ADDIS ABABA UNIVERSITY

ADDIS ABABA INSTITUTE OF TECHNOLOGY

SCHOOL OF CIVIL AND ENVIRONMENTAL ENGINEERING

ASSESSMENT AND EVALUATION OF ROAD TRANSPORTATION REGULATIONS IN ETHIOPIA

(A case study in Addis Ababa city)

A Thesis Submitted to the School of Graduate Studies of Addis Ababa University in partial fulfillment of the Degree of Master of Science in Civil Engineering for Road and Transport Engineering

BY MISRAK HIRUY

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Misrak Hiruy

Approval by Board of Examiners

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DECLARATION

I certify that this research work titled "ASSESSMENT AND EVALUATION OF ROAD TRANSPORTATION REGULATION, (A CASE STUDY IN ADDIS ABABA)" is my work. The work has not been presented elsewhere for assessment and award of any degree or Diploma. Where material has been used from other sources it has been properly acknowledged/ referred.

Misrak Hiruy _____ _____

Name Signature Date

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Most significant accomplishments can never be completed alone, and this thesis is the same. While it would be impossible for me to list all the peoples who helped me through this thesis, I want to recognize some.

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ABSTRACT

This thesis aims at evaluating the Addis Ababa city roads transportation system efficiency which is the relationship between the input of the transportation system and its capability of satisfying the transportation demand in the system. Then by addressing the efficiency counter backs of the policies related to the inefficiency indicators are assessed following by addressing an optional policy approach that has been practiced worldwide which resulted in a positive impact on road and transportation systems.

Rapid urbanization in Addis Ababa poses challenges of traffic congestion, accidents, transportation delays & emission. Traffic congestion in the city leads to pollution, wasted time& excessive fuel consumption.

Currently, the roads in Addis Ababa are packed, yet the demand for the transportation sector is highly increasing. Unplanned and uncontrolled development has resulted in an urban sprawl, pushing out the boundaries of the cities and making demand for transportation more complex. As a result travel distances become relatively longer, travel times and costs have increased drastically.

This thesis used exploratory and observational research design which is used to explore & observe what is happening in a given context since the main objective of the research is to explore access and evaluate road transportation system regulation in Addis Ababa. The study used data on road traffic accidents and vehicle data for the period 2009/2010-2018/2019 G.C and the data were obtained from Addis Ababa Police Commission and the Addis Ababa Transportation Authority.

The results of the analysis in this thesis showed that the road transportation demand in Addis Ababa is highly increasing and at the same time the number of the vehicle in Addis Ababa is also increasing at a higher rate in the last decade which is creating a saturation number of vehicles in the streets of Addis Ababa, therefor a series measure that gives long term demand management must be done from the core: otherwise, the situation will worsen and mobility will be adversely affected causing significant economic loss.

This research examines policy options to make the Addis Ababa road transportation system sustainable, effective and efficient. Apart from the most important capacity related solutions such as; adequate infrastructure, parking facility, vehicle population, etc., pertinent policymakers have to consider changing the transportation demand and individual behavior to create a sustainable urban transportation system.

In Addis Ababa city it is found that the vehicle number is increasing in number tremendously during the last 10 years. The total number of vehicles for those years has increased from 187,538 to 450,700. Commercial vehicles cover the larger amount which is 43.2% of the total vehicle population that is only 6.34% larger than the privately owned vehicles.

The number of crash in the city has been increasing drastically which is the privately owned vehicles covers the larger amount at which it covers 85% of the total accident that increased the vulnerability of pedestrians which resulted during the last 10 years the peoples involved in the traffic accident covers 78.42% of pedestrians, 16.2% passengers and 5.3% drivers.

To cope with the problems encountered in Addis Ababa city road transportation system this research recommends a regulation based solutions for the problems of which applying a regulation for demand management is the first outstanding solution that gives a long term solution and approaches that have given a pleasing result elsewhere but not tested in Ethiopia are assessed and explained in detail on this research which can be exercised through, congestion charging, fuel taxation approach, vision zero approach, lifelong driving lesson, and excise tax.

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LIST OF ABBREVIATION

APTA: American Public Transportation Association

CO_2: Carbon dioxide

CSA: Central statistical agency of Ethiopia

DNRR: Depletion of non-renewable resources.

ERA: Ethiopian Roads Authority

EU- European union

FDRE: Federal Democratic Republic of Ethiopia

GDP: Gross Domestic Product

HOV-high occupancy vehicles

RTA: Road and Transport Authority

TRAIN: Tax Reform for Acceleration and Inclusion

UN: United Nations

UNCSD: United Nations Conference on Sustainable Development

UNESCECA: United Nation Economic and Social Council Economic Commission for Africa

UPT: Urban Public Transport

USA: United States of America

USD: United States dollar

CHAPTER ONE

INTRODUCTION

1.1. Background of the study

Ethiopia is included among the oldest countries in the world which is located in East Africa, which is known as the Horn of Africa. It is located in the tropics between 3^{o}-18^{o}N Latitude and 33^{0} – 48^{0}E Longitude. Ethiopia has a land area of 1.13 million Km^2 and has a population of more than 100 million, it is the second-largest population in Africa comprising of more than 80 different ethnic groups. (Wubneh 2013)

The terrain of the country consists of a high plateau with mid to high central mountains which is divided into two by the Great Africa Rift Valley and surrounded by the lowlands of the border regions. The topography and the influence of the surrounding continental masses and oceans have created a varying climate, agro-ecology, and vegetation with immense natural resources potentials for development. (Wubneh 2013)

The capital city of Ethiopia is Addis Ababa. Despite Ethiopia's long history of civilization, Addis Ababa is a relatively new city. After uniting the tribes to form the modern country of Ethiopia, King Menelik II established Addis Ababa as the country's centrally-located capital in 1886. (Wubneh 2013)

Addis Ababa is one of the highest cities in the world with an elevation ranging from 2100 to 3000 meters above sea level. This elevation explains its moderate climate temperatures range between 15–18^{0} C with highs of 24^{0}C and lows of 10^{0}C. (Wubneh 2013)

The city receives over one-half of its annual 110 cm (43 inches) rainfall during the summer months of June, July, and August (Wubneh 2013).

1.2. Statement of the problem

Nowadays, we have a saturated number of transportation infrastructures due to the growing number of vehicles over the last few decades. This situation impacts our lives particularly for the populations living in urban areas. while people need more and more to travel rapidly from one place to another, it will result in

traffic congestions, accidents, transportation delays, and emission.

Many studies around the world indicated that the mobility of people, freight, and information is fundamental to economic and social activities. Increasing car ownership and existing road infrastructure are the most crucial factors that determine traffic conditions. For a highly increasing number of cars If proper road provision cannot be made accordingly, the expected road service level will never be possibly attained.

Evaluation of most developed and industrialized societies indicated that they have been noted for the high quality of transportation systems and services.

Eddington (2006) cites adequate transport networks, traffic management and control system, and effective, efficient, and reliable mass transit as key factors that affect the urban transportation system. Nadiri (1998) writes that an investment in inadequate transport infrastructure improves transport efficiency in terms of increased productivity and continues that transportation infrastructure involves good road networks, adequate bus stops, parking areas with traffic signals. Shapiro et al, (2002) assert that mass transit is a prerequisite for ensuring efficient and effective transportation systems in urban areas in terms of energy conservation reduced traffic congestion and environmental preservation. They argue that effective mass transit system is underpinned by availability, accessibility, and reliability of buses. Effective traffic management and control system is key to ensure an effective transportation system in the urban areas. This involves management and control of road signals, road space, parking space, and road users (Arasan 2012; Jones 1999).

Urban areas need special attention because traffic congestion in the city leads to pollution, health-related problems, wasted time, and excess fuel consumption. Currently, the roads in Addis Ababa are occupied yet the need for transportation demand is highly increasing. Public transport is not properly functioning to its ultimate serviceability and no mechanism currently exists for its measurement of effective frequency to cover the demand. The city is developing rapidly and the development in the city is taking place without consideration of transport needs or impacts. Unplanned and uncontrolled development has resulted in an urban sprawl that is pushing out the boundaries of the city extremely which makes the demand for transportation more complex. As a result of urban sprawling, travel distances become longer, travel times and costs have increased.

Enforcement of existing laws and regulations safeguarding transport infrastructure, services, and users are

weak or inconsistently applied and there are no standards controlling vehicle construction or emissions.

1.3. Objectives of the thesis

1.3.1. General objective

The general objective of this research is to provide a platform for dialogue and assess the current road transportation system problems in Addis Ababa city following by providing a regulation based solutions for the problems and give government authorities and planners a toolkit for system improvement on Addis Ababa city road transportation by applying the recommended regulations on the research.

1.3.2. Specific objectives

The specific objectives of this paper are to;-

- assess the current practicing pattern of the Addis Ababa road transportation system and identify the deficiency for the efficient and effective operation of the system;
- assess the road transportation regulations regarding the identified deficiencies and identify whether the cause for the assessed deficiencies in the absence of regulation or lack of enforcement;
- assess a selected world's best road transportation system practices with its positive experience;
- recommend for regulation if regulations for the deficiencies are not set yet, and
- Recommend for enforcement if the policies are regulated but there is low or no enforcement regarding the issue.

1.4. Research questions

This research consists of a synthesis of the road transportation sector in Addis Ababa city; to address the specific objectives that are listed above in this regard the following questions are formulated.

- What is the pattern of the road transportation system in Addis Ababa city?
- Is there an efficient and effective pattern in the transportation sector?
- If there is no efficient and effective road transportation system in Addis Ababa city, what are the implications for the deficiency from the perspective of all stakeholders?
- What causes a deficiency in the transportation sector?
- What do the regulations say about the deficiencies? And why it isn't enforced to fulfill its goal?

Or is it not regulated yet?

- What do developed country's regulations say about the areas of implications that were assessed as a deficiency?
- What positive benefits they got as they regulate and enforce the regulations?

1.5. Scope of the study

The objective of this paper is to give government authorities and planners a toolkit of the current road transportation system deficiencies as a case study in Addis Ababa city with their relative regulations, possible and tested solutions available worldwide, together with an indication of potential positive impacts. The paper concluded by recommending the possible available ways to foster a good road transportation system however, the recommended ideas are not tested in this paper and left for further study.

1.6. Limitation of the study

There was a limitation of time in collecting data from the questionnaire. In data collection, some respondents were uncooperative in providing information. Specifically, they were not interested to fill an open question. Lack of full documents on regulation based information on the road transportation system of the city was the vital limitation while doing this thesis.

1.7. Organization of the thesis

The report has been organized into five chapters; as follows:

Chapter one- deals with the introduction which covers the topics; background of the study, statement of the problem, objectives of the study, the research questions, and lastly with the limitations and scope.

Chapter two- covers literature reviews on issues concerned with the research.

Chapter three- discusses the research materials and methodology adopted.

Chapter four- deals with data analysis, results, and discussion.

Chapter five- presents the conclusions and recommendations of the study. Finally

Chapter six- proposes future research areas.

CHAPTER TWO

LITERATURE REVIEW

2.1. Importance of transportation

Transportation is essential for any nation's development and growth in both the public and private sectors. For as long as the human race has existed, transportation has played a significant role by facilitating trade/commerce, conquest, and social interaction, while consuming a considerable portion of time and resources. The primary need for transportation has been economic, involving personal travel in searching of food or work, travel for exchange of goods and commodities, exploration, personal fulfillment, and the improvement of a society or a nation (Nicholas J. Garber and Lester A. Hoel, 2003)

Most economies now rely heavily on road transport for passenger and freight movements. Even countries historically dominated by other modes of transport are now witnessing remarkable expansion in demand for road transport. The hard truth is that roads are the main arteries for moving good and people in the global economy and they are becoming increasingly dominant (Heggie, 1998)

Examination of most developed and industrialized societies indicates that they have been noted for high-quality transportation systems and services. Nations with well-developed maritime systems (such as the British Empire in the 1900s) once ruled vast colonies located around the globe. In more modern times, countries with advanced transportation systems such as in the United States, Canada, Asia, and Europe are leaders in industry and commerce. Without the ability to transport manufactured goods and raw materials and without technical know-how, a country is unable to maximize the comparative advantage it may have in the form of natural or human resources. Countries that lack an abundance of natural resources rely heavily on transportation to import raw materials and export manufactured products (Nicholas J. Garber & Lester A. Hoel 2003).

As the world population increases, life requires competition which needs increased mobility. The ability to move from place to place with comfort, reasonable cost, and the desired time is one of the major factors affecting the competency of individuals. Human beings use different modes of transport for mobility. The growth of modes of transport varies based on the level of development of countries.

Five transport modes have been witnessed so far in the history of humanity's technological development:

namely; road transport, water transport, rail transport, air transport, and continuous flow system.in Ethiopia road- transport is the dominant mode and accounts for 90 to 95 percent of motorized inter-urban freight and passenger movements. The importance of transportation will be seen into two broad groups as follows:

A good transportation system is a prerequisite for economic growth and poverty reduction. On the international front, changes in trading relationships brought about by globalization require changes in a country's transportation system and its performance. Research [World Bank (2006) Doing Business report, including a world survey of country business practices], shows that an effective transport system can reduce costs and comparative distances between trading partners, increasing trade effectiveness and maximizing existing industrial investments and production outputs.

Experience from around the world shows that as economies grow rapid urbanization takes place embracing as much as 60% of a nation's population. Cities become significant 'engines of growth' attracting manufacturers and providing significant employment opportunities. (World Bank (2006) China: Building Institutions for Sustainable Urban Transport EASTR Working Paper No. 4).

Development is related to improving the welfare of a society through appropriate social, political, and economic conditions. The expected outcomes are quantitative and qualitative improvements in human capital (e.g. income and education levels) as well as physical capital such us infrastructures (utilities, transport, telecommunications). While in the previous decades, development policies and strategies tended to focus on physical capital, recent years have seen a better balance by including human capital issues. Irrespective of the relative importance of physical versus human capital, development cannot occur without both as infrastructures cannot remain effective without proper operations and maintenance while economic activities cannot take place without an infrastructure base. (The geography of Transport systems, Dr. Jean-Paul Rodrigue and Dr. Theo Notteboom, 2017).

Good transportation, in and of itself, will not assure success in the marketplace, as the availability of transportation is a necessary but insufficient condition for economic growth. However, the absence of supportive transportation services will serve to limit or hinder the potential for a nation or region to achieve its economic potential. Thus, if a society expects to develop and grow, it must have a strong

internal transportation system consisting of good roads, rail systems, as well as excellent linkages to the rest of the world by sea and air. Thus, transportation demand is a byproduct derived from the needs and desires of people to travel or to transfer their goods from one place to another. It is a necessary condition for human interaction and economic competitiveness (Nicholas J. Garber & Lester A. Hoel 2003).

As far back in the eighteenth century, Adam Smith noted the beneficial impact of transport on the economic performance and growth of nations. According to Smith (1977), transport stimulating agricultural production, low levels of regional inequality by opening up remote areas, and as a result induces better territorial integration.

The availability of transportation facilities can strongly influence the growth and development of a region or nation. Good transportation permits the specialization of industry or commerce, reduces costs for raw materials or manufactured goods, and increases competition between regions, thus resulting in reduced prices and greater choices for the consumption (Nicholas J. Garber & Lester A. Hoel 2003).

Because of its intensive use of infrastructures, the transport sector is an important component of the economy and a common tool used for development. This is even more in a global economy where economic opportunities have been increasingly related to the mobility of people, goods, and information. A relation between the quantity and quality of transport infrastructure and the level of economic development is apparent. High-density transport infrastructure and highly connected networks are commonly associated with high levels of development. When transport systems are efficient, they provide economic and social opportunities and benefits that result in positive multiplier effects such as better accessibility to markets, employment, and additional investments. When transport systems are deficient in terms of capacity or reliability, they can have an economic cost such as reduced or missed opportunities and lower quality of life. (Dr. Jean-Paul Rodrigues and Dr. Theo Notteboom, The geography of transport systems, 2017).

Dr. Jean-Paul Rodrigue and Dr. Theo Notteboom, (2017) briefly stated the economic importance of transportation in their book the Geography of Transport Systems as follows; “At the aggregate level, efficient transportation reduces costs in many economic sectors, while inefficient transportation increases these costs. Besides, the impacts of transportation are not always intended and can have unforeseen or

unintended consequences. For instance, congestion is often an unintended consequence in the provision of free or low-cost transport infrastructure to the users. However, congestion is also an indication of a growing economy where capacity and infrastructure have difficulties keeping up with the rising mobility demands. Transport carries an important social and environmental load, which cannot be neglected." And they started assessing the economic importance of transportation requires a categorization of the types of impacts it conveys which involves core (the physical characteristics of transportation), operational and geographical dimensions;

- Core: The most fundamental impacts of transportation-related to the physical capacity to convey passengers and goods and the associated costs to support this mobility. This involves the setting of routes enabling new or existing interactions between economic entities.
- Operational: Improvement in the time performance, notably in terms of reliability, as well as reduced loss or damage. This implies a better utilization level of existing transportation assets benefiting its users as passengers and freight are conveyed more rapidly and with fewer delays.
- Geographical**:** Access to a wider market base where economies of scale in production, distribution, and consumption can be improved. This results in increases in productivity from the access to a larger and more diverse base of inputs (raw materials, parts, energy, or labor) and broader markets for diverse outputs (intermediate and finished goods). Another important geographical impact concerns the influence of transport on the location of activities.

The economic importance of the transportation industry can thus be assessed from a macroeconomic and microeconomic perspective:

- At the macroeconomic level (the importance of transportation for a whole economy), transportation and the mobility it confers are linked to a level of output, employment, and income within a national economy. In many developed countries, transportation accounts between 6% and 12% of the GDP.
- At the microeconomic level (the importance of transportation for specific parts of the economy) transportation is linked to the producer, consumer, and production costs. The importance of specific transport activities and infrastructure can thus be assessed for each sector of the

economy. Usually, higher income levels are associated with a greater share of transportation in consumption expenses. Transportation accounts on average between 10% and 15% of household expenditures, while it accounts for around 4% of the costs of each unit of output in manufacturing, but this figure varies greatly according to sub-sectors. Dr. Jean-Paul Rodrigue and Dr. Theo Notteboom, (2017).

The added value and employment effects of transport services usually extend beyond those generated by that activity; indirect effects are salient. For instance, transportation companies purchase a part of their inputs (fuel, supplies, maintenance) from local suppliers. The production of these inputs generates additional value-added and employment in the local economy. The suppliers in turn purchase goods and services from other local firms. There are further rounds of local re-spending which generate additional value-added and employment. Similarly, households that receive income from employment in transport activities spend some of their income on local goods and services.

An effective transportation system, therefore, has a significant impact on the quality of life and opportunity for citizens and businesses. It helps form an important part of the social safety net facilitating the distribution of wealth through trade and employment opportunities in both urban and rural communities.

Figure 2.1 below illustrates the transport and economic development key Connections.

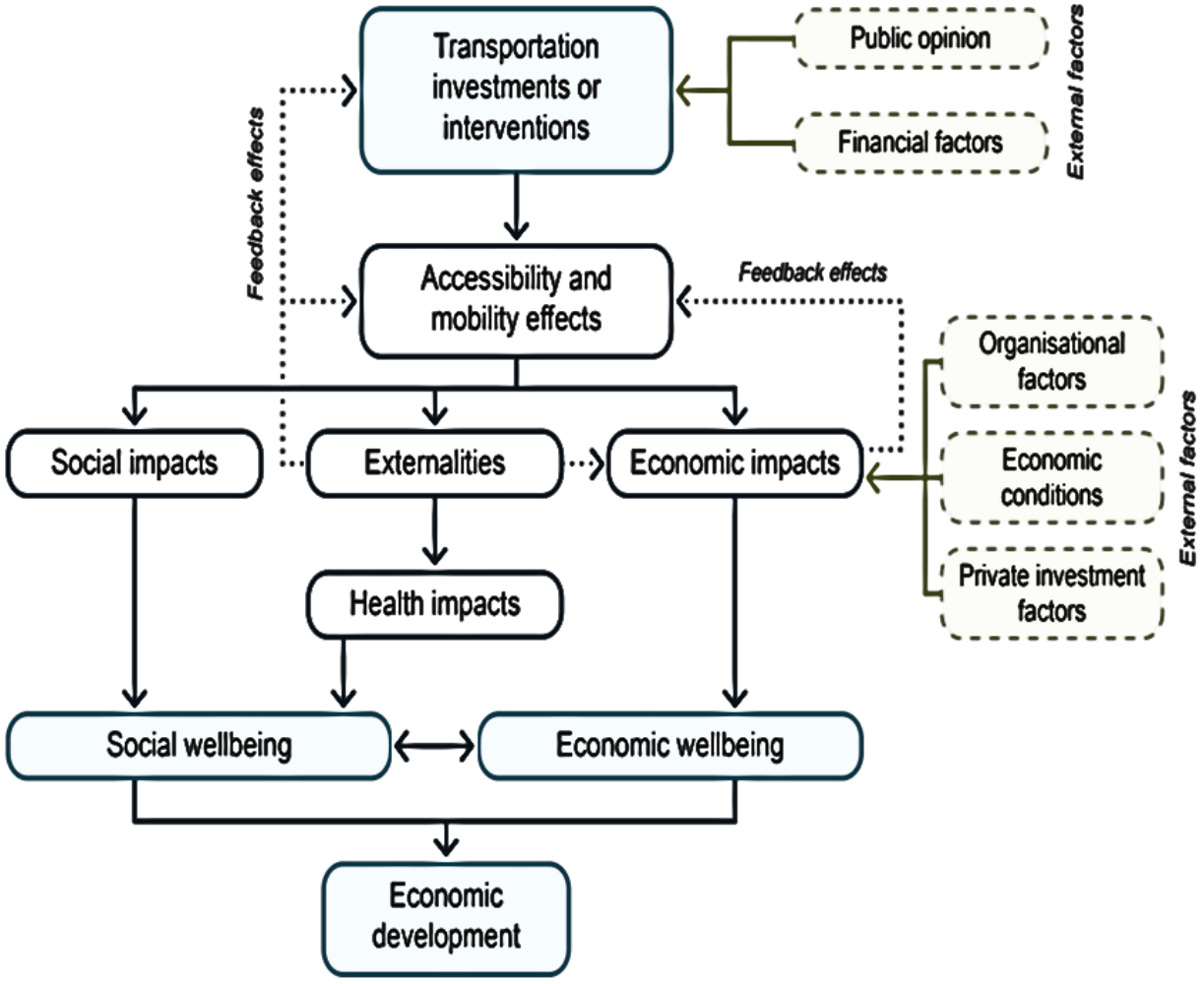

Figure 2.1: Transport and Economic Development – Key Connections

Source: Leung, 2006.

Dr. Jean-Paul Rodrigue and Dr. Theo Notteboom, (2017) illustrate the socioeconomic benefits of transportation briefly in their book the Geography of Transport Systems stating that transport improvements usually increase the scale and scope of economic and social interactions. There is a wide range of economic benefits conveyed by transportation systems, some direct (capacity and efficiency), some indirect (accessibility and economies of scale), and some induced (multipliers and opportunities). They are impacting transport supply and demand as well as the economy as follows;

- **Direct Impacts**- The direct benefits are mostly related to capacity and efficiency improvements that impact users and operators, particularly in terms of the time and costs savings. Corporations involved in the provision of transport services earn an income and are paying wages to their

employees.

- **Indirect Impacts**- The indirect benefits are mostly related to accessibility gains and better economies of scale. While employers and the retail sector (as well as other activities such as institutions) gain a better access to labor or customers, the customers of freight transport services (distribution centers, manufacturing, retailers) derive some productivity gains that are the outcome of better transport services. The owners of land and activities also usually derive higher rents from the increasing intensity of passenger and freight traffic taking place in the vicinity. Both passenger and freight traffic also convey additional demands for goods and services (e.g. fuel, maintenance, repairs, insurance). Freight related activities also benefit from a wider range of suppliers for its inputs and markets for its outputs.
- **Induced Impacts**- The induced benefits are mostly related to economic multipliers and increased opportunities. A society benefits from increased mobility since individuals have a wider range of options for their activities and the associated social opportunities (education, leisure). An economy usually becomes more competitive, attracts new and expanded economic activities, and has more complex distribution networks. At this level, transportation becomes a factor in promoting economic competitiveness.

2.2. Sustainable transportation and development

2.2.1. Sustainable development

Sustainable development is most commonly defined as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs (Oxford University Press, 1987). In short tautology, it means sustainable development". Development can be defined as a collective process of change toward improvements in quality of life for human beings and their communities, and sustainability can be seen to refer to the need for development to be integrated, socially, economically and environmentally sound, oriented to the long-term, and hence, able to last.

Sustainability is the ability to maintain the balance of a certain process or state in any system. The three pillars of sustainability are economic, social, and environmental. They are not mutually exclusive but mutually reinforcing. The current concern with sustainability shows a clear change in the social values

and leads to a new perception of road safety with a domineering role of the systematic approach. A lot has been said about sustainable transportation and its influence on the environment (Haq 1997, Fontela et al. 2007, Kohler 2006, Geurs and Van Wee 2000) but little attention has been paid to sustainability in road safety and how that will affect the policymaking and the importance given to each criterion by the main stakeholders. The question that the policymakers should bear in mind is how to estimate the impact of all measures and the rebound effects.

Globalization, the pursuit of sustainable development, and good governance within a democratic, decentralized environment puts new demands on policymakers. They must look further into the future to ensure the sustainability of their choices for generations to come. They must also consider the needs of wider-ranging stakeholders, utilizing multi-stakeholder consultation to ensure their effective engagement in policy formulation and implementation.

One of the great challenges facing policy-makers is to reconcile the different priorities between economic development and environment, while at the same time considering the different social importance and the distributional consequences of decisions. Transport is a good example of the complexity of these choices. Those policymakers who engage the stakeholders within the domain of sustainability can potentially affect government understanding, interpretations, and knowledge.

Three interrelated systems within sustainable development include the ecological system (“planet”), the economic system (“profit”), and the socio-cultural system (“people”). Sustainability is increasingly gaining a wider definition including a broad dimension of issues, as shown in Table 2.1below;

Economic (profit)	Environmental (planet)	Social (people)
- Affordability - Resource efficiency - Cost internalization - Trade and business activity - Employment - Productivity - Tax burden	- Pollution prevention - Climate protection - Biodiversity - Precautionary action - Avoidance of irreversibility - Habitat preservation - Aesthetics	- Equity - Human health - Education - Community - Quality of life - Public participation

Table 2.1 Sustainability issues

Source: Geerlings and Lohuis, 2008

2.2.2. Sustainable transportation

Litman and Burwell (2003) stated that transport sustainability is defined dispersedly from a narrow definition incorporating individual technologies to a wider concept involving more comprehensive approaches; improved travel choices, economic incentives, institutional reforms, land-use changes as well as technological innovation.

Some definitions of sustainable transport are recorded such as “transportation that does not endanger public health or ecosystems and meets the mobility needs consistent with the use of renewable resources at below their rates of regeneration and use of non-renewable resources at below the rates of development of renewable substitutes" (OECD, 2001) or “a sustainable transport system is one in which fuel consumption, vehicle emissions, safety, congestion, and social and economic access are of such levels that they can be sustained into the indefinite future without causing great or irreparable harm to the future generation of people throughout the world” (Richardson, 1999).

Table 2.2 below shows sustainable transportation issues.

Economic (profit)	Environmental (planet)	Social (people)
- Accessibility quality - Traffic congestion - Infrastructure costs - Consumer costs - Mobility barriers - Accident damages - DNRR	- Air pollution - Climate change - Noise pollution - Water pollution - Hidrologic impacts - Habitat and ecological degradation - DNRR	- Equity / fairness - Impacts on mobility disadvantaged - Affordability - Human health impacts - Community cohesion - Community livability - Aesthetics

Table 2.2 Sustainable transportation issues

Source: Litman and Burwell, 2003

Providing access to sustainable transport will require advances in three key areas: policy development and implementation, financing, and technological innovation. If rigorous action is pursued in each of these areas, together they will drive change and help individuals, businesses, and governments mobilize sustainable transport.

Daly (1992) does not define sustainable transport but specifies parameters for any sector being sustainable. Within this context transport is sustainable if it satisfies three conditions:

- The rate at which it uses renewable resources does not exceed their rates of regeneration,
- The rate at which it uses nonrenewable resources does not exceed the rate at which sustainable renewable substitutes can be developed, and
- Its rate of pollution emissions does not exceed the assimilative capacity of the environment.

Schipper (1996) states that sustainable transport is transportation where the beneficiaries pay their full social costs, including those that would be paid by future generations. He further notes that changes in travel are associated with several prominent externalities, including accidents, air pollution, congestion, noise, damage to species habitat, increases in carbon dioxide production, and the importation of oil. It is these externalities, and not transportation or travel parse that threaten the sustainability of the system, according to Schipper.

Probably in an attempt to be more comprehensive, the Centre for Sustainable Transportation (1998) in

Canada states that a sustainable transportation system is one that

- allows the basic access needs of individuals and societies to be met safely and in a manner consistent with human and ecosystem health, and with equity within and between generations;
- is affordable, operates efficiently, offers choice of transport mode, and supports a vibrant economy; and
- limits emissions and waste within the planet's ability to absorb them, minimizes consumption of nonrenewable resources, reuses and recycles its components, and minimizes the use of land and the production of noise.

Litman proposed a different set of sustainable transport indicators that are based more on personal or household travel characteristics. The following are included in his list of indicators:

- Average portion of household expenditures devoted to transport;
- Average amount of residents' time devoted to non-recreational travel;
- Per capita automobile mileage;
- Ability of non-drivers to reach employment centers or services;
- Per capita land area paved for roads and parking;
- Quality of pedestrian and bicycle facilities;
- Quality of public transit (frequency, speed, safety, and so forth);
- Special transit services and fares relative to low income;
- Transit coverage, residents within 0.5 kilometer;
- Motor vehicle accident fatalities;
- Per capita transport energy consumption;
- Medical costs attributable to transport;
- Publicly financed transport costs; and
- Public residents and stakeholders' role in transport and land-use decisions.

2.2.3. Objectives of sustainable transport

To cover overall aspects of sustainable transport, principles and approach have to be further broken and adapted to the specific needs of the area. The following table summarizes several possible policy objectives for road transport as found in practice and literature.

Table 2.3 below presents the objectives of sustainable transport. Subsequently, Figure 2.2 illustrates the challenges of making mobility sustainable.

Economic Goals	Environmental Goals	Social Goals
– Provide infrastructure for sound economic development and employment – Allow for cheap, fast and high volume transport – Reduce congestion – Strengthen rural urban inter linkages – Create sound financial basis for public transport – Raise revenue for infrastructure and transport facilities set-up, operation and maintenance	– Improve health and safety in transport – Reduce pollution on local, regional and global level; contribute to climate stabilization – Reduce land take – Integrate environmental and economic dimensions in transport planning and development – Develop an environmentally sensitive strategic framework	– Guarantee transport services and access for all social groups – Focus on transport for the (urban) poor – Improve methods of addressing transport problems of the poor – Protect poor against adverse changes in transport policies – Ensure democratic participation in transport policy decision making

Table 2.3 Objectives of sustainable transport

Source: (Schwaab and Thielmann, 2001)

2.3. Transportation planning and transportation policy

Transport services must be planned to most effectively meet the current and future needs of people and producers. Project planning and preparation times coupled with construction periods mean that long lead-in times must be allowed when planning transport infrastructure projects.

Transport policy is the development of a set of constructs and propositions that are established to achieve particular objectives relating to social, economic, and environmental development, and the functioning and performance of the transport system. Transport planning deals with the preparation and implementation of actions designed to address specific problems. A major distinction between the planning and policy is that the latter has a much stronger relationship with legislation. Policies are frequently, though not exclusively, incorporated into laws and other legal instruments that serve as a framework for developing planning interventions (Rodrigue et al, 2009).

Since transportation is such an important component of contemporary society, capable of producing significant benefits, yet giving rise to many negative externalities, appropriate policies need to be devised to maximize the benefits and minimize the inconveniences. At the same time, the allocation, design, and construction of transport infrastructure and services must be subject to careful planning, both by public and private agencies. A distinction must be drawn between policies and planning since the former usually relate the strategies and goals while the latter refers to concrete actions. Because they both have to reflect the fundamental changes in society and contemporary issues and problems, policies and planning are constantly changing. For instance, the changing orientation of public policy led to deregulation in many transport sectors. Among the core policy issues, transport safety and security have come at the forefront. Natural and man-made disasters are also serious challenges for transport planning.

The word policy, as defined by Bridgman and Davis (2004), is an authoritative response to a public issue or problem. Peters (1993) treats the policy as a sum of government activities influencing the citizen's lives. This infers that the word policy means a set of principles and/or rules meant for guiding decisions and achieving optimal rational results. Policy process and political conditions play a decisive role in determining the economic development of an area (Berechman, 2002).

Dr. Jean-Paul Rodrigue and Dr. Theo Notteboom on their book "The geography of transport systems, 2017" briefly described about transport planning and transport policy clearly as the follows:-

- Transport policy deals with the development of a set of constructs and propositions that are established to achieve particular objectives relating to social, economic, and environmental development, and the functioning and performance of the transport system.
- Transport planning deals with the preparation and implementation of actions designed to address specific problems.

A transport policy-design characterized by over-optimism and misrepresentation of facts results in inaccuracy and thus wrong implementation of projects (see, for example, Flyvbjerg (2008)). Better political condition is a necessary pre-requisite for economic development as noted by Banister and Berechman (2001). Adey (2010) regards mobility as being directly related to political decision-making with the relations of society and power in the backdrop. This power as a research methodology has been presented by Flyvbjerg (2002). He coins the notion of phronetic planning research based on power studies by authors such as Machiavelli and Michael Foucault. His phronetic planning research, in simple words, raises four basic questions:

- Where are we going with planning,
- Who gains and who loses from this power mechanism,
- Is such development desirable and
- What should be done?

Transport policies arise because of the extreme importance of transport in virtually every aspect of national life. Transport is taken by governments of all types as a vital factor in economic development. Transport is seen as a key mechanism in promoting, developing, and shaping the national economy. Transport policies shape and are shaped by a wide range of stakeholders, including governments, transport authorities and operators, financial institutions, businesses, and enterprises of all sizes, community organizations, research institutions, and individual experts.

Well-intentioned policies formulated at the global or national level may not be adopted or properly implemented at the local level if they are not coherent with local priorities.

Transport policies are shaped by a wide range of stakeholders, including governments, transport

authorities and operators, financial institutions, businesses, and enterprises of all sizes, community organizations, research institutions, and individual experts.

Design and implementation of policies aligned with the guidelines will depend on integrated institutions, enhanced governance frameworks, short- and long-term planning taking into account the business case for sustainable transport and development, capacity building including for developing countries and countries in special situations, stakeholder engagement, and monitoring and evaluation.

Transportation policy planning is a cooperative process designed by the governmental or local agencies to foster involvement by all users of the system such as the general public, the business community, community groups, environmental organizations, the traveling public, and freight operators through a proactive public participation process (Rodrigue et al, 2009; Litman, 2011) This co-operation and input from all interest groups results in developing and implementing a regional or state transportation policy.

As stated by Berechman (2002), transportation policy should state the governments' primary goals for transport system investments. Four key goals are recommended to be set by national transportation policy, all of which are critical to the national interest, require state-level leadership and action, and are intrinsically national:

- Economic Growth: producing maximum economic growth per monetary unit of investment;
- Metropolitan Accessibility: providing efficient access to jobs, labor, and other activities throughout metropolitan areas;
- Energy Security and Environmental Protection: integrating energy security and environmental protection objectives with transportation policies and programs;
- Safety: improving safety by reducing the number of accidents, injuries, and fatalities associated with transportation

Consequently, transportation policy needs to be performance-based, directly linked to a set of clearly articulated goals, and accountable for results. If a transportation policy has lost direction and a clear sense of purpose, it has substantial costs to collective prosperity, security, environment, and quality

of life.

2.4. Transportation demand and supply

Transportation is a market composed of suppliers of transport services and users of these services. Well-functioning transport markets should allow the transport supply to meet transport demand so that transport needs for mobility are satisfied. An economic system including numerous activities located in different areas generates movements that must be supported by the transport system. Without movement, infrastructures would be useless and without infrastructure, movements could not occur, or would not occur in a cost-efficient manner. This interdependency can be considered according to two concepts, which are transport supply and demand.

2.4.1. Transportation supply

Transportation supply is the capacity of transportation infrastructures and modes, generally over a geographically defined transport system and for a specific period. Supply is expressed in terms of infrastructures (capacity), services (frequency), and networks (coverage). Capacity is often assessed in static and dynamic terms where static capacity represents the amount of space available for transport (e.g. terminal surface) and dynamic capacity are the improvement that can be made through better technology and management. The number of passengers, volume (for liquids or containerized traffic), or mass (for freight) that can be transported per unit of time and space is commonly used to quantify transport supply. (Dr. Jean-Paul Rodrigue and Dr. Theo Notteboom, 2017)

Transportation is a service that must be utilized immediately and thus cannot be stored. Mobility must occur over transport infrastructures, providing a transport supply. In several instances, transport demand is answered in the simplest means possible, notably by walking. However, in some cases, elaborate and expensive infrastructures and modes are required, which represents a remarkable technological achievement. (Rodrigue: 2003)

The relationship between transport supply and demand continually changes, but they are mutually interrelated. From a conventional economic perspective, transport supply and demand interact until equilibrium is reached between the quantity of transportation the market is willing to use and the quantity being supplied. (Rodrigue; 2003)

The production of all goods and services can be described using the concepts of inputs, outputs, and technology. Inputs have to be acquired by the firm and combined to produce and supply outputs. In the

case of transport, the firm has to use vehicles, terminals, rights-of-way, energy, labor, and so on, to produce movements of freight or passengers, from many different origins to many destinations in various periods and at various frequencies.

The supply side of the transport system can be altered in several ways:

- additions to, or improvements in, the quality or capacity of transport infrastructure;
- replacement of existing infrastructure assets;
- accelerated additions or replacements during economic recessions when there are underemployed labor and other resources;
- better management of the asset base (clearing breakdowns faster, better management of traffic
- flows, new services making fuller use of existing infrastructure);
- changes in costs (e.g. in the case of roads, tolls, parking charges, fuel prices);
- changes in regulations relating to the delivery of transport services (e.g. changes in competition and
- Regulations affecting entry to public transport and taxi market.

2.4.2. Transportation demand

Transportation demand is the Transport needs: even if those needs are satisfied fully, partially, or not at all. Similar to transport supply, it is expressed in terms of the number of people, volume, or tons per unit of time and space. (Dr. Jean-Paul Rodrigue and Dr. Theo Notteboom, 2017)

Transport demand is generated by the economy, which is composed of persons, institutions, and industries and which generates movements of people and freight. When these movements are expressed in space they create a pattern, which reflects mobility and accessibility. The location of resources, factories, distribution centers, and markets is related to freight movements. Transport demand can vary under two circumstances that are often concomitant;

- The number of passengers or freight increases or
- The distance over which these passengers or freight are carried increases.

Geographical considerations and transport costs account for significant variations in the composition of freight transport demand between countries. For the movements of passengers, the location of

residential, commercial, and industrial areas tells a lot about the generation and attraction of movements.

The demand for transport services is dynamic. The transport needs of people and producers will continue to change; depending on many factors such as: International standards and trends in movement; Government development policy; cost and availability of fuels, technologies, human resources, finance; etc. Transport users will continue to demand improvements in transport services. Also, as more research is carried out, and existing research is made available to the Sector, expectations and possibilities will change. For example, we should expect bolder use of innovative vehicles, fuel, information, and communication technologies in the Transport sector. There will be a need to update the Policy concerning user demands and the latest research findings.

The demand for-road transportation can be altered because of different reasons:

- the supply of suitable transport services, including speed, quality, and convenience factors relating to the services (e.g. service frequency, reliability, crowding);
- the financial cost (or price) of the services; and
- Perceptions of any social and environmental costs associated with the trip and the services involved (e.g. level of safety and security, adverse environmental effects).

2.4.3. Transportation supply and demand relationship

Relationships between transport supply and demand continually change, but they are mutually interrelated. From a conventional economic perspective, transport supply and demand interact until an equilibrium is reached between the quantity of transportation the market is willing to use at a given price and the quantity being supplied for that price level.

Generally, transport demand is variable in time and space whereas transport supply is fixed. When demand is lower than supply, transit times are stable and predictable, since the infrastructures can support their load. When transport demand exceeds supply for a period in time, there is congestion with significant increases in transit times and higher levels of unpredictability. A growth of the transport demand increases the load factor of a transport network until the transport supply is reached. Speed and transit times drop afterward. The same journey can thus have different durations according to the time of

the day.

2.5. Measures of quality of road transportation

The quality of transport service can be measured against reliability, convenience, safety, security, and comfort (Iles, 2005; Height and Creswell, 1979). Speed, accessibility in time, reliability, and frequency, are quality indicators of transport services (Wood and Johnson, 1989).

2.5.1. Reliability

Reliability is an important element of service quality, which determines the level of passengers' satisfaction. The primary determinant of service reliability is the reliability of the vehicle itself (Ibid, 2005). The availability of sufficient numbers of vehicles will attract more passengers to use road transportation system for their traveling needs. Poor reliability within an operation is the result of several breakdowns, which in turn harms vehicle availability and affects the quality and quantity of the overall services (Ibid, 2005).

2.5.2. Convenience

Convenience comprises accessibility, waiting time, interchangeability between services, travel expenditure, ease of payment, and availability and accuracy of information as an important element, which determines the quality of the service (Iles, 2005).

- Accessibility: can be expressed in terms of the distance passengers have to walk starting from their home to the initial road transportation access and from the final road transport access to their final destination (Ibid, 2005).
- Walking distance: is an indicator of the coverage of the service. High walking distance indicates small coverage (World Bank, as cited in Armstrong-Wright, 1993). In dense urban areas, the walking distance should range from 300-500 meters. In low densely urban areas, 500-1000 meter is the acceptable distance that passengers may walk to and from the road transport access (World Bank, as cited in Armstrong-Wright, 1993; Iles, 2005).
- Waiting time: is the time passengers have to wait to get the transport service (World Bank, as cited in Armstrong-Wright, 1993). Even though their expectations may vary, most passengers are delighted with minimum waiting time. The shorter the waiting time is the greater the level of convenience (Iles, 2005). Longer waiting time indicates poor quality of service. To achieve a

reasonable level of service, the average waiting time should be in the range of 5-10 minutes and the maximum waiting time should be in the range of 10-20 minutes (WorldBank, as cited in Armstrong Wright, 1993).

- Interchangeability between services: is the number of times a passenger has to change modes on a journey to or from work (World Bank, as cited in Armstrong-Wright, 1993). Passengers are more satisfied with a route network which enables them to complete their journey without having to transfer from one vehicle to another (Iles, 2005). The average interchanges between routes and services are determined to be in the range of zero to one and the maximum should not be more than two. At the same time, the number of passengers who interchange two times (i.e. the maximum interchange) should be less than 10% of passengers (World Bank, as cited in Armstrong-Wright, 1993).

2.5.3. Safety

In most situations, high standards of safety are a desirable objective of most passengers. Road accidents are the main threat to passengers. Poor driving standards and poor vehicle conditions are considered as the primary causes of accidents.

Appropriate road traffic safety policy is one of the essential elements of a well-balanced overall transport and public health policy (Michael Ray, 1995). This should be followed by proper enforcement. From this point of view, the national parliaments, governments, government ministries, and agencies have one of the main responsibilities for road safety.

Traffic safety constitutes a major health problem in developing countries. About 350,000 people are killed every year on the roads of developing countries at an estimated worldwide total of 500,000(World Bank, 1990), even though developing countries have a very small proportion of motor vehicles in the world. Road accidents are a major cause of death in those countries.

The operation of the nation's highway system is the responsibility of the traffic engineer. Traffic engineering involves the integration of vehicle, driver, and pedestrian characteristics to improve the safety and capacity of streets and highways. All aspects of the transportation system are included after the street or highway has been constructed and opened for operation. Among the elements of concern are traffic accident analyses, parking, and loading, design of terminal facilities, traffic signs, markings,

signals, speed regulation, and highway lighting. The traffic engineer works to improve traffic flow and safety, using engineering methods and information technology to make decisions that are supported by enforcement and education. Traffic engineers work directly for municipalities, county governments, and private consulting firms (Nicholas J. Garber & Lester A. Hoel 2003, 20).

Traditionally there are many areas in which safety actions are taken. The most common ones are;

- Education-driver training, training at school, retraining program;
- Information- mass media campaign, roadside information;
- Law practice- laws concerning drinking and driving, speed limit, give way rules;
- Planning- organization of road network, modal split measures; and
- Traffic engineering measures- design of roads and intersections.

2.5.3.1. Key road safety problems

Traditionally, the driver was the only responsible entity for the road accident. Currently, however, road safety is seen as a system where the responsibility is shared among all parties involved. The approaches to driving have been altered accordingly. Malaterre (2006) distinguishes the systematic and the driver-centered approaches. According to the first approach, the blame cannot be attributed to a single actor but it has to be attributed to the interaction between multiple actors within the system; whereas, within the second approach the drivers are encouraged to act according to their moral obligations as an individual and are fully responsible for the road accidents.

Following the systematic approach, three factors may play a role in the occurrence of road accidents: user-related, vehicle related, and the physical environment. In many cases, it is shown that the interaction of these factors is responsible for accidents. Considering this human-vehicle-environment model and the chronology pre-crash-crash-post- crash, a matrix of factors that affect road safety, and that could be used to improve road safety, can be set up (Haddon, 1968; MOW 2008). This matrix is shown in Table 2.4 below.

		Human/user	Vehicle & Equipment	Environment/Infrastructure
Pre-crash	Accident prevention	Information Attitude Disorders Police enforcement	Speed control Lighting Breaks Technical equipment	Road layout Speed limits facilities for vulnerable road users
Crash	Injury prevention during accident	Use of protective tools	Injury avoiding design Protective tools	Protective tools in road design
Post-crash	Life conservation, care	First aid Specialized aid	Accessibility Fire danger	Congestion Call facilities

Table 2.4 Haddon matrix, a matrix of factors that affect road safety

Source: MOW 2008

2.6. Traffic congestion

The word congestion is frequently discussed in the road traffic context, both by technicians and by the public. Webster's Third New International Dictionary defines it as "a condition of overcrowding or overburdening", while "to congest" means "to overcrowd, overburden or fill to excess to obstruct or hinder" something: in this case, road traffic.

The fundamental cause of congestion is the friction or mutual interference between vehicles in the traffic flow. Up to a certain level of traffic, vehicles can circulate at a relatively freely determined speed which depends on the legal speed limit, the frequency of intersections, and other conditioning factors. At higher levels of traffic, however, every additional vehicle interferes with the circulation of the others: in other words, the phenomenon of congestion appears. A possible objective definition, then, would be: "congestion is the situation where the introduction of an additional vehicle into a traffic flow increases the journey times of the others" (Thomson and Bull, 2001).

Traffic congestion is a situation where "more people are trying to use a given transportation facility during a specific period than the facility can handle with what are considered to be acceptable levels of delay or inconvenience" (A Toolbox for Alleviating Traffic Congestion, 1989).

Traffic congestion is a result of a phenomenon called traffic waves. Traffic wave "occurs when cars slow down, and the slowing trend continues backward like a domino effect." The higher the demand for that specific road the bigger the traffic wave is (Traffic Causes, 2007).

Factors contributing to traffic congestion can be divided into two groups: Traffic Disturbances and Network Overload (Traffic Causes, 2007). Traffic disturbances are temporary occurrences and only impact traffic as they happen. These include accidents, harsh weather conditions, and road constructions. In-Network Overload fall all the cases where the road congestion is caused either by a decreased capacity of the road or increased demand for transportation.

Some of the physical factors of the road that cause traffic congestion are bottlenecks, road intersections, and heavy vehicles. Bottlenecks are narrowed roads that lead to increased congestion when traffic demand is higher than supply.

According to Atomode (2013), "urban road intersections easily become the worst hit of traffic delay. This is because, at intersections, vehicular flows from several different approaches (link/edge) making either left-turn, through and right-turn movements seek to occupy the same physical space at the same time" In addition to vehicular flows, there are also pedestrians who need space to pass the streets thereby making the situation even worse.

The third physical factor of traffic delay can be considered the presence of heavy transport vehicles. Due to the number of stops that buses have to make throughout their daily routine, and the fact that the majority of the time there are no designated lanes for buses, they end up unintentionally delaying vehicles behind them, thereby adding to traffic congestion (Doçi and Bajraktari, 2011).

However, not all traffic congestions are caused by physical restrictions; there are cases when the demand for a road increases more than the capacity that a specific road can withstand. These factors are called

demand factors: The increasing population living in urban areas and the number of vehicles per household lead to an increase in the demand for roads (A Toolbox for Alleviating Traffic Congestion, 1989).

Because of weak public transportation, people will be encouraged to use their cars instead, thus adding to the demand for roads. Moreover, increases in job opportunities, inadequate parking spaces, poor urban planning, economic growth, signal failure, and other important factors contribute to increasing demand for road usage (Kiunsi, 2013).

2.7. Overview of road transportation in Addis Ababa, Ethiopia

Urban transport plays an important role in transferring people and goods from a given origin to some other destination (within a city or beyond) of Addis Ababa. Within the context of rapid urbanization, a well-planned transport system is essential for attracting investment. The presence of an efficient transport system makes a city livable and productive, enabling fast economic growth. Streets link spaces for different land uses and are vital for urban transport services. Urban road infrastructure can be planned to be either a boulevard or motorway, linked with roads of different hierarchies connecting different functions and allowing different types and volume of motorized and non-motorized traffic.

The multi-dimensional effect of lack of integration between urban land use and urban transport has given rise to unnecessary trips, congestion, costly fuel consumption, pollution, and low productivity.

2.7.1. Road transport infrastructure classification in Addis Ababa

Constraints in road transport infrastructure, lack of efficient public transport systems, and an increase in private vehicle ownership have all contributed to high traffic congestion. Besides, the city is facing problems of road traffic accidents and air pollution.

The growing usage of motorized private vehicles coupled with the increasing congestion levels led to increased fuel consumption, thereby making the transport system expensive and economically unsustainable. The city does not have comprehensive and safe pedestrian facilities.

According to the City Development Plan of Addis Ababa (2002-2012), road hierarchies are classified into five:

- Express-way (the ring road 40m width and above) with controlled access and high speed;
- (PAS) Principal Arterial streets above 30m width (East-West, and North-South axes); These streets have high mobility levels in connecting major trip generators, which demand long trip length and high traffic volumes, and speeds higher than on local and collector streets. The urban principal arterial system is streets and highways significant to the corresponding area, assigned to serve the major activities, highest traffic volume corridors, and longest trip desires that provide access to various land uses, such as houses, shops, small business, and workshops. Sidewalk is important on all streets, and particularly necessary on collector and arterial roads.
- (SAS) Sub-arterial streets 20m – 25m width;

Urban sub-arterial street systems offer lower mobility levels; put the accent on land access, and carry through traffic between multiple specific areas (collector streets) and the arterial roads.

- (CS) Collector streets 15m-19m width;

The urban collector street system has two significant features: land access service and connection of the urban areas. It links the local and arterial highways and serves subordinate traffic generators.

- (LS) Local Street (<15m width)

The lowest level of mobility and the highest land access are the basic characteristics of the urban local streets that are located within the environmental cell or specific area and serve a relatively minor role in the wider city context for carrying motorized traffic. Consequently, traffic volumes and speeds on these roads should below.

2.7.2. Non-motorized road transportation in Addis Ababa

Physical activity is a fundamental means of improving physical and mental health. For too many people, however, it has been removed from everyday life, with dramatic effects on health and well-being. (Cavil, Kahlmeier & Racioppi, 2006).

Walking and cycling represent practical opportunities for people to integrate physical activity into everyday life and are tangible and achievable alternatives to sport and exercise for which important positive health effects have been demonstrated (Andersen et al, 2000; Matthews et al, 2007, WHO, 2002).

The promotion of cycling and walking has become an area of emerging interest and high relevance to the development of comprehensive health and environment policies; in particular, those related to the implementation of sustainable transport policies. In recent years, support for policies promoting modal shifts towards cycling and walking has been advocated within several strategies for health and sustainable development (WHO Europe, 2005; WHO-UNECE, 2008; European Commission, 1999).

Walking in Addis Ababa constituted the largest modal share in 2005 (60.5%). According to the household survey by CES, the average walk trip is estimated to be 1.49 km (CSA, 2005). Walking was still the dominant mode accounting for 55% of modal share in 2011. According to travel demand projections, the share of walk trips was estimated to be around 45% in the year 2020.

Cycle transport is negligible; terrain and absence of cycle lanes have contributed to discouraging its use because of lack of attention given to this mode by policymakers and planners.

CHAPTER THREE

MATERIALS AND METHODS

3.1. Study area

3.1.1. Ethiopia

Ethiopia is one of the oldest countries in the world which is located in East Africa, known as the Horn of Africa. It is located in the tropics between 3^{o}-18^{o} N Latitude and 33^{0} – 48^{0} E Longitude. Ethiopia has a land area of 1.13 million Km^2 and has a population of more than 100 million, the second largest population in Africa comprising of more than 80 different ethnic groups.

The terrain of the country consists of a high plateau with mid to high central mountains which is divided into two by the Great Africa Rift Valley and surrounded by the lowlands of the border regions. The topography and the influence of the surrounding continental masses and oceans have created a varying climate, agro-ecology, and vegetation with immense natural resources potentials for development.

Currently, the transportation modes in Ethiopia comprise: road transport, air transport, rail transport, and water transport. Of these four types, the dominant mode which is the road sector serves about 90 to 95 percent of motorized inter-urban freight and passenger movements. The road transport sector can be examined under two headings; infrastructure and services.

3.1.2. Addis Ababa

The construction of the first roads in Addis Ababa dates back to the foundation of the city in November 1886 by Emperor Menilik II and Etegie Taitu. The first roads served to link Sefers (villages within bigger settlements) by non-motorized modes of transport (Addis Ababa City Structure Plan (2017-2027) AACPPO, September 2017)

The construction of modern roads was intensified during the beginning of the reign of Emperor Haile Selassie. The construction of roads during that period was carried out by the Public Works Department of the Municipality of Addis Ababa. The road construction had further been strengthened during and after the brief Italian occupation. The total length of roads in the city before 1983 was 1,503Km, while the share of asphalted roads was below 20%. Following the establishment of the Addis Ababa City Road Authority (AACRA) in 1998, large scale road construction had commenced.

The Ethiopian Census of 2007 reported that 2.72 million people lived in Addis Ababa. For 2019, the United Nations world population prospects estimated a total of 4,592,000 residents. This is the largest city in the country and its population growth is due to both in-migration and natural population increase (UN Habitat, 2014).

According to the CSA July 2015 estimate, Ethiopia's total population is about 90 million people. Of the total population, 19.5% (17.5 million people) live in urban areas. This number is rising fast due to an annual urban population growth of 4.89%. Ethiopia's urban population is expected to triple by 2037 (World Bank, 2015). At that time Addis Ababa hosted an estimated 3.238 million people, which is a 17% share of Ethiopia's total urban population. Currently, Addis Ababa is experiencing an annual growth rate of 4.36% and is estimated to reach 4.7 million inhabitants by 2030(United Nations world population prospects, 2019).

In 2006, the 'built' portion of Addis Ababa was 24,942 ha or 48% of the area within the city's municipal boundary. By 2016, the 'built' portion of the city had expanded by 10,108 ha to 35,050 ha (67% of the area within the city's boundaries). The annual rate of expansion during this decade was 1.9%. Based on the 2007 census and 2019 population projections, the population of Addis Ababa increased by an estimated 1,266,000 people. Between 2006 and 2019, every additional person increased the urban area by 0.014 ha (Larissa Larsen, Kumelachew Yeshitela, Tilahun Mulatu, Sisay Seifu, and Hayal Desta, 2019).

Table 3.1 below shows the population of Addis Ababa between 2010 and 2019 with respective growth rates. Subsequently, Figure 3.1 presents the estimated populations and growth rates of Addis Ababa (2010-2019).

year	Estimated population	Growth rate
2010	3126000	4.34
2011	3263000	4.38
2012	3405000	4.35
2013	3554000	4.38
2014	3709000	4.36
2015	3871000	4.37
2016	4040000	4.37
2017	4216000	4.36
2018	4400000	4.36
2019	4592000	4.36

Table 3.1 Addis Ababa estimated population (2010-2019),

Source: United Nations world population prospects, 2019

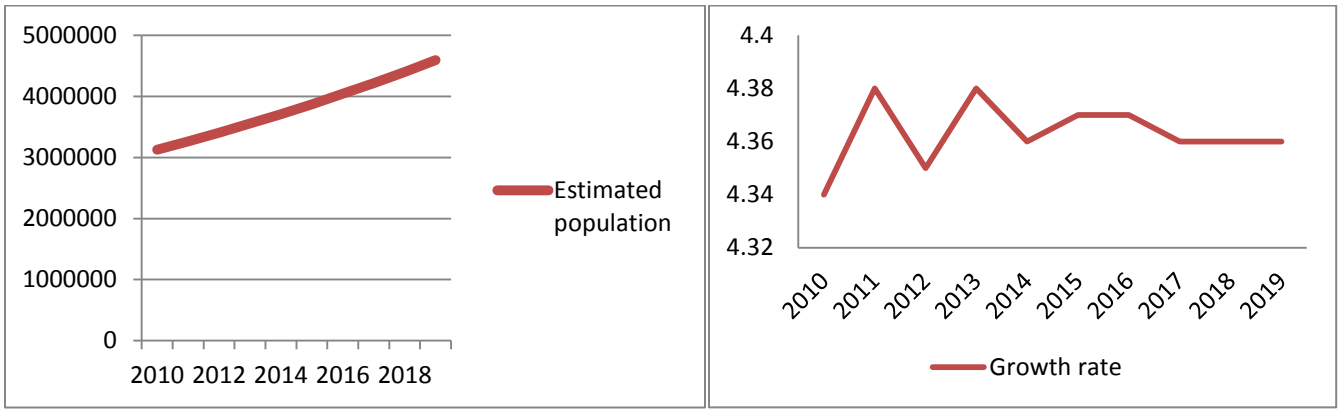

Figure 3.1 Estimated Populations and Growth Rate of Addis Ababa (2010-2019)

Source: United Nations world population prospects, 2019

Ethiopia has increasingly been improving in ensuring good governance, as reflected in various policy and strategy documents. Ethiopia has a three-tier government structure: federal, regional, and local. The 1995 Federal Constitution officially promulgated and assigned autonomy and functions to federal authorities and the nine autonomous states in the country (World Bank, 2015). An exception, however, applies to the cities of Addis Ababa and Dire Dawa, who are both granted the same autonomy level as

state governments.

Ethiopia's efforts to institute urban governance show both the opportunities and challenges. A recent study on the economic impact of local government capacity-building concluded that increased autonomy along with improved fiscal and other capacities among Ethiopian city authorities generates better economic outcomes and helps to close regional spatial inequalities (Chaurey and Mukim, 2015).

UN habitat under its publication titled 'the state of Addis Ababa, 2017 the Addis Ababa we want', it is stated that Ethiopia's local authorities continue to face challenges and the key among them is a severe institutional capacity gap, particularly a lack of well-trained personnel capable of implementing urban development policies, strategies and programs. In addition to human resource capacity limitations, urban institutions lack adequate material resources such as adequate computerized systems. as a result, urban local governments are underequipped to execute comprehensive infrastructure investment plans; lack the capacities for assets management and maintenance to enforce laws and regulations, as well as to monitor progress and to identify emerging challenges. Urban local governments cannot further generate revenues to pay for programs and projects. Moreover, local authorities also lack adequate monitoring systems.

Addis Ababa's attractiveness to businesses, companies, individuals, and foreign direct investment has enhanced its importance in the domestic economy. Based on the urban employment and unemployment survey (CSA 2015), the overall primacy index of Addis Ababa is 24.8. The city is simultaneously experiencing high rates of economic growth and urbanization, suggesting a likely further rising dominance of Addis Ababa in Ethiopia's economy as well as growing agglomeration of economic activities in and around the city.

Addis Ababa is sub-divided into 10 sub-cities as illustrated in Figure 3.2 below;

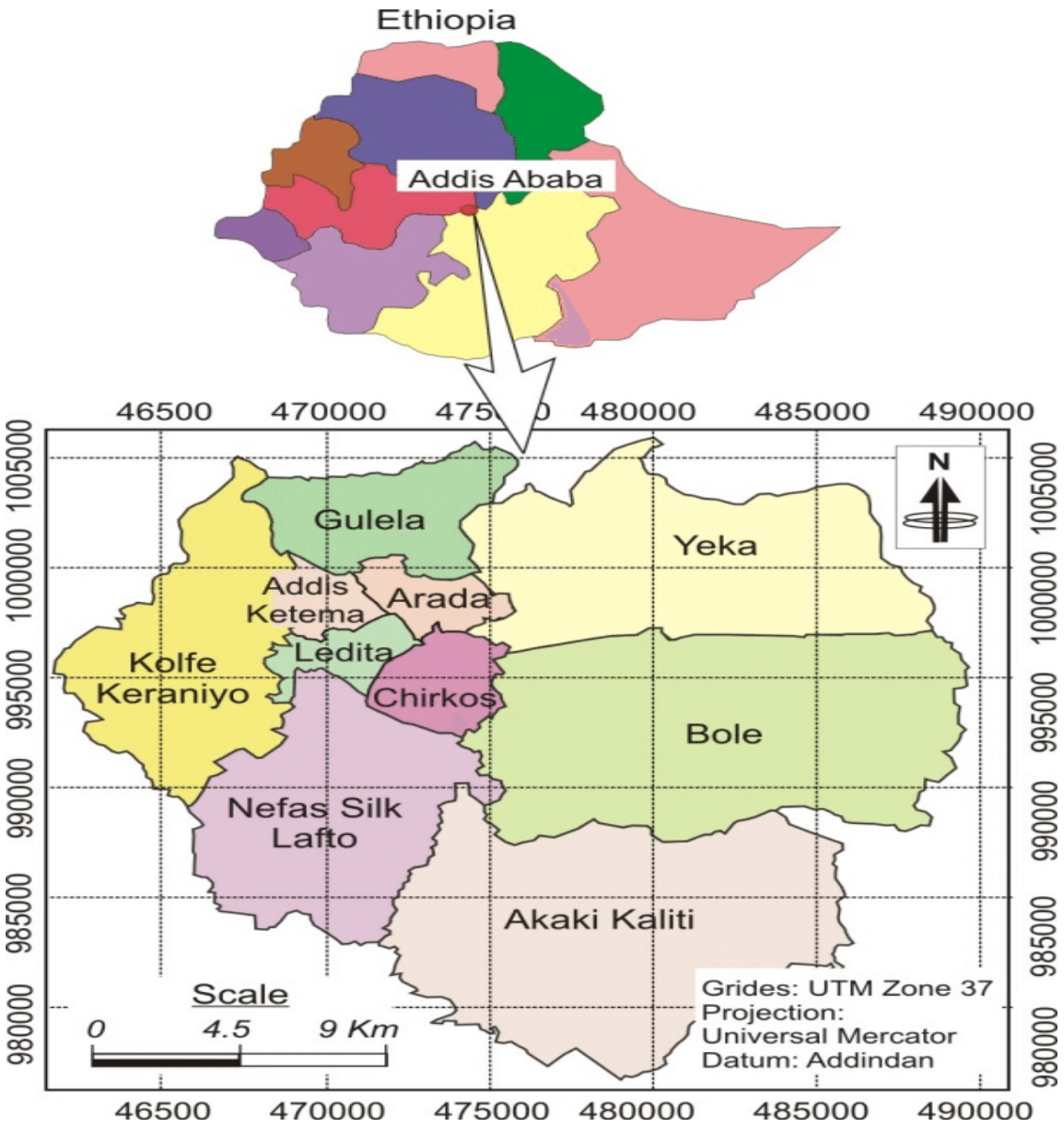

Figure 3.2 Map of Addis Ababa with locations of sub-cities

Source: Web-Based GIS Approach for Tourism Development in Addis Ababa City, Ethiopia, Jan 2017

3.2. Study design

Once the research questions and study objectives were developed then, the study design was determined to answer questions. There are different kinds of study designs for monitoring, evaluation, and research which can either be exploratory and observational or experimental. Exploratory and observational is used to explore and observe what is happening in a given context and experimental is used to test the impact of an intervention. In this research, an exploratory research design was used since the main

objective of the research is to explore access and evaluate road transportation regulations in Ethiopia.

In this research, both qualitative and quantitative study approach was applied. This was because some of the study objectives seek to make standardized and systematic comparisons while others seek to evaluate a phenomenon or situation in detail. Qualitative research is the development of concepts that help to understand social phenomena in natural (rather than experimental) settings, giving due emphasis to the meanings, experiences, and views of the participants, (Pope & Mays, BMJ 1995). The Qualitative and quantitative methods in this research support each other, both through a triangulation of findings and by building on each other because findings from a qualitative study will be used to guide the questions in an institutional data survey.

3.3. Materials

A mix of research materials were used to collect relevant information regarding the road transportation system in Addis Ababa. These materials were prepared to assess the current trend of the road transportation sector. Figure 3.3 below illustrates the materials used in this research.

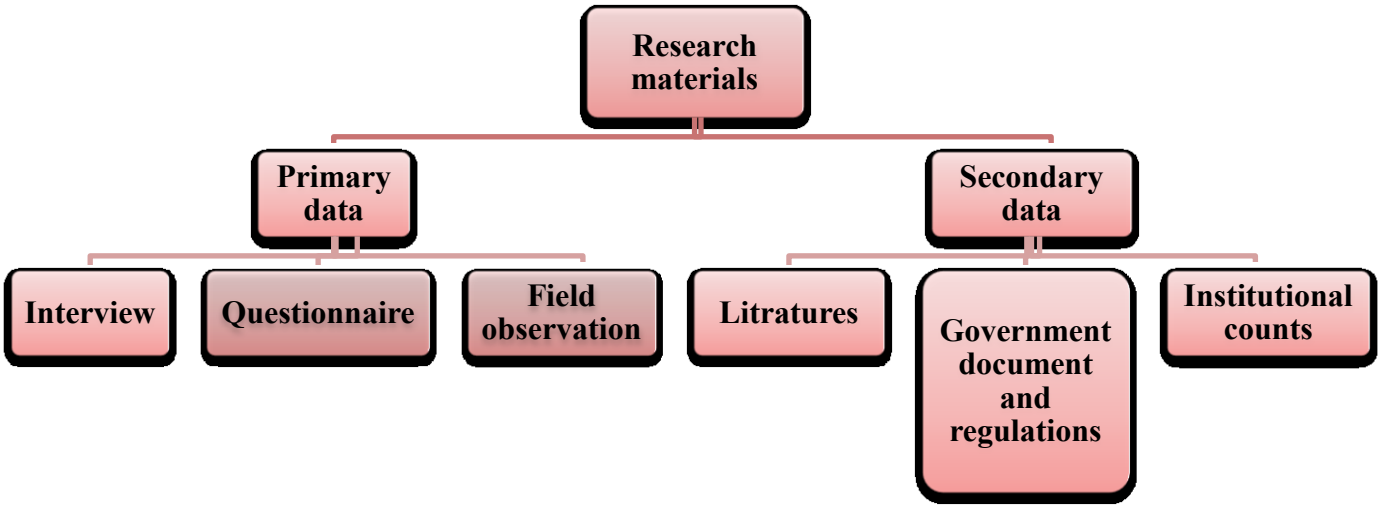

Figure 3.3 data collection flow chart in the research.

3.3.1. Primary data

Primary data included in-depth conducting individual data. Interviews were conducted with the representative of stakeholders in the road transport sector in Addis Ababa city, copies of the questionnaire were filled by the major stakeholders of the road transport sector and also field observations were conducted.

3.3.1.1.Data acquired through Questionnaire

The questionnaire design took into consideration the objectives of the study to answer the research questions. The focus of the questionnaire was to identify the problems encountering in Addis Ababa city road transportation system. The questionnaire was envisaged to address the first two specific objectives of the thesis The questions in the questionnaire had to be simple, clear, and understandable to respondents concomitantly the responses needed to be interpretable by the researcher.

Litman (2003) stated that one of the sustainable transport indicators is Public residents' opinion and stakeholders' role in transport and land-use decisions, in this regard an open-ended questionnaire was developed to assess the initial data. The questions helped in assessing the currently practiced pattern of the road transport sector. The questions developed were to give ideal and hypothetical answers by the participants.

3.3.1.1.1. Sampling technique

The sampling technique is the method for the selection of individuals on which information is to be made (Kish, 1965, Gupta and Kapoor, 1970).

In this research stratified random sampling was practiced, which is a useful method for data collection if the population is heterogeneous. Accordingly, the population was divided into several homogeneous groups, usually known as strata. Each group is homogeneous and then units are sampled at random from each stratum. The sample size in each stratum varies according to the relative importance of the stratum in the population.

3.3.1.1.2. Sample size

Sample size determination is the technique of selecting the number of observations to be included in the study. No survey can produce a precisely correct result. Sampling is done aiming to achieve a degree of acceptable accuracy. Accordingly,

Sample size determination was based on Yamane's (1967) simplified formula to calculate sample sizes.

The Sample Size for infinite population size is determined using the following formula:

$$n = \frac{N}{1 + N(e)^2}$$

Where;-

N – Population size.

e- The level of precision

A 95% confidence level and P=.05 is assumed

Taking the total population stated in Section 3.1.2, as 4,592,000, the estimated sample size n would be 400. An additional 100 were included for better accuracy.

The questionnaire was developed to assess the sample population of Addis Ababa city Road users by

- Age classification;
- Classification by types of stakeholders involved in the questionnaire;
- Gender classification;
- Transportation use;
- Trip purpose;
- Emotional state about Addis Ababa city road sector;
- Opinions on problems; and
- The corresponding opinions on solutions to the subject issues.

with the argument that the data collected will open an eye for further assessing the current road transportation system in Addis Ababa by the sections, stronger field observation, interview with the Addis Ababa Transport Authority officials, and assessing literatures and regulations.

3.3.1.2. Data from the interview

An individual interview is a conversation between two people that has a structure and a purpose. It is designed to elicit the interviewee's knowledge or perspective on a topic. Individual interviews, which can include key informant interviews, are useful for exploring an individual's beliefs, values, understandings, feelings, experiences, and perspectives of an issue. This method was performed on

government officials by asking them for their opinions regarding the subject issues. . Four types of interviews were conducted as follows: There are four types of interview:

- Structured interview;
- Semi-structured interview;
- In-depth interview; and
- Focused group discussion

In all cases, semi-structured interviews that aimed at seeking answers to the questions on the objective were prepared. Semi-structured interviews included several planned questions, but the interviewer has more freedom to modify the wording and order of questions.

Accordingly, Engineer Fikadu Kemaw (Addis Ababa Transport Authority) was asked on about:

- His opinion on the current trends of road transportation in Addis Ababa as a person and organization
- What's being done to reduce the problems that are seen in Addis Ababa as an organization

3.3.1.3.Data from field observation

Under this method, the information was sought by way of the investigator's direct observation without asking from the respondent. It can be a structured or non-structured type of observation (C.R. Kothari, 1990).

The main reason why field observation was used during the data collection was that sometimes the information provided by the sample respondents may not exist at all or maybe exaggerated as they express. So, after the questionnaire had been submitted, a field observation took place to strengthen the acquired data.

It was observed whether the responses collected through the sample were true or not and then assessed the City's main roads for further observation. To cite the data, photographic data was developed to see the details and decide what secondary data would be appropriate to additionally collect to strengthen the collected data and for further analysis.

3.3.2. Secondary data

3.3.2.1. Road traffic accident data of Addis Ababa

Road traffic accident data were collected from the Traffic Police Commission of Addis Ababa City for the study period from 2008/2009 to 2018/2019. The report included: general information about the

number and type of traffic accidents, the age of the vehicle that caused the traffic accident; the people involved in the accident; the number of fatalities due to traffic accident; property damages; and other data. The road traffic accident form was designed using an Excel Software sheet conforming with the national statistical database.

Data types:

i. Number of accidents;
ii. Vehicle type and age of vehicles;
iii. Accident type, Degree of severity;
iv. Driver's experience;
v. Number of victims (driver, passenger, and pedestrian); and
vi. Contributing causes of the accidents.

3.3.2.2.Vehicle share for Addis Ababa by vehicle type

Vehicles were represented by different codes (numbers and numerals) on their plate and the plate was colored with different colors for different types of vehicles.

Data Description;

i Code-1 Taxis engaged in transport passengers in the city;
ii Code-2 Private vehicles used for transportation of personal and family purposes;
iii Code-3 Commercial vehicles mostly engaged in commercial road transport use or car hire businesses;
iv Code-4 Government-owned vehicles;
v Code-5 Vehicles owned by non-government organizations (NGOs); and
vi Others- UN, diplomatic, AU, police, and others.

3.3.2.3.Vehicle share of Addis Ababa city by vehicle age classification

Data Description:

i Vehicles Older than 1999;
ii Vehicles manufactured between 1999-2004;
iii Vehicles manufactured between 2005-2009;
iv Vehicles manufactured between 2010-2014; and
v Vehicles manufactured between 2015-2019

3.3.2.4.Vehicle share of Addis Ababa city by fuel type

Data Description:

i Vehicles that consume petrol;

ii Vehicles that consume benzene;

iii Electric rechargeable; and

iv Others

3.3.2.5. Road transportation regulation

Assessing and evaluating all road transportation regulation cannot be done through this short period, therefore in this research regulations regarding the areas under which Addis Ababa city encounters a challenge will be assessed and evaluated;-

i Regulation regarding traffic license permit;

ii Regulation regarding importing vehicles;

iii Regulation regarding road ethics;

iv Regulation regarding traffic crash;

v Regulation about congestion; and

vi Regulation on enforcement

CHAPTER FOUR

DATA ANALYSIS, RESULTS AND DISCUSSIONS

Chapter four covers the analysis of data's from the questionnaire, the interview, the traffic counts from Addis Ababa city police commission, and vehicle counts from Addis Ababa road transportation authority followed by the results and discussions of the result.

4.1. Data Analysis

4.1.1. Questionnaire analysis

Qualitative data analysis is usually based on an interpretative philosophy. The idea is to examine the meaningful and symbolic content of qualitative data. Qualitative data can be analyzed in one of the following analysis methods:-

i Content analysis

ii Narrative analysis

iii Discourse analysis

iv Framework analysis

v Grounded theory

The Framework Analysis was chosen to analyze the acquired qualitative data from stakeholders and literature.

Framework Analysis works by:

- Familiarization: Transcribing & reading the data
- Identifying a thematic framework: Initial coding framework which is developed both from prior issues and from emergent issues
- Coding: Using numerical or textual codes to identify a specific piece of data which correspond to different themes
- Charting: Charts created using headings from the thematic framework.
- Mapping and interpretation: Searching for patterns, associations, concepts, and explanations in the data.

The research instrument provided for demographic information such as age, gender, and transportation mode usage for mobility to ensure representative geographical and social-demographic sampling.

Age classification

Table 4.1 below shows the age distribution of the respondents.

AGE	No. of respondent	Percentage of respondent
15-20	45	9%
21-25	22	4.44%
26-30	54	10.8%
31-35	86	17.2%
36-40	108	21.6%
41-50	127	25.4%
50+	58	11.6%
sum	500	100%

Table 4.1 Age distribution of questionnaire respondents

According to the data, the largest population age covered in this research were, between 41 and 50 of which they covered 25.4% of the total sample size, followed by the ages between 36 and 40 which covered 21.6% of the total sampled population.

Classification by types of Stakeholders involved in the questionnaire

Public car users accounted for 30% of the total sample size, which is the largest population in the sample followed by public transport drivers and private car drivers that covered 24 % and 20% respectively.

Figure 4.1 below illustrates the stakeholders participated in the questionnaire:

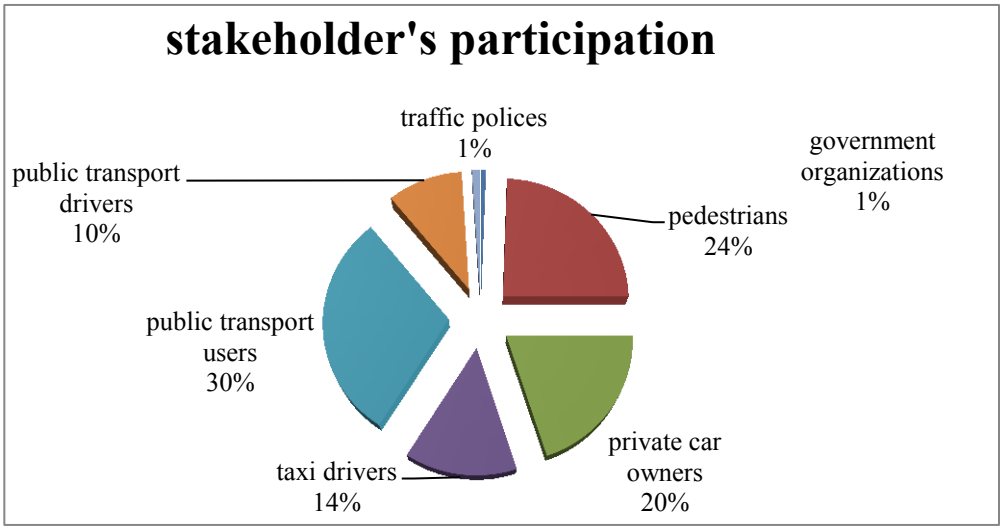

Figure 4.1 Stakeholder's classification of respondents

Gender classification

While conducting the survey the total amount of male respondents was 69% while females covered 31%, the reasons for this variance are the unbalanced numbers of female drivers especially in the public sector.

Figure 4.2 below illustrates the participant's classification by gender:

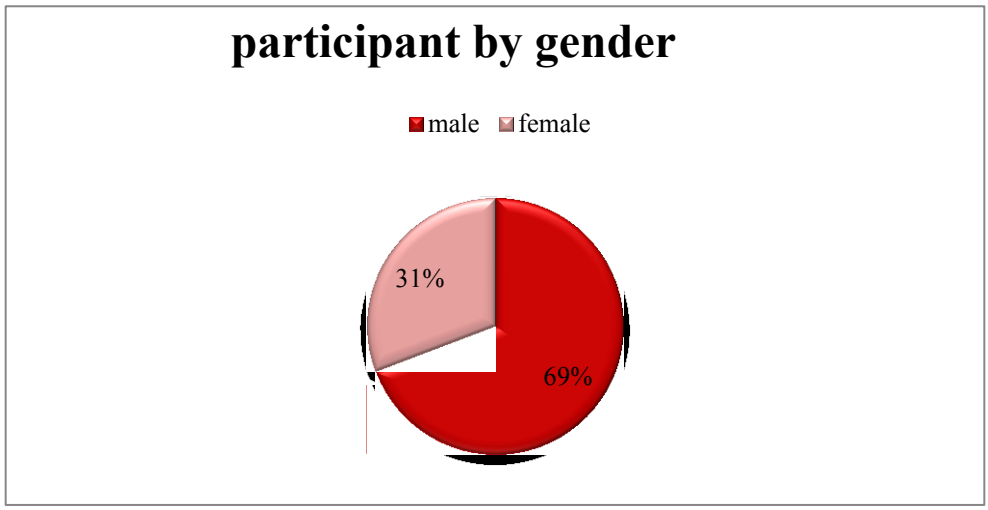

Figure 4.2 Classification of respondent by gender

Classification by Transportation use

Addis Ababa city residents use different types of road transportation mechanisms for mobility, among the respondents of the questionnaire the larger numbers were the users of taxi transport which covers

29% of the sample population, followed by public transport users and pedestrians which are 28% and 24% respectively. Figure 4.3 below illustrates the classifications of respondents by alternative use of road transportation.

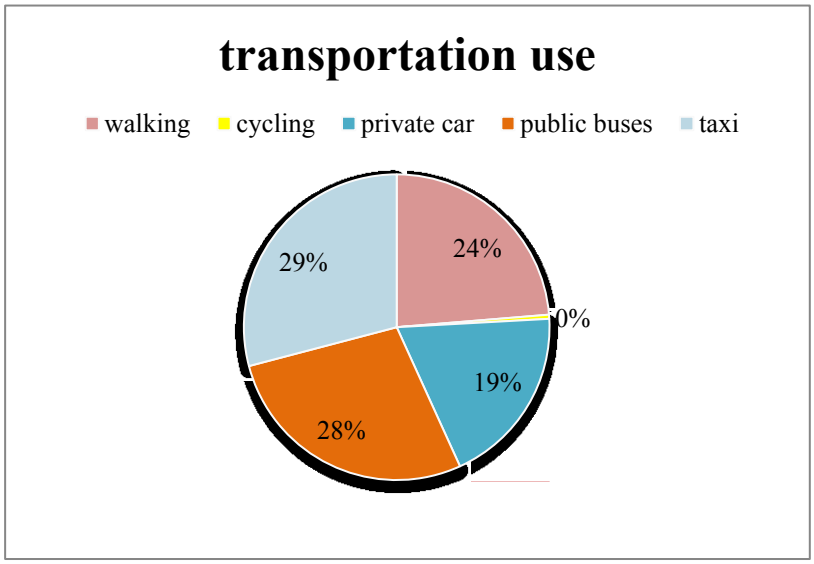

Figure 4.3 Classifications of respondents by alternative use of road transportation

Transportation by Trip purpose

The demand for transport is "derived": in other words, journeys are rarely made because of an intrinsic desire to travel but are generally due to the need to travel to the places where various kinds of activities are carried on, such as work, shopping, studies, recreation, relaxation, etc., all of which take place in different locations. Residents in Addis Ababa city travel for many reasons, In the survey, work is identified as the highest priority moving issue in it is nominated by 40% of the respondents as one of the three highest priority issues among the trip purpose's collected from the sample population trip followed by a trip to school which ranked 32%. Figure 4.4 below presents the Classifications of questionnaire respondents by purpose of trip.

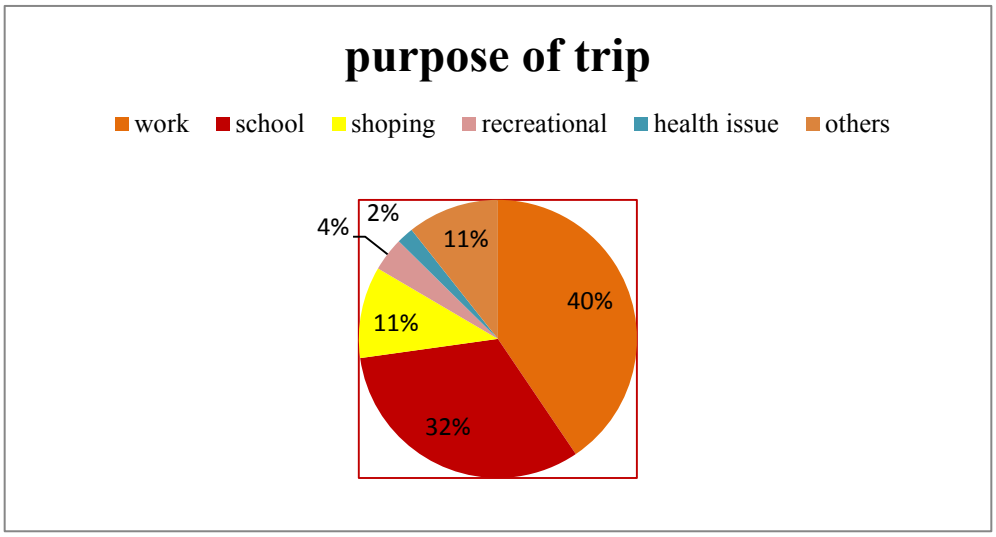

Figure 4.4 Classifications of respondents by purpose of trip

Public opinion on Problems

Respondents explained their opinions on the issues facing the Addis Ababa road transportation activities. The challenges in this respect are much alike to the sustainable transportation issues sited under Chapter Two Section 2.2 (Litman and Burwell, 2003). The sampled respondents cited many problems facing the system, among which the top are expressed below in Figure 4.5:

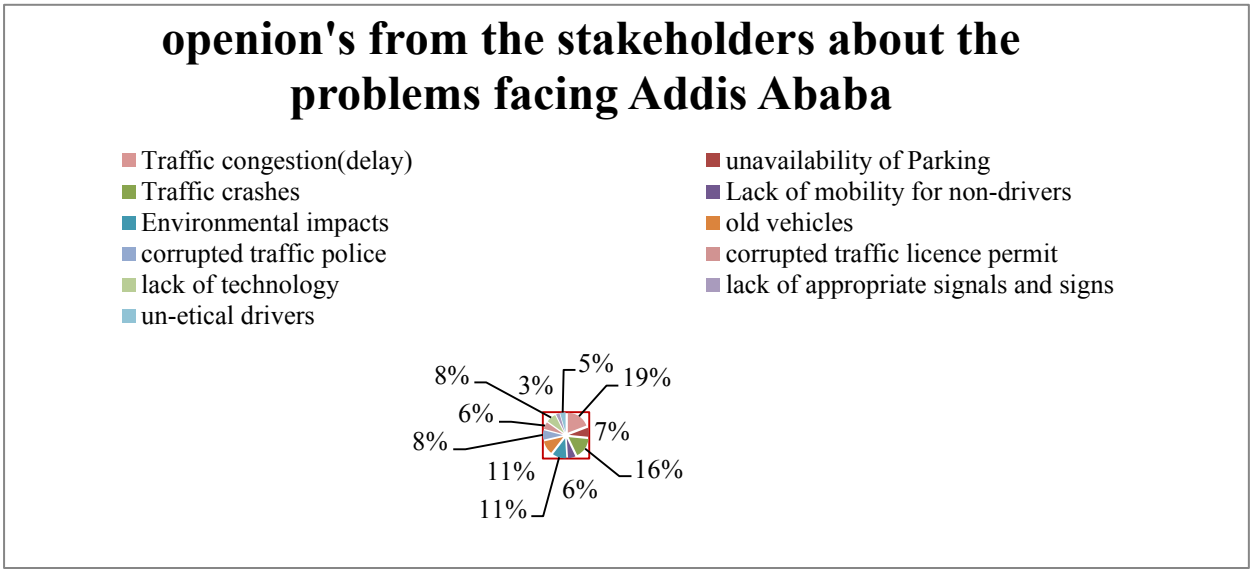

Figure 4.5 opinions on challenges of the road transportation system in A.A by the respondents

4.1.2. Descriptive Analysis of the Accident Data from Addis Ababa Police Commission

The Addis Ababa city road crash (accidents) data from Addis Ababa Police Commission for calendar years from 2008/2009 to 2018/2019 were used in this research. The data included general information about the number and type of traffic accident, the age and type of the vehicle that caused the traffic accidents, the fatalities, and other data. the road traffic accident form was designed using excel software conforming with the national statistical database.

4.1.2.1. Accident Analysis based on vehicle ownership

The road traffic crashes (accidents) occurring in Addis Ababa city covered a high number of privately owned vehicles which are increasing at a higher rate. According to the data provided by Addis Ababa Police commission the accident number and vehicle types causing the accident are related as follows on table 4.2 and figure 4.6 for the period 2009/2010 – 2018/2019 subsequently:

Relationship between total traffic accidents and vehicle ownership										
Year	**private**	**governmental**	**non-business associations, religious sector and other similar organization owned**	**police& military**	**diplomatic**	**UN& AU**	**international organizations**	**others**	**unknown**	**total**
2009/2010	4324	657	630	51	50	29	1	2	541	6285
2010/2011	7361	673	438	97	11	14	54	2	484	9137
2011/2012	9370	804	698	89	47	36	127	4	354	11529
2012/2013	12106	1245	1268	179	81	46	190	54	646	15815
2013/2014	13987	1302	1234	183	507	100	133	146	312	17904
2014/2015	16587	1502	1789	137	10	17	2	22	366	20432
2015/2016	18569	946	2616	224	43	72	101	0	368	22939
2016/2017	21982	1366	2784	254	40	55	63	0	398	26942
2017/2018	24566	1226	1979	122	10	9	16	7	429	28364
2018/2019	25099	1434	2291	184	18	5	5	0	510	29546

total	137364	11155	15727	1520	827	383	692	237	4408	188893

Table 4.2 Relationship between total road traffic accidents and vehicle ownership of Addis Ababa city (2009/2010- 2018/2019)

According to the above data from Addis Ababa city police commission, the data of the number of crash concerning vehicle ownership the larger number of crash record is found to be private vehicles, of which it was recorded that 68.8% of the total accident number at the start of this study and raised to a pick of 86.6% and 85% at the end of the study year. Throughout the span year of the study, the average accident number percentage caused by private vehicles is 72.72% followed by non-business associations, religious sector, and other similar organization owned vehicles which covers 8.32% of the total road traffic accidents for the 10 years. The crash data showed that 5.9% of the total accident was caused by government-owned vehicles. The following figure shows illustrates this data clearly as follows;

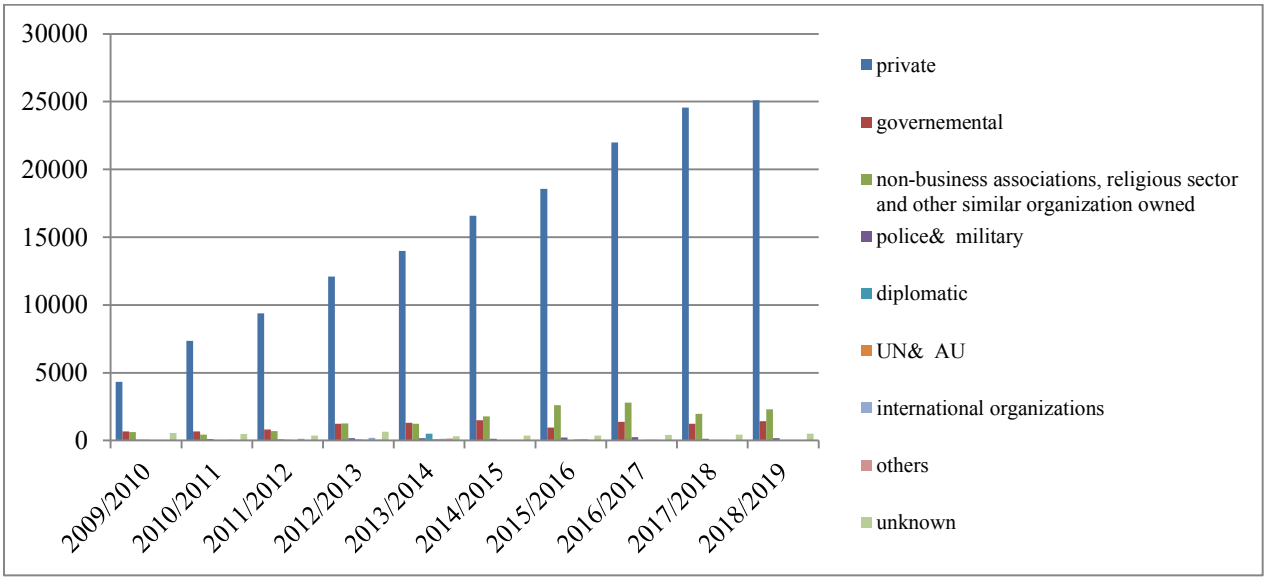

Figure 4.6 Relationships between total road traffic accidents and vehicle ownership of Addis Ababa city (2009/2010- 2018/2019)

4.1.2.2. Accident analysis based on vehicle age

The relationship between the vehicle age and total road traffic accident is analyzed below on table 4.3 and figure 4.7 for the period 2009/2010 – 2018/2019 and the graph shows the vehicle age and accident rate has a positive relationship of which vehicle age increment increases the number of accident while other components are set constant.

relationship between total road traffic accidents and vehicle age						
year	**age of vehicle**					
	<1 year	**1-2 year**	**2-5 year**	**5-10 year**	**>10 year**	**Unknown**
2009/2010	305	388	1051	2302	1649	590
2010/2011	310	744	2311	2426	2859	484
2011/2012	608	1474	2740	3727	2626	354
2012/2013	957	1919	3741	4954	3598	646
2013/2014	895	2043	4474	4996	5184	312
2014/2015	1209	2422	4715	6884	4836	366
2015/2016	954	3944	6403	6811	4359	368
2016/2017	1550	3808	6373	8586	5856	405
2017/2018	1191	3361	9527	8512	5344	429
2018/2019	2348	3798	8141	9369	5380	510
total	10327	23901	49476	58567	41736	4464

Table 4.3 relationship between total road traffic accidents and vehicle age of Addis Ababa city (2009/2010- 2018/2019)

From the data in the above table, it is calculated that vehicles aged less than 1 year tend to create less crash as compared to vehicles aged between 5-10 years and vehicles aged more than 10 years. At the starting year of the study vehicles aged less than a year counted to cause 4.85% of the total traffic crash, as that of vehicles aged greater than 5 years caused 62.86 % of the total traffic accident in Addis Ababa city. In the 10^{th} year which is 2018/2019, the total traffic accident caused by new vehicles less than a year covers 7.94%, and vehicles aged more than five years cover 50% of the total accident that occurred in that year. The following figure will illustrate the data graphically as follows;

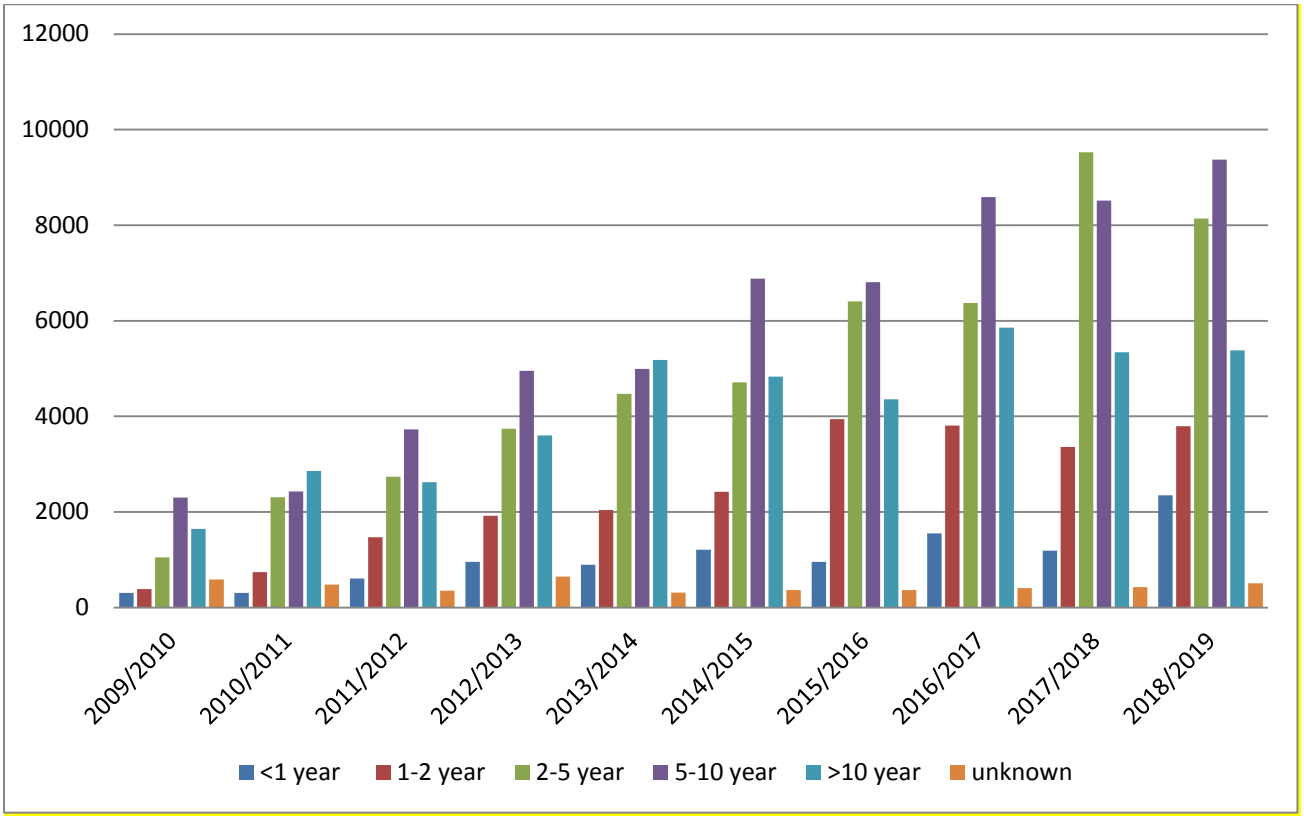

Figure 4.7 relationships between total road traffic accidents and vehicle age of Addis Ababa city (2009/2010- 2018/2019)

4.1.2.3. Fatality analysis based on vehicle age

The relationship between the vehicle age and total fatality number is analyzed below in table 4.4 and figure 4.9 for the period 2009/2010 – 2018/2019. According to the analyzed graph, the top numbers of fatality indicated that the vehicles causing the accidents are above10 years old.

year	vehicle age					
	<1 year	**1-2 year**	**2-5 year**	**5-10 year**	**>10 year**	**Unknown**
2009/2010	12	3	52	116	84	51
2010/2011	11	24	77	98	81	41
2011/2012	16	34	93	85	119	22
2012/2013	8	4	77	83	148	47
2013/2014	9	26	114	84	130	28
2014/2015	11	33	110	79	143	40
2015/2016	4	39	110	122	121	43

2016/2017	96	128	94	67	28	50
2017/2018	43	109	125	81	53	48
2018/2019	12	27	86	106	143	84

Table 4.4 relationship between fatality number and vehicle age of Addis Ababa city (2009/2010-2018/2019)

The above numerical data of the relationship between vehicle age and the fatality number resulted that there is a clear relationship between fatality rate and vehicle age in the roads of Addis Ababa. In the starting year of the study, the total fatality number caused by relatively new vehicles that aged less than a year caused 3.77% of the fatality, and vehicles aged more than 5 years caused 62.89 % of the total fatality in that year. In the final year of the study, the fatality number caused by vehicles older than 5 years found to be 67% and fatality by vehicles less than a year covers only 2.62%. the following graph will give a visual elaboration as follows;

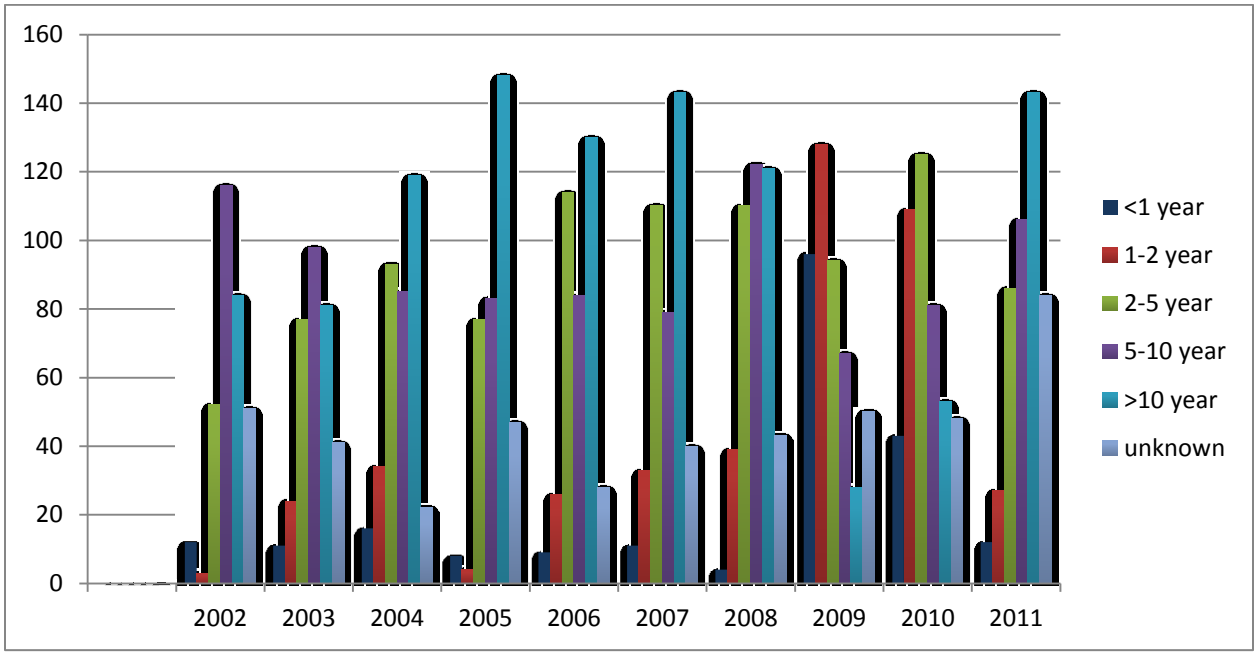

Figure 4.8 relationships between fatality number and vehicle age of Addis Ababa city (2009/2010- 2018/2019)

4.1.2.4. Accident analysis based on vehicle type

	vehicle type and accident														
year	cycle	motor cycle	authomobile	steshien wagen	pick up < 10 k	large vehicle 11–40 k	large vehicle 41–100 k	large trailer	liquid tanker vehicle	taxi	public bus 12 seat	public bus 13-45 seat	public bus above 46 seat	unique moving vehicle	unknown
2009/2010	26	44	1714	884	644	404	498	107	36	776	417	390	180	36	122
2010/2011	35	60	3094	996	755	518	523	161	30	1174	638	414	211	19	475
2011/2012	43	97	3073	1396	1323	695	763	220	35	1346	982	547	362	49	354
2012/2013	36	130	4920	1653	1736	945	794	293	46	2003	1406	655	471	41	646
2013/2014	32	112	5364	1720	1876	1159	963	408	156	2195	1979	671	538	300	312
2014/2015	100	289	4863	2152	2517	1397	1064	424	86	3231	2769	634	391	89	366
2015/2016	59	240	4774	2174	3318	1238	981	227	40	4843	2980	1192	330	69	368
2016/2017	39	346	4709	1946	3992	2028	1343	326	43	5852	3570	1408	531	22	405
2017/2018	32	927	6384	1913	4695	2027	1124	465	22	4626	3396	1702	349	501	
2018/2019	32	729	6674	2297	3992	1596	1201	197	78	6381	3852	1263	592	59	510
total	434	2974	45569	17131	24848	12007	9254	2828	572	32427	21989	8876	3955	1185	3558

Table 4.5 Relationship between total road traffic accident and vehicle type of Addis Ababa city (2009/2010- 2018/2019)

By default in the city Addis Ababa we assume that the larger traffic crash occurs by taxis because they are seen to disobey the traffic law most of the time, but the actual results from the assessment of the relationship between vehicle type and total road accident indicated that the automobiles play even the higher role in creating the traffic crash in Addis Ababa city.at the start of the study year 27.27% of the accident was happened because of the automobiles followed by station wagon and taxis which covered 14.1% and 12.34% respectively. From the total sum of accidents, automobile and taxi covers the larger

number which is 24.12% and 17.16% respectively. The following graphics will show the above data visualized as follows;

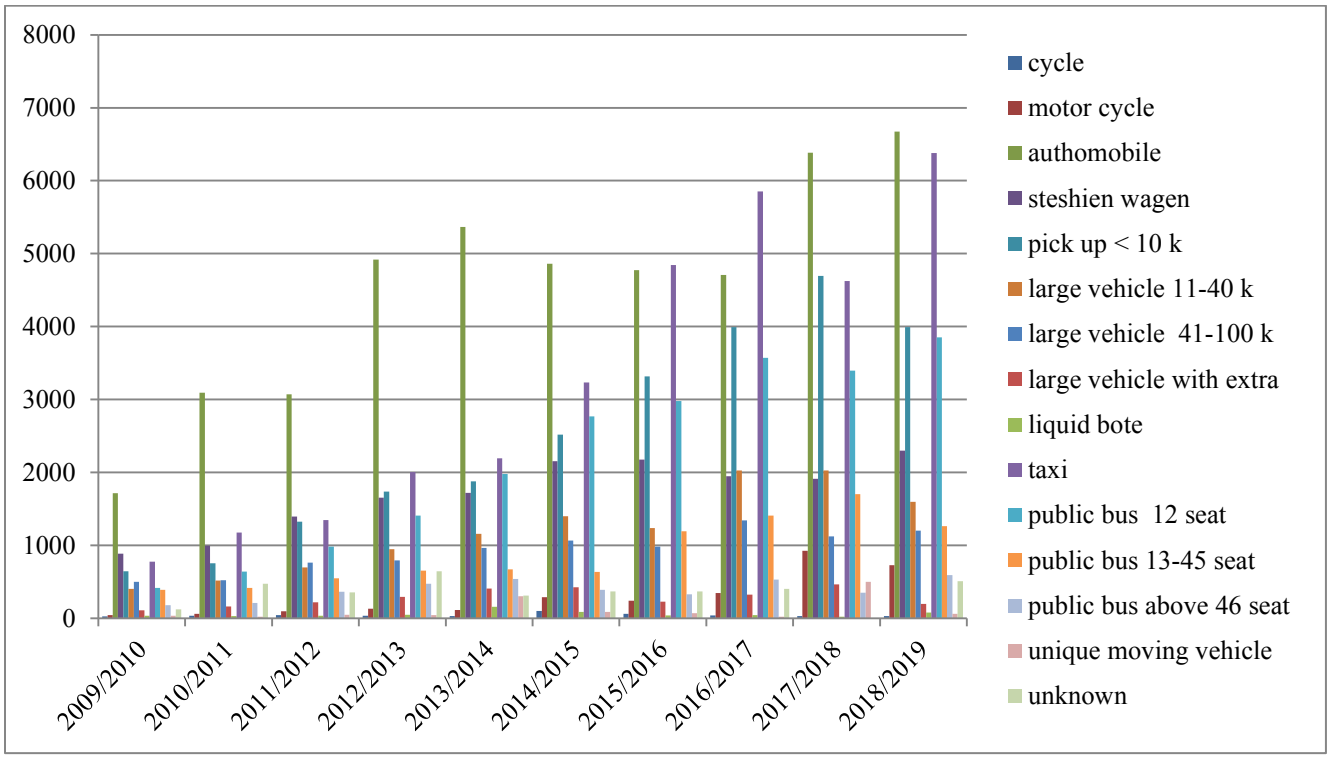

Figure 4.9 relationships between total road traffic accident and vehicle type of Addis Ababa city (2009/2010- 2018/2019)

4.1.2.5. Accident analysis based on drivers experience

According to the experience of the drivers in Addis Ababa, the road traffic accidents for the period of 2009/2010 – 2018/2019 is presented in Table 4.6 and Figure 4.10 below

Driving experience	**Year**									
driving experience	2009/ 2010	2010/ 2011	2011/ 2012	2012/ 2013	2013/ 2014	2014/ 2015	2015/ 2016	2016/ 2017	2017/ 2018	2018/ 2019
no driving license	159	100	205	207	133	112	126	253	327	100
<1 year	181	427	1147	1221	1849	1795	1735	2071	1691	2662
1-2 years	431	804	1493	2433	3069	3961	3197	4912	5426	5342
2-5 years	1293	2288	2634	3692	4221	4725	6248	6771	9822	8660
5-10 years	1996	2641	2994	4187	4690	5860	6076	7152	6320	6674
>10 years	1635	2390	2702	3429	3630	3613	5189	4938	4349	5598
Unknown	590	484	354	646	312	366	368	844	429	510

Table 4.6 relationship between total road traffic accident and drivers experience of Addis Ababa city (2009/2010 – 2018/2019)

"Practice makes perfect" this is a great quote working in real life but doesn't align perfectly as it comes to the numerical data analysis of the relationship of driver's experience and road traffic accident in Addis Ababa city because the result showed the more the driver's experience increases the more accident they create, overconfidence let's say. They may become overconfident that they are fully efficient to maneuver the vehicle in their way. The result gives at the starting year of the study it was found that drivers with experience of less than a year create 2.86% of the traffic accident with that of drivers who had an experience of more than 5 years creates 57.8% of the accident. And at the final year of the study drivers with less than a year were engaged in 9% of the traffic crash in the city of which 41.53% of the total crash in that year was caused by drivers who had a driving experience more than 5 years.

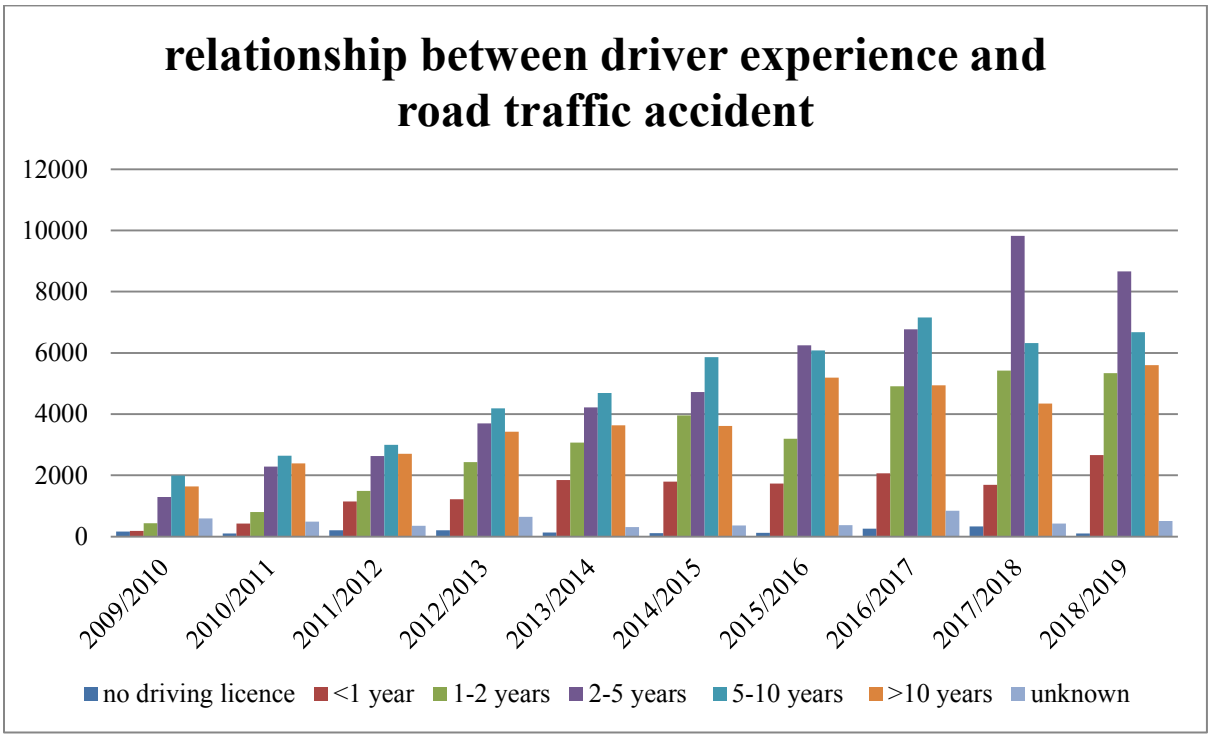

Figure 4.10 Relationship between total road traffic accident and drivers experience of Addis Ababa city (2009/2010 – 2018/2019)

4.1.2.6. Analysis of the data on peoples involved in the accident

The peoples involved in road accidents are classified as the driver, pedestrians or passengers, the numbers of the peoples involved in Addis Ababa city road accidents for a period of 2009/2010 – 2018/2019 are presented below on table 4.7 and figure 4.11;

The number of people involved in road traffic accidents			
year	**driver**	**pedestrian**	**passenger**
2009/2010	85	1477	263
2010/2011	41	2011	237
2011/2012	110	2414	371
2012/2013	103	2731	124
2013/2014	186	2672	1149
2014/2015	191	2621	749
2015/2016	235	3091	714
2016/2017	190	2844	760
2017/2018	413	2945	263
2018/2019	218	3037	709

Table 4.7 Relationship between total road traffic accident and the peoples involved in the accident in Addis Ababa city (2009/2010 – 2018/2019)

The data in the above table clearly shows that pedestrians are vulnerable in the city streets of Addis Ababa, on 2009/2010 which is the starting year for the study the pedestrians involved in the accident cover 80.9% of the total peoples involved in the accident, followed by passenger and driver which covers 14.4% and 4.66% respectively.at the end of the study year, the pedestrians involved in the accident remains the greater showing it covers 76.61% of the peoples involved in the accident were pedestrians. The following graph will give a graphic illustration for the above table;

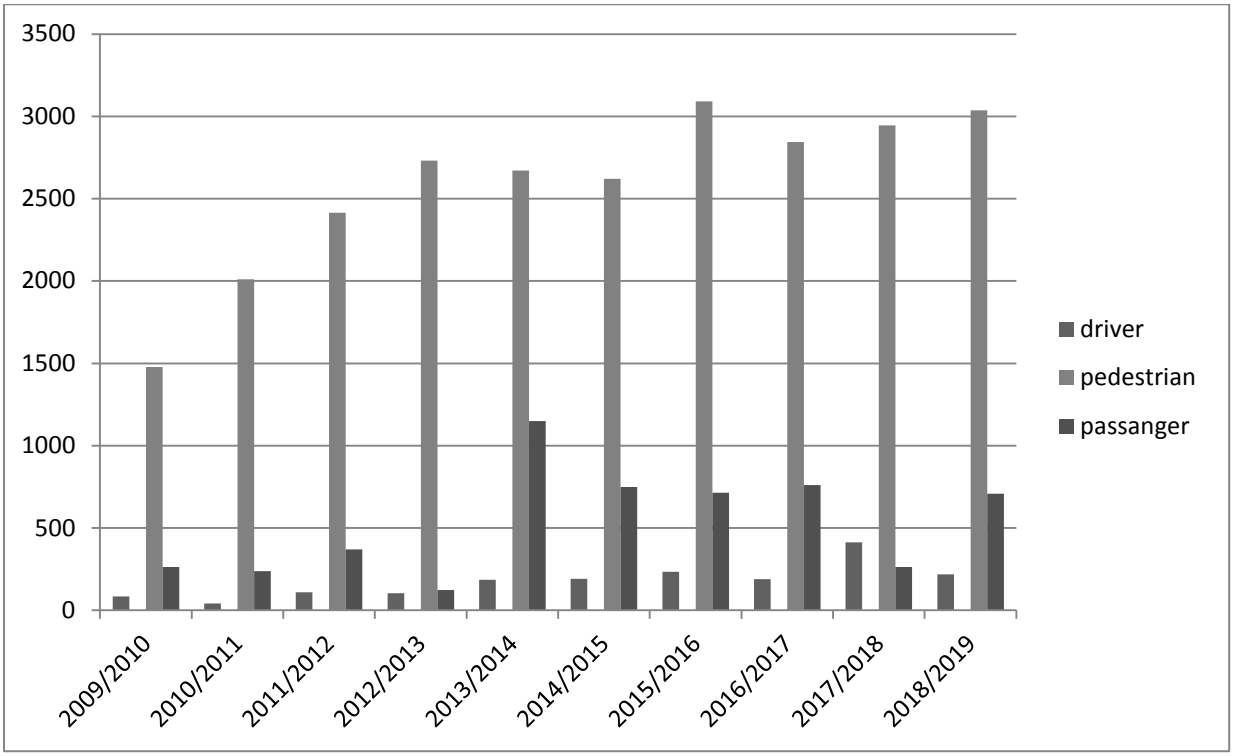

Figure 4.11 relationship between total road traffic accident and the peoples involved in the accident in Addis Ababa city (2009/2010 – 2018/2019)

4.1.2.7. Financial estimation of property damage

Financial estimation of property damage	
year	**property damage(ETB)**
2009/2010	29,345,713
2010/2011	45,728,573
2011/2012	52,013,101
2012/2013	72,687,411
2013/2014	182,815,163
2014/2015	194,322,838
2015/2016	296,315,747
2016/2017	417,922,804
2017/2018	109,882,371
2018/2019	141,822,992

Table 4.8 financial estimation of property damage due to road traffic accident in Addis Ababa city (2009/2010 – 2018/2019)

The city is losing millions of birrs with property damage due to a road traffic crash every year; the total financial estimation of property damage due to traffic accidents is increasing yearly. As a developing country, the money that shall use to build new infrastructures is being lost by the traffic accidents. The yearly loss is increasing highly and it is noted that the pick was registered in the year 2016/2017 which Addis Ababa lost around half a billion birr.

4.1.2.8. Illustration of causes for pedestrian accidents

circumstances	2009/ 2010	2010/ 2011	2011/ 2012	2012/ 2013	2013/ 2014	2014/ 2015	2015/ 2016	2016/ 2017	2017/ 2018	2018/ 2019
While crossing with pedestrian zebra	23	495	247	760	645	830	640	832	786	981
While crossing without pedestrian zebra	1002	438	694	588	510	313	456	1016	739	530
going on vehicle roadway while pedestrian walkway is not available	276	293	563	333	351	295	163	220	432	221
going on vehicle roadway while pedestrian walkway is available	16	100	189	221	153	216	337	137	204	202
going on pedestrian walk ways	52	311	177	317	329	151	487	232	128	172

Table 4.9 the reasons for pedestrian accidents in Addis Ababa city for the period of 2009/2010 – 2018/2019.

In the previous analysis's it is found that pedestrians are vulnerable in the streets of Addis Ababa, from the above table the circumstances of the pedestrian accidents for the city of Addis Ababa resulted in much of the accident in the city occurs while pedestrians are crossing the road, with or without zebra. 31.5% of the pedestrian accident occurs while pedestrians are crossing the road with zebra crossing and 31.7% while pedestrians are crossing the road without zebra crossing. The following graph shows an illustration of the circumstance of the pedestrians in yearly incidence clearly;

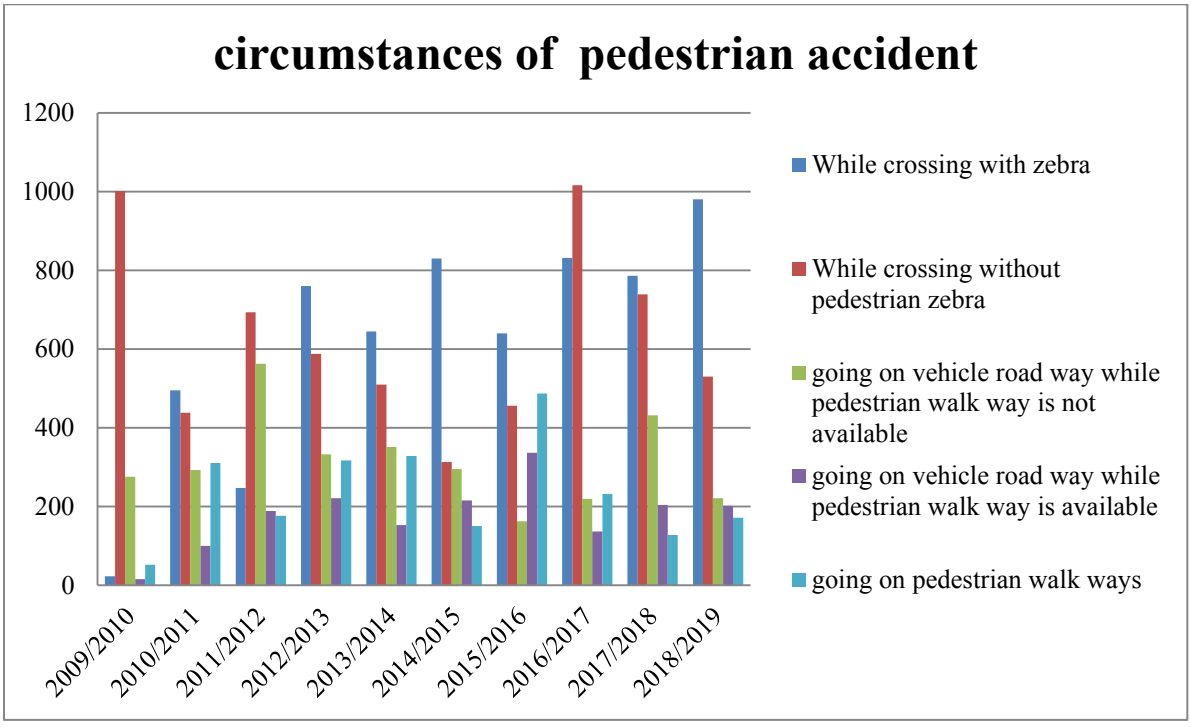

Figure 4.12 Circumstances for pedestrian accidents in Addis Ababa city for the period 2009/2010 – 2018/2019.

4.1.3. Descriptive analysis of vehicles in Addis Ababa

4.1.3.1. Vehicle numbers by type

vehicle number by code											
	2008/2009	2009/2010	2010/2011	2011/2012	2012/2013	2013/2014	2014/2015	2015/2016	2016/2017	2017/2018	2018/2019
code 1	23280	23596	23774	24065	24248	24426	24650	25593	25746	25986	29275
code 2	64234	65318	65842	68992	74426	89001	105036	123400	137911	149362	199131
code 3	80538	82672	84193	89289	95448	111385	130829	151236	165175	174238	174256
code 4	10145	10460	10888	11228	12075	14151	15745	17367	18120	19173	19173
code 5	7701	8304	9051	9477	10246	12067	13195	14233	15155	13195	19359
others	1640	1916	2187	2856	3012	4186	4927	5736	6843	10048	9506
total	187538	192266	195935	205907	219455	255216	294382	337565	368950	392002	450700

Table 4.10 Vehicle number by type (code) for the period of (2008/2009- 2018/2019)

The number of the vehicle in Addis Ababa is rapidly increasing in the last decade, which the commercial vehicles cover a larger amount which is 43.2% of the total population of vehicles, but the private automobiles that are used for private purpose are increasing in number tremendously, which is only 6.34 % lesser than the commercial vehicles that are creating a saturation number of vehicles in the streets of Addis Ababa. The following figure shows the graphical representation of the data mentioned above.

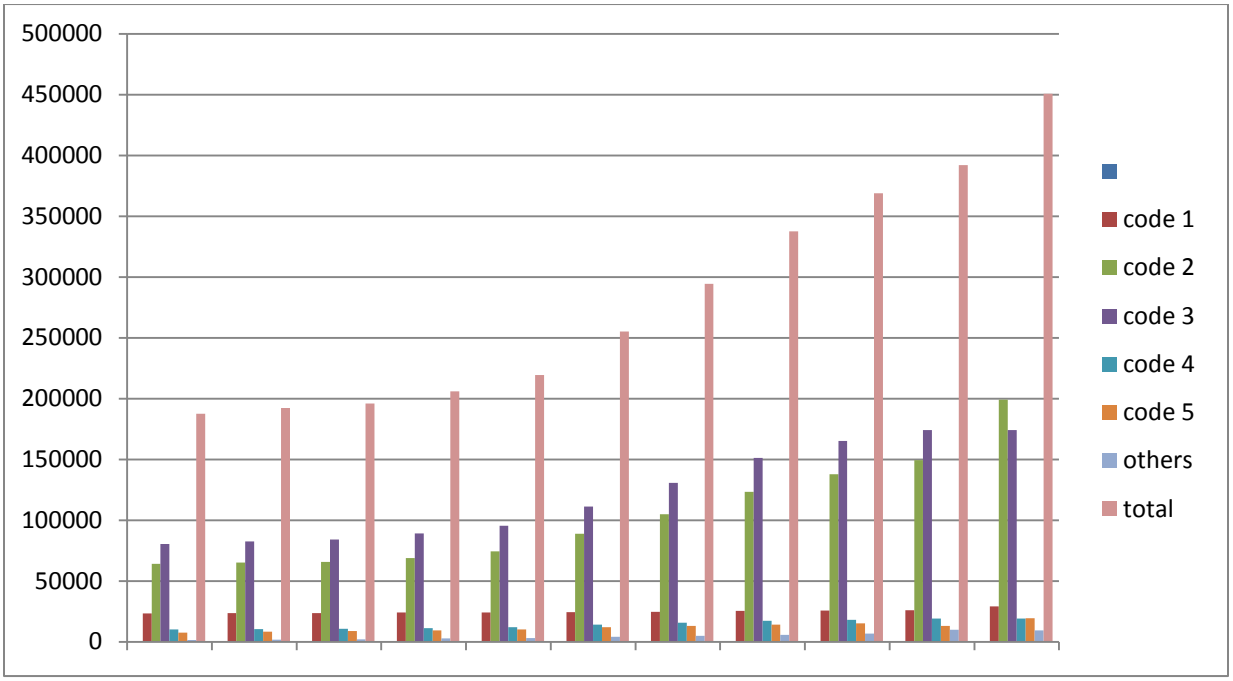

Figure 4.13 Vehicle numbers by vehicle type (code) of Addis Ababa for the period of (2008/2009-2018/2019)

4.1.3.2. Vehicle number by the age

	Vehicles Older than 1999	Vehicles manufactured between 1999-2004	Vehicles manufactured between 2005-2009	Vehicles manufactured between 2010-2014	Vehicles manufactured between 2015-2019
code 1	22072	22382	22832	22983	23973
code 2	64587	121753	151712	164531	170314
code 3	52185	84691	131214	184229	215424
code 4	2537	4449	8473	14768	17123
code 5	1380	2200	4665	6406	7494

others	759	1564	3103	5269	6503
total	143520	237039	321999	398186	440831

Table 4.11 Total Vehicle number of Addis Ababa city by the age

The vehicles licensed under the Addis Ababa city Administration can be classified based on their manufacturing year as it's seen in the above table and the following figure gives a graphic representation of the above data.

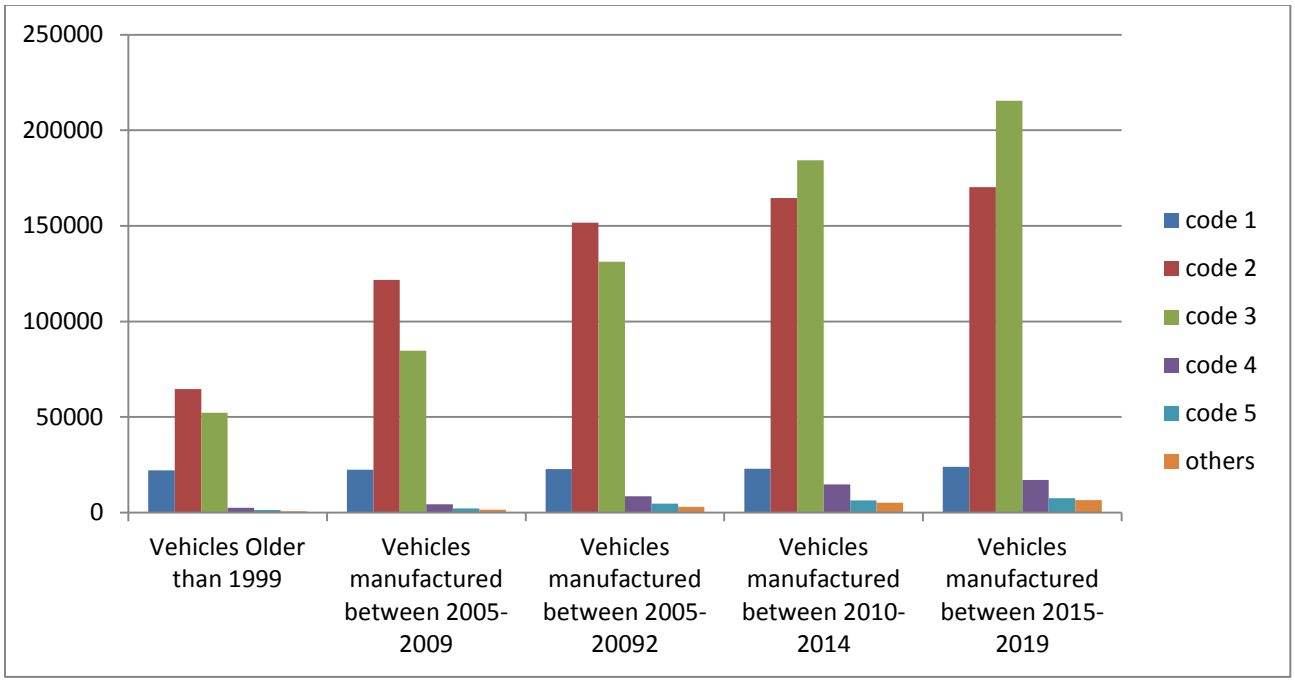

Figure 4.14 Total Vehicle number of Addis Ababa city by the age

4.1.3.3. Vehicle number by the type of fuel consumption

vehicles number by fuel type			
year	**petrol**	**Diesel**	**Electric Rechargeable**
2009/2010	97500	83396	2
2010/2011	98811	85367	2
2011/2012	102058	89727	2
2012/2013	108465	95741	2
2013/2014	114967	101877	2
2014/2015	123011	108618	2

2015/2016	140116	128917	16
2016/2017	160016	148765	21
2017/2018	178990	164478	21
2018/2019	195501	174273	22

Table 4.12 Total Vehicle increment of Addis Ababa according to fuel type

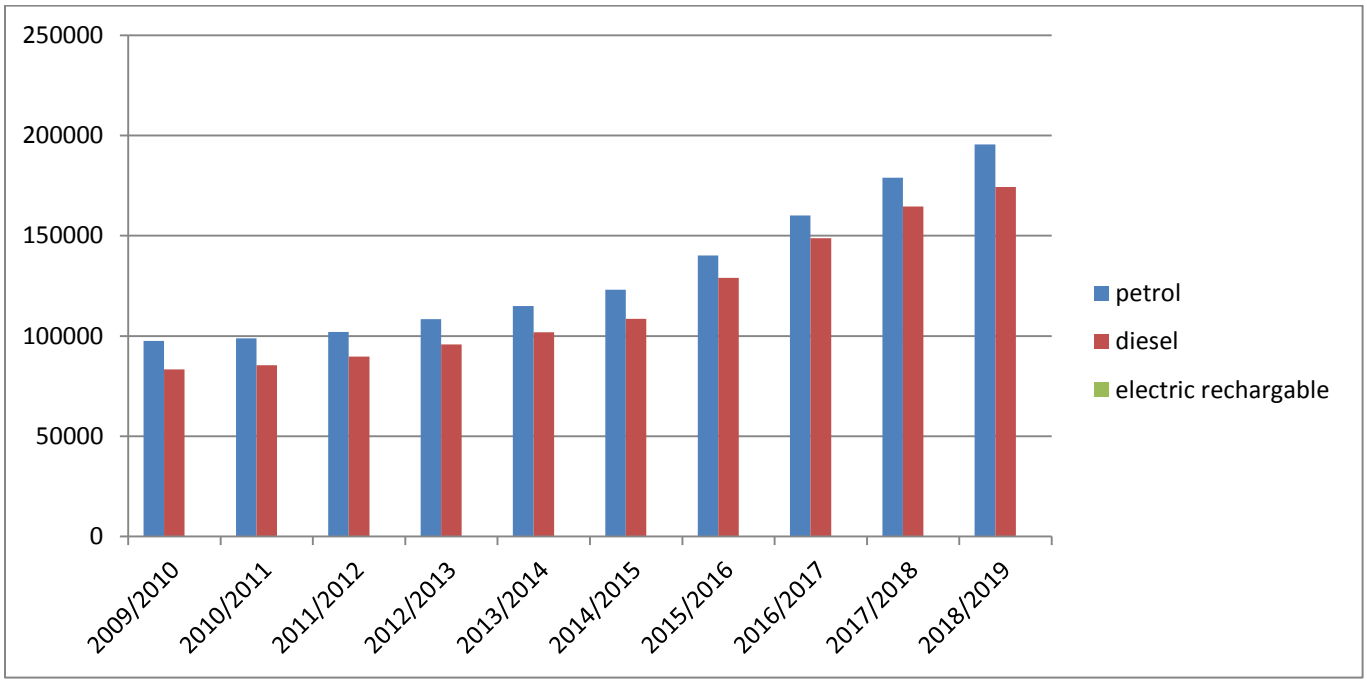

Figure 4.15 Total Vehicle increment of Addis Ababa according to fuel type

4.2. Results

The findings from the analysis of this research resulted in the following major road transport issues in Addis Ababa. The results are classified as factors for increasing demand in Addis Ababa city, existing supply, and gaps between demand and supply.

4.2.1. Transportation demand and supply in Addis Ababa

Increases in demand for transportation play a leading role in producing congestion in Addis Ababa. Economic growth and social development increase mobility and promote the use of vehicles. People's desire to access to numerous activities is increasing because of the sprawled urban environment of Addis Ababa, so an increase in demand is inevitable.

The transportation industry is an integral part of the economy. Nearly all businesses use some form of

transportation to connect people, goods, and resources. Improvements in the transportation industry support and create jobs, increase household disposable income, and improve business productivity (Maryland Department of Transportation 2015).

Growth in the economy and society occurs largely in large urban areas, where most of the activities, money, and knowledge are located and can interact with each other. Such a condition affects transportation needs, which consequently increases transportation demand and the possibility for congestion to occur on the urban transport system. However, while the mobility in urban areas is increasing along with population growth, not all cities in Ethiopia share the same pattern of mobility growth.

Addis Ababa is the largest city in the country and its population growth is due to both in-migration and natural population increase (UN Habitat, 2014).

According to the CSA July 2015 estimated data, Ethiopia's total population is about 90 million people. Of the total population, 19.5% (17.5 million people) live in urban areas. This number is rising fast due to an annual urban population growth of 4.89%. Ethiopia's urban population is expected to triple by 2037 (World Bank, 2015).

CES, 2005 forecasted that the population of the city will reach 3.7 million by 2020, and the same study had proposed a projection of travel demand to rise to 5.6 million in the same year. The plan estimates the population of the city will reach 4.4 million in 2025 and 6.4 million in 2040. With this in consideration, it is estimated that travel demand will reach 6.6 million in 2025, and will increase to 9.7 million in 2040. The population forecasted by the United Nations World Population Prospects is a total of 4,592,000 in Addis Ababa city which was forecasted by CES, 2005 and for the year 2040, it has been estimated at 6.4 million with the corresponding travel demand of 9.7 million. The population growth with an increasing rate will increase the demand for transportation. An increasing number of population at a higher rate will directly or indirectly affect land use and transportation pattern.

The total urban land area of Addis Ababa has grown rapidly in the past decade. The World Bank has estimated that while urban populations of a representative sample of cities in the developed world grew by approximately 5 percent, their built-up area increased by 30 percent.

Urban transportation aims at facilitating accessibility and supporting transport demands generated by the diversity of activities in the urban environment. In Addis Ababa, the mixed effect of spatial development and circulation of passengers and goods in the city creates several contradictory issues.

Given the significant negative externalities of urban accessibility, Addis Ababa is characterized by sprawling and vehicle-based urban agglomerations.

More complex land-use patterns in Addis Ababa leads to a more complex trip making patterns. Moreover, Addis Ababa is affected by urban sprawl which is leading to longer trips that increase in both traffic and congestion which makes it difficult to have a shorter trip which creates the possibility of using other modes like walking and cycling.

Addis Ababa City today shows a great variety of travel behavior patterns which are mode choice and trip lengths. Travel demand patterns mostly related to land uses have a serious effect on the increment of travel demand in Addis Ababa. Since travel patterns are a product of the need for mobility they have a great influence on the city's transportation system.

While conducting a questionnaire survey at the beginning of the study Work trips and school trips tend to cover a larger number for trip purposes, and the time of the travel demand to work and school is almost the same, which creates a saturated number of transportation demand.

An increase in personal income stimulates the increasing number of car usage and ownership. The research by Todd Littman from the Victoria Transport Regulation Institute indicates that: there are as many as 20 items that constitute the overall cost of small private cars, including internal costs and external costs, and the costs paid by the users of small private vehicles are only internal costs. According to Todd Litman averagely, each $1 operational cost paid by a small car user creates $2.7 social costs. The costs paid by users are only approximately 1/3 of the social cost.

When choosing transport, individuals will choose the option of transportation which maximizes utility for the individual. The utility cost of transport is affected by quantitative factors, where travel time (divided into in-vehicle time, waiting time, and walking time) and cost of travel are the two major areas (Ortúzar and Willumsen, 2011). Qualitative factors such as comfort, perceived safety, and opportunities to perform other activities during travel also affect utility (Ortúzar and Willumsen, 2011). Looking at the data perspective in Addis Ababa, the choice of transport is becoming dependent on owning a private vehicle. According to the analysis, Private vehicle ownership has increased dramatically in recent decades, the number of private cars has increased by around 51% during the last 10 years.

Transportation infrastructure mainly includes roads, parking lots, vehicles, and transportation terminals. It is the direct carrier of urban transportation demands and the basic input of the capacity of transportation supply.

Addis Ababa is developing its road network with a series of projects underway, much of the road expansion and maintenance program has been devised by the Addis Ababa City Roads Authority (AACRA). Most of the intersections are very narrow and prone to traffic congestion.

Public transport is considered an essential component in the road transportation sector worldwide. However, in the case of Addis Ababa, the unattractiveness of public transport contributes to a more complicated scenario, since it turns passenger's attention away from public transport and into private vehicles. The reasons for less preferred ability of public transportation include: poor performance, lack of network coverage, low level of personal security and comfort: and low level of reliability. Even if there is significant demand for public transportation, the city roads are packed by private vehicles which leads to congestion that public transportation takes a longer time to reach their destinations that leads to the lower frequency of service.

Traffic management system is an important component to properly control and guide the distribution of traffic flows on roads, and it can help improve the environment in Addis Ababa. Researches showed that even the urban transportation infrastructure in different cities is at the same level, the capacity of urban road systems may vary greatly with different traffic management systems.

4.2.2. The efficiency of the road transportation system in Addis Ababa

The Efficiency of transportation systems is the relationship between the input of the transportation system and its capability of satisfying the transportation demand in the system. Based on the data analyzed in this research, the gaps between the demand of the road transportation and the supply (capability of satisfying the transportation demand) are expressed as follows:

4.2.2.1. Congestion

Traffic congestion in Addis Ababa should be understood in the wider context of the city dynamics. Traffic congestion in Addis Ababa is the outcome of successful urban economic development, employment, and housing. There are many indications that, even though they may not be thrilled by the prospect, road users are prepared to live with crowded roads so long as they derive other benefits from living and working in their city.

Figure 4.16 Picture of congested road in Addis Ababa, 2020

Congestion involves vehicle queuing, relatively slower speeds, and increased travel times, which impose direct and indirect costs on the economy and generate multiple impacts on urban regions and their inhabitants. Congestion creates an indirect impact including the marginal environmental and resource impacts of congestion, impacts on quality of life, stress, and safety as well as impacts on non-vehicular road space users such as the users of sidewalks and road frontage properties. The results obtained from the survey conducted in this study showed that traffic congestion in Addis Ababa city affects people's social life, as they must take much of their time waiting for transport and stayed longer on congested roads of the city. Road congestion causes late arrival to workplaces, causing loss of output, reduced productivity, and restricted economic growth.

Many studies show that the demand for transportation is expressed in terms of socio-economic growth, Increase in Urban Population, socioeconomic growth and personal income. In the case of Addis Ababa All the demand indicators are increasing at an increasing rate, with supply increasing at a relatively lower increasing rate because the city is occupied by buildings and also building infrastructure by itself

generates additional traffic demand unless and otherwise a demand management mechanisms are done or regulated as a regulation.

4.2.2.2. public transportation system

Opinion from the public transport users claim that the public transport is not giving abundant service as much as its demand, but the government is also providing more and more new bus services to the sector every fiscal year and still, the demand is not fulfilled completely rather the problem is worsening year by year. in the case of the city Addis Ababa, the above statement mentioned the insufficient level of transportation doesn‘t only means providing more buses to the system because as the ways of the roads are already saturated with private automobiles the buses fail to provide the required service because of the congested roads. As the result, the trips take longer time creating queues to get transportation services; when the bus arrives, it occupies above the carrying capacity to meet the demand which leads to passengers’ discomfort resulting in the modes neglect to be chosen as a preferred means of mobility.

4.2.3.4. traffic safety

Injuries resulting from road accidents continued to pose a serious public health problem and large economic loss as expressed in the analysis. The results from the traffic safety in Addis Ababa are categorized under two groups as stated in the following sub-sections:

4.2.3.4.1 Vehicle age

Many researchers have developed the relationship between vehicle age and traffic safety. Developed countries have agreed on the negative results of old vehicles and should be gradually removed from the market. But in the case of Ethiopia, peoples were motivated to choose old vehicles over new vehicles because the taxes paid on new cars are exorbitantly high and very expensive that the majority of the peoples can‘t afford. Ethiopia’s car taxation is one of the highest in the world.

In sections 4.1.2.2 and 4.1.2.3 above, the relationship of vehicle age with total accident number and fatality was analyzed which resulted as illustrated in Figure 4.17 below,

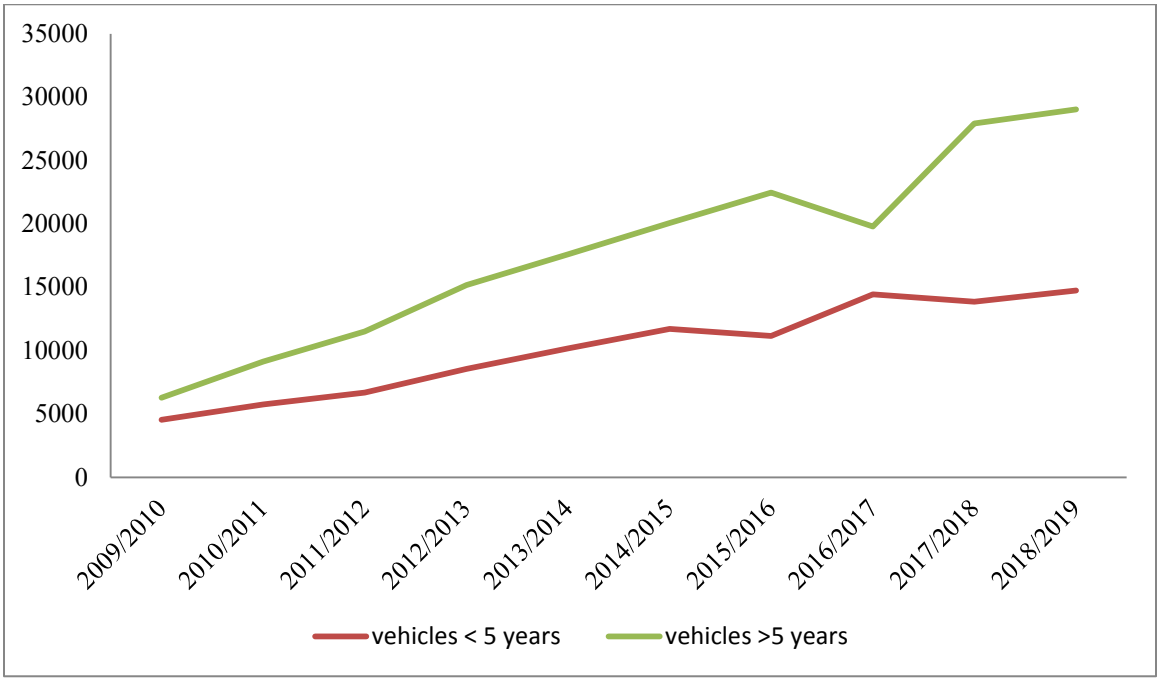

Figure 4.17 fatality rate for vehicles aged below and above 5 years (2009/2010- 2018/2019)

Figure 4.20 above clearly shows that vehicle age and the accident rate have a positive relationship with which vehicle age increment increased the number of accidents while other components are set constant. The relationship of fatality rate with vehicle age is illustrated in Figure 4.18 below:

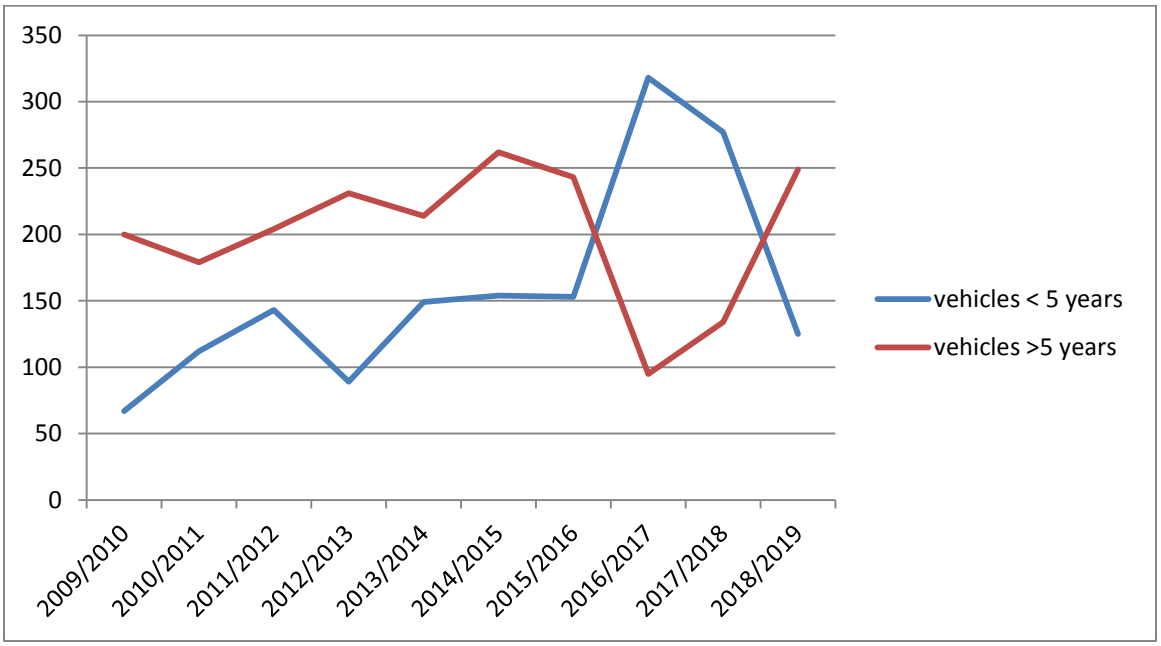

Figure 4.18 fatality rate for vehicles aged below and above 5 years (2009/2010- 2018/2019)

As it is illustrated in Figure 4.21 above, the large number of accidents occurred in the case of vehicles aged more than 5 years, except for the year 2016 to 2018 which relatively newer vehicles accounted for the fatality number which might be due to the importation of vehicles with their steering's changed from right side to left side that is not internationally approved.

Figure 4.19 pictures for the vehicle population in the streets of Addis Ababa, 2020

4.2.3.4.2. Vulnerable road users

According to the results of the analysis of the data in this research, the groups of road users that had higher incidents of falling into road accidents were pedestrians. As presented in Section 4.1.2.6 after analyzing the 10 years data on peoples involved in the road traffic accidents, the victims resulted as follows: pedestrians 78.4%, drivers 5.3%, and passengers 16.3%. The data in the table 4.7 clearly shows that pedestrians are vulnerable in the city streets of Addis Ababa, on 2009/2010 which is the starting year for the study the pedestrians involved in the accident cover 80.9% of the total peoples involved in the accident, followed by passenger and driver which covers 14.4% and 4.66% respectively.at the end of the study year, the pedestrians involved in the accident remains the greater showing it covers 76.61% of the peoples involved in the accident were pedestrians.

4.2.3.5. level of Enforcement of laws

Traffic enforcement continues to be an important tool in dealing with the objective and subjective lack of safety on the roads. Some policies and regulations were proclaimed for the sake of prevailing safe and comfortable riding environment for pedestrians and vehicles. However, the actual data on the roadways do not indicate that there is full implementation and enforcement.

4.3. Discussions

The findings of the research in the combination of current policies and suggested policies for the problems encountered in Addis Ababa city road transportation system are interpreted as follows;

- A major issue, influencing the road transport system in Addis Ababa is the rapid population growth;
- A high population growth and expected increases in economic activities will induce a continuous increase in the travel activities of people and goods in Addis Ababa, and consequently its negative effects such as air pollution, global warming, accidents, congestion, noise, energy consumption, and use of land;
- regulation based solution is a key tool for optimization and sustainable urban mobility and
- Thus, possible regulation options needed for sustainable road transport in Addis Ababa will be expected to address three main issues, i.e. the problem of increases in travel demand, increases in

the use of private cars, and the vulnerability of peoples due to vehicle use in Addis Ababa.

4.3.1. Managing travel demand

The current issue of increasing travel demand can be managed in two main ways which are; by either decreasing travel activities within the city or by changing travel behaviors to reduce the frequency of trips. The first will require regulations & policies to decentralize some urban functions especially governmental functions evenly in different cities of the country other than Addis Ababa to ease travel activities within Addis Ababa. This strategy can be best enforced through close cooperation among national and local governments, infrastructure developers of transportation and housing, and the local people.

Figure 4.20 pictures of a saturated number of private vehicles in Addis Ababa roads, 2020

The second approach, which will control the travel demand pressures from increasing in Addis Ababa, is by reducing the frequency of trips through land-use policies that focus on higher population density and better accessibility to daily activities. Examples of some cities that have experienced such a system include Curitiba (Brazil), Singapore, Hong Kong (Peoples Republic of China), Freiburg (Germany), and Portland (US) (Litman, T., 2003). To get successful results from applying this approach a good coordination with all public transport infrastructure development is needed.

Current regulation on controlling travel demand in the city:

Demand management plays a significant role in controlling road transportation congestion that is a significant issue in Addis Ababa City today. This can be done by reducing the need to choose motorized transportation modes for everyday life. In Ethiopia regarding demand management, no nationwide regulation is regulated, except motivational advertisements to use non-motorized modes as it is important. But, under this research, it is strongly believed that managing the demand is the first outstanding option that will give a long-lasting result. The regulation based approaches to reduce transportation demand worldwide with their positive outcomes are listed below:

Suggested regulation approaches

4.3.1.1. Congestion pricing as an approach

Congestion charging is applied in many countries as the best measure of demand management regulation, congestion charging regulation can effectively regulate the external cost generated by private cars, help governmental authorities to avoid distortion in the mode of resource benefit allocation, and thus facilitate a more efficient and fair transport system.

From an economic contribution perspective, many developed countries system mentioned it as "congestion charging regulation means to internalize the external costs due to road congestion through administrative measures in the form of charging, Thus to determine the rational price of transportation, a special kind of commodity, and thereby to rectify the uneconomic usage of the resources of the transportation system, adjust the space and time distribution of traffic volume, and make the whole system run more efficiently".

The main agenda for applying congestion charging is to give price to time costs and delays which are negative externalities of transportation, that are imposed on other road users by an additional driver entering the road (Knight 1924; Pigou 1920). In this regard, road users not only measure their costs and benefits when deciding whether to enter a congested area or not, but also the costs they impose on other drivers. Traffic is efficiently allocated when the price paid by each road user equals the marginal cost faced by the rest of the users. (Knight 1924; Pigou 1920)

Many U.S. regulation makers were attracted to the benefits of congestion pricing because of the possibility of its implementation in heavily congested urban areas across the country. (Schrak and Lomax, 2007).

Implementation of congestion charging

As stated by De Palma et al. (2005) charging congestion tolls is an optimal regulation strategy technically for reducing congestion, but it may not always be a politically optimal strategy it is mentioned that Politicians and planners are usually in doubt to charge for a good that has always been free and is considered by citizens to be a right, he further added, the degree of consensus among economists in support of congestion pricing seems to be inversely proportional to its acceptance among the public and politicians. Thus, the main obstacle to road pricing is political, much more than operational (Downs 1992; King, Manville, and Shoup 2007; Wachs 1994).

Most developing countries use the following framework for analyzing the implementation of congestion

pricing that consists of three main factors:

- Policy development process and implementing processes for congestion charging;
- Payment structure;
- revenue uses; and
- Political impacts.

Policy development and implementing process

In the overall process from the idea of applying congestion charging to the introduction, many steps need to be taken. In the policy development stage the following steps will be taken step by step;

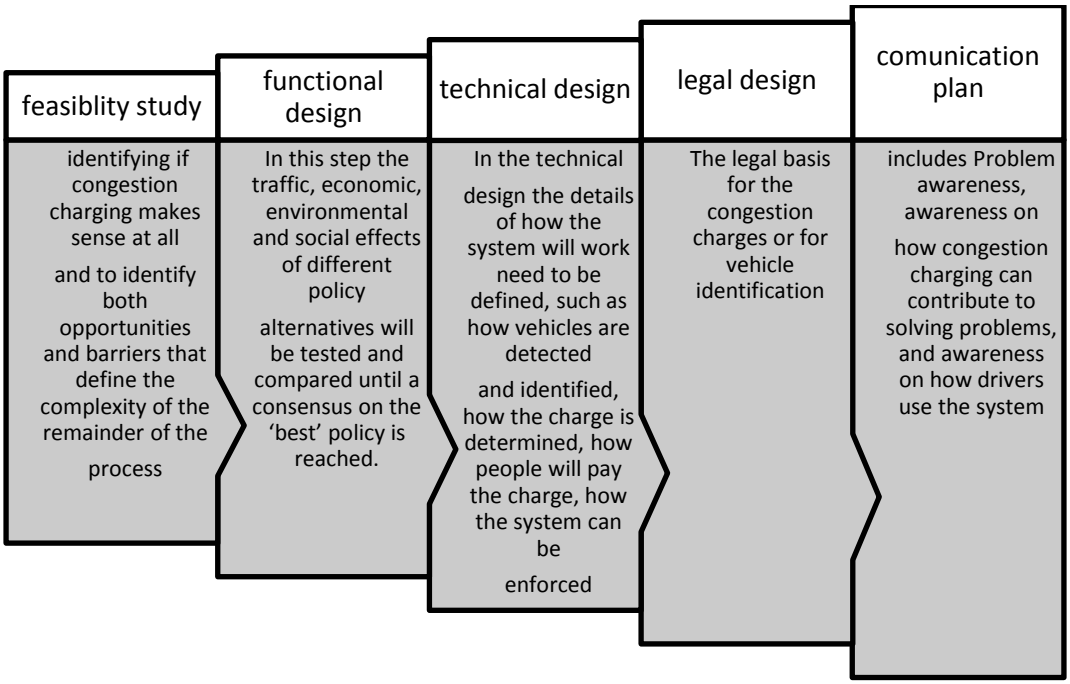

Figure 4.21 steps in policy development of congestion charging

Payment structure

The payment structure and the technical operation is the first necessary issue that regulation makers must take into consideration. Both payment structure and the operation of technology must be studied in detail in accordance to apply the congestion charging and the nature of the city itself in its traffic pattern. If the central city is congested throughout the day, the regulation makers are forced to follow a constant

payment structure in which the fair is the same throughout the day. And on other situations, if the central streets of the city are congested only in a certain time of the day, the policymakers shall apply a flexible payment scheme which is variable throughout the day.

An application of a constant payment structure is simpler than applying a time variable payment structure because the application of a time-varying payment structure needs a more complex operational system.

In the process of calculating the fee for the congestion charging, since congestion affects the magnitudes of other road-traffic externalities including emissions (Daniel and Bekka, 2000; Glaister and Graham, 2005), accidents (Hensher, 2006; Steimetz, 2008), and road damage (Hussain and Parker, 2006). This interdependence would not matter for setting congestion tolls if the external costs of accidents, emissions, and road damage were internalized by efficient pricing or some other means, but since these costs are not internalized these external effects should, in principle, be factored in when setting congestion tolls.

Revenue Uses and Investments

Road pricing implies charging users, Schade and Baum (2003) concluded that it is naturally challenging to win major support among motorists while applying payment for the road that they have been using for free. But in other ways, it also raises funds that can be used for different purposes.

Goodwin (2004) discusses that the regulation discussion of road pricing and consensus building cannot avoid explicit attention to the use of its revenue. In the same way, Alberini (2001), Harrington, and Krupnick claim that public discussions of congestion often ignore the fee revenues, making it difficult for the public to see that it is receiving value for the new charges imposed.

Marcucci, Marini, and Ticchi (2005) assert that a key to the successful implementation of congestion pricing is to distribute toll revenues to public mass transport. Investing in an efficient, accessible, and efficient alternative to individual travel by car increases support for the implementation of a new fee, or at least diminishes opposition, and this connects this result with the political impacts described here.

Political impact

Distributional concerns arise not only from the imposition of the toll, but also from how the revenues are

spent (Button 2006).

Regulation decisions have to accommodate this allocation to achieve political support. For example, in a study of popular sentiment for congestion pricing in Edinburgh, Scotland, Farrel, and Saleh (2005) found that voters were most in favor of the new fee structure when the revenues were directed to bus service improvements.

In fact, in all successful experiences, the share of drivers charged was a minority, and toll revenue was expected to be invested in public transport. Because of this, congestion charging was seen as favoring the majority's welfare.

Worldwide Experiences with Congestion Pricing

London:

London's congestion pricing program was the first important experience in the use of charges to regulate traffic demand and the best-known success in reducing congestion costs in a large European city. Since February 2003, London drivers pay a fee (neither time-dependent nor vehicle dependent) to enter the city center through almost 200 entry points during weekdays between 7:00 a.m. And 6:30 p.m., except for motorcycles, public transport vehicles, and other particular vehicles (disabled people or emergency vehicles).Once the charge is paid, it includes unlimited journeys into and around the restricted area.
Leape (2006) and Banister (2003), explained, revenues obtained from congestion charges are used to fund public transportation investments (80 percent of total net revenues). Leape (2006) sites that the low net revenue is attributable to the success of the plan in reducing car use, the expensive implementation costs, and the extended discounts awarded to several groups of citizens. However, growing fees over time have caused an increase in revenues that has reduced the relative weight of the operational costs. According to Banister (2003), the main beneficiaries of congestion charging are assumed to be commercial vehicles and those still using private cars and enjoying substantial time decreases, as well as those who were already using public transport because of new public investments funded from charging revenues. Savings from reductions in road accidents are also considered again related to the implementation of the measure.

As a result, right after the implementation of congestion pricing, private vehicles declined between 15 percent and 20 percent in two weeks—30 percent after several months—and significant increases were

found in the use of public transportation. According to Transport for London reports, 50 percent of car reductions resulted in transfers to public transport, 25 percent were diverted around the charging cordon, 10 percent decided to use other private modes such as taxis, motorbikes, or bicycles, and the remainder decided to avoid trips or shifted to non-charging hours.

Singapore:

The experience of Singapore is also well known for its unique length and its success in using variable daily road charges to manage traffic efficiently (Olszewski and Xie 2005). The objective of the measure was to manage traffic allocations rather than generate revenue, and it remains unique as the longest-standing full-scale urban road pricing scheme designed to reduce peak-time traffic in the world (Olszewski 2007). Congestion pricing was introduced in Singapore in 1975 when authorities decided to use an Area Licensing Scheme in the center of the city. This measure was contained in a wider traffic management plan, together with tax increases (vehicle ownership, petrol, imports, etc.), higher parking fees, and the development of public mass transport. Despite its name, the Area Licensing Scheme was implemented as a cordon toll, as vehicles were only charged upon entry. The system was manually enforced, and Santos (2005) considers that this is the reason behind the low operational cost of the project. The fee (S$3) was raised six months later, but decreased to the same amount in 1989. The scheme was initially based on 22 entry points, and it's charging hours covered 7:30 a.m. to 9:30 a.m., the peak rush hour period. However, several changes to this basic schedule have been added. For instance, in 1989, peak-time charges from 4:30 p.m. to 7:00 p.m. were introduced to reduce evening traffic.

Later, in 1998, after sustained successful reduction in peak-time traffic congestion, Singapore decided to upgrade the system by using electronic road pricing. This decision was made to maintain the current traffic speed but also to alleviate congestion at pricing points. Charges are paid in the central area between 7:30 a.m. and 7:30 p.m. on weekdays, but those entering from 10:00 a.m. to 12:00 p.m. are exempted. On the other hand, in other radial arterial roads, charges are only paid between 7:30 a.m. and 9:30 a.m. As mentioned, tolls vary depending on time, but also by vehicle (Olszewski 2007). The highest fee is $3 during the peak time (8:30 a.m. to 9:00 a.m.), and the lowest toll is $1 during an off-peak time (9:00 a.m. to 9:30 a.m.).

As in London, Singaporean authorities were committed not only to reducing traffic, but also to providing public mass transport alternatives (Santos 2005). As a result, they expanded the railway

network and improved the quality of bus services.

Addis Ababa

In Addis Ababa there is no congestion charging policy in the city. But the congestion in the city is increasing on a daily basis, in this research, after gathering worldwide literatures and experiences, a survey was made to ask 100 drivers opinions about the congestion in the city and about applying a congestion charging and their response were concluded as follows;

4.3.2. Managing owning and usage of private cars

The strategy to provide more environmentally sound, higher usage of public transport, as well as non-motorized transport, involves: improving the efficiency of public transport, providing an alternative to vehicle use such as walking and cycling, and finally, reducing car ownership and its use.

The efficiency of public transportation depends on the carrying capacity, operational speed, infrastructure and financial requirement, flexibility to transport demand, and environmental effect.

In addition to the above solutions to reduce road traffic congestions in Addis Ababa, policies aiming at promoting alternatives to vehicle use such as walking and cycling could be introduced and promoted. Although walking and cycling are not recognized as a significant solution to the problem of road congestion, walking and cycling can serve as a viable option to meet the basic mobility needs of all groups in a sustainable way.

Walking and cycling are environmentally friendly, i.e. no air or noise pollution; besides, it is more efficient in terms of the scarce road space of the city since the majority of the land space is covered by buildings, this alternative combat road traffic congestion and also improves physical health.

Several European countries have worked actively to promote walking and cycling, influenced by both social and environmental problems induced by motorization.

Concerning private motorized vehicles, fiscal regulation instruments can be applied to vehicle purchase, circulation, and use (Potter 2008). Vehicle purchase taxes and circulation charges such as registration or road tax - typically levied at the national and state levels and can be applied differentially to meet a range of regulation objectives, and may be used to influence both aggregate demand for vehicle ownership and vehicle choice (including overall fuel efficiency and emissions standards, and key performance drivers such as vehicle size and weight, engine size, engine technology and fuel type).

In addition to applying purchase and circulation fees, many countries also employ positive fiscal

measures (such as tax reductions and subsidies) to actively support and incentivize vehicle purchases. Although these can play a useful role in increasing the adoption of new, less polluting, and more fuel-efficient technologies (such as electric vehicles) if correctly designed, they are currently often used to support sales of existing vehicle technologies. The last option for improving public transport use is instituting policies to reduce the number of private car ownership and restrict its use.

Current regulation

Current issues about owning a private vehicle in Ethiopia are not regulated formally, but the analysis of this research resulted in the increasing number of private car ownership is the main problems on Addis Ababa road transportation system both as a congestion increment and as a cause for a road accident, thus strong regulation should be stated that will not influence the economy negatively.

Suggested regulation approaches

4.3.2.1. Fuel taxation as an approach

The single most important fiscal instrument related to vehicle use is fuel pricing. Transport fuel taxation has historically been a key part of government fiscal regulation due to its characteristics as a stable, dependable revenue source that is easily administered, and typically has progressive characteristics (Ekins and Potter 2010). Besides, it is also now widely recognized as a key mechanism to facilitate the internalization of external costs imposed by vehicle use, manage total transport demand, influence vehicle and modal choice, and promote urban densification. Despite this recognition, transport fuels in many countries continue to be priced at a level far below their marginal social cost, and in many cases at a level below the cost of production. Figure 4.22 below highlights the differential in global fuel prices, including Ethiopia reflecting the high levels of direct and indirect subsidy in many countries.

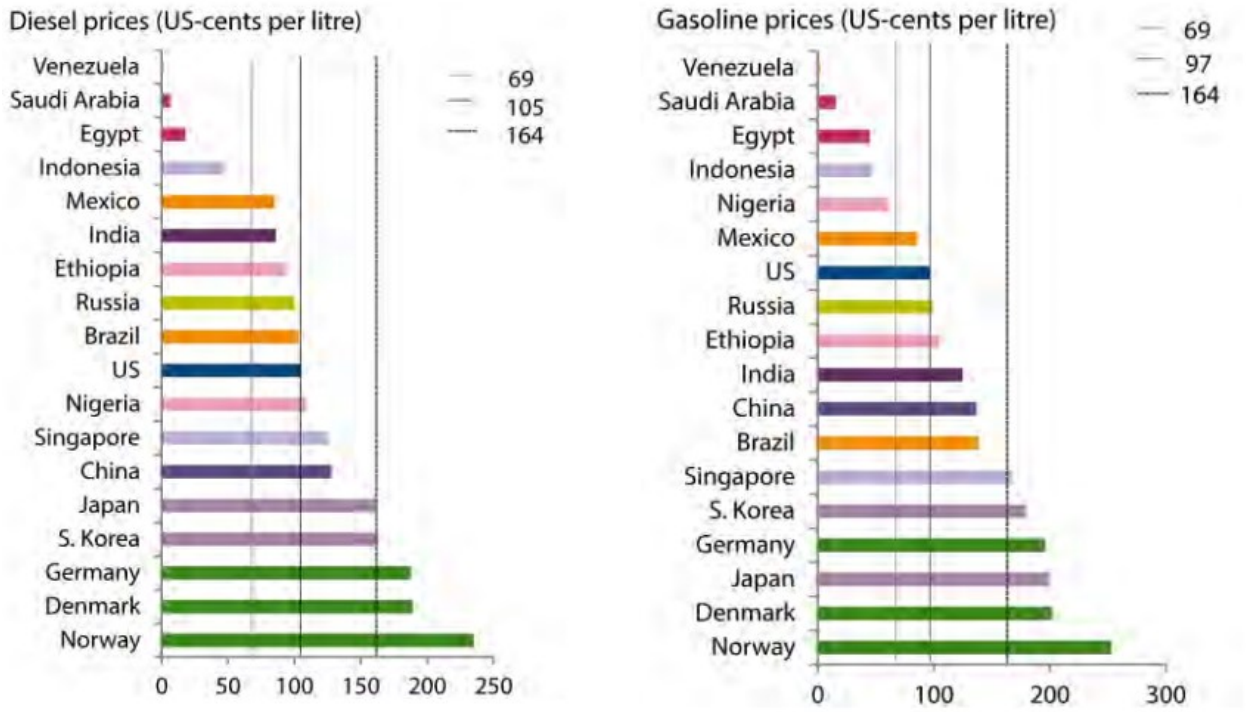

Figure 4.22 diesel and gasoline prices of some countries worldwide

Source: Wagner 2013

As it's seen in the above figures the price of fuel in Ethiopia is lower as compared to the countries which have a relatively better road transportation system. Increasing fuel price alone doesn't create a relief but will cause economic problems but when deciding to consider fuel pricing other incentives must be given from the government side which is the next section:

Worldwide experience with fuel taxation

Philippines revised fuel tax regulation:

In the past fuel prices were not significantly subsidized by the Pilipino government, due to the 'Downstream Oil Industry Deregulation Act of 1998', which liberalized and deregulated the downstream oil industry. However, in 2008 the government provided funding for fuel discounts for tricycle drivers which continued up until 2009 and was aimed at alleviating the impacts of the continuous rise in fuel prices on the livelihoods of drivers (CAI-Asia 2010). Since the beginning of 2018, there is a new provision for the taxation of fuels under the newly-enacted Tax Reform for Acceleration and Inclusion (TRAIN). Under this new tax scheme, a tax has been introduced for diesel and increased for gasoline. These taxes will be increased in the interim until 2020.

4.3.2.2. Adding Incentives to public transportation

Public transportation is one and the most important means of alleviating traffic congestion for it makes roads work better by reducing the number of vehicles on the road.

Transitioning to public transportation from private transportation is considered an effective policy instrument designed to reduce transport sector externalities, mainly congestion and emissions problems. adding incentives on public transportation could be the main fiscal instrument that facilitates a change from one mode of transportation to another.

As Timothy and David (2005) indicated, without public transportations, the annual increase in travel time due to traffic congestion would have been reached 1.1 billion hours globally. This show that, a great concern should go towards the expansion of high capacity public transportation system, like the introduction of light rail, heavy rail, rapid bus transit, and high occupancy vehicles (HOV) lanes, which coupled with better management of the existing road network and traffic management (Litman, 2008).

Offering incentives on public transportation is a good way to encourage peoples to try using public transportation over owning a private vehicle:

World wide experience with incentives on public transportation

Public transportation has already been subsidized in many countries around the world for several reasons.

For example, only 25% of the total capital and operating expenses in the United States and 50% in Europe are covered by fares for public transit (Brueckner, 1987)

Subsidized Public Transport in Israel:

Government policy to subsidize public transport fares, regulate destinations, and set service frequency, in 2009 direct subsidies for public transport operators exceeded $600 million. Most of this budget around $500 million was allocated to subsidize bus and train fares. Additionally, the government supports public transport companies in their annual procurements and renewal of their bus fleet. The government also subsidizes public transport fares for children and senior citizens. These subsidies include discounts on bus and train fares:

- Free travel for children under 5 years old accompanied by an adult.
- Discounted fares for school children.
- A 50% fare discount on urban and inter-city travel for senior citizens over 65.
- A semestrial city bus pass at a reduced price of up to 50% for university and college students in

selected cities including Tel Aviv, Jerusalem, Haifa, Safed, and Beer-Sheva.

- Discounted fares for entitled welfare beneficiaries of the National Insurance Institute of Israel.

4.3.3. Reducing environmental pollution

Worldwide, policies and strategies needed for reducing road transport emissions may include, the introduction of vehicle emissions standards and Inspection/Maintenance (I/M) program, the introduction of vehicle fuel standards, the introduction of green fuel tax, promoting the use of high-efficiency vehicles, promoting the use of alternative fuels and finally promoting good vehicle driving.

But Considering the development level of Ethiopia as a whole, the introduction and promotion of some of these strategies to control road transport emissions will require some time to be fully implemented because it needs a huge investment. However, good driving behaviors can trigger an impact on environmental pollution created by road transportation.

Current regulation

As it has been assessed currently there is no regulation and trend to manage the environmental impact of the road transportation systems. But Addis Ababa is becoming polluted environmentally and a special assessment and action is needed to reduce the problem, developed countries some policies and strategies to cope with the environmental problems and its expressed as follows:

Suggested Regulation approach

4.3.3.1. Managing second-hand vehicles through Excise tax

Ethiopia does not have sufficient vehicle manufacturing capability hence rely on the import of the entire vehicle fleet. A large percentage of these vehicles are imported as used or second-hand.

Vehicles that meet minimum emission standards in exporting markets, when combined with clean fuels and regular maintenance, have the potential to lower the impact of road transport in terms of CO_2 and non-CO_2 emissions in all markets. Regulation, therefore, is a key to controlling the quality of used vehicle imports in line with the importing country's aspirations.

Current regulation

Currently, Ethiopia lacks the standards to address used vehicle imports. In real-world situations, however, used vehicle importers in Addis Ababa operate in an environment where price is the main factor of consideration. As Ethiopia lacks the requisite regulations to control used vehicle imports, the

bulk of vehicles imported into the country are not in the best of condition. Many vehicles imported into the country are compromised in terms of safety/roadworthiness, fuel economy, and emissions.

World wide experience with excise tax

Mauritius:

Mauritius Excise Act provides for a taxation system for vehicles to promote the use of more energy-efficient vehicles, based on their engine capacity. Since 2011, the excise tax has been used. As of July 2016, excise duty on electric cars up to 180 KW has been waived. There is a further reduction by 30% points of the duty charged on hybrid cars depending on their engine capacity. (UNEP. Green Economy Fiscal Regulation Analysis, 2016)

Because of the consolidated interventions by the Mauritian government, the average age of imported vehicles is improving with 51% of the vehicle fleet being imported as new in 2016. In October 2018, the fleet of fuel-efficient vehicles comprised of 9,383 hybrid vehicles and 76 electric vehicles. The combination of policies adopted, including favorable rates in registration duty and road tax on hybrid and electric vehicles has acted as a catalyst in boosting the demand and sales of fuel-efficient vehicles, in particular, hybrid vehicles. This is an indication that the existing regulation intervention is incentivizing the adoption of cleaner vehicles.

Costa Rica:

The vehicle market in Costa Rica is valued at an annual average of USD 314 Million (UN Comtrade Database). Most vehicle imports originate from the United States, Thailand, Japan, and China. From 2005 the vehicle imports started to shift towards new instead of used vehicles due to fiscal adjustments. In 2015, new light-duty vehicle imports reached more than 70%, according to data facilitated by the Customs Agency. Though the importation of used vehicles has declined, it isn't negligible.

On average, at the time of registration, most used vehicle imports have an average age of more than 11 years from the year of manufacture. On the other hand, the new vehicles imported are not necessarily equipped with the best technologies available due to a lack of updated regulations.

Costa Rica imposes several taxes when a vehicle is imported into the country including import duty, consumption tax, sales tax, luxury tax, etc. There are also other vehicle management measures the government is using to attract cleaner vehicles.

Costa Rica uses a selective import duty taxation scheme that varies with the age of vehicle imported as shown in Table below Vehicle Age from date of manufacture:

Table 4.12 Costa Rica's Selective Vehicle Import duty tiers, 2015

Vehicle age from date of manufacture	Import duty
Less than 3 years	52.29%
4-5 years	63.91%
6 years and older	79.03%

Source: PCFC, used vehicles working group report, February 2019

4.3.4. Better Safety

Current regulation

In Ethiopia, regarding safety especially for vulnerable pedestrians, some policies aimed at achieving better safety on the road transportation sector.

Figure 4.23 Picture of roadside activities blocking pedestrian pathway, 2020

It is regulated to give priority for pedestrians, but it is not seen to be implemented fully because of three reasons which are:-

- Un availability of sufficient walkways and safe crossing bridges;
- Because the unavailability of sufficient crossing bridges long queue of pedestrians enter the roadway to cross which create a vehicular congestion; and
- Poor enforcement from the sector enforcement officials

Suggested Regulation approach

4.3.4.1. Vision zero as an approach

Vision Zero was first introduced by the Swedish Parliament in 1997 under an ethical imperative that "No one will be killed or seriously injured within the road transport system." While it is accepted that humans can make mistakes, the core concept is a biomechanical tolerance of a human body. Crash severity needs to be addressed through the design of a more forgiving transport system in a way that minimizes the forces on humans, thereby preventing or reducing human injury. The main change is shifted away from a traditional traffic safety system toward the adoption of an approach where responsibilities are shared between system designers and road users. The system designer has the ultimate responsibility for the transport design and operation, whereas the road user needs to follow traffic laws and rules. If the road user fails to obey these rules, the system designer is required to take a further step to improve infrastructure design to be more forgiving, thereby reducing the severity of traffic injury and especially the probability of fatal injury.

World wide experience with vision zero

Sweden:

One of the greatest examples of how road safety can be improved is with the bold approach and high goals of the Swedish "Vision Zero" initiative. It has become a world example of how to reduce road accidents with specific measures that can produce significant results.

In summary, this initiative aims at having zero fatalities due to road accidents; it is a very ambitious goal but has produced highly positive impacts. This initiative had such an impact that in 1997 the Swedish parliament suggested it should be the basis for all traffic-safety related work in Sweden.

Figure 4.24 City of Goteborg, Sweden

Source: Traffic Safety by Sweden Vision Zero Initiative: Solutions (2011)

The city of Goteborg, Sweden found that these measures were difficult to implement at the beginning, both for technical reasons and for reasons of public acceptance. But results showed they were well worth the trouble and the impacts of the strategies that were implemented were very positive.

The Vision Zero approach has four main components, namely infrastructure (planning and building roads and related infrastructure to improve road safety), vehicle technology (improving driver, passenger and pedestrian safety), services and education (ranging from driver education to planning services), and control and surveillance (systems for monitoring traffic and weather), Traffic Safety by Sweden (2011) The approach includes the following guidelines:

- Focus on fatalities and serious injuries
- Integrate the failings of human beings in design
- Share responsibility between system and design
- Stimulate industry to improve safety design

- Saving lives is cheap.

The Swedish Vision Zero had an initial general target to halve the number of fatalities and decrease serious injuries by one quarter between 2007 and 2020. This strategy resulted in a successful reduction in fatalities. In 1997 when Sweden launched Vision Zero, the fatality rate was 6.1 killed/100,000 inhabitants. In 2015, the fatality rate was 2.6 killed/100,000 inhabitants; the number of road deaths has decreased by 57%, which represents an average annual decrease of 3%. (The Swedish Transport Administration, Statistic for Road Traffic Injuries 2015.). This, however, primarily resulted from improved safety of the vehicle fleets and infrastructure design and operation with notably reduced traffic operating speeds (OECD/ITF, Road Safety Annual Report 2017; International Transport Forum: Paris, France, 2017). Besides, a renewed commitment to Vision Zero was released in 2016, and this updated regulation highlighted the need for infrastructure design, maintenance, and operation improvements specifically targeted at vulnerable road users. Speed limit investigations in built-up areas are targeted primarily at the safety of pedestrians and cyclists (Government Office of Sweden, Renewed Commitment to Vision Zero 2016: Intensified Efforts for Transport Safety in Sweden. Stockholm, Sweden 2016).

4.3.4.2. Lifelong Driving lesson as an approach

The requirement to hold a driving license to drive a motor vehicle on the public highway dates to the very first motor car built by Karl Benz in 1888. The world's first mandatory national driver's test was introduced in France in 1899; by 1903 the major European economies had introduced laws relating to driving licenses, and in 1910 forms of tests were also introduced in Germany and the USA. At that time the number of vehicles was minimal and mainly involved passenger cars, but the main motivation of regulators was the same as today: the concern for road safety. In 1907 and 1908 early motorists participated in road races from Paris to Beijing and from New York to Paris, but most vehicles had traveled relatively short distances. The First World War (WWI) began as a cavalry-reliant conflict and ended with using motorized transport for the movement of equipment, people, and supplies. During the war (1914–1918) large numbers of troops learned to drive different vehicles and, following the peace, they and the vehicles represented the nascent road transport industry.

It is assumed that the Increasing experience of driving reduces the accident rate, but the analysis in section 4.1.2.5, the accident analysis based on the driver's experience gives the results of an increasing

number of driving experience resulted in a high accident rate. In Ethiopia, driving license is given once and every 2 or 4 years depending on the type of license it's renewed with approval of medical test of physical fitness of the seeing and hearing ability.

Suggested regulation approach

Lifelong driving education

European Union (EU):

The EU prompts the directive imposes on drivers 35 hours of periodic training every five years. Lifelong driving education is an essential part of the strategy. After traffic safety lessons in school and the requirements of the driving license test, it should also be possible for drivers to keep their knowledge and driving skills. Calls are rising for a 'return session' for licensed drivers. After all, traffic rules have changed over time, and road traffic is busier than before.

4.3.5. Enforcement of traffic laws

The analysis of the impact of these measures will help to define the application of the approaches listed above. The main positive impacts are expected on safety and efficiency for the road users. Better enforcement will lead to a decrease in the number of traffic offenses. Among the positive impacts, the following were distinguished:

- Respecting the traffic rules has a positive impact on traffic fluency which will result in less time pressure for the professional drivers.
- Besides less time pressure for truck and bus drivers, an indirect positive impact for professional transport can be expected regarding the physical damage in accidents and the time lost due to congestion.
- An indirect effect of improved enforcement will be less congestion due to accidents. Vehicles use more energy at very low speeds; as a result, energy consumption goes up with congestion. Fewer accidents will lead to less energy consumption.

In Ethiopia, the promulgation of traffic rules and regulations had started more three-quarters of a century ago. However, the respect in that regard is below standard. For instance: rules of vehicle overtaking, drivers' behaviors at roundabouts, lane changing, roadside parking, pedestrians behaviors along roads

and on crossing, pack animals treatment by users, roadside reflections at night, intensity and location of vehicle horn blows, pedestrian walkways, non-motorized traffic operations, etc. are all in disarray. This does not mean that regulations are not there but enforcement is lacking. It is the drivers of vehicles who are mainly responsible for traffic mess ups but the enforcing entity. The required and respective enforcements should be implemented in accordance with the regulations without any comprise.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

5.1. Conclusions

This research analyzed the trend of demand and supply for the road transportation system in Addis Ababa with the analysis of the gaps between them. A detailed relationship between the input of the road transportation system and its capability of satisfying the transportation demand in the system is analyzed. As the population is still growing and will grow for the next decades over a limited space, the situation will get worse and worse which leads to deteriorating the road transportation system and so it is vital that a detailed investigation and of the current and future optimization of demand and supply must give priority. In this research, peoples' opinions on the road transportation sector were gathered and data from appropriate government institutions were collected and finally were analyzed and gaps were identified. Where the gaps are emerging the relative regulations in the area is assessd both in the city and worldwide, and recommend regulation approaches and enforcement ways to create a livable Addis Ababa.

Based on the findings of the analysis in this study, the following points are concluded.

- In Addis Ababa city it is found that the number of crash according to vehicle ownership is largely related with privately owned vehicles, of which it covers above 85% of the total crash record.

- As the vehicle age increases the occurance of traffic crash and fatality rate increasesin the city which vehicles aged less than a year covered an average of 2.6% of the total fatality number, and the vehicles aged more than 5 years old found related to more than 63% of the total fatality number.

- "Practice makes perfect" this is a great quote working in real life but doesn't align perfectly as it comes to the numerical data analysis of the relationship of driver's experience and road traffic accident in Addis Ababa city because the result showed the more the driver's experience increases the more accident they create, overconfidence let's say. They may become overconfident that they are fully efficient to maneuver the vehicle in their way. The analysis of the data fromAddis Ababa police commission concludes an average of 50% of the total traffic accident involved a driver with a driving experience of more than 5 years.

- pedestrians are more vulnerable in the city streets of Addis Ababa,during the last 10 years the peoples involved in the traffic accident covers 78.42% of pedestrians, 16.2% passangers and 5.3% drivers.

- the circumstances of the pedestrian accidents for the city of Addis Ababa largely relates when pedestrians are crossing the road, with or without zebra. The result of thelast 10 year analysis concludes 31.5% of the pedestrian accident occurs while pedestrians are crossing the road with zebra crossing and 31.7% while pedestrians are crossing the road without zebra crossing.

- Addis Ababa is a developing city which needs a provision of new infrastructures which needs a higher amount of money, at the same time a huge amount of money is being loosen every year due to road crashes. During the last 10 years Addis Ababa looses 1,542,856,713 Ethiopian birr due to road traffic crashes.
- The number of the vehicle in Addis Ababa is rapidly increasing in the last decade,which is creating a saturation number of vehicles in the streets of Addis Ababa. The private vehicles and commercial vehicles are increasing at a competing rate. According to fuel type petrol and diesel consuming vehicles cover relatively the same number and almost null registered as other alternative power supply for the vehicles.

5.2. Recommendation

As mentioned above, the gaps between transportation supply and demand in Ethiopia in general and in Addis Ababa City were identified and dealt with thoroughly. Accordingly, the following recommendations are forwarded for considerations by pertinent regulation makers.

The following recommendations are given for the regulation makers as a tool kit:

5.2.1. Demand management

- Create major economic development centers outside Addis Ababa to generate employment concurrently curbing internal migration concurrently enticing the residents of Addis Ababa to move out to those areas so that nationwide development will be enhanced by diminishing population explosion of Addis Ababa and other potential towns as well.
- Create awareness on non-motorized transportation.

- Limit private car dependency and encourage public transport.
- Adopt applicable pricing policies on restricting traffic and reducing traffic congestion.
- Adopt life long driving lesson scheme.

5.2.2. Supply improvement

- Build a comfortable and safe non-motorized transportation schemes so that citizens choose non-motorized modes over motorized modes.
- Build grade-separated busways.
- Encourage the public transportation sector by introducing incentives.
- Build pedestrian bridges.
- Build grade-separated cycleways and encourage using it.
- Encourage the use of new vehicles to avoid old vehicles both for safety and the environment.

5.2.3. Enforcement of laws

The measures listed above as demand management and supply improvement cannot give solutions unless laws are enforced strongly. Accordingly, the following recommendation is suggested

5.2.4. Education and training

Education comprises of driver training, traffic education and information campaigns. Public information campaigns provide information or advice on a particular subject related to all road users, or aim at a particular transport mode or age group. Road transportation awareness education and training emphasis on:

- Promotion of knowledge and understanding of traffic rules and situations
- Improvement of skills through training and experience
- Strengthening and/or changing the attitude towards risk awareness, personal safety, and the safety of other road users.

It is important to stress that road transportation awareness creation is no longer only a school-based activity but rather the involvement of several other organizations, such as health care, youth centers, and sports associations.

5.2.5. Suggested regulation's

The findings of this research suggested some regulation's regarding road transportation that is used by developed countries and bring a positive impact on the system in Ethiopia in general and in Addis Ababa in particular as follows:

- Congestion pricing;
- Adding incentives on public transportation;
- Clean fuel regulation;
- Fuel taxation;
- Excise tax;
- Vision zero and
- Lifelong Driving class.

CHAPTER SIX

FUTURE PROPOSED RESEARCH AREAS

6.1. A case study on the application of congestion pricing along selected road segments of Addis Ababa.

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APPENDIXES

Appendix –A: Sample Traffic Data Of Addis Ababa for 1 year

የ2002ዓ/ም ከሐምሌ 1/2001 ዓ/ም እስከ ሰኔ 30/2002 ዓ/ም ዓ/ም

1. በዕለቱ የደረሱ አደጋዎች

ተ/ቁ	ዕለት	ብዛት
1	ሰኞ	117
2	ማክሰኞ	898
3	ረቡዕ	863
4	ሐሙስ	952
5	ዐርብ	928
6	ቅዳሜ	957
7	እሁድ	670
	ድምር	6285

2. በሰዓት የደረሱ አደጋዎች

ተ/ቁ	ሰዓት	ብዛት	ተ/ቁ	ሰዓት	ብዛት	ተ/ቁ	ሰዓት	ብዛት
1	0100-02000	104	9	0900-1000	386	17	1700-1800	361
2	0200-0300	112	10	1000-1100	389	18	1800-1900	271
3	0300-0400	89	11	1100-1200	400	19	1900-2000	374
4	0400-0500	84	12	1200-1300	337	20	2000-2100	265
5	0500-0600	127	13	1300-1400	343	21	2100-2200	181
6	0600-0700	198	14	1400-1500	371	22	2200-2300	167
7	0700-0800	368	15	1500-1600	366	23	2300-2400	126
8	0800-0900	371	16	1600-1700	397	24	2400-0100	98
							ድምር	6285

3. አደጋ የፈፀሙ አሽከርካሪዎች እድሜ

ተ/ቁ	የአሽከርካሪው ዕድሜ	አደጋው ያስከተለው ጉዳት				ድምር
		ሞት	ከባድ የአካል	ቀላል የአካል	የንብረት	
1	ከ18 ዓመት በታች	1	3	8	38	50
2	ከ18-30 ዓመት	126	213	274	1677	2290
3	ከ31-50 ዓመት	116	220	219	1777	2332
4	ከ51 ዓመት በላይ	24	84	76	839	1023
5	ያልታወቀ	51	106	75	358	590
	ድምር	318	626	652	4689	6285

4. የአሽከርካሪዎች ፆታ

ተ/ቁ	ፆታ	አደጋው ያስከተለው ጉዳት				ድምር
		ሞት	ከባድ የአካ	ቀላል የአካ	የንብረት ጉዳት	
1	ወንድ	265	507	542	4158	5472
2	ሴት	2	13	35	173	223
3	ያልታወቀ	51	106	75	358	590
	ድምር	318	626	652	4689	6285

5.አደጋ የፈጸሙ አሽከርካሪዎች የት/ደረጃ

ተ/ቁ	የት/ደረጃ	አደጋው ያስከተለው ጉዳት				ድምር
		ሞት	ከባድ የአካል	ቀላል የአካል	የንብረት	
1	ያልተማረ	1	-	3	16	20
2	መሰረተ ትምህርት	4	1	4	18	27
3	ነኛ መ/ደ/ትቤት	29	54	50	495	628
4	መ 2ኛ ት/ቤት	47	89	165	618	919
5	ከፍ . 2ኛ ደ/ት/ቤት	136	259	238	1968	2601
6	ከከፍ.2ኛ/ት/ቤት	50	117	117	1216	1500
7	ያልታወቀ	51	106	75	358	590
	ድምር	318	626	652	4689	6285

6. የአሽከርካሪ ተሸከርካሪ ግንኙነት

ተ/ቁ	የአሽከርካሪ የተሸከርካሪ ግንኙነት	አደጋው ያስከተለው ጉዳት				ድምር
		ሞት	ከባድ የአካ	ቀላል የአካ	የንብረት ጉዳት	
1	የተሸከርካሪው	43	98	126	783	1050
2	ተቀጣሪ	176	320	368	2926	3790
3	ሌላ	48	102	83	622	855
4	ያልታወቀ	51	106	75	358	590
	ድምር	318	626	652	4689	6285

7. የአሽከርካሪው የማሽከርከር ልምድ

ተ/ቁ	የማሽከርከር ልምድ	አደጋው ያስከተለው ጉዳት				ድምር
		ሞት	ከባድ የአካል ጉዳት	ቀላል የአካል ጉዳት	የንብረት ጉዳት	
1	መጀመሪ ፈቃድ	24	31	27	77	159
2	ከ1 አመት በታች	9	14	30	128	181
3	ከ1-2 አመት	23	49	60	299	431
4	ከ2-5 አመት	64	124	158	947	1293
5	ከ5-10 አመት	75	170	171	1580	1996
6	ከ10 አመት በላይ	72	132	131	1300	1635
7	ልታወቀ	51	106	75	358	590
	ድምር	318	626	652	4689	6285

8. የተሸከርካሪው የአገልግሎት ዘመን

ተ/ቁ	የአገልግሎት ዘመን	አደጋው ያስከተለው ጉዳት				ድምር
		ሞት	ከባድ የአካል ጉዳት	ቀላል የአካል ጉዳት	የንብረት ጉዳት	
1	አስከ 1 ዓመት	12	36	18	239	305
2	ከ1-2 ዓመት	3	28	42	315	388
3	ከ2-5 አመት	52	86	139	774	1051
4	ከ5-10 አመት	116	188	224	1774	2302
5	ከ10 ዓመት በላይ	84	182	154	1229	1649
6	ያልታወቀ	51	106	75	358	590
	ድምር	318	626	652	4689	6285

7.1 . አደጋ የፈፀሙ አሽከርካሪዎች የየመንጃ ፈቃድ ደረጃ

ብዛት	የመንጃ ፈቃድ								
	1ኛ	2ኛ	3ኛ	4ኛ	5ኛ	ልዩ ተንቀሳቃሽ	ያሌለው	ያልታወቀ	ድምር
6285	28	1425	2219	1031	799	34	159	590	6285

በአዲሱ የመንጃፈቃድ ደረጃ የተከሰሱ አሽከርካሪዎች

ሞተር	አውቶ	አውቶ 1	አውቶ 2	ህዝብ 1	ህዝብ 2	ታክሲ 1	ሲ 2	ደረቅ 1	ደረቅ 2	ደረቅ 3	ጭነት 1	ጭነት 2	ጭነት 3	ልዩ1	ፈሳሽ 1	ፈሳሽ 2	ድምር
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

9. አደጋ የፈፀሙ ተሽከርካሪዎች ዓይነት

ተራ ቁጥር	የተሸከርካሪ ዓይነት	የተሸከርካሪው ዓይነት																		
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	ድምር
		ተራ ብስክሌት	ሞተር ብስክሌት	አውቶሞቢል	ስቴሽንዋገን	ፒክ አፕ እስከ10	የጭነት 11-40 ኩንታል	100 ኩንታል	ከተሳቢው	ቦቴ	ታክሲ	12 መቀመጫ	45 መቀመጫ	በላይ 46 መቀመጫ	ልዩ ተንቀሳቃሽ መሳርያ	ልዩ ተንቀሳቃሽ ከተሳቢው	ጋሪ	ባቡር	ሌላ	ያልታወቀ	
1	ሞት	2	7	50	24	27	29	37	14	2	41	18	33	8	2	-	-	-	-	24	318
2	ከባድ የአካል	15	11	153	72	74	46	32	3	1	102	49	38	4	6	-	-	-	-	20	626
3	ቀላል የአካል	4	15	175	86	54	36	44	8	1	104	54	29	15	-	-	1	-	-	24	650
4	የንብረት ጉዳት	5	11	1336	702	489	293	385	82	32	529	296	290	153	25	3	4	-	-	54	4689
	ድምር	26	44	1714	884	644	404	498	107	36	776	417	390	180	33	3	5	-	-	122	6283

10 . አደጋ የተፈጸመበት ተሽከርካሪዎች ንብረትነት

ተራ ቁጥር	የተሸከርካሪ ዓይነት	1	2	3	4	5	6	7	8	9	10	11	
		የመንግስት	የአዝዘ ድርጅት	የመ ሀይሎች	የፖሊስ መ/ቤት	የግል	ዲፕሎማቲክ	መንግስታት	የአፍሪካ አንድነት	ኢትዮጵያና ል.ድርጅት	ሌላ	ያልታወቀ	ድምር
1	ተራ ብስክሌት	-	-	-	-	24	-	-	-	-	-	2	26
2	ሞተር ብስክሌት	1	10	-	3	28	-	-	-	-	-	3	45
3	አውቶሞቢል	136	112	1	1	1304	14	12	2	-	-	132	1714
4	ስቴሽንዋገን	168	147	10	8	458	33	12	-	1	-	47	884
5	ፒክ አፕ እስከ10 ኩንታል	138	119	2	11	340	1	1	-	-	-	32	644
6	የጭነት 11-40 ኩንታል የሚጭን	18	45	-	-	285	-	-	-	-	-	56	404
7	የጭነት 41-100 ኩንታል	23	58	3	4	383	2	-	-	-	-	25	498
8	የጭነት ከነተሳቢው	5	13	1	-	86	-	-	-	-	-	2	107
9	ቦቴ	2	4	-	-	29	-	-	-	-	-	-	35
10	ታክሲ	-	-	-	-	690	-	-	-	-	-	86	776
11	የአዝብ እስከ 12 መቀመጫ	16	67	4	1	317	-	2	-	-	-	10	417
12	የአዝብ ከ 13-45 መቀመጫ	29	23	-	-	318	-	-	-	-	-	20	390
13	የአዝብ ከ 46 መቀመጫ	117	24	1	1	35	-	-	-	-	-	2	180
14	ልዩ ተንቀሳቃሽ መሳርያ	4	5	-	-	22	-	-	-	-	-	2	33
15	ልዩ ተንቀሳቃሽ ከነተሳቢው	-	2	-	-	1	-	-	-	-	-		3
16	ጋሪ	-	1	-	-	4	-	-	-	-	-		5
17	ባቡር	-	-	-	-	-	-	-	-	-	-		
18	ሌላ	-	-	-	-	-	-	-	-	-	2		2
19	ያልታወቀ	-	-	-	-	-	-	-	-	-	-	122	122
	ድምር	657	630	22	29	4324	50	27	2	1	2	541	6285

11. የተሸከርካሪው ጉድለት

ተራ ቁጥር	የተሸከርካሪው ጉድለት	አደጋው ያስከተለው ጉዳት				
		ሞት	ከባድ የአካል ጉዳት	ቀላል የአካል ጉዳት	የንብረት ጉዳት	ድምር
1	የፍሬን ጉድለት	-	-	2	37	39
2	የመሪ ጉድለት	-	-	-	8	8
3	የላሸቀ ጎማ	-	-	2	9	11
4	የመብራት ጉድለት	-	-	6	16	22
5	ሌላ መካኒካል	-	-	-	23	23
6	ጉድለት የሌለበት	267	520	567	4238	5592
7	ያልታወቀ	51	106	75	358	590
	ድምር	318	626	652	4689	6285

12.አደጋው የተፈፀመበት መንገድ

ተራ ቁጥር	የተፈፀመበት መንገድ	አደጋው ያስከተለው ጉዳት				
		ሞት	ከባድ የአካል	ቀላል የአካል	የንብረት ጉዳት	ድምር
1	ከ/ሱቫር የሚያገናኝ	-	-	2	10	12
2	አውራጃ የሚገናኝ	-	-	-	-	
3	የገጠር መንገድ	-	-	-	-	
4	የከተማ መንገድ	318	626	650	4679	6273
	ድምር	318	626	652	4689	6285

13. አደጋው የተፈጸመበት አካባቢ

ተ/ቁ	አካባቢው	አደጋው ያስከተለው ጉዳት				
		ሞት	ከባድ የአካል ጉዳት	ቀላል የአካል ጉዳት	የንብረት ጉዳት	ድምር
1	በገጠር መንገድ	-	-	-	-	
2	ከገጠር መንገድ	-	-	-	-	
3	ትቢት አካባቢ	7	41	35	190	273
4	ፋብሪካ አካባቢ	2	2	9	25	38
5	ቢተ ፀሎት አካባቢ	14	29	28	254	325
6	ገበያ ስፍራ አካባቢ	28	83	94	816	1021
7	መዝናኛ ስፍራ	18	58	58	507	641
8	ሆስፒታል አካባቢ	6	16	18	114	154
9	መስሪያ ቤት አካባቢ	188	310	323	2379	3200
10	መኖሪያ ሰፈር	51	84	87	397	619
11	ሌላ	4	3		7	14
	ድምር	318	626	652	4689	6285

14.የመንገዱ አካፋይ

ተ/ቁ	መንገድ	አደጋው ያስከተለው ጉዳት				
		ሞት	ከባድ የአካል	ቀላል የአካል	የንብረት ጉዳት	ድምር
1	ባለአንድ አቅጣጫ	11	32	55	335	433
2	ባለሁለት አቅጣጫ	98	193	207	1166	1664
3	በደሴት የተከፈለ	192	366	322	2800	3680
4	በማቋረጫ ቀለም	16	30	43	275	364
5	በተቆራረጠ ቀለም	1	5	25	113	144
	ድምር	318	626	652	4689	6285

15. የመንገዱ አቀማመጥ

ተ/ቁ	መንገዱ	እደጋው ያስከተለው ጉዳት				ድምር
		ሞት	ከባድ የአካል ጉዳት	ቀላል የአካል ጉዳት	የንብረት ጉዳት	
1	ቀጥ ለጥ ያለ	308	586	552	4213	5659
2	ቀጥተኛና በመጠኑ	4	11	26	132	173
3	ቀጥተኛና በጣም	-	4	4	28	36
4	ቀጥተኛና ወጣ ገባ	-	3	4	18	25
5	መጠነኛ ጠመዝማዛ	-	2	9	95	106
6	በጣም ጠመዝማዛ	-	-	1	6	7
7	ዳታ	-	2	16	54	72
8	ቁልቁለት	5	18	39	142	204
9	ሌላ	1	-	1	1	3
	ድምር	318	626	652	4689	6285

16.የመንገዱ መጋጠሚ ወይም መገናኛ

ተ/ቁ	የመንገዱ አይነት	እደጋው ያስከተለው ጉዳት				ድምር
		ሞት	ከባድ የአካል	ቀላል የአካል	የንብረት ጉዳት	
1	መገጣጠሚ	264	434	409	2588	3695
2	Y ቅርፅ	1	6	21	58	86
3	T ቅርፅ	32	82	97	772	983
4	O ቅርፅ	7	42	48	319	416
5	+ ቅርፅ	14	60	73	945	1092
6	X ቅርፅ	-	2	4	6	12
7	የሐዲዮማቋረጫ	-	-	-	-	-
8	ሌላ	-	-	-	1	1
	ድምር	318	626	652	4689	6285

17. የመንገዱ ንጣፍ ዓይነት

ተ/ቁ	የንጣፍ ዓይነት	እደጋው ያስከተለው ጉዳት				ድምር
		ሞት	ከባድ የአካል ጉዳት	ቀላል የአካል ጉዳት	የንብረት ጉዳት	
1	ጥሩ አስፋልት	314	619	628	4547	6108
2	የተቦረቦረ አስፓልት	2	4	3	48	57
3	ጠጠር	2	2	16	71	91
4	ጥርጊያ	-	1	5	23	29
	ድምር	318	626	652	4689	6285

18.የመንገዱ ሁኔታ

ተ/ቁ	መንገድ	እደጋው ያስከተለው ጉዳት				ድምር
		ሞት	ከባድ የአካል	ቀላል የአካል	የንብረት ጉዳት	
1	ጥርጊያ	296	550	584	4260	5690
2	እርጥበ	22	75	68	429	594
3	ጭቃ	-	1	-	-	1
4	ሌላ	-	-	-	-	
	ድምር	318	626	652	4689	6285

19. የብርሃን ሁኔታ

ተ/ቁ	የብርሃን ሁኔታ	እደጋው ያስከተለው ጉዳት				ድምር
		ሞት	ከባድ የአካል ጉዳት	ቀላል የአካል ጉዳት	የንብረት ጉዳት	
1	በቀን ብርሀን	199	448	388	3455	4490
2	ፀሐይ በመጥለቅ ላ	3	10	25	102	140
3	ፀሐይ በመውጣት	4	7	43	115	169
4	በጨለማ	109	157	177	934	1377
5	በጨለማ	3	4	5	40	52
6	በለማ የመን/መብራ	-	-	14	43	57
7	ሌላ	-	-	-	-	-
	ድምር	318	626	652	4689	6285

20የአየሩ ሁኔታ

ተ/ቁ	አየሩ	እደጋው ያስከተለው ጉዳት				ድምር
		ሞት	ከባድ የአካ ል	ቀላል የአካ ል	የንብረት ጉዳት	
1	ጥሩ አየር	289	550	538	4128	5505
2	ጭጋግ /ጉም/	-	-	2	8	10
3	ዳመና	-	4	7	22	33
4	ካፍያ	5	10	16	109	140
5	ከባድ ዝናብ	18	29	25	93	165
6	ከባድ ንፋስ	-	-	-	-	-
7	አቧራ	-	-	-	-	-
8	ሞቃት	-	-	-	-	-
9	ብርድ	6	33	64	329	432
10	ሌላ	-	-	-	-	-
	ድምር	318	626	652	4689	6285

21. አደጋ ፈፃሚ ተሽከርካሪ እንቅስቃሴ

ተ/ቁ	የተሽከርካሪ እንቅስቃሴ	አደጋው ያስከተለው ጉዳት				ድምር
		ሞት	ከባድ የአካል	ቀላል የአካል	የንብረት	
1	መጋጠሚያ መንገድ	-	1	9	121	131
2	ወደሚገነጠልበት	1	1	11	117	130
3	ወደቀኝ ሲጣጠፍ	5	20	22	261	308
4	ወደግራ ሲታጠፍ	9	17	33	431	490
5	« ሀ» ቅርፅ ሲታጠፍ	1	2	3	35	41
6	ሲቀድም	1	3	3	152	159
7	ቀጥጣ ሲጓዝ	282	547	534	2973	4336
8	ከሰፈር (ገሚቢ)	2	-	1	19	22
9	ወደኋላ ሲሄድ	14	27	27	400	468
10	በስቀለኛ መንገድ	-	8	8	159	175
11	ሲያቆም	-	-	1	17	18
12	ሌላ	2	-	-	4	6
13	ያልታወቀ	1	-	-	-	1
	ድምር	318	626	652	4689	6285

22. የተፈፀመው የአደጋ አይነት

ተ/ቁ	የአደጋው አይነት	አደጋው ያስከተለው ጉዳት				ድምር
		ሞት	ከባድ የአካ	ቀላል የአካ	የንብረት ጉዳት	
1	ፊት ለፊት ግጭት	1	3	3	177	184
2	ፊትእና ኋላ ግጭት	5	23	35	1683	1746
3	ፊት እና ጎን ግጭት	9	16	25	1160	1210
4	ጎንለጎን ግጭት ፣	-	5	14	857	876
5	መገልበጥ	14	12	13	63	102
6	አግረኛ መግጨት	271	535	528	-	1334
7	እንስሳ መግጨት	-	-	-	-	-
8	ከተሽከርካሪ	8	18	6	-	32
9	የቆመ ተሽከርካሪ	1	-	3	112	116
10	ግዑዝ አካል	6	14	22	633	675
11	ከባቡር ጋር	-	-	-	-	-
12	ሌላ	2	-	3	4	9
13	ያልታወቀ	1	-	-	-	1
	ድምር	318	626	652	4689	6285

23. ጉዳት የደረሰባቸው አግረኞች መግለጫ

23.1. የእግረኛው ስራ

ተ/ቁ	የአካል ብቃት እና ጤንነት	አደጋው ያስከተለው			ድምር
		ሞት	ከባድ	ቀላል	
1	ተሪ	30	106	99	235
2	ሠራተኛ	204	415	379	998
3	ገበሬ	5	4	3	12
4	ስራ አጥ	16	46	110	172
5	ቦዘኔ	-	-	-	-
6	ያልታወቀ	31	18	11	60
	ድምር	286	589	602	1477

23.2. የእግረኛው የአካል ብቃትና ጤንነት

ተ/ቁ	የአካል ብቃት እና ጤንነት	አደጋው ያስከተለው			ድምር
		ሞት	ከባድ	ቀላል	
1	ዲዳ (ደንቆሮ)	-	-	-	-
2	አይነ ስውር	-	2	-	2
3	አካለ ጎዶሎ	1	-	1	2
4	ምንም	254	569	590	1413
5	የሰከረ	-	-	-	
6	ያልታወቀ	31	18	11	60
	ድምር	286	589	602	1477

23.3 የእግረኛው እንቅስቃሴ

ተ/ቁ	የእግረና እንውስቃሴ	አደጋው ያስከተለው			ድምር
		ሞት	ከባድ የአካል	ቀላል የአካ	
1	የትራፊክ መብራ ባለበት መስቀለና መንገድ ላይ ሲያቋርጥ	-	1	-	1
2	የትራፊክ መብራ በሌበት መስቀለና መንገድ ላይ ሲያቋርጥ	-	-	-	-
3	በመስቀለና መንገድ ላይ በአግድም ሲያቋርፅ	-	4	20	24
4	በእግረና ማቋረአጫ መስመር ላይ ሲያቋርጥ	-	-	23	23
5	የእግረኛ ማቋረጫ በሌለበት መንገድ ላይ ሲጓዝ	226	439	337	1002
6	ተሽከርካሪ ጸከጽሎ ሲያቋርጥ	-	6	3	9
7	የእግረኛ ሜጋ መንገድ እያለ በተሽከርካሪ መንገድ ላይ ሲጓዝ	-	6	10	16
8	በእግረኛ መንገድ ላይ ሲጓዝ	3	21	28	52
9	የእግረና መንገድ በሌለበት ግራውን ይዞ ሲጓዝ	13	51	91	155
10	የእግረና መንገድ በሌለበት ቀኙን ይዞ ሲጓዝ	22	40	59	121
11	የተሽከርካሪ መንገድ መሀል ይዞ ሲጓዝ	-	4	3	7
12	ተሽከርካሪ ሲጓዝ ወይም ሲሰራ	1	-	-	1
13	በተሽከርካሪ መንገድ ውስጥ ሲጫወት	-	-	2	2
14	በተሽከርካሪ መንገድ ውስጥ ቆሞ	1	4	5	10
15	በተሽከርካሪ መንገድ ውስጥ ተቀምጦ ወይም ተኝቶ	11	1	3	15
16	ተሽከርካሪ ላይ ሲወጣ ወይም ሲወርድ	-	1	3	4
17	ከተሽከርካሪ ወይም ከእግረና መንገድ ውጪ	-	7	8	15
18	ሌላ	1	-	6	7
19	ያልታወቀ	8	4	1	13
	ድምር	286	589	602	1477

24 አሽከርካሪውን ለአደጋ ያበቁት ምክንያቶች /መንስኤ/

ተ/ቁ	መንገድ	አደጋው ያስከተለው ጉዳት				ድምር
		ሞት	ከባድ	ቀላል	የንብ	
1	ሰክሮ መንዳት	-	-	1	1	2
2	በዕፅ ደንዝዞ መንዳት	-	-	-	2	2
3	ቀኙን ለቆ በመንዳት	29	42	52	542	665
4	ለተሸከርካሪ ቅድሚያ ባለመስጠት	12	26	27	1120	1185
5	ለእግረኛ ቅድሚ ባለመስጠት	231	479	459	-	1169
6	ረቀት ጠብቆ ባለመንዳት	8	16	36	1432	1492
7	ኮረብታ ጫፍ ላይ በመቅደም	-	-	-	-	
8	ጠምዛዛ /ከርቭ/ መንገድ ላይ በመቅደም	-	1	2	13	16
9	ከቀደመ በኋላ ድንገት ታጥፎ በመግባት	-	-	2	30	32
10	ከተወሰነ ፍጥነት በላይ በመንዳት	1	2	5	57	65
11	አለአግባብ መቅደም	-	8	10	277	295
12	አለአግባብ በመቅደም	13	22	30	579	644
13	የትራፊክ ፖሊስ ትዕዛዝ በመጣስ	-	-	-	29	29
14	የትራፊክ መብራት በመታስ	-	-	1	40	41
15	የቁም ምልክት በመጣስ	-	-	-	25	25
16	ቅድሚ ስጥ የሚለውን ምልክት በመጣስ	-	3	-	32	35
17	ከቆመበት አለአግባብ በመነሳት	13	13	10	475	511
18	አለአግባብ በማቆም	-	-	1	4	5
19	በድካም ወይም በመተኛት	-	-	-	-	-
20	በሀሳብ በመዋጥ	-	-	-	1	1
21	አለአግባብ በማብራት	-	-	-	-	
22	አለአግባብ በመቀጫን	6	7	2	5	20
23	የፍሬን ጉድለት	2	7	4	3	16
24	የጎማ መውለቅ	-	-	1	5	6
25	የጎማ መፈንዳት	-	-	-	1	1
26	የመሪ ጉድለት	-	-	1	6	7
27	የመንገድ ጉድለት	-	-	-	2	2
28	የእግረኛ ጉድለት	-	-	3	-	3
29	ሌላ	-	-	5	7	12
30	ያልታወቀ	3	-	-	1	4
	ድምር	318	626	652	####	6285

25. አደጋ የደረሰባቸው ሰዎች

ተ/ቁ	ተጎጂዎች	ዕድሜ	ሞት		ከባድ የአካል ጉዳት		ቀላል የአካል ጉዳት		ድምር
			ወንድ	ሴት	ወንድ	ሴት	ወንድ	ሴት	
1	አሽከርካሪ	ከ18 ዓመት በታች	1	-	1	-	-	-	2
		ከ18-30 ዓመት	5	-	11	-	19	1	36
		ከ30-50 ዓመት	5	-	13	3	19	-	40
		ከ51 በላይ	2	-	4	-	1	-	7
ድምር			13		29	3	39	1	85
2	እግረኛ	ከ7 ዓመት በታች	3	4	16	3	1	2	29
		ከ7-13 ዓመት	15	5	30	8	24	14	96
		ከ14-17 ዓመት	3	-	31	11	55	12	112
		ከ18-30 ዓመት	68	24	181	70	214	78	635
		ከ31-50 ዓመት	78	16	119	24	101	41	379
		ከ51 በላይ	53	17	68	28	46	14	226
ድምር			220	66	445	144	441	161	1477
3	ተሳፋሪ	ከ7 ዓመት በታች	-	-	-	-	-	-	
		ከ7-13 ዓመት	2	-	7	1	3	4	17
		ከ14-17 ዓመት	1	1	2	-	1	2	7
		ከ18-30 ዓመት	16	2	40	11	51	23	143
		ከ31-50 ዓመት	15	3	12	9	26	13	78
		ከ51 በላይ	1	-	3	1	11	2	18
ድምር			35	6	64	22	92	44	263
		ጠ/ድምር	268	72	538	169	572	206	1825

26. አደጋ የደረሰባቸው እንስሶች

ብዛት	የሞቱ	የቆሰሉ	ድምር
-	-	-	-

27. የተጎጂ ተሽከርካሪዎች ብዛት

ብዛት	በከባድ የተጎዳ	በቀላል የተጎዳ
7328	442	6886

28. ባለፈው ……በምርመራና በቀጠሮ ቆይተው ውሳኔ ያገኙ

የክስ ባዛት	የተዘጋ	በነፃ የተለቀቀ	በገንዘብ		እስራት	
			ብር	ሣ		
-	-	-	-	-	-	-

29. በንብረት የደረሰ ጉዳት በገንዘብ ሲተመን

ብር	ሣ
29,345,713	0

30. እርምጃው

ተራ ቁጥር	አደጋው	የክስ ብዛት	ክሱ የተቋረጠ	በምርመራ	የተዘጋ	በቀጠሮ	በነፃ	ውሳኔ					
								የክስ ብዛት		በገንዘብ			በእስራት
										ብር	ሣ		
1	ሞት	318	-	-	-	-	-	-	-	-	-	-	-
2	ከባድ የአካል ጉዳት	626	-	-	-	-	-	-	-	-	-	-	-
3	ቀላል የአካል ጉዳት	652	-	-	-	-	-	-	-	-	-	-	-
4	የንብረት ጉዳት	4689	-	-	-	-	-	-	-	-	-	-	-
		6285	-	-	-	-	-	-	-	-	-	-	-

ሪፖርቱ የተዘጋጀው

በአዲስ አበባ ፖሊስ ኮሚሽን ወንጀልና ትራፊክ አደጋ ምርመራ ምክትል ኮሚሽነር ጽ/ቤት

ሪፖርትና ስታስቲክስ ማስተባበሪያ ክፍል

አ/አበባ

Appendix -B: Questionnaire to the public road transportation user

በኢትዮጵያ የመንገድ ትራንስፖርት ህግ እና ትግበራ እስካሁን ባለው ደረጃ በምን ደረጃ ላይ እንደሚገኝ፣ በአፈፃፀም ላይ እየተከሰተ ስላለው ችግርና፤ ትግበራቸው ስላስገኘው ውጤት ለማስተርስ ዲግሪ ማሞያ ጥናት ከተለያዩ የህብረተሰቡ ክፍሎች፤ የፅሁፍ ጥያቄዎችን በማዘጋጀት መረጃ ሰብስቦ የዳሰሳ ጥናት ለማካሄድ በመሆኑ በታማኝነትና በቅንነት ለምትሰጡኝ መልስ በቅድሚያ ያለኝን አክብሮትና ምስጋና አቀርባለው።

1. ጾታ ሴ ☐ ወ ☐
2. እድሜ

15-20	☐
21-25	☐
26-30	☐
31-35	☐
36-40	☐
41-50	☐
50+	☐

3. በ መንገድ ትራንስፖርት ላይ ያሎት ድርሻ ምንድነው?

የመንግስት የትራንስፖርት አገልግሎት ሰጪ	☐
የታክሲ ሹፌር	☐
የታክሲ ተጠቃሚ	☐
የህዝብ ትራንስፖርት ተጠቃሚ	☐
እግረኛ	☐
ትራፊክ ፖሊስ	☐
የግል መኪና አሽከርካሪ	☐

4. እርስዎ በአብዛኛው ለምን ምክንያት የመንገድ ትራንስፖርት ይጠቀማሉ?

ወደ ትምህርት ቤት ለመሄድ ☐
ወደ ስራ ለመሄድ ☐
ዘመድ ለመጠየቅ ☐
ለመዝናናት ስሄድ ☐
ገበያ ስሄድ ☐
ሌላ ☐

5. **ስለ ኢትዮጵያ የመንገድ ትራንስፖርት ምን ያስባሉ?**
   - .....
   - .....
   - .....
6. በአርስዎ አመለካከት በኢትዮጵያ የመንገድ ትራንስፖርት (በተለይም የ አ.አ. መንገድ ትራንስፖርት) አገልግሎት ደካማ ጎን የሚሉትን አምስት ነጥቦች ቢገልፁልን ?
   - .....
   - .....
   - .....
   - .....
   - .....
7. ከላይ በቁጥር 6 ጥያቄ ላይ ደካማ ጎን ብለው ለገለፁት መፍትሄ ሊሆኑ የሚችሉ ነጥቦች ምንድናቸው ብለው ያስባሉ?
   - .....
   - .....
   - .....
   - .....
8. በአርስዎ አመለካከት የኢትዮጵያ የመንገድ ትራንስፖርት የትግበራ መንገድ ልክ ነው ብለው ያስባሉ?
   - .....
   - .....
   - .....
9. ለጥያቄ ቁጥር 8 መልስዎ አዎ ከሆነ ቢጨመር የሚሉትን ነጥብ ቢያስቀምጡልኝ፤ መልስዎ አይደለም ከሆነ መፍትሄ የሚሉትን ነጥብ ቢገልጹልኝ ?
   - .....
   - .....

Appendix –C: Questionnaire to Anbessa city bus drivers

በኢትዮጵያ የመንገድ ትራንስፖርት ህግ እና ትግበራ አስካሁን ባለው ደረጃ በምን ደረጃ ላይ እንደሚገኝ፣ በአፈፃፀም ላይ እየተከሰተ ስላለው ችግርና፤ ትግበራቸው ስላስገኘው ውጤት ለማስተርስ ዲግሪ ማሞያ ጥናት ከተለያዩ የህብረተሰቡ ክፍሎች፤ የፅሁፍ ጥያቄዎችን በማዘጋጀት መረጃ ሰብስቦ የዳሰሳ ጥናት ለማካሄድ በመሆኑ፤አንበሳ የከተማ አውቶቡስ ከፍተኛ ሚና ፅንደሚጫወቱ በማመን ስለመንገድ ትራንስፖርት የተዘጋጀ መጠይቅ ሲሆን በታማኝነትና በቅንነት ለምትሰጡኝ መልስ በቅድሚያ ያለኝን አክብሮትና ምስጋና አቀርባለው፡፡

1. ስለ ኢትዮጵያ የመንገድ ትራንስፖርት ምን ያስባሉ?
   - .....
   - .....
   - .....
2. በእርስዎ አመለካከት በኢትዮጵያ የመንገድ ትራንስፖርት አገልግሎት ደካማ ጎን_የሚሉትን አምስት ነጥቦች ቢገልፁልን ?
   - .....
   - .....
   - .....
   - .....
   - .....
3. ከላይ በቁጥር 2 ጥያቄ ላይ ደካማ ጎን ብለው ለገለፁት መፍትሄ ሊሆኑ የሚችሉ ነጥቦች ምንድናችው ብለው ያስባሉ?
   - .....
   - .....
   - .....
   - .....
4. ማንኛውም ስራ የራሱ የሆኑ ተግዳሮቶች አሉት ፤የኢትዮጲያ ትራፊክ ፖሊሶች ስራቸውን በአግባቡ እንዳይሰሩ ጫና የሚፈጥርባቸው ምንድነው ብለው ያስባሉ ?
   - .....
   - .....
   - .....
   - .....
   - .....
5. ለጥያቄ ቁጥር 4 ተግዳሮት ብለው ለሰጡት ሃሳብ መፍትሄ የሚሉትን ነጥብ ቢገልጹልኝ ?
   - .....
   - .....
   - .....
   - .....
   - .....

Appendix –D: questionnaire on driver's opinion on congestion charging

በኢትዮጵያ የመንገድ ትራንስፖርት ህግ እና ትግበራ አስካሁን ባለው ደረጃ በምን ደረጃ ላይ እንደሚገኝ፣ በአፈፃፀም ላይ እየተከሰተ ስላለው ችግር፤ ትግበራቸው ስላስገኘው ውጤትና ዘላቂ መፍትሄ ስለሚሰጡ ተግባሮችና ህግጋት ለማስተርስ ዲግሪ ማሞያ ጥናት ከተሰያዩ የህብረተሰቡ ከፍሎች፤ የፅሁፍ ጥያቄዎችን በማዘጋጀት መረጃ ሰብስቦ የዳሰሳ ጥናት ለማካሄድ በመሆኑ፤እርሶም በአዲስ አበባ የመንገድ ትራንስፖርት ዘርፍ ውስጥ ባለድርሻ አካል እንደሆኑ በማመን ይህንን ስለመንገድ ትራንስፖርት ያዘጋጀሁትን የጽሁፍ መጠይቅ በታማኝነትና በቅንነት እንድትሞሉልኝ አጠይቃለው፡፡ለምትሰጡኝ መልስ በቅድሚያ ያለኝን አክብሮትና ምስጋና አቀርባለው፡፡

1. እርስዎ የምን አይነት መኪና አሽከርካሪ ነዎት?_____
2. አዲስ አበባ ከአንድ ቦታ ወደ ሌላ ቦታ ለመንቀሳቀስ ምቹ ነች ብለው ያስባሉ?
   - _____
3. ለጥያቄ ቁጥር 2 መልስዎ አይ ከሆነ በአዲስ አበባ ውስጥ ላለው የትራንስፖርት ምቹ አለመሆን ምክንያት ይሆናሉ ብለዉ የሚያስቀምጡዋቸውን ነጥቦች ቢገልጹልኝ፤
   - _____
   - _____
   - _____
4. አዲስ አበባ ውስጥ ያለው የትራንስፖርት ሁኔታ በስራዎ ላይ ወይም በህይወትዎ ላይ የፈጠረብዎት ተጽእኖ አለ?ካለ ቢገልጹልኝ፤
   - _____
   - _____
   - _____
5. ለቁጥር 4 ምላሽዎ አዎ ከሆነ አርስዎ እንደመፍትሄ የሚያስቀምጡት ነጥብ ካለ ቢገልጹልኝ ፤
   - _____
   - _____
   - _____
6. መንገድ መጨናነቅ በሚኖርበት ሰአት(መንገዱ በትራፊክ መብዛት በሚዘጋጋበት ሰአት) አርስዎ ምን የሚያጡት ነገር ይኖራል?
   - _____
   - _____
   - _____
7. ባደጉት ሃገራት በከተማ ውስጥ የተሽከርካሪ ጉዞዎች ላይ መጠነኛ ገንዘብ ከፍለው በምቹና ከ ትራፊክ መጨናነቅ የጸዳ መንገድ ላይ የሚሄዱበት አሰራር አለ፡፡ ይህ አገልግሎት አሰጣጥ እ.አ. ውስጥ ቢተገበር ፤ አርስዎ ከፍለው ከ ትራፊክ የጸዳውን መንገድ ይጠቀማሉ ወይስ ምንም የማይከፈልበትን ነገር ግን የትራፊክ መጨናነቅ ያለበትን መንገድ ይጠቀማሉ?ከነምክንያቱ ቢገልጹልኝ፤
   - _____
   - _____
   - _____

Appendix –E: Questionnaire to traffic police's

በኢትዮጵያ የመንገድ ትራንስፖርት ህግ እና ትግበራ እስካሁን ባለው ደረጃ በምን ደረጃ ላይ እንደሚገኝ፣ በአፈፃፀም ላይ እየተከሰተ ስላለው ችግርና፤ ትግበራቸው ስላስገኘው ውጤት ለማስተርስ ዲግሪ ማሞያ ጥናት ከተለያዩ የህብረተሰቡ ክፍሎች፤ የፅሁፍ ጥያቄዎችን በማዘጋጀት መረጃ ሰብስቦ የዳሰሳ ጥናት ለማካሄድ በመሆኑ፤ትራፊክ ፖሊሶች የመንገድ ትራንስፖርት ህጉን በማሳለጥ ከፍተኛ ሚና ዕንደሚጫወቱ በማመን ስለመንገድ ትራንስፖርት የተዘጋጀ መጠይቅ ሲሆን በታማኝነትና በቅንነት ለምትሰጡኝ መልስ በቅድሚያ ያለኝን አክብሮትና ምስጋና አቀርባለው።

1. ስለ ኢትዮጵያ የመንገድ ትራንስፖርት ምን ያስባሉ?
   - .....
   .....
   .....
2. በእርስዎ አመለካከት በኢትዮጵያ የመንገድ ትራንስፖርት አገልግሎት ደካማ ጎን_የሚሉትን አምስት ነጥቦች ቢገልፁልን ?
   - .....
   - .....
   - .....
   - .....
   - .....
3. ከላይ በቁጥር 2 ጥያቄ ላይ ደካማ ጎን ብለው ለገለፁት መፍትሄ ሊሆኑ የሚችሉ ነጥቦች ምንድናቸው ብለው ያስባሉ?
   - .....
   - .....
   - .....
   - .....
   - .....
4. ማንኛውም ስራ የራሱ የሆኑ ተግዳሮቶች አሉት ፤የኢትዮጲያ ትራፊክ ፖሊሶች ስራቸውን በአግባቡ እንዳይሰሩ ሚና የሚፈጥርባቸው ምንድነው ብለው ያስባሉ ?
   - .....
   - .....
   - .....
   - .....
   - .....
5. ለጥያቄ ቁጥር 4 ተግዳሮት ብለው ለሰጡት ሃሳብ መፍትሄ የሚሉትን ነጥብ ቢገልጹልኝ ?
   - .....
   - .....
   - .....
   - .....
   - .....