private owned Hospitals	2	27	80	9	8	20	9	8

Source: Adama city Hospital, Adama General Private Hospital and Medhanielem Private Hospital, 2014/2015.

3.5. Land Use Patterns and Master Plan

Adama has shown an extensive physical growth. The original location of Adama was the plateau to the west of the existing city, the place on which the New Administrative Center is being built now. It is said to be established in the early 1920s. The existing location of the city was a result of the topography of the area and engineering considerations related to the location of the rail way station. However, it came about as a result of an accident rather than a preconceived plan. As a result of this, the city can be seen in totality from the hill of Adama, which is an entry from Addis Ababa. Like the traditional classic cities, the city can be seen in its entirety due to its relation to the topography. However, this location was not a result of any planning (See photo 3).

Photo 3 View of the Adama city entering from Addis Ababa.



Source: Field Survey Photograph.

The first settlers of Adama were employees of the railway station. The first structures rail way station and a handful of houses constructed by the rail way company. Later on farmers from the surrounding region started to settle near the station in search of the stations water supply and other facilities. The first major transformation of Adama took place during the Italian occupation (1936-41). The Italians had contributed greatly to the city's development and growth. They built the town with a new plan connecting it with many of their provincial centers by telephone, telegraph and radio networks. Newly developed roads also connected it with Addis Ababa and other regional states. Even after their withdrawal the Italians have continued to contribute to the growth and stability of Adama. Thus, as a compensation for their atrocities during their occupation, they built the Awash Hydro Electric Power plant which provided electricity to Adama as well as other parts of the region. There was no piped water supply at the time people used to fetch water from Awash River which is about 17 km to the south travelling on foot. The Italians helped to provide piped water from this river. The Municipal office of Adama was also first established by the Italians. After the Italian period, Adama continued to play an important role in the administrative and economic life of the country. It became the administrative center for Yererena Kereyu Awraja. The town became a hub of a number of courts, public offices as well as security and armed forces. Adama, which was the original name of the town, was changed, in 1944/45, to Nazerth by Emperor Haile Sellasie the first marking an increasing attention it started to get from the rulers of the time. However, it got its original name back after the 1991 change in government (Addis Mebratu, 2006) The Adama city Administration under taking various infrastructure activities.

New asphalt roads have been built. Cobblestone and gravel roads have been constructed. Flood preventing canals have been also built. Constructing a new 10km asphalt ring road that goes around the city. The ring road will enable trucks coming from Djibouti to avoid the trouble of going through the city. In a related development the City Administration is to build new condominium houses under the 20-80 and 40-60 housing project program. The infrastructure asset management plan is considered as the appropriate way of identifying and keeping records at basic infrastructure, mainly roads, drainages, sanitation(both liquid and solid waste management), water supply, street light, health and education social infrastructure facilities/infrastructure, public facilities and offices(Adama City Administration June, 2014).

The Land Use of Adama (Nazerth) also includes the role of urban agriculture in addressing urban food security, environmental greening, job creation and neutralization of urban wastes. Urban agriculture which includes-growing of food crops, fruits, trees, herb, flowers, firewood as well as the raising of animals including cattle, poultry, fish, bees and pigs. It is a labor intensive farming requiring only small area around small residential areas such as vacant plots, outdoors, gardens, parks, containers, road strips and even on the roofs or upper covering of buildings. There is no adequate data related to urban farming in Adama city. However, it is safe to say that many poor urban households engage in local production of food, vending and related activities. The establishment of Aba Geda Recreation Center at the heart of the city and the efforts made by the limited number of small scale commercial nursery persons alongside major roads in Adama are worth mentioning in this regard. In the environmental greening, maintaining the micro-climatic conditions, job creation, bringing-fourth fruits, vegetables on flowers for consumption or commerce, and urban waste recycling (Messay Mulugeta,2010).

The Major Framing Elements of the Revised Master Plan of Adama (Nazerth) consists of direct and strong impact on the development of the city. Such as growth and housing expansion trend- here there is a need for new expansion areas and thus a new urban boundary should be redefined and implemented. The other frame is topography, environment and green-Adama is surrounded by ridges at all directions, but the central part has flat topography suitable for development. As a result, rehabilitation and protection of environmentally sensitive areas at the ridges and along the hills and deteriorated areas within the boundary of the city and its immediate vicinity, protection of the north-south greenery at the east and west border of the city and provision of formal green in different parts of the city. The other frame Centers, markets and services- decentralizing, equitable and balanced distribution of services

that promote accessibility and geographic centrality of services. Smooth and facilitated development of centers in accordance with requirements The other frame element is Road network and transportation-which consider ring, radial and grid road network system, north south extensions of rings, centralized mass transportation lines, mass transportation line along the internal ring and integrated customs, truck freight terminals and inland port. The other frame is Manufacturing and storage-considering fostering healthy area development, segregation of large industries from other functions and such developments out of the internal ring road that is at intermediate and periphery areas, relocating the existing manufacturing and ware houses that create disturbance at the city core, readjusting plot use of large establishments for smooth and safe traffic flow of goods and efficient use of land resource particularly along the main roads and minimizing environmental impacts of manufacturing and storage in the city.

Photo 4 Aerial Photo Adama.



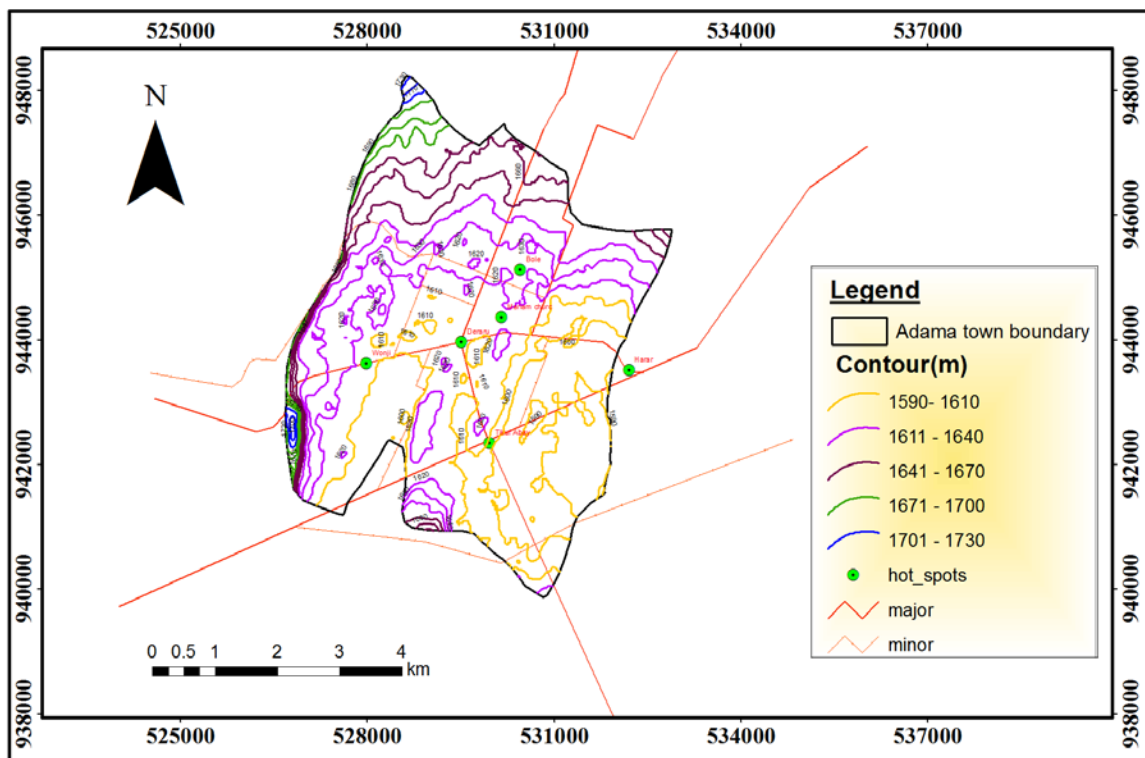
Source: Digital Globe Google, 2015

Generally, the Master Plan addresses the major land use recommendations presented result from analysis of city's environmental and physical conditions as well as the planner's vision for future growth. A map of future land set aside for parks and opens space; residential areas; commercial; offices and industrial uses; civic and institutional uses and mixed-use areas.

Land use patterns have also the major impact on transportation system performance. A more multi-modal land use pattern has destinations clustered in to walk able centers. Adama most progressively commit resources to undertake several detail studies in order to implement the master plan within the specified 15 years period including the development of the rail way station and depot, inter-urban rail way, and communications. The new master plan calls for development, redevelopment, relocation and settlement in the city. This requires the renovation of existing structures, road network, constructions of new ones integrated with other developments in the city. The storm water problem has been one of the serious problems in the Adama. Although the master plan had several studies to ameliorate the problem, it requires supporting the proposals by studying the designs of sewerage plant for the city a big venture which requires additional consulting and know-how. Similarly, Adama has serious environmental degradation. Its surrounding has been stripped off natural beauty it used to have some few decades ago. Nowhere in the region than in the Adama that environmental problem have immediate effects. Therefore, it is high time that measures taken to rehabilitate Adama and its surrounding (Adama City Administration, 2012/13)

3.6. Topography of Adama.

Figure7 Contour Elevation Model Map.



Source: Shape file CSA, 2007

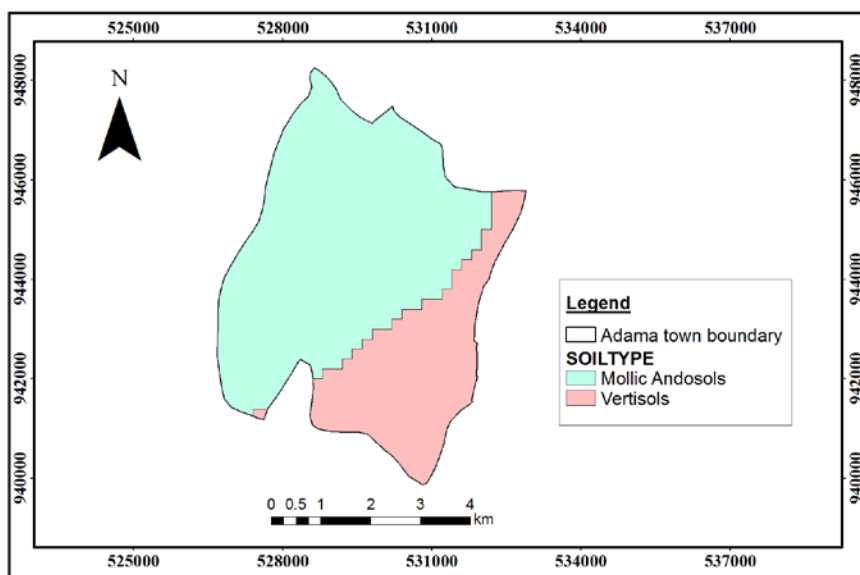
A topographic map is a detailed and accurate two-dimensional representation of natural and human-made features on the earth's surface. The most distinctive characteristics of topographic map is that the three-dimensional shape of the earth's surface is modeled by the use of contour lines. Contour makes it possible to represent the height of a place and steepness or gentleness on a two-dimensional map surface.

Figure 7 shows the Adama city's contour elevation. The south and south east of the city, the land seems gentle slopping areas compare to the other side of the city. Except the Bole accident spot areas the rest lie on the gentle slopping contour lines that the road is more or less straight and flat, which could make drivers lose their safety vigilance and be more likely to be involved in traffic accidents. When driving on these sections in high speed, due to lack of proper cross-fall, drivers cannot resist the centrifugal force and the deviate from the driving direction, rushing down the embankment, causing an accident. Gentle/ flat grades permit all vehicles to operate at the same speed. Steeper grades produce variation in speeds between lighter vehicles and the heavier vehicles both the uphill and downhill directions.

Research suggests that speeding is a factor in around 1 in 5 serious crashes. This increases to around 40% for fatal crashes. Travelling at 65km/hour in 60km/hour zone doubles the chance of having a crash that injures someone. At 70km/hour, the risk increases 11 times (Australian Government Department of Finance,2015)

3.7. Soil Type in Adama

Figure 8 Map of Soil type in Adama.



Source: Shape files CSA, 2007

The soil type of Adama consists of Mollic Andosols and Vertisols. Much of the north, north west, west and around central part of the city is under mollic andosols. The south, south east, north east and eastern part is covered by Vertisols. Both soils have similar character in development that volcanic origin and have color black. Their difference is mollic andosols has less clay soils, high water binding and high permeability, fertile and generally quite young. Whereas vertisols predominantly clay mineral, almost Impermeable, very soft when wet, and very hard when dried, or crack during the dry season, becomes sticks after the rains.

Mollic Andosols consists of deep, well-drained nearly level to gently sloping areas clayey soils on uplands and terraces. These soils formed in material weathered in place from clay shale or washed in from adjacent soils.(Nur Riana Rochimawati ,et al,2014).

Vertisols are weak and unstable when subjected to moisture content fluctuations either due to seasonal climatic variations (cyclic dry and wet periods) or artificial causes. This has an impact engineering costs for it may cause major deterioration and distress on light weight and shallowly founded structures such as infrastructures(small buildings, roads, air port runway pavements, pipelines and sewerage system .The shrinking and swelling of vertisols can also damage buildings and roads leading to extensive subsidence(Fekerte Arega et al.2009).

The roads out let to Wonji shewa and Harar from Adama have deteriorated and need maintenance. This may cause of as already discussed that the area is under the coverage of vertisols. The road on vertisols has needed movement at depth between 2 and 4 meters to minimize damage of the structure.

3.8. Road and Transport

3.8.1. Classification of Roads

According to the Adama (Nazerth) City planning division and plan project officer's classification, the determinant factors like their location importance, volume and the tonnage of roads. Taking in to account, roads of Adama can be classified in to two groups mainly. Namely principal Arterial Streets and Minor Arterial Streets. The principal roads are designed in such away ensure the connection of the principal centers to the city. The minor roads are important and create interconnection among principal and collector roads

As Table 12 shows, the city's roads in progress way and invests high cost to construct the asphalt road. The road infrastructure deteriorates over the last few years. In my observation,

the Asphalt road towards Harar exit has not had enough width that many vehicles pass using the edge of the asphalt with the non-asphalted land.

Table 12 Road Types and cost of computation.

Types of Road	Number of Lanes Road for Asphalt	Width in Meter	Total Length of in Km	Rate Ethiopian Birr
Asphalt	Dual	10-11	47.28	12,000,000
Asphalt	Single	11-12		
Gravel		-	43.7	4,700,000
Red ash		-	35	1,000,000
Cobble stone		-	83	2,520,000
Earthen		-	281	400,000

Source: Adama City Municipality, 2012

3.8.2. Transportation

Transport is the movement of people and goods from one place to another. And also comprises movement of information. Similarly, transportation is the conveyance of people, properties and information from one place to another (Belachew, 1997).

The most important modes of transports in the Adama city are road transport and in future railway. The road transport is the most proffered because it gives door to door service. On the contrary, it is the most vulnerable to traffic accident than any other mode of transport. The absence of sufficient parking is a problem that observed by the high congestion and traffic accident. Likewise, as far as the number of vehicles in the city is increasing from time to time, the same will happen to the congestion and accident size. Today, according to the Adama Transport Agency, the total number of vehicles in the city is over 7000.

Table 13 Transportation Characteristics in Adama.

Type of vehicle	Purpose of Vehicle	Numbers and Years		Rate of increment in (%)
		2010/2011	2014/2015	
Automobile	Private use	755	1100	45.7
Bajaj	Commercial	1000	3000	200
Bicycle	Private use	Unregistered	Unregistered	
City mini- bus(Taxi)	Commercial	135	345	155
Government Vehicles	Service	210	320	52.4
Heavy truck	Construction	125	210	68
Horse cart	Commercial	660	760	15.2
Mini -bus(12-26seats)	Commercial	870	1329	52.8
Motor cycle	Private use	130	275	111.5
Public bus	Service	-	4	-
Total		3885	7445	91.6

Source: Adama Transport Agency, 2014/15

As shown in Table 13, the number of vehicles in Adama city growing 3560 in the last 4 years or 91.6%. Especially, the rate of increase of Bajaj commercial passengers transport is too high followed by Mini-buses transporting passengers especially work for commercially purpose close to neighboring towns and city of Addis Ababa. In the city there are different modes of transport. Road accident may result from a combination of factors related to the component of the system including roads, the setting, vehicles movement, pedestrian road use and the way they interact. Speed affects to both crash jeopardy and crash magnitude in the city especially the Bajaj and Mini-bus taxi(WHO,2008)

CHAPTER FOUR

Analysis of Research Finding

4.1. Road Traffic Accident Situation in Adama City

Road traffic accidents are becoming a major public safety and development obstacle. Various studies indicated that Ethiopia has one of the highest fatality rates per vehicle in the world. Adama (Nazerth) is also one of the city which shows high level of traffic accident from time to time and year to year. The collected data for ten years showed the trend (Table14).

Table 14 Road Traffic Accident situation 2004/05 to 2013/14.

Year	Death	Annual Change in %	Slight Injury	Annual Change in%	Serious Injury	Annual Change in%	Property Damage	Annual Change in %
2004/2005	10	9.8	11	6.7	05	4.6	38	9.4
2005/2006	16		13		08		60	
2006/2007	13	15.5	07	7.3	13	12.7	42	8.8
2007/2008	28		19		23		50	
2008/2009	35	28.1	65	25.6	34	24.7	99	20.6
2009/2010	39		27		36		116	
2010/2011	24	22.7	52	30.9	41	34.6	125	27.4
2011/2012	36		59		57		161	
2012/2013	31	23.9	56	29.5	29	23.4	175	33.8
2013/2014	32		50		37		177	
Total	264	100.0	359	100.0	283	100.0	1043	100.0

Source: Adama Traffic Police Department.

As shown in table 14, the rate of increases in number of death of people by the rate of increase in the number of accident with the exception of 2006/07 and 2010/11 with minor difference. On the other hand, in between 2004/05 to 2005/06 the number of accidents was recorded 10 in percent 9.8 % which is the lowest recorded; whereas 2008/09 to 2009/10 was more death accident recorded 74 which was 28.1%.

In case of slight injury, as shown Table 14, the number of recorded from year to year increased with the exception in 2006/07,2009/10 and 2013/14 which had minor difference in

lower form. In the case of serious injury, as shown in Table14, the number of recorded increasing year to year with the exception 2012/13 which had dropped 29% and again increased 37% towards 2013/14.

In case of material destruction, the number of recorded at the beginning of the year 2004/05 slightly higher than the coming year of 2005/06 which were 9.4 and 8.8 percent respectively. But from 2006/07 onwards the rate of the number of material destruction increased from year to

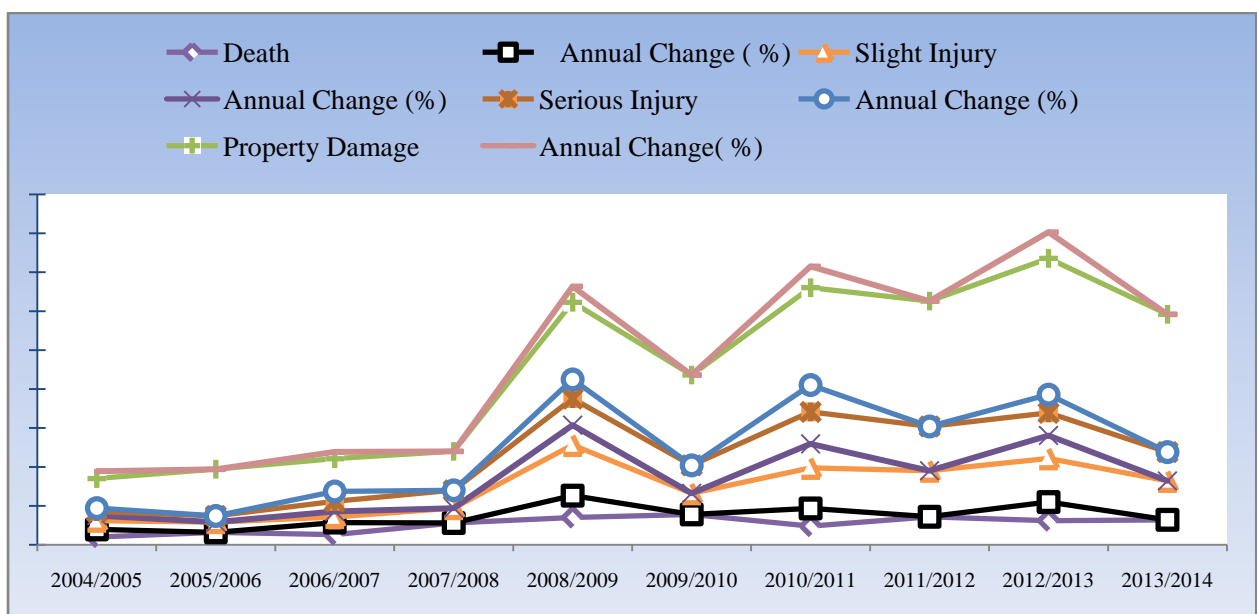
year up to 2013/14. The statistics Table14 about vehicles (motorized and non-motorized) totally 7445. The number of accidents on human and material total 1949. Therefore, the average of accident occurred during the period of the last ten years would be 3.8 or near 4 accidents per week happened in the city of Adama.

Let see the average road traffic accident from total traffic accident of the above table 14 using the arithmetic mean formula $\mu = \frac{\sum x}{N}$ where: μ = mean, Σ = the sum of, x = the value of an individual variable, N = the number of value of the variable.

The average number of death in Adama city was 13.6, the average slight injury was 18.4, the average serious injury were 14.5 and the average property damage were 53.5 per annually in 10 years.

Graphical Representation of Road Traffic Accident in Adama (2004/05-2013/14).

Figure 9 Graph of Road Traffic Accident in Adama.



Source: Adama Traffic Police Department.

4.1.1. Estimated Cost of Road Traffic Accident in Adama City 2004/05 to 2013/14

The estimated total cost of road traffic accident in Adama city, reaches Ethiopian Birr (ETB) 9,936,722.16. The highest estimated road traffic accident has been recorded at ETB 1,735,838.32 in 2012/13, while the lowest at ETB 403,175.83 in 2004/05 in the city. The city has lost ETB 9,666,722.21 in the last ten years only due to road traffic accident

Table15 Estimated Cost of property Damage

Year	Number of Accidents Resulting Property Damage	Road Traffic Accident Estimated Cost (ETB)	Average Cost (ETB)
2004/05	38	403,175.83	10,609.90
2005/06	60	622,382.88	10,373.05
2006/07	42	436,668.06	10,396.86
2007/08	50	563,652.40	11,273.05
2008/19	99	1,076,431.75	10,873.05
2019/10	116	1,016,068.85	8,759.21
2010/11	125	1,119,131	8953.05
2011/12	161	1,215,056.73	7,546.94
2012/13	175	1,735,838.32	9,919.08
2013/14	177	1,478,316.34	8352.07
Total	1043	9,666,722.21	9,268.20

Source: Adama Traffic Police Department

4.2. The Temporal Variation of Road Traffic Accidents

4.2.1. Day and Night Variation.

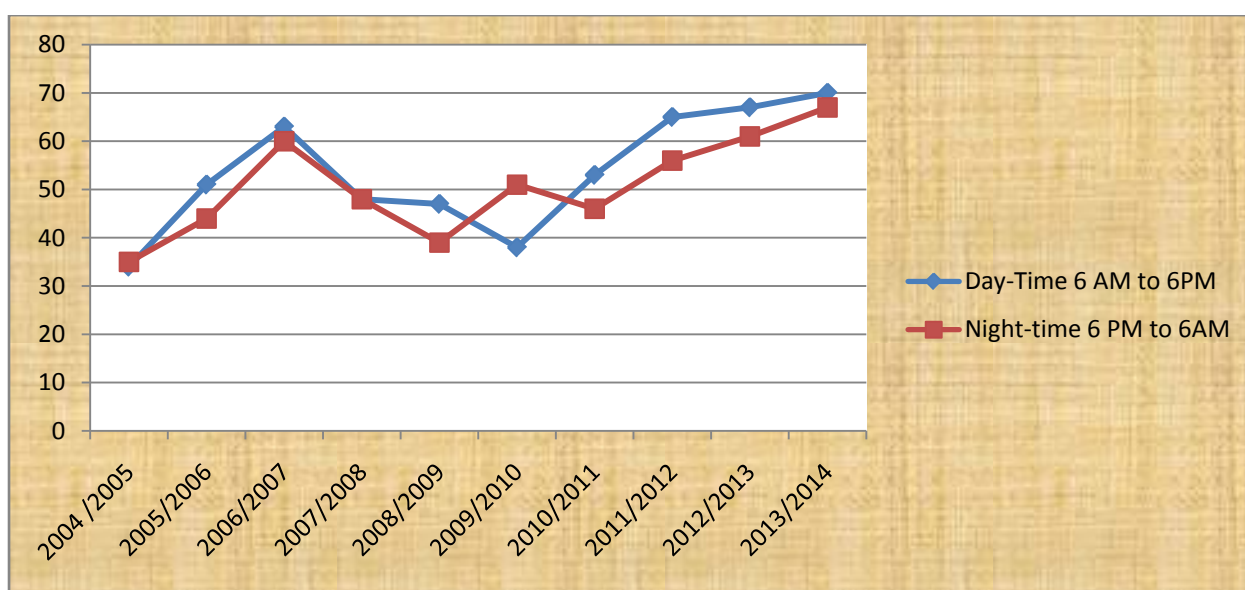
In the study, about 53.6 on the average and 51.4% traffic accident occurred during day time. The rest 50.7 on the average and 48.6% traffic accident occurred during night time. As in the table 16 shown that most of the traffic accident little more than average is occurred during day time between 6AM to 6 Pm. At night time most trucks and mini buses want to travel to the port of Djibouti and eastern towns and city of Ethiopia protecting them from high Scorched sun and to hidden contraband goods from the police and drive with high speed. As such condition they may face to crash with vehicles and sometime suddenly go out of road and exposed to accident.

Table16 Road Traffic Accident Variation in 24 hours.

Year	Day-Time	Night-time	Total
	6 AM to 6PM	6 PM to 6AM	
2004 /2005	34	35	69
2005/2006	51	44	95
2006/2007	63	60	123
2007/2008	48	48	96
2008/2009	47	39	86
2009/2010	38	51	89
2010/2011	53	46	99
2011/2012	65	56	121
2012/2013	67	61	128
2013/2014	70	67	137
Total	536	507	1043
Average	53.6	50.7	
Percentage share	51.4	48.6	100%

Source: Adama Traffic police Department

Figure 10 Road Traffic Accident variations in 24 hours.



Source: Data Adama Traffic Police Department.

4.2.2. Daily Distribution of Road Traffic Accidents

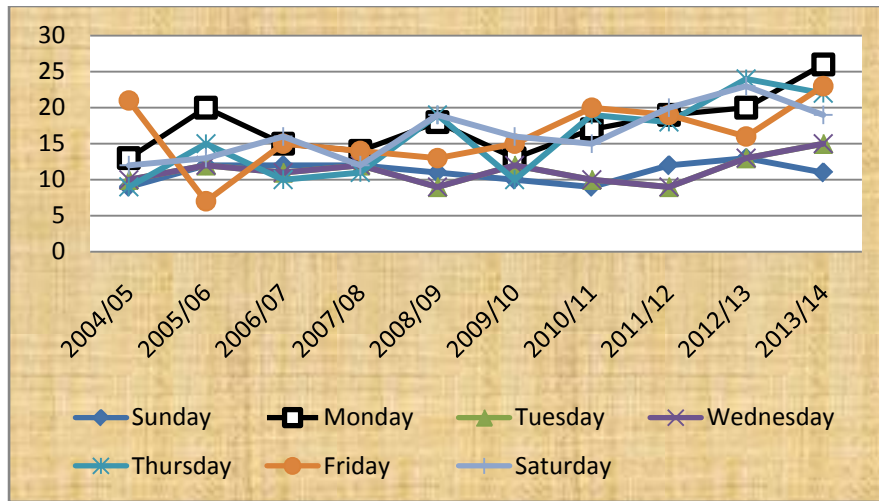
The above Table 16 shows that daily occurred of road traffic accident in Adama. The average and percentage share of the week of the day were: Sunday 11.1(10.6%), Monday 17.5(16.8%), Tuesday 15.9 (15.2%), Wednesday 11.3 (10.8%), Thursday 15.7(15.2%) Friday 16.3(15.6%), Saturday 16.5 (15.8%). Among the week of the day, Monday was reported as the highest road traffic accident and Sunday was the least. Monday is the first working day that workers and students may travel from place to place that the risk of expose to traffic accident more than the other day like week end Sun day which is the number of population travelling decreases.

Table 17 Daily Variation of Road Traffic Accident.

Years	Days							Total
	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	
2004/05	9	13	10	10	9	21	12	84
2005/06	12	20	12	12	15	7	13	91
2006/07	12	15	17	11	10	15	16	96
2007/08	12	14	12	12	11	14	12	87
2008/09	11	18	14	9	19	13	19	103
2009/10	10	13	16	12	10	15	16	92
2010/11	9	17	17	10	19	20	15	107
2011/12	12	19	18	9	18	19	20	115
2012/13	13	20	20	13	24	16	23	129
2013/14	11	26	23	15	22	23	19	139
Total	111	175	159	113	157	163	165	1043
Average	11.1	17.5	15.9	11.3	15.7	16.3	16.5	
% Share	10.6	16.8	15.2	10.8	15.2	15.6	15.8	100%

Source: Adama Traffic Police Department.

Figure 11 Graph of Daily Variation of Road traffic Accident in Adama.



4.2.3. Seasonal Distribution of Road Traffic Accident

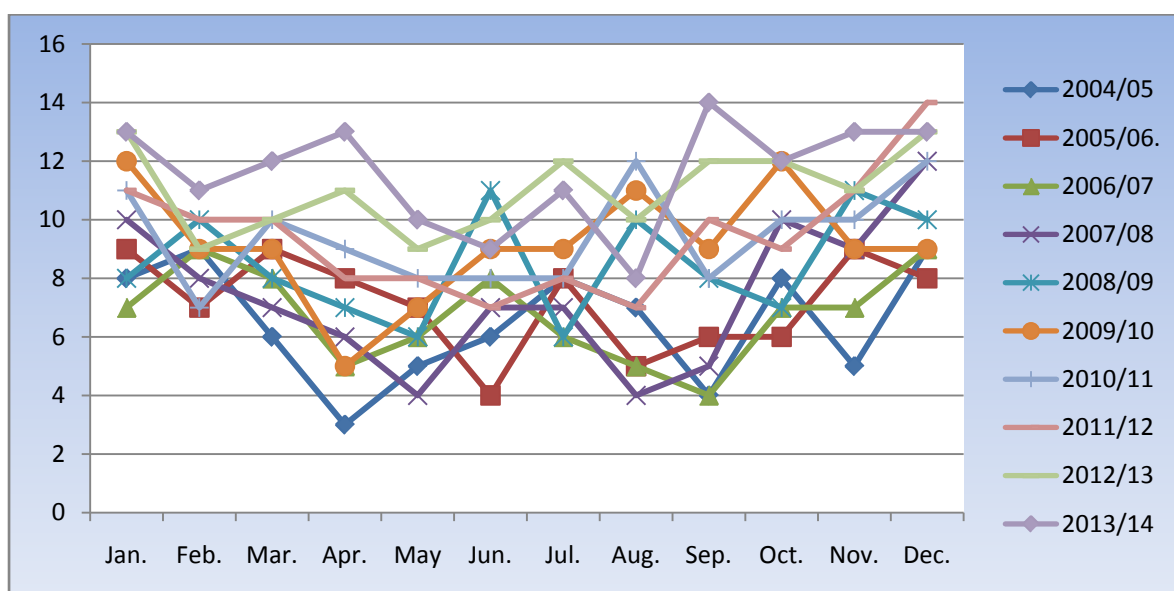
As the Table shown below, the average and percentage distribution share of road traffic accident was highest in December and January 10.9(10.5%) and 10.2(9.8%) respectively. These may happen because of many public holidays could celebrate in these months that the road crowded and expose to traffic accident. This season may also have chance to drive with speed to reach the destination fast that rainy or foggy condition not there. During rainy season the vehicles may not travel as fast because of foggy air condition. As such more attention has to give on these months by the concern bodies to minimize the problem. The month May was the least recorded 7(6.8%), this may show that the season has not have many holydays and almost sunny and dry season contribute its own implication for the road traffic accident in Adama.

Table18 Seasonal Variation of Road Traffic Accident.

Year	Month												
	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
2004/05	8	9	6	3	5	6	8	7	4	8	5	9	78
2005/06.	9	7	9	8	7	4	8	5	6	6	9	8	86
2006/07	7	9	8	5	6	8	6	5	4	7	7	9	81
2007/08	10	8	7	6	4	7	7	4	5	10	9	12	89
2008/09	8	10	8	7	6	11	6	10	8	7	11	10	102
2009/10	12	9	9	5	7	9	9	11	9	12	9	9	110
2010/11	11	7	10	9	8	8	8	12	8	10	10	12	113
2011/12	11	10	10	8	8	7	8	7	10	9	11	14	113
2012/13	13	9	10	11	9	10	12	10	12	12	11	13	132
2013/14	13	11	12	13	10	9	11	8	14	12	13	13	139
Total	102	89	89	75	70	79	83	79	80	93	95	109	1043
Average	10.2	8.9	8.9	7.5	7	7.9	8.3	7.9	8	9.3	9.5	10.9	
% share	9.8	8.5	8.5	7.2	6.8	7.6	7.8	7.6	7.7	8.9	9.1	10.5	100%

Source: Adama Traffic Police Department.

Figure12 Graph of Seasonal Variation of Road Traffic Accident in Adama.



4.3. The Spatial Variation of Road Traffic Accidents

4.3.1. Place of Occurrence

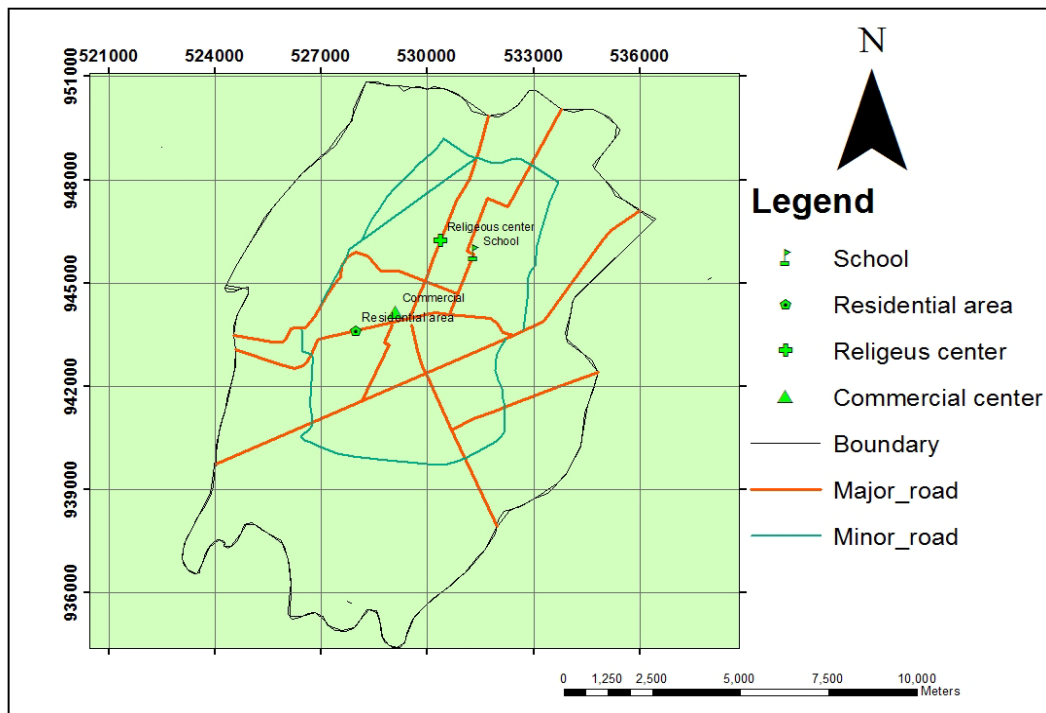
Table 19 below showed that the road traffic accidents that happened at different place of occurrence which were spatially distributed. Accordingly the business areas accounted on the average of ten years 7.6(22.7%) which was the highest may the crowded condition in these area has contributed more than the other that exchange of goods could takes place. More of the road side trade also contributed a lot. Next to this the school areas 6.4(19.4%) because of the density of the population and not giving attention rather playing on the road side contributed its own for traffic accident. The least road traffic accident reported from residential areas.

Table 19 Road Traffic Accident by Place.

Year	Place						Total
	Business Areas	Office Areas	Religious Centers	Residential Areas	School Areas	Others	
2004/05	5	2	3	2	5	4	21
2005/06	4	6	5	3	5	7	30
2006/07	4	4	6	1	7	7	29
2007/08	6	1	4	4	6	6	27
2008/09	6	7	5	2	5	5	30
2009/10	8	3	7	2	5	6	31
2010/11	8	2	4	3	8	6	31
2011/12	11	7	6	2	7	7	40
2012/13	12	9	7	3	8	8	47
2013/14	12	10	7	3	9	8	49
Total	76	51	54	25	65	64	335
Average	7.6	5.1	5.4	2.5	6.5	6.4	
% Share	22.7	15.2	16.1	7.5	19.4	19.1	100%

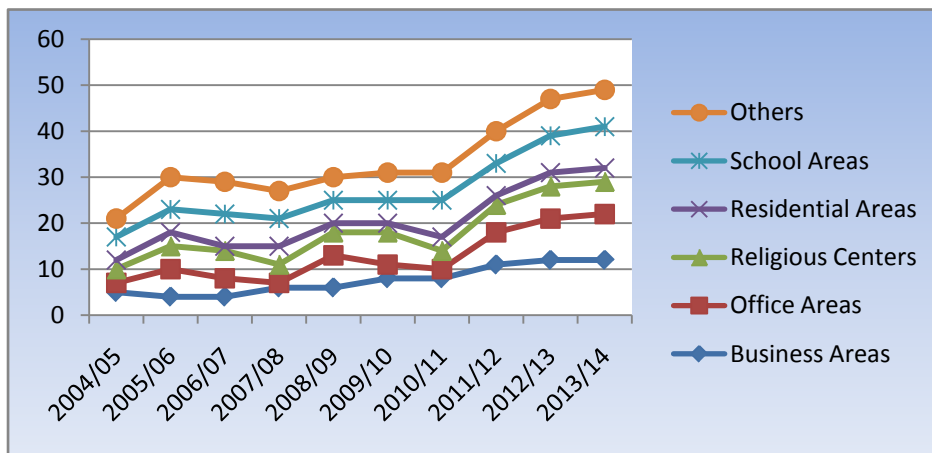
Source: Adama Traffic Police Department.

Figure 13 Map of Spatial Road Traffic Accidental Areas.



Source: Data from Adama Traffic Police Department.

Figure 14 Graph of Spatial Variation of Road traffic Accidents in Adama.



Distribution of Total Road Traffic Accident Victims in Adama, 2004/2014 Age and Sex

Based on the study of road traffic accident victims using data from police, the highest number of victims about 22.7% were from 10—19 years of age followed by about 18.7% in the age group less than 10 years and about 0.7% in the age group >60. About 99.3% of victims were less than 60 years of age. The risk of road traffic accidents were more in males than females

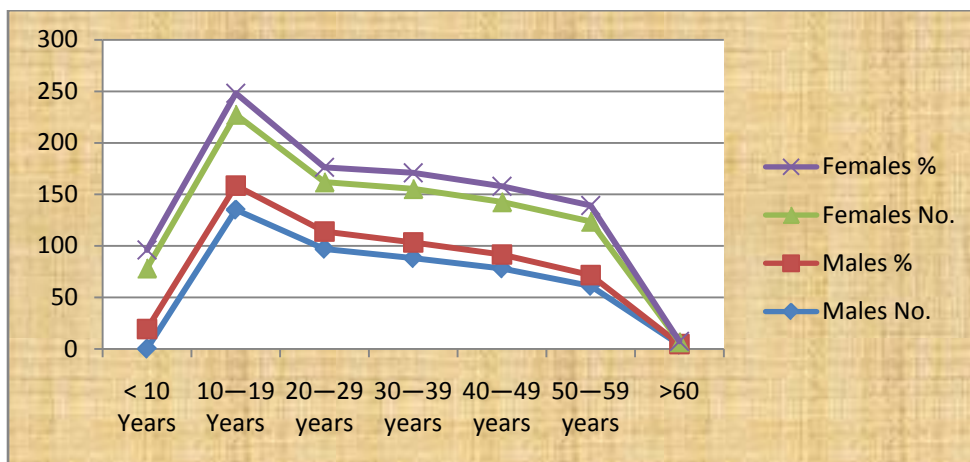
and on the average, males accounted for 63.3 percent of all causality cases in Adama (Table 20). The highest victims' age group children and youth may show more attention is given to play road side and dare to travel along the main road riding bicycle which is common one could see in Adama.

Table 20 Road traffic accident victims by age and sex.

Age Group	Males		Females		Total	
	No.	%	No.	%	No.	%
< 10 Years	110	19.2	59	17.7	169	18.7
10—19 Years	135	23.5	69	20.7	204	22.7
20—29 years	97	16.9	48	14.4	145	16
30—39 years	88	15.4	52	15.6	140	15.5
40—49 years	78	13.6	51	15.3	129	14.2
50—59 years	61	10.7	52	15.6	113	12.5
>60	4	0.7	2	0.6	6	0.7
Total	573	100	333	100	906	100

Source: Adama Traffic police Department.

Figure 15 Graphs of Victims of Road Traffic Accident by Age and Sex in Adama.



4.3.2. The Distribution of Hot Spot Areas of Road Traffic Accidents

Table 21 was shown below, the accident spot areas of Adama city. The Bole Road Street is found in kebele 04 area , has 11 meters of wide and accounts 93(8.9%) of the accident from the total 1041 accidents. The Harar Outlet Road Is found in kebele 02 has 09 meters wide, and accounted 285(27.5%) of the total accidents which makes the major accident spot areas comparing to others. The Derartu Tulu Avenue is found in kebele 06, has 11 meters wide ,and accounted for 97(9.3%) of the total road accident. The St. Marry Church area is found

in kebele 02 has 11 meters wide of road and accounted 81(7.8%) of the total accident. The Tikur Abay (Boku Michael) which is out let to Assela found in kebele03 has 10 meters wide of road, and accounted for 237(22.7%) of the total accident. This makes rank third from the Wonji Outlet to Di-Affric Hotel street road. The Wonji Outlet to Di- Affric Hotel is found in kebele01 has a width of road 10 meters, and accounted 248(23.8%) accidents from the total that makes second rank after Harar out let road. The average accident of the hot spot areas were: $1041/6 = 173.5$ and the average accident hot spot areas in terms of total accidents seem: $1041 \times 100/1949 = 53.4$ recorded Percent accidents.

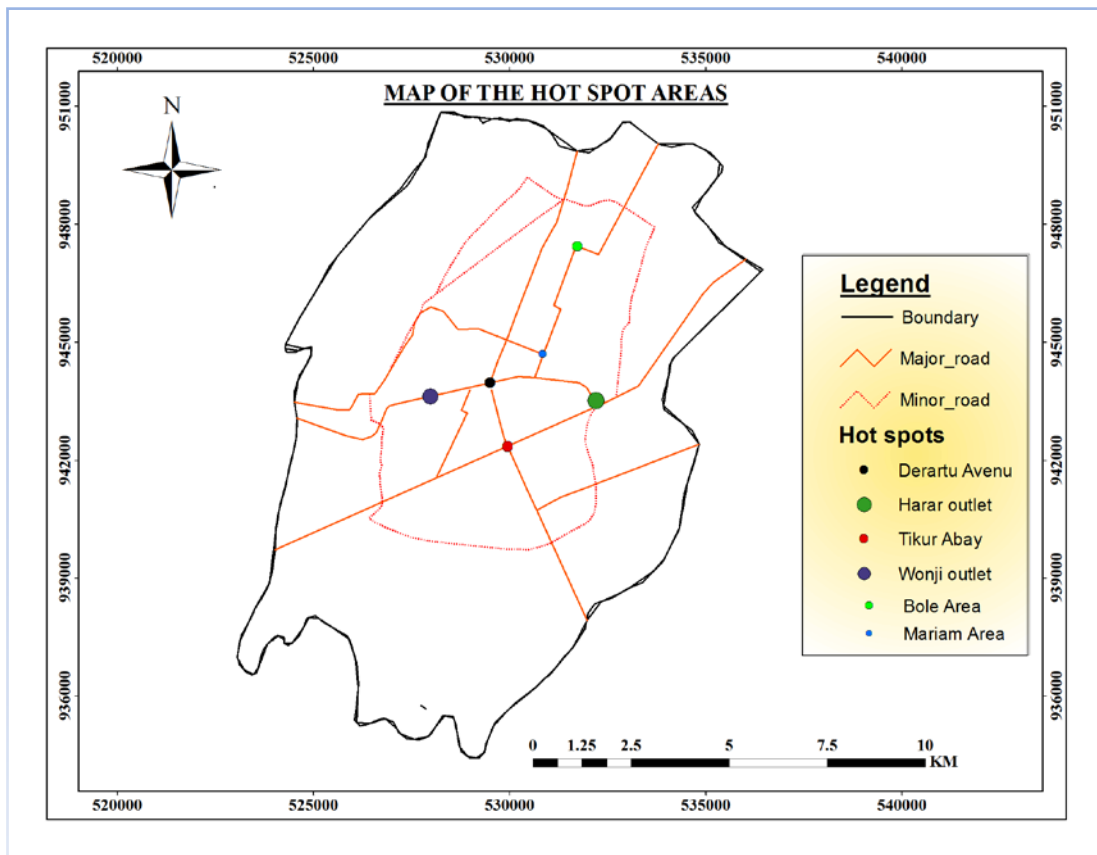
Regarding the road density the traffic count data for the main Federal Roads show flows of the order of 10,000 vehicles per day on the main road from Addis Ababa across Adama city. Trucks and truck-trailers accounted for 57%, buses (including minibuses) for 23%, cars and other small vehicles accounted 20%⁹. The road traffic is congestion at Harar out let and Derartu avenue which situated on the main road from Addis Ababa to Djibouti and eastern Ethiopia and Arsi. The width of the road is less compare to the carrying capacity of vehicles (Ethiopian Roads Authority, 2012).

Table 21 Accident hot Spot Areas.

Name of Street	Place(Kebele)	Estimation Number of vehicles flow per day	Width of Road in Meter	Number of Accident
Bole Area	04	830	11	93
Harar Out let	02(including Dabi Soloke rural Kebele)	4100	09	285
Derartu Avenue	06	4200	11	97
St.Marry Church area	02	532	11	81
Tikur Abay(Boku)	03	1225	10	237
Wonji outlet(Di-Affric)	01	1313	10	248
Total				1041

Source: Adama Traffic Police Department (2004/05-2013/14).

Figure 16 Location Map of Hot Spot Areas, researcher’s skill map from Ethio-GIS (2015).



4.4. Respondents’ Profile

I prepared 80 questionnaires to respond by concerned different category of population that randomly selected such as officers’, pedestrians’, police, students, and teachers. All the questionnaires take in to equal partition for five groups of people. This has helped to get ample information from different people with different characteristics.

4.4.1. Respondents’ (officers, pedestrians, police, students and teachers) General Background.

Table 22 (Appendix C) depicts 100% of the respondents live in Adama (Nazerth), even some of them came to Adama recent time. Regarding to the sex structure of the surveyed respondent, 70% were male; the remaining 30% female. Among the male respondents: 5 were officers, 15 were pedestrians, 19 were police, 14 were students and 11 were teachers. Among the female respondents: about 2 were officers, 4 were pedestrians, 1 was police, 6 were students and 3 were teachers.

Table 22 (Appendix C) also shows the distribution of respondents by age group. It presents the number of respondents who lie on age group 16-25 were 29(36.3%) which accounts the highest from all of the other age group followed by the age group 26-35 which accounts 21(26.3%). The rest 36-45 age group were 9(11.2%), 46-55 age group accounted 19(23.7%) which makes rank third, and 56-65 age group accounted 2(2.5%).

In the case of Marital Status a large proportion about 42 respondents (52.5%) were single and 38(47%) were married. In the survey I did not get who respond divorced, separated or widowed. Among the respondents, the officers accounted the highest in the married group (13) is followed by police (11) and the least one the students no body married. Students were also ranks first in the single (unmarried) group accounted 16 respondents followed by pedestrians and teachers accounted 9 for each.

The educational status is most often used in the analysis of a given population quality. The knowledge and skill obtained through education determine the type of skill the individual is having. The quality of the skill in turn indicates that how far a person is likely to view the content of traffic laws and is important to obey them. As the table 22 on the above clearly portrays, many of the respondents were attained preparatory school level and above. Among the respondents, who respond 14(17%) for each educational level of Preparatory and Certificate level. At diploma level respond 22(27.5%), at degree level respond 27(33.7%) which ranks first among the other educational level. Second degree level (tertiary) accounted 3(3.8%).

In the case of number of years that respondents stayed in Adama (Nazerth) so far. The category of those people (officers, pedestrians, police, students and teachers) are responded all residential in Adama even the duration of time differ from one to the other. The respond who said less than a year were 4(5%), from one year to two years respond 12(15%), from three years to five years respond 29(36.2%) which ranks the second highest among the group, from eight years to ten years respond 5(6.3%), from ten years above respond 30(37%) which ranks the highest from all of the category of duration of living. The other respondents profile was occupation. Based on this understanding, the respondents were asked to explain their specific occupations at the time of the survey. The above table 22 shows that about 43(53.8%) of the respondents were government employee at different institution, About 14 (17.5%) respondents were Self- employee which respond by the pedestrians and students. The rest 23 (28.7%) were students who are not working for the time being.

4.4.2. Respondents' Related to Road Traffic Accident

As indicated in Table 23(Appendix C) the number of accidents caused in Adama considering as a big problem respond 38(47%), whereas the accidents were considered as a moderate problem respond 42(52%). It can identify that most of the respondents lie on moderate way of traffic accident, as a matter of fact still road traffic accident be problem.

Again from the respondent drivers, who facing a traffic accidents were 44(55%) and could not face were 36(45%) in number. Among the respondent, who exposed more to traffic accident were the pedestrian accounted for 13(16.3%) alone and least could not face were students 11(13.8%). From those who faced road traffic accident saying 'yes', were: once respond 17(38%), said two to three times 13(29.6%), and said more three times were 14(31.8%). From this most respondent faced road traffic accident were once followed by two times respond. Among the respondent, the pedestrians' faced more than the others which accounts alone 13(16.3%).

Table 23(Appendix C) was also indicated the prevailing of road traffic accident in Adama city. These were: Motor vehicle crash with Motor vehicle accounts 11(13.30%), Motor vehicle with Bicycle 5(6.3%), Motor vehicle with Bajaj 11(13.8%), Motor vehicle with pedestrian 6(7.5%), Motor vehicle with static object 1(1.3%), Motor vehicle with Horse drawn cart 2(2.5%), Bajaj with horse drawn cart 5(6.3%), Bajaj with Bajaj 13(16.3%), Bajaj with Pedestrians 12(15%), Vehicle crash 10(12.5%), Vehicle with Pedestrians 4(5%). Among these different accident types, Bajaj with Bajaj was the highest one followed by Bajaj with pedestrian and motor vehicle with Bajaj thirdly. Bajaj accident is prevailing nowadays.

Among the respondent, more people were afraid of Bajaj accident which accounted for 31(38.8%), followed by public transport cars especially mini buses accounted 24(30%), thirdly the private cars 17(21.2%) and the least government car 8(10%).

The accident time concerned, below Table 24(Appendix C) shows more accident were seen by working day accounts 31(38.8) followed by the public holyday 27(33.7%) and least during week-end accounts 22(27.5%).

Concerning the traffic laws and regulations in the city, 9(11.2%) of them responded as very good, 33(41.3%) of them said good, 20(25%) of them said fair and 18(22.5%) of them responded as unsatisfactory. From this, none of them responded as excellent. As a result,

most of the responded lie on “good” that shows still the intervention is needed to aware and use properly about road traffic laws and regulation by concern body.

Table 24(Appendix C) is also shown that the usage of walking situation among different group of category of persons. Those respondent who respond frequently have to leave sidewalks and walks along roads were: 18(22.5%) said always,5(6.2%) said sometimes, 51(63.8) said rarely and 6(7.5%) of them respond never use. As the statistics shows that most of the respondent said rarely used that may be able to not face for road accident.

Concerning the understanding of traffic signs, signals and road marks, most the respondent respond ‘yes’ we understand accounted for 62(77.5%) and the rest said “no” accounted 18(22.5%). As such, most of the respondents have awareness of different traffic signs.

In the case of crossing the main road situation, 23(28.7%) said that we were crossing at traffic light, 28(35%) respond that we were crossing at junction (Zebra road), 13(16.3%) respond that at mid block pedestrians crossing and the rest 16(20%) respond that we crossing at any point. From the figure most of the respondent knows the regulation of road traffic that cross at the junction place. Still a number of people could cross at dangerous site even respond less.

In the case of crossing the main road in the city was respond “easy” 26(32.5%) in number and those respond it was “difficult” 54(67.5%). So accordingly, the city main road has a difficult situation to cross it.

Concerning the drivers that give priorities for pedestrians’ according to the traffic law seem that those respond there was “excellent ‘situation 4(5%), “Very good” situation responds 3(3.8%), there was “good” situation respond 38(47.5%) and there was “poor” condition 35(43.7%). From these data the respondent who said “good” condition was a little bit more than that of said poor condition. Still the problem is there anyway.

In the case of the commitment of traffic police for their work duties seem that those respond they have “excellent” 5 (6.3%), those respond “very good” 10 (12.5%), those who said “good” 40(50%), and those respond “poor” 25(31.2%). The figure shows that most respondent said that they are” good” followed by “poor” duties and commitment. Still the statistics shows attention to work more on their commitment for traffic police.

The source of knowledge for traffic road accident for those mentioned category of population seem that 24(30%) respond “myself”, 9(11.3%) respond that “parents”, those respond

10(12.4%)” source of knowledge was ”school” , those category of people respond “traffic police” 9(11.3%) and those said “media 28(35%). From the statistics, most population said “media” as a lot information giver followed by “themselves”.

Similarly, the respondent made a suggestion or comment on the filled questionnaire. The researcher puts that how to see the existing road safety laws and regulation in the city? The respondent most of them respond positively as follow: Traffic police do their work well, it needs strong regulation on road traffic accident and inspection, and drivers have to respect the people. Negatively, the city traffic light is not functional, the city has not enough parking, drivers make bribery with traffic police, there are drivers who do not have license, safety law and regulation is not applied in Adama because of rigorous this time punishment is up to imprisonment of 10 years if a person die by vehicle accident, the road is not safety for pedestrians and vehicle movement.

The other question to respond the concerned category of population that additional comment is important to solve the road safety problem in the city. They comment the following: the media including the regional which is found in the city has to take more time to describe about road traffic accident situation and regulation, the road has to be standardize for traffic flow, the pedestrians’ have to walk along left side of road side, the city master plan has to be reshuffled, horse drawn cart, bicycle must be stopped on the main road line, the right person should sit at the right place to minimize road traffic accident problem.

Besides, the road traffic accident situation is similar to what was noted by other writers Dinish Mohan(2002), the increment of bicycles, two and three-wheeled vehicles are the most vulnerable users of roads in poor countries that has higher risk, and contributors of traffic accidents. Fisseha Hailu, et al (2014) commented that 51% of crash involved by freight vehicles followed by passenger vehicles which makes similar that of Bajaj and commercial Mini buses accident.

4.5. Drivers Respondent Related to Road Traffic Accident

Prepared 60 questionnaires to respond by different types of vehicle drivers randomly such as Bajaj, city mini bus taxi, and commercial minibuses work from Adama (Nazerth) to Addis Ababa and neighboring towns, bicycles, motors and trucks. These drivers have direct contact with pedestrians with road safety conditions. Unsafe driving behaviors’ are all serious risk

factors for accident involvement. To see such condition, how many of the city drivers take in to consideration observing the following questions.

4.5.1. Profile of the Drivers

According to Table 25(Appendix D) the sex structure of the surveyed respondents: about 2(3.3%) were female; the remaining about 58(96.3%) was male. Regarding age structure, drivers with age of 16 to 25 were 13(21.7%), from 26 to 35 were 18(30%), from 36 to 45 age group 15(25%), from 46 to 55 were 14(23.3%).The highest frequency age group were 26-35 followed by 36 to 45.

In the case of educational status of drivers, who attended 9 grade to 12 grade were 16(26.7%), respondent who got certificate were 16(23.3%), diploma holders 18(30%), degree holders 12(20%). There were no responder who got second degree and above. Most of the drivers were diploma holder followed by high school and preparatory level. Concerning the marital status, 30(50%) drivers' respondent were married, 22(36.7%) were single, 3(5%) were widowed and 5(8.3%) were separated. Regarding the drivers' duration of time living in Adama the drivers respond as follows: no drivers respond to less than a year; one to two years respond 13(21.7%), from three to five years similar to the above 13(21.7%), from six to seven years 12 (20%) responded, from eight years to ten years respond 11(18.3%), and greater than ten years respond 11(18.3%). Accordingly, the first two age category groups have highest frequency than the rest of age category group.

4.5.2. Drivers' View of Traffic Laws and Regulations

As indicated in Table 26(Appendix D) the drivers who have third level license accounted for 28(46.6%), followed by those who hold second and fifth level of license each accounted for 16(26.7%). Concerning the type of vehicle, the drivers' respond the following way: 12(20%) of them drive private vehicles, 26(43.3%) drive public transport vehicles including the city's mini-bus taxi, Mini-bus and Isuzu have 12 to 24 seats and works from Adama (Nazerth) towards Addis Ababa and the nearest neighbor destiny towns, 18(30%) of them drive Bajaj(a three-wheel vehicle)and 4(6.7%) of them drivers' drive government vehicles. From this statistics most drivers' drive public transport vehicles followed by Bajaj and then private vehicle.

In the case of describing the speed behavior of the drivers', 27(41.7%) said the speed lie between 30 to 40 km per-hour, followed by 40 to 50 km per-hour respond 20(33.3%), from 20 to 30km per-hour respond 10(16.7%) and greater than 50 km per-hour responds 5(8.3%). From this figure see that most drivers' drive with speed limit between 30 to 40 km per-hour followed by 40 to 50 km per-hour. Concerning traffic laws related to pedestrians about drivers', most of the responders' said giving priority to pedestrians when crossing the streets accounts 50(83.3%), and only small number of drivers' that was 10(16.3%) responders' did not respect the pedestrians'' crossing the road.

Table 27(Appendix D) concerning the level of road traffic accidents in the city, 38(63.3%) of the drivers' said a big problem and the rest 22(36.7%) said that it was a moderate problem. Regarding accidents faced or observed by drivers' most of the respondents said they faced road traffic accidents account 38(63.3%) and did not face or observe any road traffic accidents respond 22(36.7%). From this figure drivers' have got traffic accident was more in number. Regarding wear of seat belt when driving, most drivers, respond 'never wear' accounts 22(36.7%), followed by 'Yes always wear' accounts 20(33.3%), then 18(30%) respond sometimes wear. Among 'never wear' respondents, all gave reason for that did not concern or bother about it.

In the case of using mobile phone when driving, most of the driver never catch accounts 32(53.3%) and those responder who said 'yes' I use accounts 28(46.7%).Regarding alcoholic beverages drinking, most of the respondents' respond that 'no' I did not drink alcoholic beverages account 31(51.7%), and the rest said 'yes' we do it accounts 29(48.3%). From those responder said 'yes' we drink, 16(55.2%) were occasionally drinker and the rest 13(44.8%) responder said rarely drink.

In the case of involving on accidents, most respondents told they did not involve accident accounts 24(40%), and those involved 36(60%). Regarding the time of accidents, 35(58.4%) responder said more accident were seen at working day, and the responder who said on public holy day account 23(38.3%), and the rest 2(3.3%) were said at week end.

In the case of any violation made and stopping by traffic police, the drivers' respond as follows: those who said 'yes' 38(63.3%), those said 'no' 22(36.7%). From those who involved in traffic accidents, 34(89.5%) were not report for traffic police, and only 4 (10.5%) were report for traffic police. From this figure most of the drivers' made violation of road traffic accident in any form and also did not report to traffic police.

Regarding the duty and commitment of the traffic police work, most of the respondent said that are poor account 26(43.3%). And those respond said that they are good account 22(36.7%), and the rest respondent said they are very poor account 12(20%).

In the case of additional education or training got by the concern government body for the drivers' seem 35(58.3%) responder said 'yes' and the rest 25(41.7%) said 'no'. Still the numbers of not getting educational training about traffic accident take in to consideration.

4.6. Finding

In this field survey, I saw the finding between the first questionnaire which was filled by concern group of people and the second questionnaire which was filled by the drivers'. Regarding the level of road traffic accident, most of the group of people respond as moderate problem accounted 42(52%), where as the drivers' respond as a big problem 38(63.3%). Here, the problem was as it is and showed difference in the rate of accident. The other was concerning the duty and commitment of the traffic police that most of the group of people respond was good accounted 40(50%), whereas some drivers' respond as poor 26(43.3%). Here also showed the communication between drivers' and traffic police seem unfair that one might benefit the other when committing violation of rule and regulation of traffic law rather educational measurement. The other finding that most of the drivers' did not report an accident for the traffic police that have seen earlier 34(56.7%) that to take immediate measure and take responsibility is questionable to survive the life of human beings. Similarly, some of the drivers did not wear seat belt 22(36.7%) showed that not bother or concern about it and needs further educational ethics for minimizing road traffic accidents. Accidents were more in working day followed by public holy day 38.8% and 33.7% respectively and more victims were males comparing to females accounted 63.3% on the average and frequent accidents recorded on Monday 16.8% on the average and from months of the year December and January recorded more 10.9% and 10.2% respectively for the last ten years of time in the studied period. Mathematically also seen that the average death from the total accident was 13.6%, the Slight injury was 18.4%, the serious injury was 14.5% and the property damage 53.5% which accounted 9,666,722.21ETB. The range of dispersion was 285- 81= 204. It had a big variation between the highest and lowest accidents throughout the studied period. Similarly, to see the standard deviation how far from mean deviated $\sqrt{\frac{\sum(x - \mu)^2}{N}}$ where Σ (sum of), x (individual value), μ (mean), N (observation). Therefore, $\frac{223,517}{6} = 37508$ Variance= $\sqrt{37508}$ SD= 193 that is deviation from the mean by 19.5 which tell us the spread

of the accident has a greater distance from the mean or spread out over a wider range of values.

Regarding the accident spot areas, the finding showed 53.4% of the total accidents 1949 occurred in the six accident spot areas. In addition, the study clearly identifies the location of the major road traffic accident spot areas in Adama by ranking according to the size of accident.

4.7. The Major Causes of Road Traffic Accidents in Adama City.

Road traffic accidents were the major causes of death, injury and material destruction in Adama and also a social and economic problem. As discussed in the city profile about population and vehicle numbers, in the last decade, the rate of increment of the population and vehicles are high. Especially the vehicles had fastest growing rate in the city. As discussed earlier, the statistics revealed that the total accidents were 1043 and the total number of vehicles was 7445. Therefore, the difference between the two figure equals to 7.1380 showed that there were 7 accidents on the average per vehicle.

4.7.1. Drivers' Characteristics

A lot of people subjected to death, serious injury, slight injury and loss of their property as a result of the faults made by drivers. Or unsafe driving behaviors are all serious risk factors for accident involvement. Officially, 81% of crashes in Ethiopia are attributed to driver error (WHO, 2010). Higher accident occurrences correlated to the drivers' can be explained by many factors, including lack of experience, age, wearing not seat belt, alcoholic drinks to some extent. I also observed during my field survey particularly minibus driver who drank at day time, parking area for those drivers park as in front of the commercial centers and road sides, over speed for some drivers especially those drive 40km per hour and above that was above the urban speed limits, for some giving priority to vehicles required by the traffic law, ignorance and inadequate understanding of the value and use of traffic laws and regulations. The basic issue of lack of knowledge lies on inadequate driver training and poor evaluation techniques nowadays. These are being believed to be the major causes of the higher accident rates by drivers in Adama city.

Photo 5 Driver's not giving priority to other vehicles and driving along pedestrian walk way.



Source: Field Survey.

4.7.2. Pedestrians' Characteristics

The accident statistics of Adama city showed that pedestrians are the most vulnerable category of road user (in traffic). Among the list of factors noted; driver respondents reported or commented that on the main road utilizing bicycles, domestic animals, horse carts and unlawful commercial goods exchange has to be avoidable, similarly, pedestrians'' have to use always the left side of the road to walk. For pedestrian respondents; driver behavior such as did not give priority to pedestrians when crossing the main road 35(43.7%), the roads, even most respondents said that it was difficult to cross the main road accounted 54(67.5%), 29(36.3%) responder crossed inappropriate way indicated earlier on Table 22. From the above it was found that drivers' and pedestrians' have been blaming each other, but accidents to some extent occur due to failure of drivers to give way to pedestrians at road crossing. Unlike drivers a considerable section of pedestrians in the city never learned the basic rules of road safety except through media or by themselves 33(41.3%) and 26(32.5%) respectively.

Photo 6 crossing the main road outside of zebra-crossing.



Source: Field Survey

4.7.3. Vehicle Characteristics

In the city most drivers were driving commercial vehicles and Bajaj accounted 26(43.3%) and 18(3. %) respectively. These drivers' who have almost 3rd level of license accounted for 28(46.7%), and were heavily involved in causality crashes in the city. Especially Bajaj and commercial vehicle accidents were more than the others accounted 31(38.8%) and 24(30%) respectively. According to a traffic police replied that; the number of accidents caused as a result of vehicle defects in the city within the study period 2004/05 to 2013/14 was seldom. More of the accidents were caused by vehicles with no defect at all. For instance, Bajaj were in use service recent time and out of 97 accidents registered by Adama Traffic Police from September to October 2008, which resulted in 9 deaths, 12 serious injuries, 84 minor injuries and damage to 197 properties. Annual inspection and spot checking was performed, even there was a problem properly computed vehicle inspection. Such thing may encourage old model vehicles to move out of the city. Unlike newer vehicles older vehicles do not have better design features and safety equipment that can provide them crash protection.

However, poor maintenance cannot be blamed for all defects. Because according to traffic report states that a lot of accidents contributed by good vehicles.

Photo 7 Congestion of Bajaj and other Vehicles around commercial Center(Nur-gebeya) and Derartu avenue.



Source: Field Survey

4.7.4. Road Environment

Efficient and economic road transport is largely dependent on road lay out. Efficiency cannot 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. Like many other town and cities of Ethiopia, Adama has an urban transportation infrastructure that was initially designed for largely motorized travel. Non- motorized transport such as bicycle un known their number and horse cart which has 760(10%) is shown on table 13 has no their own line. As a result, safety problems for bicycles and horse cart particularly in mixed traffic heavily used streets and intersections. In this way, they should face conflict with motor vehicles and pedestrians. Still there are no good standards of road design established to suit the fast growing traffic in the town. The road width on the figure and actual situation was different particularly when travelled along the main road entering Adama from Addis Ababa to the out lets of Harar/Djibouti road. The double lane road has shown in Table 12, whereas actual size is 8 to 9 meters wide and vehicles travel using the edge of the left and right side out of the road particularly when travelling to outlet from the city. The road also damaged and in poor conditions that exposed for road traffic

accident. It is a place of the highest road traffic accident recorded 187(26.1%) among all other accident spot areas. From the current study, it is evident that the number of side-side, front-side vehicle collisions were the leading problems because of speed as well as not giving priority to vehicles according to law on the unpleasant streets. Previously have seen in the literature, WHO (2002) identified that the poor or under reporting system was also masked the magnitude of road traffic accident problem relate to drivers' in Africa. This situation was also seen in the drivers, characteristics. It was also strengthened by Dr. Museru(2002) finding drivers in appropriate behaviors defined by police as reckless or dangerous driving contributed nearly 57% of the different reasons cited as contributory causes. Daniel Assefa and Gezahegn Tesfaye(2012) driving above the speed limit facing to give priority for other vehicles and pedestrians', similarly take in consideration on pedestrians' and drivers character under the study. Regarding the road environment, try to find the urban master plans, major developments are made linearly adjacent to the arterial(main) road network without any form of access control are considerations of pedestrians, parking facilities and drainage facilities. This also commented by the police responder earlier the master plan has to be reshuffled, and I observed at the time of raining many places at right and left side of the road covered by flooding water and vehicle passes through it. The other character of the road was accidents happened due high traffic congestion on the main roads mainly in adequate traffic management and unsafe road net work infrastructure facilities with poor planning control. As such bicycles have no lanes or tracks should be purposely constructed or designed to improve safety from conflict with motor vehicles and pedestrians, such measure has to be taken by concern body also suggested by drivers' respondent.

Photo8 Bicycle with Isuzu Vehicle crash along out let to Assela road.



Source: Field Survey.

Photo 9 Out let to Harar main road from Adama city.



Source: Field Survey

4.8. Traffic Law and Legislation Enforcement

Ethiopia had set its first traffic law in 1919E.C. which mainly used to make pedestrians responsible for any traffic accident cause. In 1934, a new traffic law was set that urged the pedestrians to take their left when travel along high ways. Ethiopia signed and agreed to implement international traffic law which mainly stresses the use of road signs in 1956EC. Accordingly, various universal traffic signs have been applied in the country. The traffic accident is growing at a shocking rate in Ethiopia for many reasons. For instance, drivers' inefficiency, technical defects of vehicles, improper use of roads by pedestrians', among others, are listed as major causes of accidents in the country (Samuel Taye, 2012).

Currently the country is almost using relatively simple and outdated controlling methods which had been applicable before several decades. It seems that more sophisticated optimization methods are failed for large networks. Modern instruments such as traffic speed enforcement hand-held radar and alcohol breath tester, among others, are still not introduced in the country. Of course, according to studies most traffic accidents are the result of speed, lack of road signs and drivers' impairment of judgment. Many say that speed, drunk driving and lack of enforcement are said to be the causes of the major failures of the traffic system in Ethiopia. Within a year over 2,000 people die while over 8,000 are vulnerable to light and heavy injuries and properties worth over 500 million Ethiopian Birr get damaged in the country because of road traffic accidents, studies show. From these accidents, Oromiya Regional State shares almost half for it is hosting large number of vehicles each day because of its location particularly port Djibouti to Addis Ababa. For instance, in 2004EC the accident was increased by 13.23 percent as compared to that of 2003EC. In a move to minimize the

ever worsening fatal incidents, Oromiya Transport Agency has imported ten alcohol tasters, fourhanded-held radar and two radars that are carried by car at a cost of over one million birr. As to Agency's reporter said, speed controlling radar and alcohol taster machines are expected to greatly support the effort to minimize road traffic accidents. Moreover, awareness raising activities are consistently given around bus stations for all pedestrians, passengers and drivers which has been eventually bringing about significant changes and greatly supporting traffic safety endeavors. Effective enforcement requires ensuring that the perceived task of punishment and violation remains high by making the penalty sufficiently severe and enforcing them quickly and efficiently .The traffic police of Oromiya Region have effective speed control system and is taking penalty actions along to the southern part of the country (Samuel Taye, 2012).

4.9. Necessity of Law Intervention.

It would be unquestionable to any state the role of government policy in general and laws and regulations in particular, in deciding road safety status of any nation. A long term policy vision and system wide strategies need to be complemented by interim targets to raise society's interest in road safety and guide policy making and strategy development. It was sorry to say that so far there is no specific government policy stated on road safety responsibilities in our country or does not have a national policy and strategy, which makes sector different from other sectors.

Improving road safety requires the concerted action, participation, and support of many different stakeholders in various sectors. It is important to designate a lead agency, it's clearly defined institutional management functions, organizational arrangements and processes, and develop institutional capacity across a range of sectors to facilitate intersect oral coordination, backed by strong political commitment and adequate and sustainable resources. Investing reasonable amount of capital on crash prevention activities helps practitioners to work using recent technologies in minimizing the gap between controlled safety and traffic accident. (WHO, 2004).

Creating space for civil participation helps galvanize political support on the basis of well articulated social demands from communities that have born the burden of road traffic accidents. For instance, United States nonprofit organization Mothers Against Drunk Driving (MADD) established in 1980, and involved in lobbying to reduce the legal limit for blood alcohol from a blood alcohol concentration of .10 grams per deciliter to .08 gram per

deciliter, which was approved by all state governments. These measures have contributed to decreasing traffic fatalities in alcohol- impaired driving crashes in United States by nearly 10 percent from 13,041 in 2007 to 11,773 in 2008(Lord Robertson 2009).

Successful implementation of comprehensive road safety programs requires coordination under a lead agency of the multiple government entities responsible for transport, infrastructure, urban planning, health, education and law enforcement. The main role can be assigned either to a lead ministry, a national road safety council, or a commission. In any case, the lead agency should have a clear mandate, high-level support, and sustainable funding. For instance, in France under the leadership of Jacques Chirac, who declared road safety as one of three top national priorities for his presidency and spearheaded a new road safety action plan with good results in decreased road traffic injuries and fatalities (Observatory National Inter ministerial de Securite' Routiere, 2004).

Photo 10 Road Traffic Congestion and Lessazfaire Traffic police controlling



Source: Field Survey.

Road Transport administration was established in 1967 by a proclamation No 256/67 and having under gone restructuring as Road Transport Agency (RTA) since 1976, by a proclamation No 107/76. Again it has been restructured and replaced by the new proclamation No14/92. Now a day's a few institutions are participating in the sector. In spite of the intervention measures and practices carried by responsible authorities, they had problems and capabilities (RTA).

The traffic laws in Ethiopia are not being seen on the ground. They remain good, only on paper because of poor enforcement. Of course, the existing legal instruments have gaps. Their gap largely originates from their failure to understand road safety in a comprehensive manner, properly accounting the responsibilities of drivers, pedestrians, traffic police, contractors and regulators. The gap between the number of traffic officers and the traffic flow is alarming. Although traffic management has seen insignificant technological advancements; globally, none have arrived even in the political capital of Africa. Even then, a visible collaboration between the office, the Transport Authority and local governments, has not been seen. Each lives in its own cage and with its own excuses when it comes to effective traffic flow (Fortune News Paper, May 28, 2015).

Targeted traffic control of accident locations and on the main accident causes was conducted in Oromiya Regional State and Addis Ababa. Oromiya has conducted workshops to implement targeted traffic control on injury accident causes throughout the region. However,

its implementation is not effectively pursued (United Nations Economic Commission for Africa, 2008).

If a driver is repeatedly breaking rules he/she should be first treated using all means (right him/her an offence, force him/her to participate in driving improvement courses, ban him/her from driving and disqualifying his/her license for ever. Concerning media initiatives that all medias of the country in general and the Adama city in particular were ought to match the existing road safety problem in the city, all drivers and pedestrians have to aware that media is good alternatives in raising awareness and to get the message across. As indicated in the first questionnaire respondent about 33(41.3%) were their source of knowledge for road traffic accident, while the rest 47(58.7%) believed it still needs further emphasis and advised road safety publicity to media.

CHAPTER FIVE

Summary, Conclusion and Recommendations.

5.1. Summary and Conclusion

Road traffic accidents are the cause of significance loss of human and economic resources. In this study identified the major accident hot spot areas and other place of occurrences relate with the temporal and spatial variations of road traffic accidents using location maps. The methodology used to study both the primarily and secondary data. Primarily observation, questionnaire and GIS tools and for secondary data mainly from Adama Traffic Police and other governmental institutions like Adama Transport Agency, Adama City Municipality and other related organizations to collect data. The sample of the population was purposive that identified through randomly the group of people includes: officers, pedestrians, police, students and teachers and drivers on the other by preparing two types of questionnaires respectively. The assessment was more of descriptive using quantitative and-qualitative-data.

The analysis underlined that the road traffic accident was a big problem with under-reporting of an accident in the city. It was only depended on the traffic police report on statistics. These might open for accidents go unreported, and that the statistics compiled not always reliable. It is found that the average road traffic accident in Adama was at least 4 per week that might high on the national road safety senses which are attributable to high population number and high traffic mixes increase of three wheeled vehicles of all kinds on the city roads. The relationship derive indicate that the increase in vehicles and population will bring an increase in traffic accidents and a rise in fatalities.

The results obtained throughout the assessment of the data, the extent and numbers of road traffic accidents showed an increasing trend period 2004/05 to 2013/14.

The average number of road traffic accidents in Adama city was 13.6 percent for death, 14.5 percent for serious injury, 18.4 percent for slight injury and 53.5 percent property damage. Still an increasing trend at the last survey time 2013/14 and the slight injury had similar trend and the serious injury had lower trend, and all traffic casualties have increased by 8.5 percent only in the last survey year. The estimated property damage costs incurred by road traffic accidents were very high in Adama. For the last ten years reached 9,666,722.21 from 1043 total accidents.

The road traffic accidents prevail most on working days followed by public holyday accounted 38.8 percent and 33.7 percent respectively. Monday accident was frequent shared 16.8 percent and the week end shared lowest 10.6 percent on Sunday. The monthly trend showed December was more traffic accident reported followed by January 10.6 percent and 9.8 percent respectively. These months has also their own impacts relate with a number of public holyday April reported the lowest 6.8 percent. The unique characteristics of road traffic accidents identified that near to half of the total accidents 48.6 percent occurred at night hours 6Pm to 6Am compare to a little more than half 51.4 percent occurred during day time 6Am to 6Pm. This large proportion of accidents at night time might be due to low densities of traffic volume and thus high travel speed that prevails during these hours. Since the city situated at low land parts of the country particularly between the base of an escarpment to the west and Great East African Rift Valley to the east, drivers coming from Addis Ababa or Neighboring towns to prevent the high scorched sun preferred travelling inwards or outwards from Djibouti port at night time. Regarding the place of occurrence, the business area was the highest reported of accident followed by school areas 7.6 percent and 6.5 percent respectively. Most of the victims were males; particularly some of them were economically active age group category of 10 to 19 years old. The average males accounted 63.3 percent of all causality cases in Adama.

The survey results indicate that, of all road traffic accidents of Adama, Bajaj and Commercial passenger cars which has 12 to 24 seats accounted 38.8 percent and 30 percent respectively. The traffic flow was too mixed and no distinction of flow for different modes is observed. Cycles and motor vehicles are usually parked along the side of road, on pedestrian paths, at commercial centers, and including animals walk in the center of road ways. It was also common some category of people participate illegal street trading.

The major areas of road were the most road fatalities that street lighting, appropriated road marking, traffic and decision signs, which improve safety on the road are either insufficient or totally in functional. The width of road incapable for mixed vehicles and trucks, poor road maintenance one can see road out let to Wonji Shewa and Harar from Adama city center, poor drainage systems have also been identified as a crucial problem facing the existing infrastructure and master plan to smooth mobility and safety.

Photo 11 Poor Maintenance of road Outlet to Wonji Shewa



Source: Field Survey

The drivers' errors and pedestrians' were responsible causes of road traffic accidents about 63 percent and 55 percent have faced respectively. Speeding above 40 km per hour accounts generally 41.6 percent in the city that was above normal. Wearing seat belt 36.7 percent, for some drivers using mobile phone accounts 46.7 percent, almost near to half of them consumed alcohol beverages account 48.3 percent were the main reported and observed errors of drivers. The behaviors of pedestrians were also causing loss of lives and material destruction. Some people in the city give little attention to traffic law and regulation that cross roads at any point and away from the junction area which accounted 36.3 percent. These showed that still did not bring an important behavioral change yet. Regarding Bicycles and horse drawn carts in the city operate along the road and collector streets with high level of a danger and insecurity, especially women and children.

Photo 12 Bicycle use Derartu avenue Vehicle Congestion road.



Source: Field Survey

The road safety in Adama is still a problem that the specific organization as well as coordinated and integrated traffic management with government and non-government organizations and enforcement is poor. The traffic police are in adequately equipped and giving priority for their duty and commitment is questionable to alleviate road traffic accident problem in Adama (Nazerth).

Conclusion: the study was carried out to describe the characteristics of Road Traffic Accidents in Adama city. Road Traffic Accidents are affecting the dwellers of the city in various aspects. The RTA casualties of the city mainly belong to the children and the youth who belong to productive age groups. Some causality have lost their lives, others have got serious or slight injuries. RTA is also deteriorating the economic wealth of the city.

Road traffic accidents are randomly distributed in the city in terms of space and time. The magnitude has shown an increasing trend in the study period. The accident hot spot areas exhibit the highest frequency of the RTA occurrences. Identifying map places of frequent accident spots, tries to use the application of GIS, examine the temporal and spatial trends, identify causes of traffic accidents, analyze the occurrence of road traffic accidents with respect to drivers' and pedestrians with findings, and propose the necessary interventions which could help to reduce the road traffic accidents in Adama city. Still there is a lack of well defined policy and strategy of road safety and legislation to implement effectively and efficiently for drivers' and pedestrians at large. Thus, I believe that this study contributes much for those to understand the general characteristics of road traffic accidents in Adama city and inspire other stakeholders to conduct further studies in the field.

5.2. Recommendations

This study attempt to provide a review of road traffic accident problem and related to road safety situation, drivers' and pedestrians' character in Adama (Nazreth) city. The road traffic accidents are causing heavy loss of human and economic resources with the relatively low road network and motorization level. The risk is increasing with the increase of population, the road network expansion with little consideration of safety and the increase motorization with the vehicle fleet generally in poor conditions. Considering the severity of road traffic accident problem and the road safety is vital issue to be addressed.

It should be necessary to aware the importance of accident data recording and reporting system.

Road traffic lights, signs, marks should be functional that could see in the major road functions, so that traffic polices could control traffic flow of other roads and special attention should be given to the road traffic accident spot areas already identified.

Road maintenance has to take in to consideration that the necessary budget should be put and implemented mainly by the City municipality and Transport Agency and as collaborate with nongovernmental organizations to alleviate the problem that already sited.

Students' traffic club plays a great role to minimize the traffic accidents. So such club has to be strengthening including traffic lessons as part of their proposed syllabus for non- formal education.

The human resources development enhance transport sect oral efficiency the requirements of skilled man power is indispensable one, particularly the traffic management, information science and transport management to bring the status of traffic police to be effective and efficient.

Minibuses and three wheeled motors (Bajaj) public transportation are used to convey majority of the city dwellers are fund more likely to be involved in frequent road traffic accidents than the other vehicle types. Thus, it needs well training and licensing programme required on these vehicles types.

The road safety works and its management system was not coping with the magnitude of the traffic accident problems and the worsening situation related to the road net work expansion, population and motorization. The situation requires that the government and collaborate stakeholders give attention to address in sustainable way.

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Appendices

Appendix A. Questionnaire Prepared For Concern Sample Population of Adama (Nazreth). Introduction

This questionnaire is prepared by a student of the Addis Ababa University, graduate program. The aim of the questionnaire is to examine the existing condition of road accident in Adama (Nazreth) from the perspective of road users and traffic regulations. Your cooperation in filling the questionnaire is honestly appreciated. The data collected will remain confidential, so your name and address are not needed.

Write and Tick to Respond it()

1, Address -----

2, What is your gender? Male----- Female-----

3, Age -----

4, Marriage Condition: Married----- Divorced----- Widowed----- Separated-----
Single-----

5, What is your educational level?

Primary education(1—8)-----

Secondary education(9—10)-----

Preparatory education(11—12)-----

Some College-----

College Diploma-----

College Degree-----

Second degree -----

Tertiary degree-----

6, Occupation

Government employee-----

Self-employed-----

Unemployed-----

Out of work-----

Home maker-----

Student-----

Unable to work-----

7, How long have you been in Adama (Nazreth)?

Less than a year-----

1—2 years-----

3--5 years-----

6—7 years-----

8—10 years-----

Above 10 years-----

8, How do you perceive the level of road traffic accidents in Adama(Nazreth)?

A big problem-----

A moderate problem-----

Not a problem-----

9, Have you faced or observed traffic accidents in your journey?

Yes-----

No-----

10, If your answer is 'Yes' how many times?

One times-----

Two times -----

Three times-----

More than three-----

11, Which type of road traffic accidents were highly Prevailing in Adama (Nazreth)? You can fill more than once.

Motor vehicle with motor vehicle-----

Motor vehicle with bicycle-----

Motor vehicle with Bajaj-----

- Motor vehicle with pedestrians-----
- Motor vehicle with static object-----
- Motor with horse drawn carts-----
- Horse drawn carts with pedestrians-----
- Bajaj with horse drawn carts-----
- Bajaj with Bajaj-----
- Bajaj with pedestrians-----
- Bicycle with bicycle-----
- Other(Specify)-----

12, What type of wheeled vehicle does you often afraid on your way?

- Bajaj-----
- Bicycles-----
- Horse drawn carts-----
- Mini Bus-----
- Motor Vehicles-----
- Trucks-----

13, In your understanding, in which point of time the road traffic accident seem more?

- At working day-----
- At week end-----
- On public holyday-----

14, How would you describe the traffic laws and regulations of the city?

- Excellent-----
- Very good-----
- Good-----
- Fair-----
- Unsatisfactory-----

15, Which type of vehicle most of the time make an accident?

Bajaj passenger vehicle-----	<input type="checkbox"/>	private car-----	<input type="checkbox"/>
Commercial car -----	<input type="checkbox"/>	Governmental c-----	<input type="checkbox"/>

16, How frequent do you have to leave side walks and walk along roads?

Always-----	<input type="checkbox"/>
Sometimes-----	<input type="checkbox"/>
Rarely-----	<input type="checkbox"/>
Never do this-----	<input type="checkbox"/>

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

<input type="checkbox"/>		
Yes-----	No-----	<input type="checkbox"/>

18, Where do you usually cross the main roads?

At traffic light-----	<input type="checkbox"/>
At junction-----	<input type="checkbox"/>
At mid-block pedestrians crossing away from junction-----	<input type="checkbox"/>
At any point-----	<input type="checkbox"/>

19, Crossing the main roads in the city is:

Easy-----	<input type="checkbox"/>
Difficult-----	<input type="checkbox"/>

20, How do you rate drivers give priorities to pedestrians as required by law?

Excellent-----	<input type="checkbox"/>
Very good-----	<input type="checkbox"/>
Good-----	<input type="checkbox"/>
Poor-----	<input type="checkbox"/>
Very poor-----	<input type="checkbox"/>

21, How do you rate the traffic police commitment to their duties?

Excellent -----	<input type="checkbox"/>	Good	<input type="checkbox"/>
Very good -----	<input type="checkbox"/>	Poor--	<input type="checkbox"/>

22, Who is your source of knowledge and experience about road safety rules?

My self-----	<input type="checkbox"/>
Parents-----	<input type="checkbox"/>
Schools-----	<input type="checkbox"/>
Traffic police -----	<input type="checkbox"/>
Media-----	<input type="checkbox"/>

23, How do you comment the existing road safety laws and regulations? Please write either in positive or negative out looks you have.

24, Write any additional comments you think are important to solve road safety problems in the city?

Thanks for Your Cooperation!!

Appendix B. Questionnaire Filled by Drivers. Please fill in space and make tick in the rectangle()

1, What is your gender? Male ----- Female-----

2, Age-----

3, Educational Level-----

4, Level of License

None-----

First Level-----

Second Level-----

Third Level-----

Fourth level-----

Fifth Level-----

5, How long have you been driving in Adama(Nazreth)?

Less than one year-----

1—2 years-----

3—5 years-----

6—7 years-----

8—10 years-----

Greater than 10 years-----

6, Which type of Vehicle do you normally drive?

Private car-----

Commercial car-----

Governmental car-----

Bajaj Passenger car-----

7, Where do you often Parking your car?

On street-----

Park area-----

In front Commercial or Office area----

8, When you drive, what is your normal speed(approximately) in the city?

< 20 Km per hour-----

20—30Km per hour-----

30—40Km per hour-----

40—50Km per hour-----

9,Have you give way priorities to pedestrians as required by law?

Always-----

Some-----

Never-----

10, How do you perceived the level of road traffic accidents problem in your city?

A big problem-----

A moderate problem -----

Not a problem-----

11, Are you faced or observed accidents while driving in the city roads?

Yes-----

No-----

12, Do you wear a seat belt when you drive?

Yes, always-----

Most of the time-----

Sometimes-----

Never-----

13, If your answer is 'Never wear a seat belt', what is the reason?

It is not comfortable-----

I always miss it-----

I don't know how to wear it-----

Other-----

14, Do you use a mobile phone when you are driving?

Yes-----

No-----

15, Do you drink any alcoholic beverages?

Yes-----

No-----

16, If yes, how often do you drive within alcoholic drinks?

Very often-----

Occasionally-----

Rarely-----

17, If you are involved in accidents how many times?

None-----

One-----

Two-----

Three-----

Four-----

More than four-----

18, In your understanding, which point of time traffic accident is more?

Working day-----

Week end-----

On Public Holyday-----

19, Have you ever been stopped by traffic police for any kind of violation?

Yes-----

No-----

20, If you are involved in accidents have it reported with traffic police?

Yes-----

No-----

21, How do you rate the traffic police commitment to their duties?

Very good-----

Good-----

Poor-----

Very poor-----

22, Have you got additional education or training about road safety by concerned body?

Yes-----

No-----

23, Suggest some possible solutions to prevent and reduce road traffic accidents in Adama(Nazreth) City.

Thanks For Your Cooperation!!

Appendix C

Table 22 Respondents Profile

Information	Category of Population						Total	Percent (%)
	Character	Officers'	Pedestrians'	Police	Students'	Teachers'		
Residence	All Respond in Adama	16	16	16	16	16	80	
Sex	Male	3	15	19	11	8	56	70
	Female	2	9	1	10	2	24	30
	Total	5	24	20	21	10	80	100
Age Group	16-25	2	8	2	15	2	29	36.3
	26-35	7	3	5	1	5	21	26.3
	36-45	3	1	3	0	2	9	11.2
	46-55	3	4	5	0	7	19	23.7
	56-65	1	0	1	0	0	2	2.5
	>66	-	-	-	-	-	-	-
	Total	16	16	16	16	16	80	100
Marital Status	Married	13	7	11	0	7	38	47.5
	Single	3	9	5	16	9	42	52.5
	Total	16	16	16	16	16	80	100

Educational Level	<11 Grade	-	-	-	-	-	-	-
	11-12	0	3	1	10	0	14	17.5
	Certificate	0	4	4	6	0	14	17.5
	Diploma	8	6	8	0	0	22	27.5
	Degree	8	3	3	0	13	27	33.7
	Second degree	0	0	0	0	3	3	3.8
	Tertiary degree	-	-	-	-	-	-	-
Total	16	16	16	16	16	80	100	
Duration of Living	< a Year	0	1	0	0	3	4	5
	1-2 years	3	2	5	2	0	12	15
	3-5 years	12	7	8	0	2	29	36.2
	6-10 years	1	0	3	0	1	5	6.3
	>10 years	0	6	0	14	10	30	37.5
	Total	16	16	16	16	16	80	100
Occupation	Government Employee	16	0	16	0	16	43	53.8
	Self employee	0	8	0	6	0	14	17.5
	Student	0	8	0	10	0	23	28.7
	Unemployed	0	0	0	0	0	0	-
	Total	16	16	16	16	16	80	100

Source: Field Survey.

Table 23 Category of Population Respond To Accident.

Information	Character	Category of Population					Total	In (%)
		officers	Pedestrians	police	Students	Teachers		
Level of Road traffic Accident	Big Problem	6	8	7	9	8	38	47.5
	Moderate Problem	10	8	9	7	8	42	52.5
	No Problem	-	-	-	-	-	-	-
	Total	16	16	16	16	16	80	100
Have you faced traffic accident?	Yes	9	13	8	5	9	44	55
	No	7	3	8	11	7	36	45
	Total	16	16	16	16	16	80	100
Those who said "yes", how many times?	One	2	4	3	3	5	17	38.6
	Two	2	5	3	1	2	13	29.6
	Three	-	-	-	-	-	-	-
	Greater than three	5	4	2	1	2	14	31.8
	Total	9	13	8	5	9	44	100
Prevailing of Road Traffic Accident. You can respond more than once.	Motor Vehicle With Motor Vehicle	2	4	3	1	1	11	13.3
	Motor Vehicle with Bicycle	2	2	1	0	0	5	6.25
	Motor Vehicle with Bajaj	5	4	1	1	0	11	13.8
	Motor Vehicle with Pedestrians	3	3	0	0	0	6	7.5
	Motor Vehicle with Static Object	0	1	0	0	0	1	1.3
	Motor with Horse drawn cart	1	0	0	1	0	2	2.5
	Horse drawn cart with Pedestrian	0	0	0	0	0	0	0
	Bajaj with horse drawn cart	1	1	1	2	0	5	6.3
	Bajaj with Bajaj	5	5	3	0	0	13	16.3
	Bajaj with Pedestrians	3	3	2	2	2	12	15
Vehicle crash	3	4	3	0	0	10	12.5	

	Vehicle with Pedestrians	1	1	1	0	1	4	5
	Other	-	-	-	-	-	-	-
	Total	16	16	16	16	16	80	100
Which vehicles do you often afraid?	Motor Vehicle	5	5	3	4	6	23	28.7
	Bajaj	4	4	5	6	8	27	33.8
	Bicycle	1	3	1	2	0	7	8.7
	Horse drawn cart	1	2	0	1	0	4	5
	Trucks	4	0	5	3	2	14	17.5
	Vehicle	1	2	2	0	0	5	6.3
	Total	16	16	16	16	16	80	100

Source: Field Survey.

Table 24 Categories of People Respond to Traffic Laws and Regulations.

Information	Character	Category of Population					Total	In (%)
		Officers	Pedestrians	Police	Students	Teachers		
Which time accident seems occur?	At working day	8	6	7	4	6	31	38.8
	At week end	5	8	5	2	2	22	27.5
	On public holyday	3	2	4	10	8	27	33.7
	Total	16	16	16	16	16	80	100
The city traffic laws and regulations	Excellent	0	0	0	0	0	0	0
	Very good	4	0	4	0	1	9	11.2
	Good	9	5	10	4	5	33	41.3
	Fair	3	7	2	7	1	20	25
	Unsatisfactory	0	4	0	5	9	18	22.5
	Total	16	16	16	16	16	80	100
Vehicle which makes more accident.	Bajaj	6	6	8	6	5	31	38.8
	Public Transport vehicle	5	8	5	3	3	24	30
	Private Vehicle	4	2	2	2	4	17	21.2
	Government Vehicle	1	0	1	3	3	8	10
	Total	16	16	16	16	16	80	100
How do you frequent have to leave sidewalks and walk along roads	Always	3	3	9	0	3	18	22.5
	Sometimes	1	2	0	1	1	5	6.2
	Rarely	10	8	7	15	11	51	63.8
	Never do this	2	3	0	0	1	6	7.5
	Total	16	16	16	16	16	80	100
Understanding traffic signs,	Yes	12	10	15	10	15	62	77.5
	No	4	6	1	6	1	18	22.5
	Total	16	16	16	16	16	80	100

signals and road marks.								
Where do you Usually cross the main roads?	At traffic Light	7	3	4	1	8	23	28.7
	At zebra cross road	5	4	10	5	4	28	35
	At mid block Pedestrians crossing away from junction	3	2	0	5	3	13	16.3
	At any point	1	7	2	5	1	16	20
	Total	16	16	16	16	16	80	100
Crossing the main road in the city is:	Easy	5	4	8	5	4	26	32.5
	Difficult	11	12	8	11	12	54	67.5
	Total	16	16	16	16	16	80	100
Rate of drivers give priorities to pedestrians' as required by law	Excellent	0	2	2	0	0	4	5
	Very good	0	1	2	0	0	3	3.8
	Good	12	5	12	4	5	38	47.5
	Poor	4	8	0	12	11	35	43.7
	Total	16	16	16	16	16	80	100
Commitment of traffic police for their duties	Excellent	1	1	3	0	0	5	6.3
	Very good	1	2	7	0	0	10	12.5
	Good	12	5	6	5	12	40	50
	Poor	2	8	0	11	4	25	31.2
	Total	16	16	16	16	16	80	100
5Y8o3u3r2430source of knowledge about road safety rules	Myself	5	5	8	3	3	24	30
	Parents	2	2	0	5	0	9	11.3
	Schools	0	3	0	4	3	10	12.4
	Traffic Police	0	1	5	2	1	9	11.3
	Media	9	5	3	2	9	28	35
	Total	16	16	16	16	16	80	100

Source: Field Survey

Appendix D
Table 25 Profile of Drivers.

Information	Character	Total	In (%)
Sex	Female	2	
	Male	58	
	Total	60	
Age Category	16—25	13	
	26--35	18	
	36—45	15	
	46—55	14	
	56—65	-	
	Greater 65	-	
	Total	60	
Educational Level	Less than 9 Grade	-	
	9—12	16	
	Certificate	14	
	Diploma	18	
	Degree	12	
	Second degree and above	-	
	Total	60	
Marital Status	Married	30	
	Single	22	
	Separated	5	
	Widowed	3	
	Total	60	
Duration of time living in Adama	Less than a year	-	
	One to Two years	13	
	Three to Five years	13	
	Six to Seven years	12	
	Eight to Ten Years	11	
	Greater than Ten years	11	
	Total	60	

Source: Field Survey

Table 26 Characteristics of the Drivers.

Information	Character	Total	In (%)
Driver's Level of License	None	-	-
	One	-	-
	Two	16	26.7
	Three	28-	46.6
	Four	16	-
	Five	60	26.7
	total	18	100
Type of Vehicle you drive	Bajaj Three Wheel Vehicle	26	30
	Government Vehicle	4	43.3
	Private Vehicle	12	6.7
	Total	60	20
Where do you often park your vehicle?	On Street	17	100
	Park area	19	28.3
	In front Commercial or Office area	24	31.7
	Total	60	40
Your Normal Speed when driving	< 20 km per hour	-	-
	20—30km pr hour	10	16.7
	30—40km per hour	25	41.7
	40—50km per hour	20	33.3
	>50km per hour	5	8.3
	Total	60	100
Do you give priority for pedestrian required by law?	Always	50	83.3
	Sometimes	10	16.3
	Never	-	-
	Total	60	100

Source: Field Survey