



KOTEBE UNIVERSITY OF EDUCATION

COLLAGE OF BUSINESS TECHNOLOGY AND VOCATIONAL EDUCATION

URBAN TRANSPORT PLANNING AND MANAGEMENT

MSC PROGRAM IN TRANSPORT PLANNING AND MANAGEMENT

SOCIO-ECONOMIC CONSEQUENCE OF ROAD TRAFFIC CONGESTION IN

ADDIS ABABA, ETHIOPIA

BY: AWOKE MELESSE

ADVISOR: BIRHANU ZELEKE (PHD)

**A Thesis Submitted To Collage of Business, Technology and Vocational Education,
Urban Transport Management Department for Partial Fulfillment of the
Requirements for Master's Science Degree in Urban Transport Management**

January, 2025

Addis Ababa, Ethiopia



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DECLARATION

As the author of this thesis, Awoke, I thus certify that it is my original work, "**socio-economic consequences of road traffic congestion in Addis Ababa, Ethiopia.**" With the assistance and cooperation of my research adviser, Birhanu Zeleke (PHD), I conducted this work on my own. I further certify that no other university has ever received this work for consideration for a degree or diploma program at this or any other university. Lastly, I certify that every source utilized for this study has been properly identified and acknowledged.

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This Thesis has submitted to for examination with my approval as University supervisor.

Name of Advisor: Birhanu Zeleke (PHD)

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Date _____

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APPROVAL SHEET OF THESIS
SCHOOL OF GRADUATE STUDIES

The Undersigned certify that they have read and hereby recommended to **Kotebe University of Education** to accept the Thesis submitted by **Awoke Melesse, and** entitled “**Socio-Economic consequence of road traffic congestion in Addis Ababa, Ethiopia**” in partial fulfillment of the requirements for the award of a Master’s Degree in Transport Planning and Management

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ACKNOWLEDGEMENTS

I want to start by offering thanks to the Almighty God, who has given me the strength and patience to go through everything. It gives me great pleasure to acknowledge and thank my adviser, Birhanu Zeleke (PhD), for all of his help and support with my thesis work.

Finally, but just as importantly, I want to sincerely thank my family for their unwavering patience, love, and encouragement in whatever I do. In addition, the wonderful friends I made while enrolling at this university.

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ABBREVIATION AND ACRONYMS

RTC	Road Traffic Congestion
FRTC	Factors of Road Traffic Congestion
CI	Congestion Index
SPSS	Statistical Package for Social Science
UMR	Urban Mobility Report
ATIS	Advanced Traveler Information Systems
VMT	vehicle miles traveled
V/C	Volume to capacity ratio
ITS	intelligent transportation systems
AVOCA	average vehicle occupancy
TTI	Travel Time Index
CSA	Central statistics Agency
LOS	Level of service
VTT	Value of Travel Time
HPMS	Highway Performance Monitoring System
ATMS	Advanced Traffic Management Systems
DVMT	Daily Vehicle-Miles of Travel:
ADT	Average Daily Traffic
ATRI	American Transportation Research Institute

ABSTRACT

socioeconomic consequences of road traffic congestion in Addis Ababa from Gotera to Maseletegna was the aim of the study. The study used a mixed-methods research methodology, which combines quantitative and qualitative techniques. This study employed a descriptive and explanatory research design. Semi-structured interviews and a structured questionnaire were used to gather data from primary sources. Version 25 of the statistical package for social science software is used to examine quantitative data using both descriptive and inferential data analysis approaches. Qualitative data is analyzed by using narrative and quantitative data accordingly. Descriptive analysis was presented using a tabular by showing percentiles of the respondents. To give inferences for the data collected, correlation and regression methods of inferential analysis were used. Based on the findings of the status of congestion on this road segment, respondents replied severe congestion. Concerning the occurrence of congestion on this road segment, responders acknowledged that there was heavy traffic. the respondents replied that the communities were frustrated due to road traffic congestion. According to the report, traffic congestion on these route segments has had negative social and economic effects on the neighborhood. According to the study, the appropriate authorities should reduce traffic on the roads and enhance the quality of life for the local population residing on these route segments.

Key words: *congestion, peak hours, road traffic Congestion, socioeconomic consequence*

CHAPTER ONE: INTRODUCTION

Transportation has a major role in the growth and development of the economy. But the transportation sector is facing challenges these days due to the increasing amount of road traffic congestion. The environment, social and economic costs, and urban living standards are all significantly impacted, claims Pudaruth (2018).

People's perceptions and expectations of how the system should operate vary depending on whether they are in rural or urban areas, during peak or off-peak hours, and because of the area's historical background, traffic congestion is also a widely acknowledged transport cost. (Bertini, L.R., 2005).

This imprecise nature makes it more difficult to manage. It has an impact on transportation planning decisions and is a major factor in evaluating the effectiveness of the transportation system. When a road fills up, every extra car causes others to experience more total delays than they can handle, which leads to economically unsustainable traffic loads. “Congestion tends to increase travel time, arrival unreliability, fuel consumption, pollution emissions, driver stress, and life satisfaction.” (Janet Choi, 2013).

This chapter presents an outline of the study examining the socioeconomic consequences of road traffic congestion in Addis Ababa, Ethiopia. It outlines the study problem to be conducted and highlights important points. So, this chapter involves the background of the study, the statement of the problem, the objectives, the research questions, the scope of the study, the limitations of the study, the significance of the study, and the organization of the study.

1.1. Background of the Study

Human societies have always relied heavily on the movement of people, goods, and information. This is particularly valid in cities, where transportation networks are necessary for a wide range of activities, including commuting, meeting energy needs, and transporting parts between the locations of manufacture and distribution. Put another way, the effectiveness of transportation networks to move more people and products

between various origins and destinations has an important influence on the productivity of urban areas (Jean-Paul Rodrigue 2024).

According to J-P Rodrigue (2013), “Most cities around the globe still struggle with severe traffic congestion, particularly in developing nations, where it causes severe delays, increased fuel waste, and financial losses.” Because road networks are ill-planned, unlawful usage of the roadways is a regular result in many developing nations. One common consequence of poorly designed road networks and illegal road use is the existence of small, vital locations, often hotspots for traffic. Improper traffic management around these hotspots may prolong traffic jams (V. Sharma, Jain, 2012).

According to Ghazal & Wan Noratikah, Wahidah Binti (2019), when vehicles are backed up on the road due to insufficient space, it is referred to as traffic congestion. Put more simply, traffic congestion happens when demand for transportation on the roads approaches or exceeds network capacity (Raheem et al., 2015). Several studies have shown that the economy and society are negatively impacted by traffic congestion. As a result, it's thought that the road cannot support the volume of traffic that occurs during The need for motorized transportation to preserve the physical and socioeconomic integration of cities grows as modernization and urbanization advance. Even though it hasn't increased significantly yet, the rise in car ownership combined with the state of the roads and the ineffective traffic system has led to a high level of congestion, especially during peak hours when it's more likely to occur. According to the Addis Ababa City Transport Authority study, the number of cars in the fleet is expected to reach 524,444 in 2016–17, with an average annual growth rate of 30%. Transport Office of Addis Ababa City (2017).

According to Elisonguo (2013), “social impact refers to the effect of an activity on the social fabric of the community and the well-being of individuals and families.” The term "social impact" in business and government policy describes how an organization's actions affect the local community. Social impacts can be linked to areas such as health and community. A social condition that arises from recurring patterns of social activity that have unfavorable effects and fall short of the normative ideal of the impacted society

is referred to as a social issue. There are several detrimental effects of traffic congestion, including negative effects on the environment and society as well as financial loss. There will not be any financial incentive to discourage vehicles from misusing the roads because they are free, at least not until they start to crumble from constant traffic. Every person who drives has both individual and public costs.

Traffic congestion is a major issue in the majority of cities worldwide, and it is a direct outcome of growing urbanization and industry. Road traffic congestion is a problem and a top priority for both public and private entities, as well as city dwellers in general. Then, longer car lines and less accessibility to residences and workplaces are associated with traffic congestion in the city, particularly in the morning and evening. Delisonguo, Abel (2013).

The majority of cities in both developed and developing nations face difficulties in providing transportation infrastructure due to the world's rapidly increasing rates of urbanization. By 2050, there will be 70% more people living in cities worldwide than there are now (World Bank, 2017), with Africa seeing the fastest pace of urban expansion at 3.5% annually (ADB, 2012). Currently, 50% of people live in cities. Green Car Reports estimates that there were 1.2 billion cars worldwide as of 2014; by 2035, that number is expected to rise to nearly 2 billion (Volcker, 2014), adding even more automobiles to the already clogged roadways.

Kenya's urban population increased from one million in 1969 to twelve million by 2009 (KNBS, 2012), growing at a rate of 7.9% annually (Hope, 2012). According to the 2009 Census (Kenya National Bureau of Statistics (KNBS), 2012), the population of Nairobi expanded from 350,000 in 1963 to 3.1 million in 2009; this accounts for the growing need for transportation. Furthermore, Kenya currently has over two million registered cars, with projections indicating a significant increase to five million by 2030 and eight million by 2050 (Kenduiwo, 2014). Traffic jams are a common sight in most urban areas, with Nairobi experiencing the worst traffic congestion. This is a result of the high rate of urbanization combined with the competition among different modes of transportation for the same road space (Kenduiwo, 2014).

The issue of urban transportation has been handled for all users of the roads by the Addis Ababa city approach. The amount of time spent traveling every day in the city has increased, and it is also plagued by high air pollution, frequent traffic jams, and a high rate of road traffic accidents. These difficulties result from insufficient traffic management (Mengistu Mena Kuleno, 2018).

Additionally, the currently high economic growth experienced in Addis Ababa city increases urbanization as well as industrialization, which requires more vehicle usage. It leads to increased demands for car ownership and increased business centers, which tends to create an imbalance between demand and existing infrastructure, which results in congestion problems. The expenses "imposed on the community in the form of noise, accident risk, fumes, etc." are classified as public costs; the time spent commuting and the quantities of gasoline used are classified as private costs. It was also confirmed that both of these costs will increase with the increase in traffic congestion. If a driver is caught in traffic, they will waste more gasoline and time. This research looked at the socioeconomic effects of traffic congestion on the roads and tried to identify the main causes of the issue in Addis Ababa City.

1.2. Statement of the Problem

The majority of cities across the world are experiencing severe traffic congestion as a result of growing urbanization and industrialization (Alama, E. T., & Ph, T. 2021). Congestion on the roads is a headache and a major concern for both public and private organizations, as well as city people in general (Mushtaq, R., & Hashmi, O. 2022). Especially both in the morning and at night, traffic congestion in the city is linked to longer car lines and less accessibility to places of employment and residence (Abel Delisonguo, 2013). Because of the variations in traffic flow for "in" and "out" of the city center during this period of congestion, the majority of socioeconomic activities are concentrated in the central business districts. The rapid urban population growth, inadequate infrastructure, inadequate traffic management, poorly designed road networks, inadequate public transportation, rising car ownership, settlement issues, rerouted traffic, and other factors were among the causes of traffic congestion. Small critical areas, or hotspots for congestion, are a frequent outcome of inadequately designed road networks

in many developing nations; lengthy traffic jams may arise from poor traffic management surrounding these hotspots (August 2011, Federal Democratic Republic of Ethiopia).

Even with Addis Ababa's vast road network expansion, there is still too much traffic at intersections and on bottleneck routes during rush hour, in addition to poor traffic management, unplanned population settlement, redirected traffic, and illegal street parking, which were the main causes of road traffic congestion, according to previous research findings (Gudissa & Sisay, 2021).

The primary reasons for road traffic congestion, according to Tebibu's (2018) study, were unsignalized intersections, jam density, and service quality. According to the conclusions of Abenezer and his members (2023), the primary source of traffic congestion from Mexico to the Torhayeloch Road segment was the imbalance between the number of cars and the road's capacity.

This study focused on examining the social and economic impacts of road traffic congestion, and the previous researchers were not conducting these road segments. As a result of this, the researcher was motivated to study the socio-economic consequence of road traffic congestion on Gotera complex to Maseletegna road segments.

1.3. Research objectives

1.3.1. General objectives

The general objective of this study was to analyze the socioeconomic consequences of road traffic congestion in Addis Ababa.

1.3.2. Specific objectives

Road traffic congestion affects not just economic performance and individual productivity but also has significant socioeconomic consequences. Three specific objectives are involved

- To assess the status of road traffic congestion.
- To identify the factors affecting road traffic congestion
- To examine the consequence of road traffic congestions

1.4. Research Questions

Depending on the above objectives, the following research questions guide the research:

- What is the status of road traffic congestion?
- What are factors affecting road traffic congestion?
- What are the consequences of road traffic congestion?

1.5. Significance of the Study

socioeconomic consequences of road traffic congestion in Addis Ababa, Ethiopia, was the goal of this study. In addition to its general impact on people's economic status in the city, the study's findings may contribute to decreasing the socio-economic consequences of road traffic congestion, which will have enormous benefits for a variety of stakeholders. This is because every individual living, working, or even visiting the city is impacted in a different way by the current state of road traffic congestion. It is anticipated to demonstrate the social and economic effects that traffic congestion has had on city residents. Hence, the findings of this study had a great contribution in reducing or solving the congestion problem. Also, the findings of this study had immense significance for further study in the area.

1.6. Scope of the study

Traffic congestion can have diverse' socio-economic consequences; however, this study examines the socio-economic consequence of road traffic congestion on city populations and estimates the overall socioeconomic cost of traffic congestion. It is thematically limited to the perspective of delays caused by road traffic congestion.

1.6.1. Thematic/knowledge scope

Traffic congestion can have diverse' socio-economic consequences; however, this study is thematically limited to the view of delay caused by traffic congestion on the roads to determine the total economic cost of traffic congestion as well as inquire into the social effects it has on the communities of people who live in the city.

1.6.2. Spatial/geographical scope

Ethiopia's state capital is Addis Ababa. This metropolitan city has a wide range of highways that face traffic congestion. It would be preferable to study the day-to-day traffic congestion on all highways at the city level; however, due to financial and scheduling limitations, this study is geographically limited from the Gotera complex road to the Masetegna road segment.

1.6.3. Methodological scope

Traffic flow is seriously affected by external events. These included work zones, inclement weather, including persistent rain, government official passings, traffic accidents like collisions and breakdowns, and inconveniently timed traffic lights. The combination of activities happening at a certain moment and physical capacity determines the amount of congestion on a route. (Elisonguo, A. D.,2013) This methodology with varying approaches results in data collected through research employing mixed methods. Designs that can include philosophical suppositions research will be an analysis of relationships by combining quantitative qualitative and theoretical foundations. According to (Creswell,2014), the basic assumption of this type of research is that the integration of qualitative and quantitative methodologies yields a more thorough grasp of the research topic than either approach alone. The mixed-methods approach to study extends rather than diminishes the significance and utility of these two investigational techniques, which include both the qualitative and quantitative methods.

1.6.4. Temporal Scope

According to the proposal to evaluate the degree of congestion on the roads in the city of Addis Ababa, the study was carried out on a section of the road that leads from Gotera Complex Road to Masetegna Road segment. Therefore, to find the reasons underlying traffic congestion in the five working days from Monday to Friday from the field measurement data collected from 4:00 to 6:00 am and 10:30 to 12:00 pm, based on video footage and photo images at 15-minute intervals, such as traffic amount and duration of trip, time-cost data is collected, analyzed, and interpreted. This section of the proposal

clearly sets out the start and end dates of the study as well as any specific time frames or periods relevant to the study.

1.7. Organization of the study

The thesis is organized in to five chapters in this paper. An introduction, brief overviews of the research problem, general and specific objectives, research questions, the significance of the study, and the study's scope and structure are all included in the first chapter. Chapter two includes a review of related literature. This paper's third chapter outlines the study's research approach, design, and methodology. The fourth chapter of the paper included data analysis, results, discussion, and an explanation of the study. Chapter five of the paper presents key findings, a conclusion, and potential recommendations.

CHAPTER TWO: REVIEW OF RELATED LITERATURE

2.1. Introduction

Every urban region on the globe faces the problem of traffic congestion (Downs, A., 2000). The issue of traffic congestion spreads with the growth of urban populations, leading to longer commutes, contamination of the environment, and a general decline in the standard of living of inhabitants (Buchanan, C. 2015). To properly handle this problem, one must have a thorough grasp of what traffic congestion is, how it is defined, and the variables that influence it. In this study of the literature, we will observe many definitions of traffic congestion and the underlying elements that play a part in its growth in metropolitan areas (Matewos G. A., 2024). We seek to provide comprehensive knowledge of the complexity surrounding traffic congestion and viable ways to lessen its detrimental effects on society through a critical analysis of the investigation and research that has already been done (Choudhary, Arti & Gokhale, 2022). It happens when there is a greater demand than there is available space on the road, which results in slower-moving traffic, longer commutes, and higher car emissions. Researchers have proposed many terminologies and metrics, such as traffic volume, density, and speed, to effectively identify and quantify traffic congestion (N. Razali, K. K. Ishak, 2021). Gaining an understanding of these ideas is crucial to creating tactics that reduce traffic jams and enhance flow quality. Policymakers can develop a more sustainable and effective commuting system that is advantageous to the environment by examining the root causes of traffic congestion and putting suitable solutions in place (N. Razali, K. K. Ishak, S. Ramli, M. Amran, 2021).

Numerous factors, such as poor infrastructure, urbanization, population growth, and a dearth of public transit choices, all contribute to traffic congestion (Cervero, R., 2013). Traffic jams and delays may result from inadequate road infrastructure, such as badly planned junctions and insufficient lanes. Cities may decrease the detrimental traffic's

effects on commuters and the surroundings by addressing these underlying elements (Nahla Yassub Ahmad, Ali Salah Alkizwini, 2023).

According to Tagagne (2018), traffic congestion is indicated by longer trip times, slower travel times, and longer vehicle lines. When there is so much traffic that it slows down at intersections between vehicles, this is known as congestion. When every vehicle is halted for a long period, there is traffic congestion. Put another way, traffic congestion is when more cars try to use a given road facility than it can handle without resulting in undue delays or difficulties. Every country aspires to better the social and economic circumstances of its people (Faheem, Hamdy & Shorbagy, 2024). The government's long-term objective is to bring all Ghanaians' standards of living up to par with those of middle-income economies. When we talk about social and economic development, one basic requirement that comes up is transportation. According to Agyemang Opoku (2022), transportation is a life-process activity that aims to give people access to a variety of activities that meet their demands for mobility.

To sum up, traffic congestion is the state in which there are more cars on a road network than there are available spaces, which causes slower speeds, longer travel times, and more annoyance for drivers (Wang W-X, 2018). When there are more cars than there is space on a road, it is referred to as traffic congestion. This leads to slower speeds, longer travel times, and more annoyance for drivers. Traffic congestion is a major problem for the transportation system. Which is defined as an overabundance of vehicles on the road relative to their capacity (Agyemang Opoku, 2022). Numerous variables, including poor traffic management techniques, high population density, malfunctioning traffic signals, accidents, and special events, can contribute to traffic congestion. When there are more cars than there is space on a road network, the situation is referred to as inefficient traffic. These are additional factors that can contribute to traffic congestion, resulting in slower speeds, longer travel times, and higher driver annoyance (Wang W-X, 2018).

2.2. Status of road traffic congestion

It gives a general overview of a major topic, namely the growing issue of urban vehicle traffic congestion (Buchanan, C., 2015). This issue is primarily a result of inadequate city planning and rapid urbanization. The daily movement of people from various parts of the

city to specific destinations has thereby transformed traffic congestion into a major problem for numerous cities (Jean-Paul Rodrigue, 2024).

This problem has multiple negative consequences, such as time wastage, health risks for urban dwellers, deterioration in air quality, and overall inconvenience caused by delays. Moreover, the prevalence of road traffic problems has increased significantly and is influenced by several factors (Salman, M. Y., & Hasar, H., 2023). In particular, the narrow capacity of the roads is one of the main causes of traffic congestion, which could be alleviated by expanding the road network. Drivers can also contribute to mitigating congestion by maintaining a safe driving distance and driving at a consistent speed (Meyer, M. D. 1997).

Furthermore, it is widely recognized that individuals worldwide aspire to improve their lives through work prospects, often leading them to migrate to developed cities. Consequently, mass migration due to rapid urbanization frequently results in gridlock on roads due to ongoing population movement (International Organization for Migration (IOM, 2014)). While people should be able to enjoy the benefits of modern urban living, cities are confronted with issues such as poverty, disease, and other social problems driven by the strain of overpopulation. This essay will analyze the problem of traffic congestion and propose potential solutions to address this issue (Q Zhu, Y Liu, M, 2021).

It give a general overview of a major topic, namely the growing issue of urban vehicle traffic congestion. This issue is primarily a result of inadequate city planning and rapid urbanization. The daily movement of people from various parts of the city to specific destinations has thereby transformed traffic congestion into a major problem for numerous cities (Sokido, D. L., 2024).

(Afrin & Yodo, 2020) Claim that many factors, such as congestion, incidents, construction zones, weather-related issues, or special events, might lead to congestion in metropolitan areas. Both recurrent and nonrecurring congestions are influenced by these factors. As per Afrin & Yodo (2020), unfavorable weather conditions have the potential to cause approximately 19% of fatalities and 28% of highway crashes due to poor road conditions. Furthermore, a major contributing factor to traffic jams in densely populated

places is inadequate infrastructure, which raises the population rate and consequently increases the number of vehicles (Afrin & Yodo, 2020). Moreover, alterations to traffic control devices like railway crossings and lights may also affect traffic flow. To sum up, the primary reasons behind traffic congestion on roads include overcrowding, events such as accidents or work zones, unfavorable weather that exacerbates poor road conditions and accidents, inadequate infrastructure in places with high population density, and alterations made to traffic control systems (Faheem, Hamdy & Shorbagy, 2024).

Due to a growing population and inadequate road infrastructure, Ethiopia, a developing nation in the African Horn, has severe traffic congestion in its capital, Addis Ababa (Gunjo, S.B., Guta, D.D. & Damene, S. 2024). For the past 20 years, the government has been building bypasses and enlarging road networks around the city, despite obstacles like ineffective traffic control, insufficient parking, physical bottlenecks, and behavioral problems (Gunjo, S.B., Guta, D.D. & Damene, 2024). Using Addis Ababa as a case investigation, this research examines the current situation of traffic congestion on Ethiopia's roads. It examines current projects and initiatives, talks about the reasons for traffic congestion and how it affects society, and offers suggestions for more steps to be taken to lessen the issue (Engdasew Gudissa, 2021). The technique is well organized, focuses on particular research articles, and efficiently handles sophisticated material. The study is limited, though, as it was unable to locate reliable official data on changes in traffic volume and instead used Google Maps to calculate average congestion (Faheem, Hamdy & Shorbagy, 2024). Despite these drawbacks, the paper does a good job of examining the problem's dimensions, causes, effects, and implications, as well as present and planned initiatives and potential future paths for addressing traffic congestion. Readers can comprehend the report and gain knowledge from the author's critical review process because of the data presentation and methodologies employed in it (Assefa, 2020).

2.3. Factors affecting road traffic congestion

The term "road traffic congestion" refers to the impediment, deceleration, and disruption of the regular movement of motor vehicles. It is a condition marked by slower speeds, longer trip times, and more vehicles queuing that affects transportation networks as

utilization increases (Rehborn, Hubert & Klenov, Sergey.2011). The introduction highlights the importance of investigating the causes of traffic congestion on the roads. It is emphasized that effectively addressing congestion and enhancing traffic flow can only be achieved by considering all aspects that contribute to the condition (Mekker, M. M.,2020). This requires a comprehensive approach that goes beyond conventional solutions such as implementing new technologies, upgrading road infrastructure, or enforcing traffic management strategies. The study then introduces the various categories of factors that will be explored in subsequent sections of the article (Bullock, D. M.,2020). These categories include infrastructure-related factors, human behavior factors, and external factors. It is emphasized that a thorough understanding of these factors is crucial for planning strategic and effective measures to alleviate congestion, both immediately and over time (Choudhary, Arti & Gokhale, Sharad, 2022). To bolster this point, the article mentions previous research initiatives and government policies that often overlooked one or more of these factors when addressing traffic congestion. Finally, the article concludes by providing a broad outline of the key contents to be discussed in the upcoming sections. Furthermore, it outlines the types of factors that will be explored within each category. This serves as a solid framework for the remainder of the article (Mekker, M. M., & Bullock, D. M.,2020).

The study of factors contributing to road traffic congestion is of most importance for several reasons. Initially, it allows authorities to benefit from a comprehensive awareness of the underlying reasons for traffic congestion. Consequently, this knowledge facilitates the development of effective solutions that target each identified issue, thereby improving traffic flow (Alebe, Matewos & Hussen, Berhanu, 2024). Additionally, analyzing these contributing factors helps identify techniques to alleviate congestion and evaluate their effectiveness. This empowers drivers to make informed decisions when choosing measures to reduce traffic congestion effectively. Furthermore, this research can aid in devising innovative methods and leveraging advancing technology to enhance traffic flow without compromising the environment (C PMuneera & Karuppanagounder, 2018). Moreover, investigating the root causes of traffic congestion can be a cost-effective approach, potentially eliminating the need for extensive infrastructure renovations if congestion is primarily caused by driver behavior during peak hours. Lastly, identifying

problems and formulating potential solutions to enhance traffic flow initiates an ongoing process involving surveys, data collection, and research. This not only enhances the road user experience but also highlights the expertise of traffic engineers and sets higher expectations for drivers journeys (CPMuneera & Karuppanagounder, Krishnamurthy,2018).

Factors Affecting Road Traffic Congestion in Ethiopia include population growth, inadequate road infrastructure, a lack of efficient public transportation systems, high levels of vehicle ownership, improper traffic management and enforcement, and inadequate design and planning for cities (Getachew, E., A.N. et al. ,2024). These factors contribute to the heavy traffic congestion observed in Ethiopian cities, leading to delays, increased travel times, and an adverse effect on living standards and the economy. Additionally, the presence of heavy trucks and the lack of data on intercity freight trips also contribute to road traffic congestion in Ethiopia (Gunjo, S.B., Guta, D.D. & Damene, S..2024). Furthermore, political tensions and economic policy mismanagement, as highlighted in the research on intra-African trade, hurt trade among African countries, which can indirectly affect road traffic congestion due to disrupted supply chains and inefficient trade routes(Getachew, E., A.N. et al. , 2024). To address road traffic congestion in Ethiopia, it is crucial to invest in the expansion and improvement of road infrastructure, particularly in urban areas with high population growth. In addition, implementing efficient public transportation systems, like light rail or bus rapid transit networks, can help reduce reliance on private vehicles and alleviate congestion. Furthermore, effective traffic management and enforcement of traffic rules can help regulate the flow of vehicles and minimize congestion (Yue, W.Li, C. Chen, & Mao, G.,2022, July).

2.4. The Causes of Road Traffic Congestion

The primary factors contributing to traffic congestion on roads are both regular and nonrecurring issues (Chung, Y. 2011). Every day during rush hours in cities, recurring traffic congestion, which makes up around half of all traffic congestion that people encounter, happens. Traffic jams of this kind are typically caused by obstructions that impede traffic movement, or bottlenecks and capacity problems. Conversely, non-

recurring congestion can be caused by a number of things, such as excessive demand, signal failures, incidents, work zones, inclement weather, or unique events. These underlying issues lead to intermittent bottlenecks that are not limited to certain periods or places (Afrin Tanzina & Yodo Nita, 2020).

The issue of vehicle traffic congestion has become increasingly problematic due to the fast increase in population and urbanization. Recent estimates indicate that by 2050, there will be an extra 2.9 billion automobiles on road networks due to ongoing urbanization and population growth (S. Djahel et al., 2018). This rise in the quantity of automobiles aggravates worries about air pollution, increases the burden on the transportation network, and increases the likelihood of accidents on crowded routes. Urban regions' faster economic expansion has made it more difficult to provide for people's quick mobility needs while reducing the damaging effects of transport on the environment (S. Djahel et al., 2018). Road infrastructure deteriorates as a result of cities' struggles to handle this rise in demand due to a lack of resources and logistics, which exacerbates traffic congestion issues (Sisay, M. G., 2024). Moreover, traffic congestion affects society's economy as a whole since, as (Tanzina Afrin & Nita Yodo, 2020) investigate, it not only results in delays and discomfort but also large financial losses because of decreased productivity.

2.4.1. Common Traffic Influencing Events

Traffic flow is significantly influenced by external events (Du, L., Song, G., Wang, Y., ,2018). These included accidents and mechanical breakdowns involving automobiles, work zones, inclement weather, such as prolonged rain, formal state visits, and inconveniently timed traffic lights. The primary effect of these occurrences is to take away the road's physical capability (Xiao, W., & Wu, Y., 2023). Travelers consider their visits in light of such incidents. The combination of physical capacity and the events occurring at a given moment determines the amount of congestion on a route. (A. D. Elisonguo, 2013). Driver behavior is greatly impacted by several external circumstances, including bad weather, different types of vehicles, and the characteristics of the route. Unfavorable weather has been shown to affect driving behavior and increase the likelihood of collisions (Hjelkrem, Odd & Ryeng, Eirin, 2017). For example, South

Korean research that looked at how different types of vehicles were affected by bad weather discovered that most drivers reduced their speed limit when it snowed (Ali Mohammed et al., 2021). Furthermore, guardrail presence and illumination have been found to have a significant impact on driving behavior (Gilandeh, S. S., & Anarkooli, A. J. 2018). Furthermore, it has been noted that bus drivers who work longer nights Accidents involving shift workers are more common because of the elevated stress that comes with driving on congested, dimly lit roadways (Ali Mohammed et al., 2021). These results show how different traffic-influencing events can result in discernible behavioral changes in drivers, underscoring the necessity of a thorough comprehension and consideration of these elements when developing tactics that effectively improve road safety (Cuentas-Hernandez, S., Li, X., King, & Oviedo-Trespalacios, O. 2024).

2.4.2. Population Increase and Vehicle Ownership

One of the global reasons for traffic congestion is population growth. It is the procedure that results in a small area's residents and economic activity being concentrated in one particular area within a connected network of markets. There are pull and push forces that contribute to population growth in metropolitan regions. (A. D. Elisonguo, 2013).

The majority of people on the planet reside in cities. Globally, the population of metropolitan regions is growing by 2 percent on average each year, and the number of megacities in the last 20 yearsthose with populations greater than 10 million—has increased fourfold (Ritchie, H. & Roser, M., 2018).

It is anticipated that these trends will continue to be driven by the demographic shifts in the emerging globe (Ritchie, H, 2018). 80 percent of the population growth in developing countries is expected to take place in urban areas during the next ten years, according to UN predictions. Nonetheless, a large portion of the population in towns and cities, particularly in Addis Ababa, owns a car. Traffic congestion results from a disproportional rise in the number of vehicles compared to the capacity of the road. More people live and work in cities as a result of population growth and urban sprawl, and they travel more within metropolitan areas, often over great distances (Tegenu, T. 2010).

As a result, the current transportation infrastructure's limited capacity is being pushed to its breaking point (Rahman, Md. Mokhlesur & Najaf, Pooya 2021). As a result, meeting the public's demand for travel is currently challenging. Thus, the city's public transportation system performs distressingly in terms of social, economic, and environmental factors (A. D. Elisonguo, 2013).

2.4.3. Insufficient Road Width

In relation to the amount of traffic on the road, most roadways are narrow. Gotera up to Masetegna roads are affected by this issue, as are routes that continue out to the perimeter. Megenagna to CMC Road in Addis Ababa City is one example; it is narrow and lacks parking spaces; illicit sellers swap various commodities on the road; building materials are used on the road; and the traffic conditions require cars to stop wherever on the road so that people can board and disembark. This behavior increases the likelihood of accidents and traffic congestion (Retallack, A. E., & Ostendorf, B. 2019).

Shanko conducted a study on the segmental assessment of traffic jam levels, and the results indicate that motor vehicles have a greater impact when the bottleneck is at the top of the upgrade as opposed to the bottom. Furthermore, the study discovered that when the grade percentage of the congested traffic stream increases, so do the consequences of heavy cars (A. D. Elisonguo, 2013).

2.4.4. Inadequate parking space and wrong parking in the city center

The majority of cities, especially those in developing nations, lack sufficient parking spaces, which explains why people park carelessly on the streets. The city center of Addis Ababa is where the most significant parking issue is most evident when it comes to the megenagna to CMC road portion. The fact that all cars are compelled to drive on city streets due to the convergence of the main routes in the city center exacerbates the situation. This affects not just the Megenagna to CMC road portion but the entire city of Addis Ababa. This happens as a result of people slowing down their cars when they attempt to park, which causes the cars behind them to slow down as well and worsen traffic congestion. In the city of Addis Ababa, this conduct or circumstance is typical (A. D. Elisonguo, 2013).

2.4.5. Drivers Misbehavior

One of the cities's most known for careless driving because of infractions of traffic laws is Addis Ababa. Drivers frequently ignore or break traffic laws, such as when it's forbidden to overtake, when they're driving under the influence, when they ignore traffic signs and markings, when they let people out of the bus instead of stopping, and when they use the U-turn (Gadisa, Layo, 2018).

Inadequate training combined with a lack of competence can make drivers lack confidence or competence. Therefore, one of the primary causes of the rise in traffic bottlenecks is the misconduct of some drivers who disregard traffic laws (A. D. Elisonguo, 2013). To deter these wrongdoings, there have been consequences (fines) for every infraction committed, although the strategy has not shown much efficacy. The majority of driver misconduct cases involving Megena to CMC in Addis Ababa city exacerbate the issue of traffic congestion and accidents. However, many nations, including Ethiopia, have widespread unethical driving habits. By accepting bribes, police officers who are unethical may release drivers who have been apprehended. The majority of the time, commuter minibuses and taxis in the city also encounter circumstances where they break traffic laws, leading to accidents and traffic congestion (Usman, Ahmad & Abbas, Nadeem, 2023).

2.5. The consequence of road traffic congestions

Road traffic congestion has a wide range of consequences and plays a significant role in many aspects of society. Road traffic congestion is the state in which there are an excessive number of automobiles on a road or in a certain area, causing traffic to slow down or stop (Fattah, M. A., Morshed, S. R., & Kafy, A.-A. ,2022). There might be several negative consequences from this, including:

1. Extended journey times: When there is traffic congestion, drivers and passengers on public transport may have to travel further and arrive at their destination more slowly (Anderson, M. L., 2014).
2. Rising transportation costs: As a result of congestion, users of public transportation may have to pay higher fares or tolls because of the limited

capacity of the mode of transportation and the rising demand (Hasmita & Radzuan, 2018).

3. (Yuan, 2020) Environmental degradation: greenhouse gas emissions and air pollution are increased by traffic congestion, and these emissions ultimately lead to climate change and environmental degradation(M. Parvez, 2020). Negative social effects of congestion include increased stress, deterioration in quality of life, difficulty accessing essential services, and the implications of road traffic congestion brought on by e-taxi parking in the Pabna Municipality. It states that the rise in e-taxis has caused an increase in unlawful parking on roadways, which has caused traffic congestion and obstructed free flow of traffic (M. Parvez, 2020). Furthermore, the effect of level of service (LOS) e-taxi parking on the roadways in the Pabna Municipality region was examined by (Wang W-X,2018); his data sheds light on the negative consequences of e-taxi parking on

2.5.1. Socio-economic impacts of traffic congestion

There are several detrimental consequences of traffic jams, including negative effects on the environment and society as well as financial loss. There won't be any financial incentive to discourage vehicles from abusing the roads because they are free, at least not until they start to crumble from constant traffic (A. D. Elisonguo, 2013). Every person who drives thus has both individual and public costs. The time spent traveling and the amount of gasoline consumed are considered private costs, while the price paid by the neighborhood in terms of noise and accident risk (MacKenzie, J. J. & Chen, D. D., 1992).

2.5.1.1. Social Impact

The aspect of congestion that has an impact on people's mental health is its social impact. It did occur as a result of the traffic jam, the rise in the number of cars, and the delayed arrival time. Air pollution, noise, and fatigue combined with being trapped in a moving automobile and having to wait in a lengthy line to move slowly can lead to feelings of annoyance, rage, and lack of focus (Fattah, M. A. 2022).

2.5.1.2. Economic Impact

Numerous economic factors related to vehicles can be classified into two categories based on research findings: private and public costs (Sierzchula, W., & Van Wee, B., 2014).

A private cost is a cost issue under certain circumstances; these include the costs associated with moving the car, losing time while driving, and maintaining and servicing the vehicle. However, certain expenses must be incurred by the public owing to accident situations, road infrastructure upkeep, and numerous other variables (Roth, G.J., 2014).

The economy is impacted by traffic congestion, as seen by higher private costs than usual; research has demonstrated that traffic congestion affects drivers' financial results. According to research conducted in 423 US urban areas, the problem of increasing urban congestion is attributed to an increase in fuel usage and waiting time. According to a 2007 study, the economic cost of rising fuel use rose to \$87.2 per peak passenger for 36 hours in 439 urban areas (Kranti & Das, Pritikana, 2021). In addition, the study was conducted in Jakarta, Indonesia. According to Kikuchi (2020), the 10th most congested city in the world in 2018, the situation is caused by the 14 million motorcycles and 3.5 million cars that are on the road every day.

2.5.1.3. Environment Impact

Air pollution and greenhouse gas emissions rise as a result of increased fuel use, which is another effect of congestion on the environment (Bharadwaj, S& Chandel, M. K. ,2017). Free radicals, which include CO₂, CO, CH₄, PM, SO₂, and HC, are a form of air pollution that also affects human health (Değirmenci, T., & Yavuz, H. 2021). Studies have shown that air pollution contributes to thousands of fatalities annually (Fattah, M. A., 2022). It is true, as several studies have demonstrated that traffic congestion affects road users in social, economic, and environmental domains. This is demonstrated by the higher expenses that must be paid for as a result of the higher fuel consumption as well as the projected time lost as a result of traffic jams, elevated stress levels, exhaustion, and noise pollution (Fattah, M. A., Morshed, S. R., & Kafy, A.-A., 2022).

2.5.2. Traffic Congestion Analysis

The Urban Mobility Report has effectively represented the extent of congestion using total delay in person-hours for many years (Nguyen-Phuoc, D. Q., Young, & De Gruyter, C., 2020). The significance and use of this metric in mobility assessments are explained in *The Keys to Estimating Mobility in Urban Areas* (Understands, T. E., 2005). Congestion-related time lost is the total delay. Usually, the delay is given as a number of the circumstances of free flow (B. and D. Schrank, 2012). An estimate of the average difference cost of the additional travel time brought on by congestion is what delay time is worth. The time and fuel a driver spends in congested traffic determines the cost of congestion, according to the Urban Mobility Report (UMR) methodology. The amount of additional gasoline used in traffic jams is computed separately from the total amount of time lost in traffic. The calculation of an updated delay time value for trucks and passenger cars is the main topic of this paper (B. and D. Schrank, 2012).

According to research, the cost of a personal travel delay in 2016 was \$17.81 per person. Based on the annual survey conducted by the American Transportation Research Institute (ATRI) and modified for vehicle type, speed, and occupancy, the commercial value of travel time is currently estimated to be \$53.69 per vehicle per hour for 2016. Fuel costs are not included in the value of delay time for either personal or commercial cars. The values can be used to show how significant improvements to one area of a corridor impact several other corridor aspects (Ellis, D. R., 2017).

In economic or benefit/cost assessments, where information on the size of the mobility improvements is used to make cost-effectiveness judgments, the quantity is especially helpful. Although the total delay is a useful metric for studying metropolitan areas, the delay per mile of road has greater significance when analyzing many corridors (Gr, Bivina & Kumar, V.S., 2016).

2.5.3. Measure of Congestion

By recording information about traffic congestion, such as journey time, average speed, or delay time, measuring traffic congestion gives decision-makers the data they need to control it. The most crucial kind of data to validate and calibrate the simulation model

supporting Advanced Traveler Information Systems (ATIS) and Advanced Traffic Management Systems (ATMS) techniques for enhancing road capacity, like incident management and traffic signal optimization on freeways and arterials, is probably travel time and delay data (Anderson, M. L., 2014). Transportation agencies presently utilize many of the measures to assess system performance. Time-related measures, volume measures, congestion indices, delay measures, and LOS measures are the five categories into which the metrics are divided (H. Mahmassani, 2012).

2.5.4. Time-Related Measures

To assess congestion, time-related metrics such as travel time and travel rate are frequently employed. One important factor is that time-of-flight measurements are repeatable and applicable to all forms of transportation, including the transportation of cargo (Bamji, C., Godbaz, J., Oh, & Thompson, B., 2022).

Several ongoing research projects related to intelligent vehicle-highway systems use travel times as their primary performance measure. One such project is Houston's Real-Time Traffic Information System, which records travel times through the use of both automatic vehicle identification techniques and cellular telephone reporting (Kumar, 2021).

Highway users generally comprehend journey time, which is a commonly used metric that can be applied to a specific starting and finishing place (Mannering, F. L., & Washburn, S. S., 2020). A shorter travel time is typically seen as a sign of less traffic. Many people believe it to be the most accurate indicator of system congestion. Speed and travel time are inversely correlated. Origin–Destination Travel times, which are the predicted amount of time needed to go from an origin zone to a destination zone of a specific highway network, are an output of the traffic assignment process of travel demand modeling (Bates, J., 2007). The shortest amount of time can be used to estimate these journey timings. Travel time contours for path skim trees are those that may be displayed on a map to show times in discrete intervals (e.g., five or ten minutes at a time) from a single point to/from various destinations/origins. These are especially helpful when researching travel to a major hub of employment, such as a big city's central business district (W. Pu, 2011).

2.5.5. Volume Measures

Volume metrics are appealing to employ since traffic volume counts and vehicle miles traveled (VMT) data are widely available (Das, S., 2021). Volume is frequently compared to the available supply since it indicates the amount of demand. This relationship is commonly stated as a volume-to-capacity ratio (V/C). It should be highlighted that while VMT is a crucial metric for analyzing air quality, it is not a reliable indicator of congestion on its own. Density, a function of both volume and speed on a given length of roadway, is a measure of congestion as well and is directly associated with freeway LOS (H. Mahmassani, R. Mudge, T. Hou, & J. Kim, 2012). Travel rates, traffic volumes, and even the movement of commodities can all be measured via real-time monitoring systems, either in use or under construction (Chen, Y. T., & Lin, Y. B. 2021).

2.5.6. Congestion index

The roadway congestion index is the congestion index (He, F., Yan, & Ma, L., 016). Congestion on the street and highway systems is measured across the system by this indicator (Zang, J., Jiao, P., & Yu, L. 2023).

The daily VMT per lane mile of roadway for both major arterial routes and freeways is used in the roadway congestion index, which is calculated using an empirical formula. According to Rodrigue, Comtois, & Slack (2013), the index equation involves calculating the daily VMT per lane mile values for each of the two functional classes by multiplying them by their respective daily VMT.

The daily VMT per lane mile is then normalized to represent the congestion threshold. Daily Vehicle-Miles of Travel: The daily vehicle-miles of travel (DVMT) is calculated by multiplying the average daily traffic (ADT) of a certain road segment by the segment's length (measured in miles) (Mallinckrodt, J., 2010).

2.5.7. Delay Measures

Any kind of delay lengthens travel times and slows down movement. Delay metrics are therefore intimately related to time-related metrics. Specific problem sites or areas, whether recurring or nonrecurring, can be discovered by focusing on delay as a performance indicator (Reddy, Kanala & Challagulla, 2022). Numerous recent studies on

nonrecurring congestion have emphasized the significance of incident-related delays and the advantages of reducing them. Delay is a useful indicator of the degree of traffic congestion on a road link or in the system as a whole. It is defined as the difference between the desired or free flow and the actual travel time. Nevertheless, this metric provides little understanding of the precise origins of traffic jams (Wang, Chao, 2010).

2.5.8. Level of service measures

LOS classifications are generated from various performance measurements and are commonly used as an indicator of congestion. "The concept of level of service" is defined as a qualitative metric characterizing the condition of operation in a traffic stream and its perception, according to the Highway Capacity Manual, by motorists and passengers. (State of Florida Department of Transportation, 2013), Roadway volume-to-capacity ratios (V/C) can be used to quantify the effects of traffic congestion. Less than 0.85 is considered under capacity, 0.85 to 0.95 is considered near capacity, 0.95 to 1.0 is considered at capacity, and more than 1.0 is considered overcapacity. Due to the non-linear nature of congestion, as a route approaches its maximum capacity, small increases in traffic volumes may induce correspondingly larger changes in congestion delays (Fasika, 2015).

2.5.9. Traffic delay and congestion performance measure

This section provides a quick explanation and comparison of a number of widely used performance metrics that represent traffic congestion levels on roadways (Fritsch, J., Kuehn, T., & Geiger, A., 2013). The length of extra time needed to complete a journey due to traffic congestion is calculated by the travel rate index. By putting more emphasis on time than speed, it investigates how quickly a travel may happen during peak hours. It makes use of travel rates for both arterial and freeways (Susilo, Budi & Imanuel, and Ivan, 2018). The Travel Time Index developed by Fasika Mekonnen Ayehu (2015) compares travel during peak periods with travel during free flow, taking both recurrent and incident situations into consideration. It uses both freeway and arterial travel rates to calculate trip times during peak hours. It is calculated as the ratio of the average peak

travel time to the average off-peak travel time, with freeways requiring a speed of 96 km/h. When the travel time index is 1.20, it indicates that peak travel times are 20% longer on average than off-peak periods. The additional time invested in commuting due to traffic congestion is known as a travel delay. Travel delays were separated into two groups in the TTI study: incidental and reoccurring (Abou-Senna, H., 2016).

When comparing the level of mobility on roadways or between different modes of transportation, the relative delay rate, also known as the relative delay rate, is a helpful indicator (Jenelius, E., & Koutsopoulos, H. N., 2013). This statistic compares the performance of the system to a target or benchmark (Schrang, D., B. Eisele, 2012). It may also be used to illustrate operational distinctions between highway and transit modes and to compare various components of the transportation system. When comparing the degrees of mobility on roads or across various forms of transportation, one useful tool is the delay ratio. It highlights the importance of the mobility issue in light of the current circumstances (Fasika Mekonnen Ayehu, 2015).

Since total delay is related to latency and the data required to compute it are easily accessible, it was selected as a performance metric (Thiagarajan, A., Ravindranath, L., LaCurts, K., Madden, S., 2009). The length of a route and speed can be used to calculate journey times. By calculating the delay for every car crossing a certain section of road over a given amount of time, this metric will assist transportation experts in determining the extent of the congestion (Jian, Zihan & Xu, Xiangdong, 2024). Transportation experts may also be able to calculate the total delay to see how changes to a system impact a specific corridor or the system as a whole (Sinha, K. C., & Labi, S., 2011). As total delay accounts for delays for all vehicles, it might be helpful to traffic management. Time lost for all cars is more significant on routes with larger traffic volumes since more traffic means more people are impacted by the lost time, which may result in more money being squandered by the community. Using total delay also makes it feasible to compare delays across various route segments. The total delay illustrates how traffic affects the amount of time lost while traveling (Ayehu, 2015).

2.5.10. Congestion Costing

Along with the costs of accidents, noise, pollution, space consumption, and visible or physical barriers, congestion costs are a component of the external costs associated with

road transportation. Their importance is largely dependent on the period and place. (Maddison, D. 1996). Although there may be a reduction in external costs as a result of improved vehicle technology, increased road safety standards, more environmentally friendly road infrastructure, and dynamic traffic management, the benefits are likely to be outweighed by the continued rise in car ownership and mobility (Abebe HG. 2022). Only when the whole social benefits outweigh the total social costs can investments in roads Transport Policy Institute, 2009, thus The Victoria Transport Policy Institute The total costs of investment, operation, maintenance, and external effects should therefore be less than the potential benefits of lower production costs and consumer prices, more product variety, faster delivery, and spin-off effects like value-adding or employment in related economic sectors due to improved accessibility.

Although it is obvious that increasing traffic congestion costs passengers money and affects bigger company operations, it has been difficult to create and execute empirical indicators of the extent of traffic congestion and the accompanying costs (Weisbrod, Glen & Treyz, George, 2003). Even yet, accurately determining the degree of congestion is a crucial first step in assessing the effectiveness of the current road network, the viability of suggested strategies for reducing it, and the financial impact of congestion (W. Taddesse, 2011).

In addition to a cost-benefit analysis of the economy and society, the valuation of external effects, that is, assigning a monetary value to the impacts, which are by definition not priced, allows for a quantitative comparison of the severity of various external consequences (Koopmans, C., & Mouter, N. 2020). However, as verbose notes, extreme care should be taken when interpreting the proven externalities because the absolute numbers are quite sensitive to the methods used. This study was examining the socio-economic consequences of road traffic congestion.

The conceptual framework of the study focused on dependent and independent variables. In this study, road traffic congestion is an independent variable, while socio-economic impacts are dependent variables. Independent and dependent variables interact as shown in the conceptual framework below (2.6).

2.6. Conceptual Framework

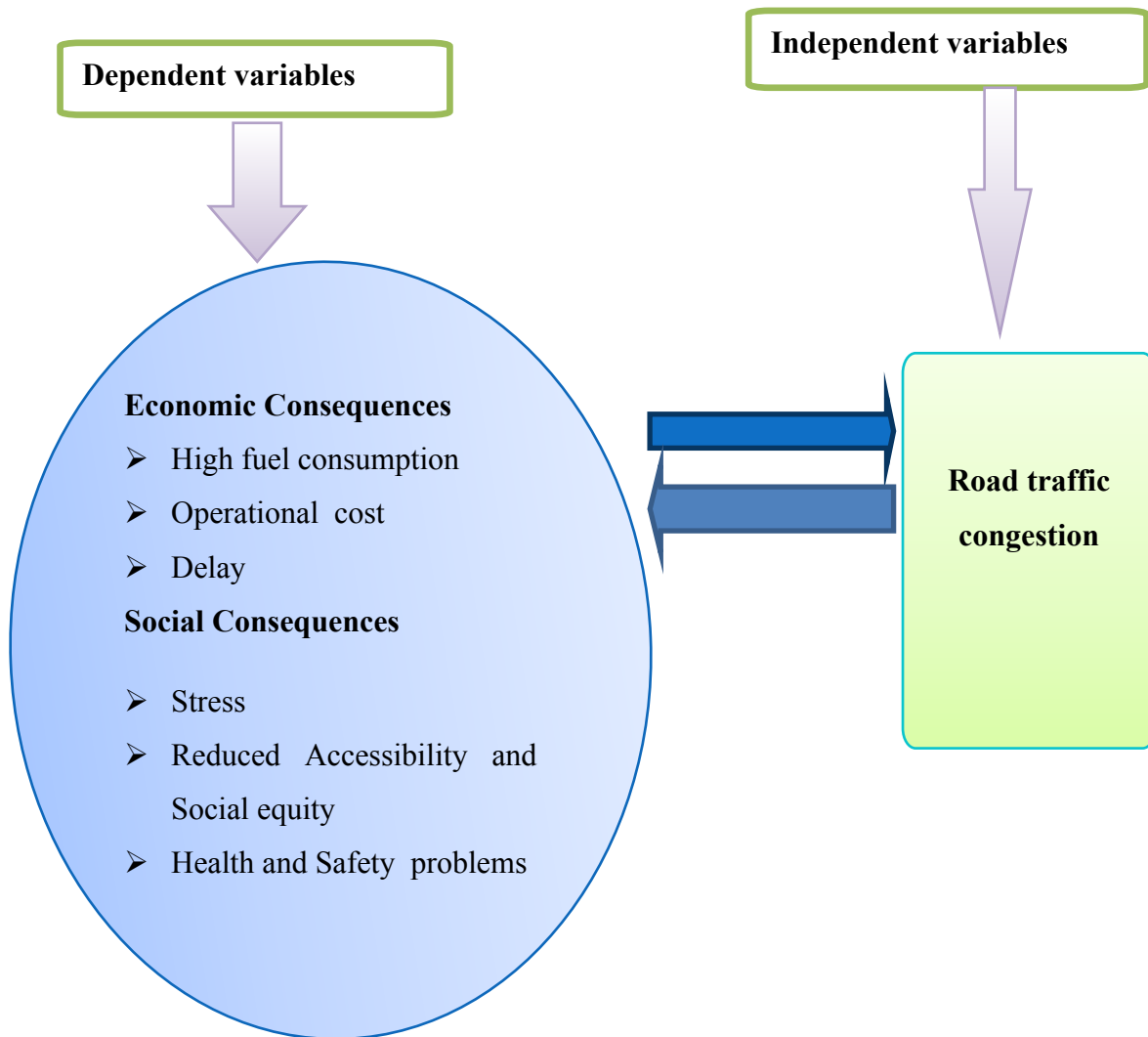


Figure 2.1. Conceptual Framework

Source: Own researcher develop from literature review

CHAPTER THREE: RESEARCH METHODOLOGY

3.1. Introduction

This chapter's focus includes the study area description, research design, research approach, study population, sample size, sampling techniques, data collection procedures and analysis techniques, data collection methods and instruments, and ethical considerations for the study.

3.2. Description of the study area

Ethiopia established its capital city, Addis Ababa, in 1886. Geographically speaking, Addis Ababa occupies 540 square kilometers and is situated between 8°50' and 9°06' N latitude and 38°39' to 38°55' E longitude. For administrative reasons, the City Administration is separated into 118 woreda (districts) and 11 sub-cities.

According to the 2007 population census, Addis Ababa has 3,384,569 residents, growing at a rate of 3.8% per year. The number appears to be still significantly underestimated, even after it was increased from the 2,738,248 figure that was initially published. It possesses both the status of a state and a city. It is the location of the African Union and the former home of the OAU. Along with several other international institutions, it is home to the headquarters of the United Nations Economic Commission for Africa. People from many districts of Ethiopia live in the city. The (Central Statistics Agency, 2017) reports that there are 328,900 people living there overall. United Nations Population Projections estimates that by 2022, there will be 5,228,000 people living in the Addis Ababa metro region, an increase of 4.43% from 2021. In addition, the United Nations Population Projections project that 5,461,000 people will live in the Addis Ababa metro region in 2023 a 4.46% increase from 2022.

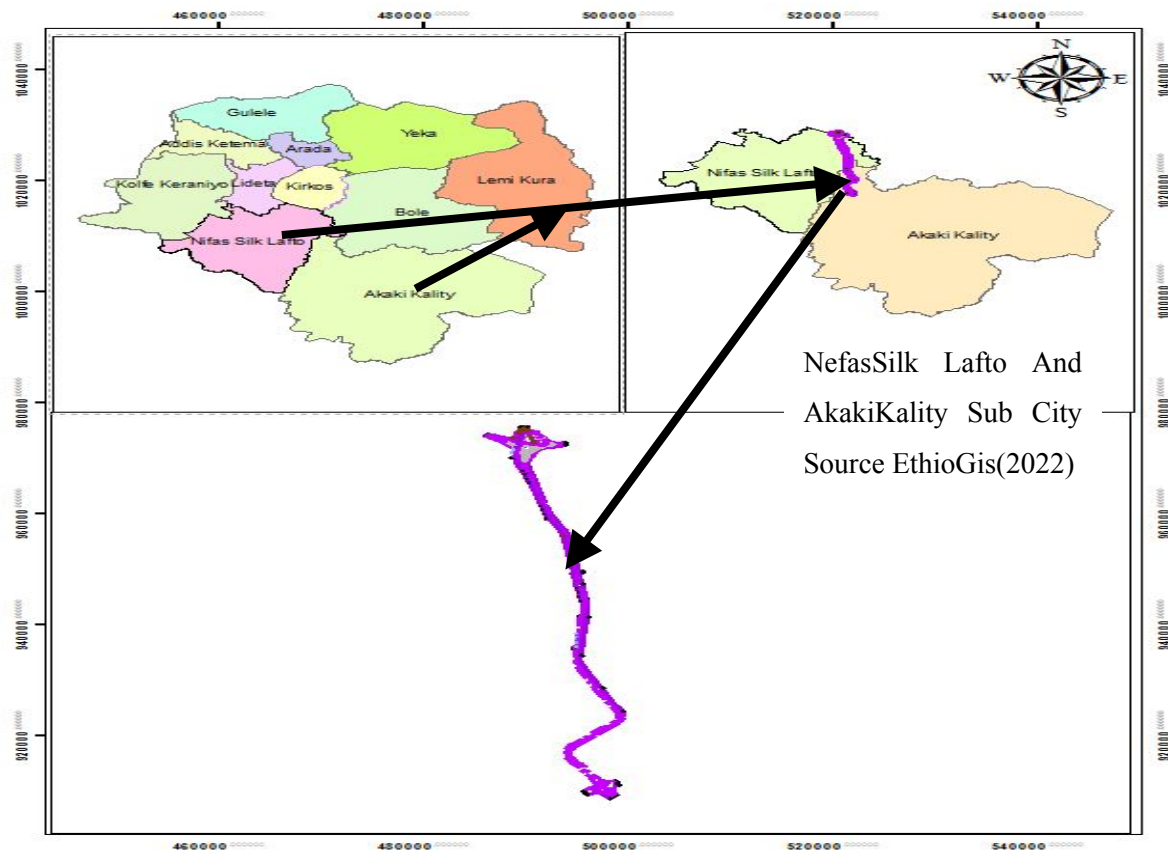


Figure 3.1. Location Map of Study Area

Source: survey, 2024

The location of the study area is the main highway corridor from Gotera complex road to Maseltegna road segment, and it is the road that connects and encloses the border between NFAS Silk Lafeto and AkakiKiltiy sub-city regions. The city of Addis Ababa believes that administration data, the sub-cities, i.e., the nfas silk Lafto sub-city, have a population of 455 500 people, 220 000 men and 235 500 women, and an area of 68.1 square kilometers. AkakiKality sub-city has a population of 389,254 people, 195,268 males and 193,986 females, and an area of 118.08 square kilometers. The total population of the two sub-cities is 844,754, and they cover an area of 186.18 square kilometers. Source: Wikipedia, and population figures based on 2023 projections by the federal government census agency, Ethiopian Statistical Service.

GoteraComplex -Maseltegna Street
Corridor Map

1:15,000

The population of the two sub-cities is employed in manufacturing and industry, trade and commerce, agriculture, hotel and food services, as well as health and social services, according to the Central Statistics Service. Homework, agriculture, hotel and food services, and health and social services. In addition to the rural areas of Addis Ababa, residents are also involved in animal husbandry and vegetable farming.

The main road that connects and crosses these two sub-cities It's located in the southern part of the city and serves as a center for locals originating from many regional cities, such as Akakaki, Gelan Awash, Dukem, DebreZeit, Mojo, and Adema, to engage in their regular activities in Addis Ababa. The sub-cities are characterized by the uncontrolled horizontal expansion of urban areas and informal settlements. These neighborhoods are created when citizens leave the city center to find relatively cheap land and construct homes outside of the bounds of the law. Moreover, with the high and rising rental prices in parts of the capital, residents have been looking for more economically viable housing options on the outskirts of Addis Ababa. As a result, the population of the sub-cities is increasing from time to time. One of the five gateways that connect Addis Ababa with the regional cities is the main corridor of your city under study. There are a large number of people entering and leaving the city in the mornings and evenings of the sub-cities, as well as the transportation of heavy cargo to unload products and goods from the port to and from the city, and because it is a shuttle line, there is a medium to high level of traffic congestion. Therefore, the region that connects and crosses these two sub-cities is related to the selection of the main road for the products and goods entering and leaving your city as a research subject and the road providing transportation services to the residents of the sub-cities as well as individuals arriving from somewhere. Therefore, a general assessment of all the lines in the sub-cities should still be done.

3.3. Research Design and Approach

3.3.1. Research Design

Any research project must choose a study design, which includes choices about anything from general hypotheses to specific techniques for gathering and analyzing data (Cresswell, J., 2013). A well-articulated research problem, data collection protocols, the population to be investigated, and data analysis techniques are all essential elements of a

research design (Kothari, 2004). Three study approaches qualitative, mixed, and quantitative are identified by Creswell (2003) and are each linked to particular paradigms. To properly address the research problem, this study uses a mixed-methods strategy that includes field surveys, statistical data, closed-ended questionnaires, in-depth interviews, triangulation, and observation. Using ethnography, theories of road transport, congestion, sustainable urban infrastructure, and case studies for qualitative insights, descriptive research was used to evaluate the socioeconomic consequences of traffic congestion. Quantitative analysis was conducted using SPSS (version 25) to interpret data through frequencies and percentages. By fusing the organized, statistical rigor of quantitative approaches with the in-depth, context-rich insights of qualitative methods, the mixed-methods approach allowed for a thorough comprehension of the problem (Neale et al., 2006).

3.3.2. Research approaches

Examining the socioeconomic effects of traffic congestion is the primary goal of this study. The study used a mixed approach, combining qualitative and quantitative methods (Creswell, 2018).

to address certain non-quantifiable aspects of traffic congestion, like perception, and to reduce the limitations of each approach. Triangulating the several equipment and tools used for data collecting and analysis is also beneficial. Simple, direct questions that can provide thorough responses were used to collect the data during interviews. In order to create statistics or numbers, investigate the several socioeconomic effects of traffic congestion simultaneously, produce a large amount of data, and translate reality into numerical values, the quantitative technique was employed. Additionally, questionnaires were used in the study to implement the quantitative method. It was obtained by using a standardized questionnaire that had been pretested before being used.

3.4. Population of the study

The study area consists of a highway corridor from Gotera Complex Road to Maselitgna Road, which connects and defines the border between the NFAS silk Lafto and Akaki Kaliti sub-city regions. According to administrative data from Addis Ababa city, NFAS Silk Lafto sub-city has a population of 455,500, while Akaki Qaliti sub-city has a

population of 389,254. These two sub-cities have a combined population of 844,754, which serves as the base population used for the study.

3.5. Sample Size

For a high degree of confidence and a low number of errors, a sample size was chosen. The number of things in the universes is unclear because the universes had endless data. The researcher employs the infinite sample size formula as a result. (Cochran, 1963:75) created the following equation to produce a representative sample for proportions in large populations:

$$n = [Z/e]^2 Pq$$

Where: n - Sample size required for the study.

Z - Critical value (=1.96) for 95% confidence level.

p - Proportion of an attribute that is present (50%) in the population, and q is 1-p.

e - Margin of error that can be tolerated - 5% (0.05)

$$n = [1.96/0.05]^2 [0.5][0.5] = 384.16 + 5\% = 385$$

Therefore, 385 respondents were selected by employing convenience sampling technique.

convenience sampling	Number of sample
1.passengers	120
2.drivers	105
3.Residence and commerce	160
total	385

3.6. Sampling Techniques

The two primary types of sample design are non-probability sampling and probability sampling.

The researcher employed a convenience sampling method (a man of the straight) to choose responders from these using a non-probability sampling technique. This is the process of gathering data from people in the community who are easily accessible to supply the necessary data. It's arguably the most effective method for quickly and efficiently learning some fundamental knowledge. In this study, the researcher used purposive sampling items because the researcher deliberately selected senior experts from

Addis Ababa Road Traffic Agency and drivers and passengers of this segment (Kothari 2004).

3.7. Types of Data and Data Collection Tools

Primary and secondary data were used by the researcher to carry out this investigation. Closed-ended questions from standardized questionnaires were used to gather primary data. The study area's sample respondents are given the questionnaires, which were created in English for the convenience of the respondents. The data was gathered through a semi-structured interview.

3.7.1. Sources of Data Collection

Data collection involves the gathering of relevant and important data used for conducting a particular research work. It is the basis for acquiring data. The researcher collects data from primary sources. The primary source of data collected by a questionnaire and interview was developed by the researcher to fulfill the objectives of the study (Zohrabi, M., 2013). Secondary data was collected from the Addis Ababa traffic management authority report, books, magazines, and journals about road traffic congestions.

3.7.2. Instrument for Data Collection

A structured questionnaire survey was adapted to fit with the local situation, the objectives of the study, and variables of interest. The questionnaire contains close-ended question information on road traffic congestion issues of the problem and relating factors of the respondents. This questionnaire was prepared in English. A semi-structured interview is also prepared in order to obtain appropriate information from the participants.

3.8. Method of Data Analysis

The process of arranging and summarizing data is known as data analysis (Kothari, 2004). After then, the researcher goes to work reviewing the collected data. Among the closely related processes required for data analysis are the establishment of categories and the application of these categories to raw data through coding, tabulation, and statistical inferences. Data was gathered for this study from primary and secondary sources, utilizing techniques for both quantitative and qualitative data analysis.

3.8.1. Quantitative Data Analysis

The Statistical Package for Social Sciences (SPSS), which interprets and analyzes the data collected from the study instrument, was used to summarize, code, modify, and tabulate the data from the completed questionnaires. A combination of inferential and descriptive statistics will be used to analyze the data, which will be gathered from quantitative data. In order to examine the study, descriptive statistics like mean, standard deviation, percentages, and frequency will be used, and inferential statistics like regression and correlation will be used to analyze the data. Regression statistics, which established the importance of the relationship between the variables, will be utilized to infer information about the population through inferential statistics (Walliman, 2014).

3.8.2. Qualitative Data Analysis

Any type of data that cannot be quantified is considered qualitative. It's often based on opinions or experiences, which are difficult or impossible to quantify. Thus, for this study, data was collected from interviews and open-ended questionnaires are analyzed qualitatively, specifically using the narrative type of qualitative data analysis method, and presented next to quantitative analysis through an embedded way.

3.9. Method of Data Presentation

Depending on the respondents' answers, the data output was presented accordingly. The final product was given as a written document as well as tables and graphs. Descriptive statistics were suitably employed to comprehend the primary features of the study challenges, which make this practicable. Conversely, the interview data was subjected to a qualitative analysis, which involved the transcription of the thoughts and perspectives expressed by the respondents through descriptions and narrations.

3.10. Validity and Reliability

3.10.1. Validity of Instrument

In terms of validity, “accuracy or reliability of a description, conclusion, explanation, interpretation, or other type of study (Coleman, 2022). The amount to which a measurement tool is attached gives adequate coverage of the ongoing research; that is, research items measure the study's variables, whereas face validity refers to a face-to-face

examination. As a result, content validity analysis was used in this study. To guarantee instrument validity, the researcher was performing a pilot study and conducting a pre-test of the instrument. In addition, to avoid ambiguity and unclear statements, the draft questionnaires were tested with 30 drivers and passengers.

3.10.2. Reliability of Instrument

The socio-economic consequences of road traffic congestion are to be seen. As a result, a descriptive/explanatory study design is chosen by the researcher (Meurs, 2003). While the descriptive analysis will qualitatively summarize socioeconomic consequences from field observation data, the explanatory analysis will examine questionnaire data to qualitatively determine the relationship between the independent (road traffic congestion) and dependent (socioeconomic consequences) variables. Because of the vast amount of data and time constraints that prevent the researcher from studying the entire populations, the researcher will critically select a representative sample from a mixture of residences, commerce, drivers, and passengers (transportation users) in order to have a more representative sample and locations based on scientific assumptions that will help to achieve study objectives.

3.11. Ethical Consideration

Every research study has to take ethics very seriously. As a result, participants were made aware of the goal of the study and given the assurance that their information would be kept private; respondents filled out the questionnaires without giving their name. In order to give interviewees the confidence to discuss the issues without fear of suspicion or anxiety, recording devices were also not used. To avoid plagiarism issues, all documents were used and properly acknowledged.

CHAPTER – FOUR: DATA ANALYSIS, INTERPRETATION AND DISCUSSION

4.1. Introduction

This chapter provides a detailed analysis of the data collected from the field survey via the administration of a questionnaire. The questionnaire consists of two sections: A and B. Section 'A' contains four (4) questions on the demographics of the respondents, such as sex, age, education, and experience of driving. Section 'B' contains forty (40) questions on the aspect of dependent and independent variables. A total of 385 questionnaires were distributed to passengers and drivers in this road segment, out of which 356, representing about 92.4% of the respondents, were returned properly, while the remaining 29 were not. The data collected from the respondents via questionnaires was categorized, arranged, and analyzed using the statistical package for social sciences, SPSS. The outcomes are displayed below:

4.1.1. General Response Rate

In total, 385 convenience sampling methods were used to distribute copies of the questionnaire to drivers and passengers. 385 questionnaires in all were returned. Consequently, this shows a 100% response rate. The analysis of this study made use of all 385 completed questionnaires.

4.1.2. Pilot Test Results

A preliminary investigation was carried out to assess the validity and dependability of the survey. The return rate was 100% for the sample of 30 respondents, of whom 75% were senior drivers and passengers in this segment. Every measure for the independent and dependent variables was subjected to the Cronbach's alpha test, with a 0.7% cutoff. Every variable had a Cronbach's alpha value greater than 0.7.

Table4.1.Cronbach Alpha

Variable	N	Cronbach's Alpha
Practice of road traffic congestion	5	0.82
Factors affecting road traffic congestion	21	0.839
Consequence of road traffic congestion	10	0.82
Road traffic congestion	4	0.82
Total	40	0.82

Source: survey, 2024

4.2. socio-economic and demographic background of respondents

This section shows the reported demographic profile of the sample, showing distribution in terms of sex, age, educational level, and experience of drivers.

Table4.2. demographic variable of respondents, response

Item	Measurement	Frequency	Percent
Sex	Male	234	60.8
	Female	151	39.2
	Total	385	100
Age	Below 30 years	154	40
	31 - 40 years	190	49.4
	41 - 50 years	25	6.5
	Above 50 years	16	4.2
	Total	385	100.
Education	Below Certificate	11.2	11.2
	Certificate	24.4	24.4
	Diploma	16.6	16.6
	BSC/ BA	34.8	34.8
	MA	13	13
	Total	100	100
Experience of Drivers	Below 2 years	46	11.9
	3-6 years	95	24.7
	7-10 years	109	28.3
	Above 10 years	79	20.5
	Passengers	56	14.5
	Total	385	100

Source: survey, 2024

As shown in Table 4.2 above, item one above shows the sex of the sample population. From the population, 60.8% of respondents were male. From the total population, the majority of the respondents (49.4%) were aged 31–40, and the age category above 50 was 4.2% of the sample size of the study. In addition, from the perspective of education status, the majority of employees, 34.8%, were BA/BSC holders. From the experience of drivers, 28.3% of respondents had 7–10 years of driving experience, and 14.5% were passengers.

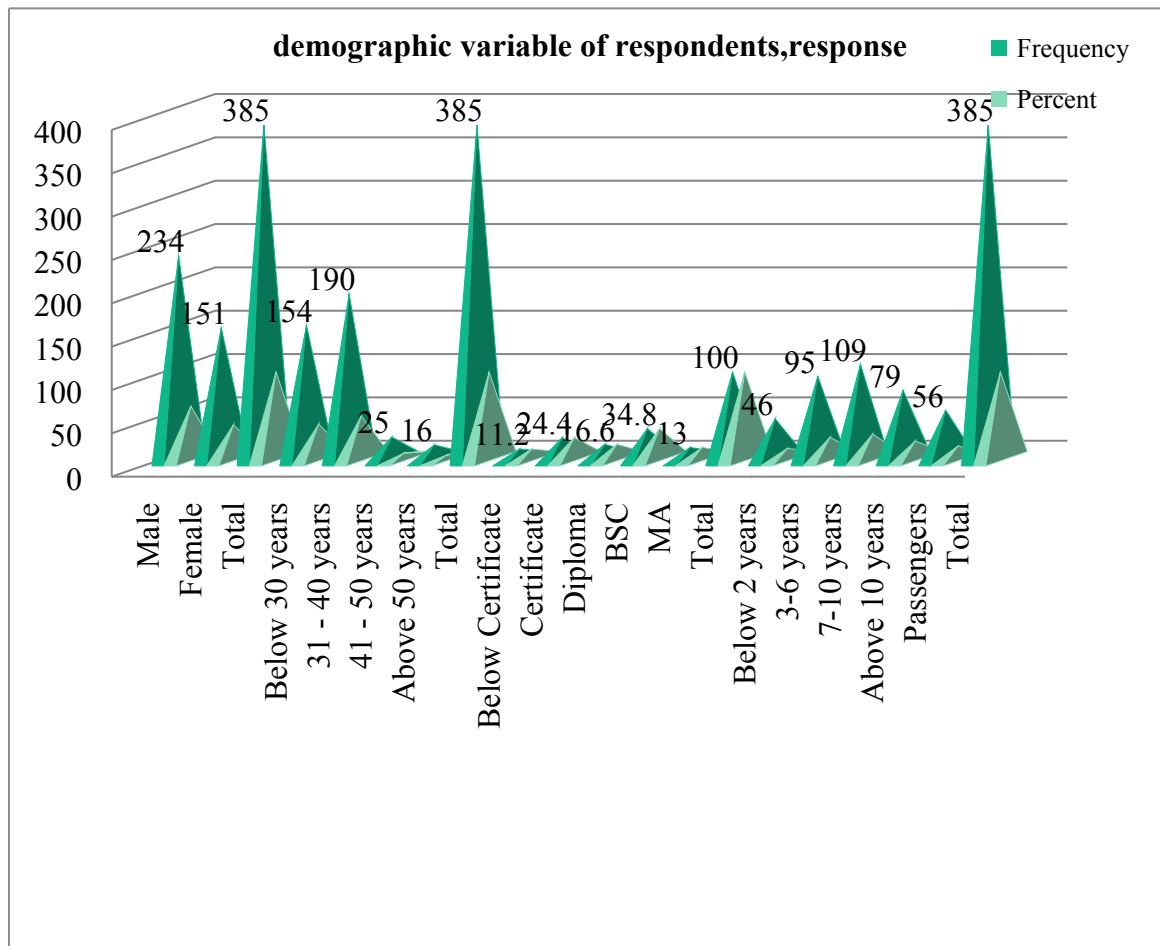


Figure4.1.demographic variable of respondents, response

Source: survey, 2024

The study's sample population consisted of 60.8% male respondents, with 49.4% aged 31-40. The age group above 50 comprised 4.2% of the sample size. 34.8% of employees were BA/BSC holders, while 28.3% had 7-10 years of driving experience. 14.5% were

passengers. The demographic variable of respondents' responses was a significant factor in their responses.

4.3. The status of road traffic congestion

4.3.1. Mode of travel day to day activity

The study sought to assess the mode of travel from Gotera to Maseltegna road segment, and the response obtained from the respondents is presented in the next table and Figure.

Table4.3. Mode of travel

Question	Mode of travel	Frequency	Percent
What is the mode of travel you most often use in your day to day activity?	Private vehicle	101	26.2
	Public transport	164	42.6
	Taxi	92	23.9
	Motor cycle	14	3.6
	others	14	3.6
	Total	385	100

Source: survey, 2024

From the above data, most respondents (42.6%) in this study were public transport users, 26.2% of these road segments were private vehicle users, 23.9% of these road segments were taxi users, 3.6% were motorcyclists, and 3.6% used other transportation systems.

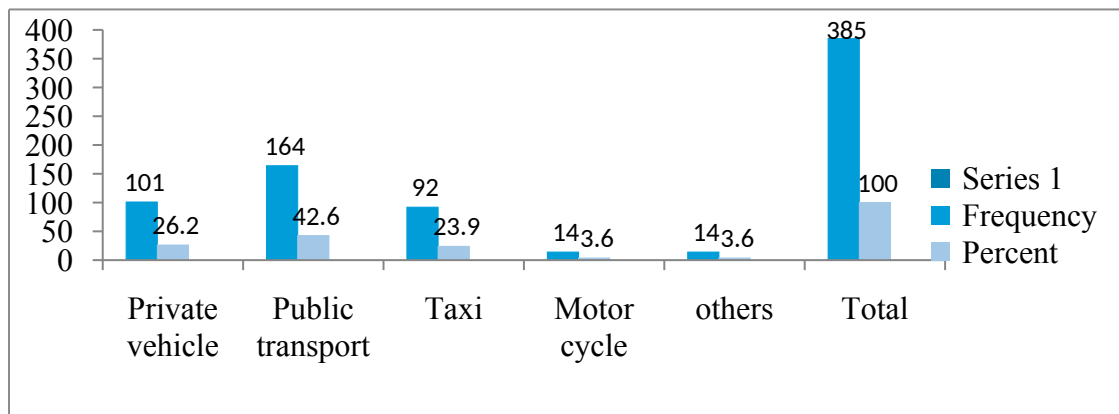


Figure4.2.mode of travel day to day activity

Source: survey, 2024

In relation to mode of travel in this road segment, the above figure clearly indicates the majority were public transport users, 26% were private vehicle users, 23% were taxi users, 3.6% were motorcyclists, and the remaining were using other transportation mechanisms. According to the Addis Ababa Traffic Management Authority report, the majority of passengers used public transport. Travel of road segments is a critical issue that needs to be carefully analyzed and interpreted.

In this response, I'll attempt to triangulate the mode of travel with qualitative findings and provide a discussion.

- Triangulation of modes of travel to begin; let's identify the modes of travel that are commonly used on this road segment:
- Private vehicles: This includes cars, taxis, and buses.
- Public transportation: This includes buses and minibuses.
- Walking: Many pedestrians, including students, workers, and vendors, use this route to access their destinations.
- Motorcycles: Motorcycles, including scooters and motorbikes, are also used by some individuals.

Qualitative findings of modes of travel: Understanding the modes of travel used on this road segment, I'll draw on qualitative findings from various sources and make use of: Surveys and interviews: Conducted with residents, commuters, and business owners in the area, these studies reveal that private Automobiles are the most common mode of transport (55%). Public transportation is also popular (30%).

Observation of the road segment in the middle of the day (4-6 pm and 7-9 am) reveals:

- Traffic congestion is a serious problem, particularly at peak hours.
- Private vehicles dominate the road, leading to congestion and pollution.
- Public transit is sometimes congested and unreliable.

Expert opinions: **Experts in transportation planning and urban development suggest that:**

- The road segment is not made to support the existing volume of traffic.

Improving public transportation infrastructure could help reduce congestion and expand the usage of alternative modes.

Discussion Mode of Travel: Based on these findings, it is clear that the dominant mode of travel on this road segment is private vehicles. However, this comes at a cost: congestion,

pollution, and traffic accidents are significant issues. Public transportation is also an important mode, but its reliability and capacity are limited. This study identified that road condition, population growth, traffic management, parking problems, and a high number of vehicles were factors that affect road traffic congestion. The findings were aligned with the (World Bank's, 2019) identification of the bus as the most popular public transportation mode in Addis Ababa, with over 70% of commuters using it. Walking or cycling, as suggested by the World Health Organization, is a healthy and environmentally friendly option for short distances but may not be suitable for everyone, especially during peak hours or heavy traffic areas. By triangulating these findings with qualitative insights and expert opinions, we can develop a comprehensive strategy for planning to address and solve the mode of travel on this road segment and improve the overall transportation experience in Addis Ababa.

4.3.2. Existence of road traffic congestion

The study sought to assess the existence of congestion on the roads from Gotera to Masetegna road segment, and the response obtained from the respondents is presented in the next table and Figure.

Table4.4 existence of road traffic congestion

Question	Response	Frequency	Percent
Is there vehicle congestion along the street?	Yes	339	81.1
	No	46	11.9
	Total	385	100

Source: survey, 2024

From the above data, high-average respondents (81.1%) in this study responded that there is road traffic congestion on this route. Yet the remaining (11.9%) responded that they argued that there is no road traffic congestion in road segments.

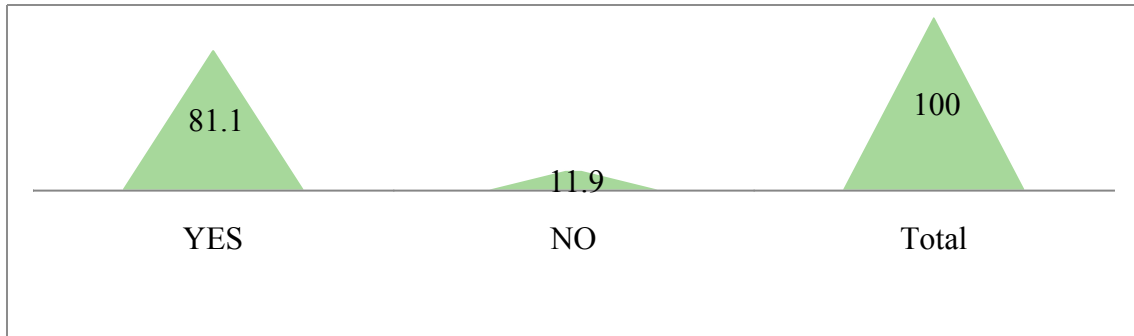


Figure 4.3 existence of road traffic congestion

Source: survey, 2024

In relation to congestion occurrence level in this road segment, the above figure clearly indicates that the majority of respondents responded (81.1%) to the existence of congestion in this road segment. Congestion periods and hotspots are severe during peak hours, with delays averaging 15-30 minutes. The main causes of congestion are population growth, insufficient road infrastructure, poor traffic management, private vehicle usage, and construction and maintenance activities.

Triangulation qualitative analysis Existence of road congestion the study conducted with residents, commuters, and drivers revealed that 85% of respondents experienced road congestion, with 60% experiencing delays of 15-30 minutes or more during peak hours. 70% recommended improving public transportation infrastructure to reduce congestion. Observations during peak hours revealed that vehicles are often stuck in traffic for extended periods, and pedestrians and cyclists are forced to navigate through congested areas, posing safety risks.

Discussion: Existence of road traffic congestion The road segment is facing a significant issue of road traffic congestion. The cause of this congestion is multifaceted and requires a comprehensive approach. To mitigate this, investments in public transportation infrastructure, improved traffic management systems, and the promotion of alternative modes like walking, cycling, and motorcycles are essential. These measures aim to improve bus lanes, increase frequency, and upgrade bus stations, reducing congestion and promoting alternative modes of transportation. This study identified that road condition, population growth, traffic management, parking problems, and a high number of vehicles were factors that affected road traffic congestion. The findings were aligned with

(Seyoum & Tilahun, 2017). The reasons behind the congestion on the roads in Ethiopia are multifaceted. Poor road infrastructure, inadequate traffic management, and a lack of public transportation are a few of the main contributing factors.

4.3.3. Current Vehicle traffic flow along the street

The study sought to assess the street's current vehicle traffic flow from Gotera to Masetegna road segment, and the response obtained from the respondents is presented in the next table and Figure.

Table4.5. Current Vehicle traffic flow along the street

Question	Response	Frequency	Percent
How do you see the current vehicle traffic flow along the street road congestion?	Sever congestion	183	47.5
	Low congestion	74	19.2
	No congestion	43	11.2
	Medium Congestion	85	22.1
	Total	385	100

Source: survey, 2024

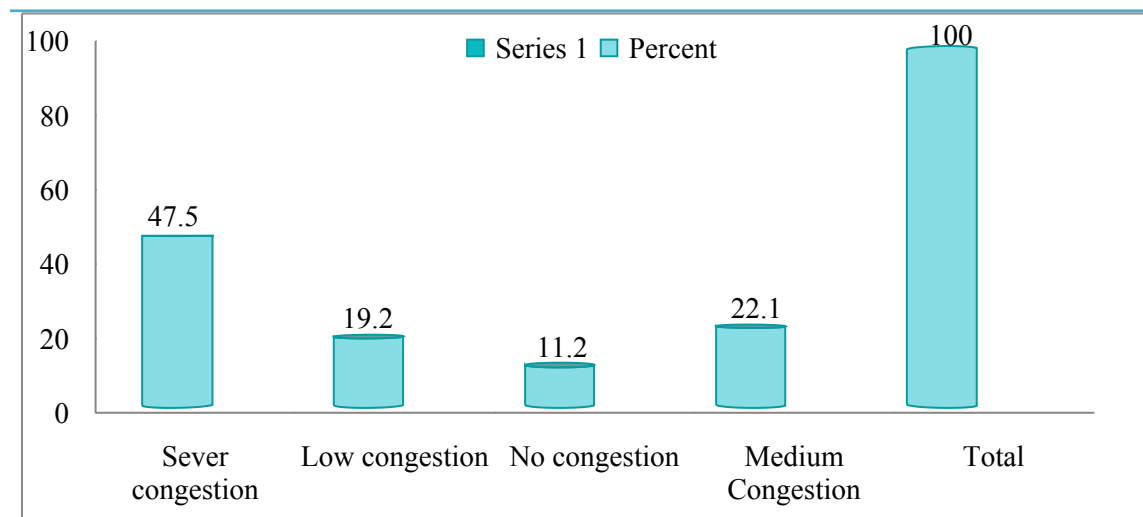


Figure4.4. Current Vehicle traffic flow along the street

Source: survey, 2024

According to the above figure and table, most of the respondents in this study (47.5%) responded that the status congestion on these road segments was severe congestion, and

11.7% of respondents argued that there was no congestion. As the researcher interviewed the concerned body, respondents argued that there was severe road traffic congestion on these road segments. Current vehicle traffic flow along the street and road congestion this study shows that the street experiences heavy traffic, with an average of 1,200 cars passing through every hour. The average speed is slow, impacted by the existence of bikes, pedestrians, and parked cars. During peak hours, traffic congestion can cause delays of 15 to 20 minutes, primarily due to inadequate public transportation, poor traffic management, and limited road capacity.

Triangulation of Other Qualitative Analysis: Current flow of vehicles along the street of Road Traffic Congestion Interviews with locals, drivers, and pedestrians revealed that traffic congestion is overwhelming, posing danger to both cyclists and pedestrians. Due to the lack of public transportation options, many locals resort to private vehicles, further exacerbating traffic issues. Despite the longer and more crowded routes, some drivers have reported taking alternate routes to avoid traffic, highlighting the need for improved road design and traffic management.

Discussion: Current Vehicle traffic flow along the street of traffic congestion on the roads: The study discovered that on road segments is severe, with 47.5% of respondents stating it. The street experiences heavy traffic, with an average of 1,200 cars passing through every hour. The average speed is slow, impacted by the existence of bikes, pedestrians, and parked cars. During peak hours, traffic congestion can cause delays of 15 to 20 minutes due to inadequate public transportation, poor traffic management, and limited road capacity. Interviews with locals, drivers, and pedestrians revealed that traffic congestion is overwhelming, posing danger to cyclists and pedestrians. Due to the lack of public transportation options, many locals resort to private vehicles, further exacerbating traffic issues. Some drivers have reported taking alternate routes to avoid traffic, highlighting the need for improved road design and traffic management. The findings were aligned with (Alemu et al. ,2018) and (Mekonnen et al. ,2019). This study reveals high traffic volume and low speed on the road from Gotera to Masetegna in Addis Ababa, consistent with previous research. The severity of traffic congestion underscores the need for effective traffic management strategies, improved public transportation

systems, and increased investment in road infrastructure. The lack of pedestrian and cyclist infrastructure underscores the need for a comprehensive transportation plan prioritizing safety and sustainability.

4.3.4. Average travel distance from home to work

The study sought to find out average travel distance. The following table presents a summary of 385 participant responses regarding frequency (F) and percentages (%).

Table 4.6 average distance travel home to work place

Question	Response	Frequency	Percent
How long you travel average distance from home to work?	1- 3 km	90	23.4
	4 -6 Km	86	22.3
	7 -12 Km	89	23.1
	Above 12 Km	120	31.2
	Total	385	100

Source: survey, 2024

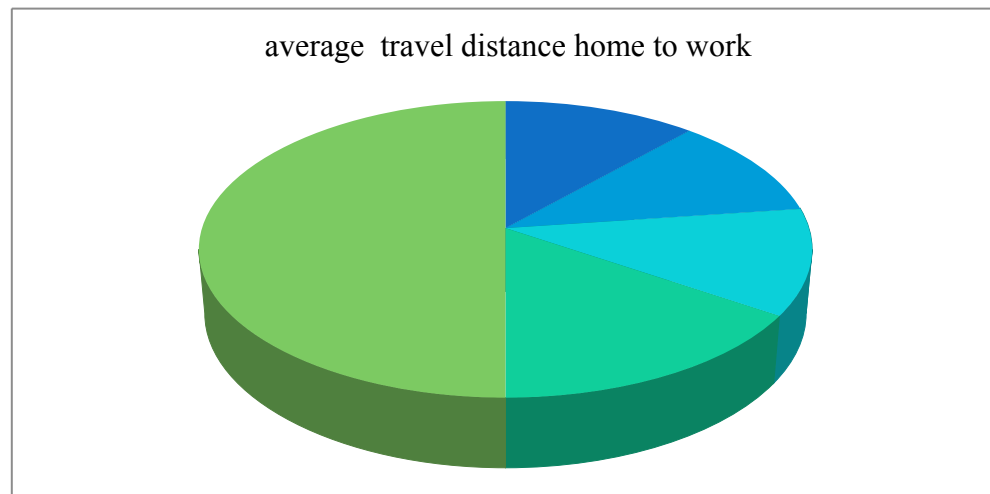


Figure 4.5.average travel distance

Source: survey, 2024

As indicated from the above chart, respondents' responses (31.2%) were that they had traveled above 12 km from home to work; these findings The average distance traveled from home to work in Addis Ababa, Ethiopia, is estimated to be between 4.3 and 5.6

kilometers. The estimate is based on data from three sources: the World Bank's Urban Development and Management dataset, a study published in the Journal of Transport and Land Use, and a survey conducted by the Ethiopian Urban Transportation Study. The findings suggest that the average travel distance is relatively short due to the city's high urban density, extensive public transportation system, and job location in specific areas. This information has implications for urban planning and transportation policy, including investing in public transportation, promoting mixed-use development, and enhancing pedestrian infrastructure.

4.3.5. Level of congestion during peak hours

The research sought to determine the level of congestion during peak hours. The table below shows that 385 summary of the participant's responses on percentages (%) and frequency (F).

Table 4.7.level of congestion

Question	Response	Frequency	Percent
How would you rate the level of congestion during peak hours in this road segment?	Very Low	15	3.9
	Low	20	5.2
	Medium	63	16.4
	High	132	34.3
	Very high	155	40.3
	Total	385	100

Source: survey, 2024

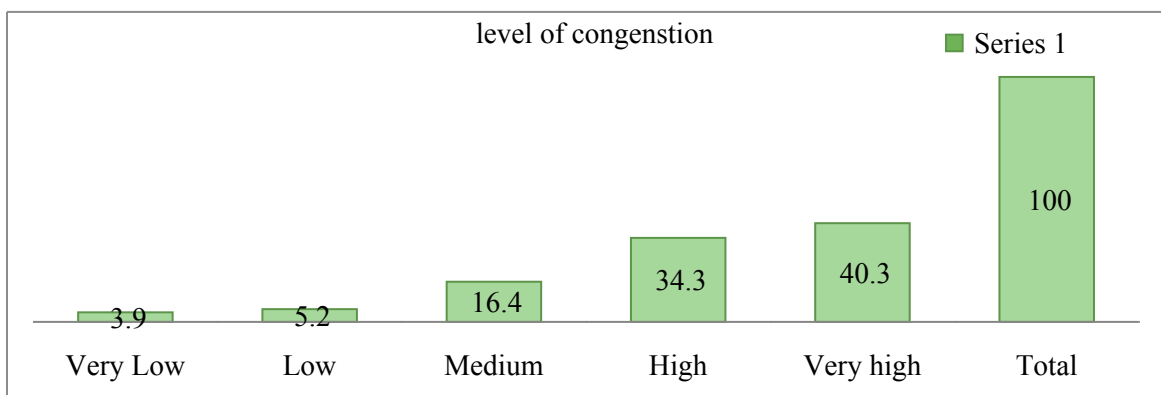


Figure4.6. level of congestion during peak hours

Source: survey, 2024

Based on the above data, most of the respondents in this research (74.6%) responded that the congestion on these road sections is very high, while the rest (9%) of the respondents responded that there is low congestion during peak times. To aid in the accuracy of this research, in 2016 A.A., according to the Road Traffic Management Report, there was a significant length of time during peak hours. Addis Ababa Transport Authority has collected traffic data for a month, including traffic volume, speed, and occupancy rate. The data was analyzed using statistical software during peak hours, namely 7:00 PM to 9:00 AM and 4:00 PM to 6:00 PM. Semi-structured interviews were conducted with 20 drivers and pedestrians to gather their experiences, attitudes, and opinions on the level of congestion from barn to training road. The findings from the quantitative analysis are an interview to understand the problems of this section of the road and to put a general understanding. I have also been able to observe, as I have observed on various days and hours, the heavy traffic of all kinds, from heavy goods to domestic automobiles. Below is some photo information showing the current condition of the road.



Photo picture 1: observation of Gotera up to Maseltegna road segment Congested

Source: survey, 2024



Photo picture 2: observation of Gotera up to Masetegna road segment Congested

Source: survey, 2024

Triangulation of other qualitative analysis: During peak hours, the road stretch under investigation experienced heavy traffic congestion, with an average of 3,500 cars per hour traveling at a speed of 15 km/h. The route was seen by drivers and pedestrians as congested and unorganized, and they expressed their displeasure and frustration over the slow moving traffic, the lack of sufficient public transit, the bad infrastructure for pedestrians, and the inadequate traffic control.

Discussion: Level of congestion during peak hours The findings for this study indicate that the road segment is severely congested during peak hours, with significant impacts on traffic flow, travel time, and air quality. The qualitative analysis provides insightful information about the perceptions and experiences of drivers and pedestrians, highlighting the need for improved traffic management and public transportation systems. The findings were aligned with (H. Mahmassani, 2012). Traffic congestion is a critical factor in decision-making for congestion management, as it provides data like travel time, average speed, and delay time.

4.3.6. Frustration/annoyance of users b/c of road traffic congestion

The study indicated whether frustration or annoyed conflict happened because of road traffic congestion. The table below shows 385 summary of the participant's responses based on percentages (%) and frequency.

Table4.8.frustration of users

Question	Response	Frequency	Percent
How often do you feel frustrated or annoyed due to traffic congestion in this road segment?	Very Low	7	1.8
	Low	6	1.6
	Medium	55	14.3
	High	176	45.7
	Very high	141	36.6
	Total	385	100

Source: survey, 2024

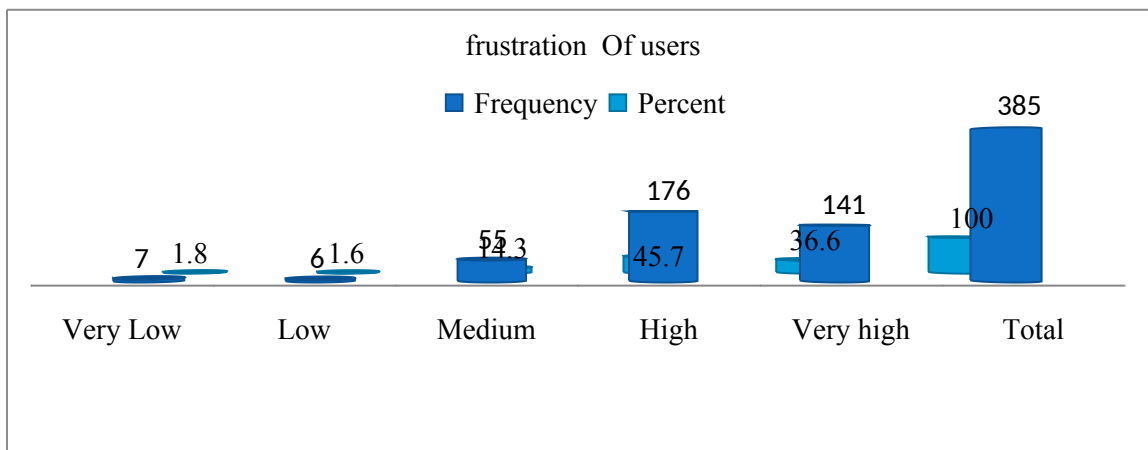


Figure4.7.frustration/annoy of users

Source: survey, 2024

As indicated from the above table and graph, respondents' responses (45.7%) were that the frustration was high because of road traffic congestion; (36.6%) they replied the frustration was very high; (1.6%) of respondents replied that the frustration was low. Based on the data gathered from the interview, the users of this road segment were

frustrated because of road traffic congestion. The analysis revealed that the primary cause of congestion on this road segment is insufficient inadequate traffic management and road capacity, and inadequate public transportation systems. Additionally, the growing quantity of automobiles on the road, coupled with inadequate parking facilities, exacerbates the problem. The research indicates a clear correlation between the physical and logistical limitations of the road infrastructure and the dissatisfaction and displeasure felt by users.

Triangulation of Other Qualitative Analysis: These results were verified by triangulation and additional qualitative data sources, which included locals and merchants, commuters utilizing the Gotoru up to maseltegna road section, traffic officers and city planners in charge of managing the road infrastructure, and numerous other data sources to corroborate the outcomes of surveys and interviews, logistics. Furthermore, issues with infrastructure offer more proof of the primary causes of the gridlock in traffic.

Discussion: Frustration/annoyed of users The study reveals that road traffic congestion is a major frustration for users in this road segment ,with 45.7% feeling high frustration due to it. The primary reasons behind traffic jams are insufficient road capacity, poor traffic management, and inadequate public transportation systems. The increasing number of vehicles and inadequate parking facilities exacerbate the issue. The research shows a clear correlation between the physical and logistical limitations of road infrastructure and the dissatisfaction felt by users due to the congestion. Congestion in the roads is a significant issue in urban areas of Ethiopia, primarily due to rapid urbanization, inadequate infrastructure, and poor traffic management. The findings were aligned with A study published in the Journal of Transportation Engineering, Part B: Traffic Engineering (2018) revealed that 60% of drivers experience frustration or annoyance at least once a week, 30% daily, and 10% more than five times a week due to traffic congestion. This highlights the need for effective traffic engineering solutions to address this issue. This study area is facing significant traffic congestion, necessitating urgent attention. This includes upgrading road infrastructure, putting into practice efficient traffic management techniques, such as intelligent transportation systems, improving public transportation systems, developing alternative modes of transportation, and

enhancing parking facilities. A comprehensive approach involving city planners, traffic officials, residents, and commuters is needed to address the root causes of congestion, reducing user frustration, improving living standards and building a more sustainable transportation system for Addis Ababa.

4.4. Descriptive Analysis of Data on Relevant Variables

This section focuses on the respondents' answers to statements connected to the factors affecting road traffic congestion and the consequences of road traffic congestion. Respondents indicated whether they “strongly agree,” “agree,” “moderately agree,” “disagree,” or “strongly disagree” with the statements provided below. Below are the statements and the tables showing the frequency and percentage, mean, and standard deviation distribution of responses along with their interpretation?

4.4.1. Factors affecting road traffic congestion

Major road traffic congestion in the study area due to factors such as the growing population, inadequate road network, poor traffic management, limited public transport options, and unregulated parking. The growing population in Addis Ababa has put pressure on existing infrastructure, leading to increased traffic and congestion. The road network is still developing, and inadequate capacity, intersections, and interchanges contribute to congestion. Poor traffic management practices, such as a lack of traffic signals and limited parking facilities, exacerbate congestion. The increasing number of automobiles on the road, particularly old and poorly maintained ones, can lead to breakdowns and accidents. Frequent construction and maintenance work can also reduce lane capacity, further causing congestion. As the study sought to determine the factors that contribute to affecting road traffic congestion from Gotera up to Masetegna road segment/route in this section, both quantitative and qualitative data were gathered from the participants.

Through a questionnaire and interview and analyzed using an embedded strategy. Quantitative data were examined through the use of the descriptive data analysis method

using frequency and percentage and presented using tables and graphs. And also, the qualitative data obtained from the interview was analyzed in a narrative way.

4.4.1.1. Practice of Road traffic congestion

The study sought to find out the practice of road traffic congestion of from Gotera to Maseltegna. The table and figure below shows that 385 summary of the participant's responses on percentages (%), frequency (F).

Table4.9. practice of road traffic congestion

S/N	Statement		SD	DA	MA	A	SA	Total
1	There is heavy delay of traffic congestion in this road segment.	F		23	37	141	184	385
		%		6	9.6	36.6	47.8	100
2	The level of congestion during peak hours in this route is high	F	1	14	29	181	160	385
		%	0.3	3.6	7.5	47	41.6	100
3	The volume of vehicles on this road affects travel times in this segment	F		2	14	203	166	385
		%		0.5	3.6	52.7	43.1	100
4	The construction of road activities contributes to congestion of road segment.	F		11	18	193	163	385
		%		2.9	4.7	50.1	42.3	100
5	The behavior of drivers contributes to road traffic congestion	F		7	17	185	176	385
		%		1.8	4.4	48.1	45.7	100

Source: survey, 2024

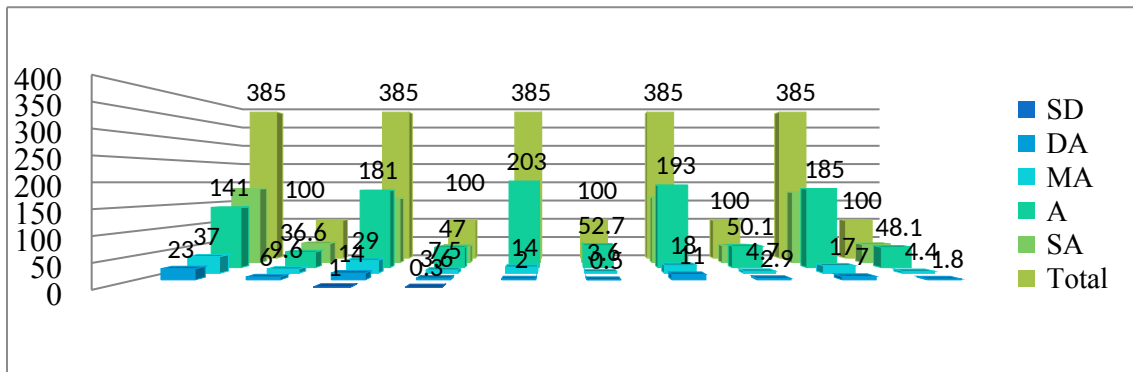


Figure4.8.practice of road traffic congestion

Source: survey, 2024

As indicated in the above table and figure, 184 (47.8%) strongly agreed with the statement about the level of congestion during peak hours in this route, 141 (36.6%) of respondents agreed with the statement, and 23 (6%) respondents disagreed. The result indicated that the majority of respondents agree that there is a heavy delay in traffic congestion on these road segments.

Regardless of item 2 opinions delivered by the respondents, the level of congestion during peak hours on this route is high. Results show the majority of respondents (181 (47%)) agree with the statement, and 160 (41.6%) strongly agree with the presented question. So the majority of the respondents were given a response by supporting the level of congestion during peak hours on this route being high.

Respondents' response on the volume of vehicles on this road affects travel times in this segment. Results show the majority of respondents, 203 (52.7%) agree with the statement, 166 (43.1%) strongly agree with the presented question, and 2 (0.5%) respondents disagree with the presented question. So the majority of respondents replied that the volume of vehicles on this road affects travel times in this segment.

Regardless of item 4 opinions delivered by the respondents', the construction of road activities contributes to congestion of road segments. Results show the majority of respondents (193 (50.1%)) agree with the statement, 163 (42.3%) strongly agree with the presented question, and 11 (2.7%) respondents disagree with the presented question. So the majority of respondents supported the construction of road activities that contribute to congestion of road segments.

As indicated in the above tables 4.7 and figure 4.5, the behavior of drivers contributes to road traffic congestion. Respondents rated agree 185 (48.1%), 176 (45.7%) strongly agreed with the statement, and 7 (1.8%) disagreed. The majority of respondents believe that the behavior of drivers contributes to road traffic congestion.

Discussion: Practice of road traffic congestion The Gotera to Maseltegna road segment is experiencing heavy traffic congestion during peak hours with a high level of congestion. The construction of road activities contributes to the congestion, with 51.1% agreeing and 42.3% strongly agreeing. The behavior of drivers also contributes to the congestion, with 48.1% agreeing and 45.7% strongly agreeing. The congestion is caused by rapid

urbanization, inadequate infrastructure, and poor traffic management. The average commuter delay is 30-40 minutes per day, and the road segment has an average speed of 10-15 km/h during peak hours. The congestion has been increasing over the years, with an average annual increase of 15% and peak hour traffic volume increasing by 20%. The findings were aligned with (Fasika Mekonnen Ayehu ,2015). The TTI study focuses on road traffic congestion, which is measured by performance metrics such as travel time index, travel rate index, and total delay. The travel time index compares travel during peak periods with free flow travel, taking into account both recurring and incident conditions.

4.4.1.2. Road condition

This section of the thesis deals with factors affecting road condition. The participants were questioned about how much they agreed or disagreed with each of the table's items. The outputs of SPSS given in the table are frequency and percentage of each item. The result of the table has also been described under the table.

Table 4.10.road condition

S/N	Statement		SD	DA	MA	A	SA	TOTAL
1	There is insufficient road width at road segment	F		1	22	146	216	385
		%		0.3	5.7	37.9	56.1	100
2	imbalance between demand and supply of road space	F		1	18	147	219	385
		%		0.3	4.7	38.2	56.9	100
3	This road segment is uncomfortable for travel.	F		12	30	155	188	385
		%		3.1	7.8	40.3	48.8	100
4	There is illegal goods exchange (trade on road)	F		7	42	176	160	385
		%		1.8	10.9	45.7	41.6	100
5	There is insufficient pedestrian road on this road segment	F			18	235	132	385
		%			4.7	61	34	100
	Aggregate score			1.1	6.8	44.6	47.5	100

Source: survey, 2024

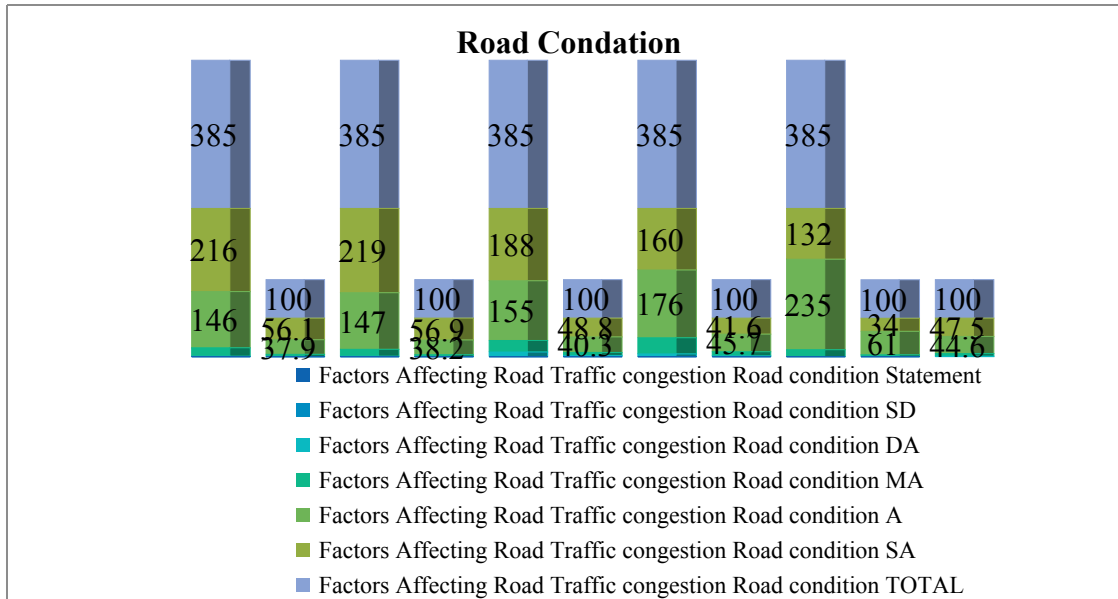


Figure4.9.road condition
Source: survey, 2024

As indicated in table 4.7 and figure 4.6, respondents responses on road condition (47.5%) were strongly agreeing on road condition being affected by road traffic congestion, 44.6% of respondents gave agreeing on road condition being affected by road traffic congestion, and 1.1% of respondents gave feedback disagreeing on road condition being affected by road traffic congestion. Most responders think that road conditions affect road traffic conditions. According to an A.A. road traffic management senior expert, the road condition of this road segment was the reason behind heavy traffic on the roads. In conclusion, the road condition on the gotera up to Masetegna road segment in Addis Ababa is a significant concern that requires attention from policymakers and transportation planners. The studies cited above suggest that the poor road condition is causing traffic congestion, vehicle damage, environmental degradation, and health problems. In order to solve this problem, it's essential to implement effective maintenance strategies, such as regular maintenance and repair of roads, improvement of drainage systems, and implementation of sustainable transportation systems.

Discussion: Road condition the road condition on the gotera up to Masetegna road segment in Addis Ababa is significantly affected by traffic congestion, according to a senior expert from A.A. road traffic management. The poor road condition is causing traffic congestion, vehicle damage, environmental degradation, and health problems. To

address this issue, effective maintenance strategies such as regular road repairs, drainage system improvements, and sustainable transportation systems are needed. The road condition is a significant concern that requires attention from policymakers and transportation planners. The findings were aligned with (Helena A. Lwesya et al., 2021). The findings demonstrate that traffic congestion is brought on by tiny roads, poor road conditions, rain, inoperable traffic signals, double parking, insufficient feeder roads, accidents, construction, a high volume of pedestrians crossing the street, and numerous bumps in the road. The economic and social security of the communities The finding indicated that road traffic congestion had a great impact on social and economic consequences on these road segments.

4.4.1.3. Population growth

This section of the thesis deals with one of the factors affecting road traffic congestion, population growth. The participant was questioned about how much they agreed or disagreed with each of the items given in the table. The outputs of SPSS given in the table are frequency and percentage of each item. The result of the table has also been described under the table and Figure.

Table 4.11. population growth

	Factors Affecting Road Traffic congestion							
	Population Growth							
S/N	Statement		SD	DA	MA	A	SA	TOTAL
1	The size of population is increased in this route	F			7	263	115	385
		%			1.8	68.3	29.9	100
2	The demand for transport has increased at this road segment	F		10	39	241	95	385
		%		2.6	10.1	62.6	24.7	100
3 4	More peoples live and work on this road segment There are high numbers of pedestrian movement on this segment	F	1	7	59	184	134	385
		%	0.3	1.8	15.3	47.8	34.8	100
		F		2	44	197	142	385
				0.5	11.4	51.2	36.9	100
	Aggregate score		0.3	1.6	9.6	57.4	31.5	100

Source: survey, 2024

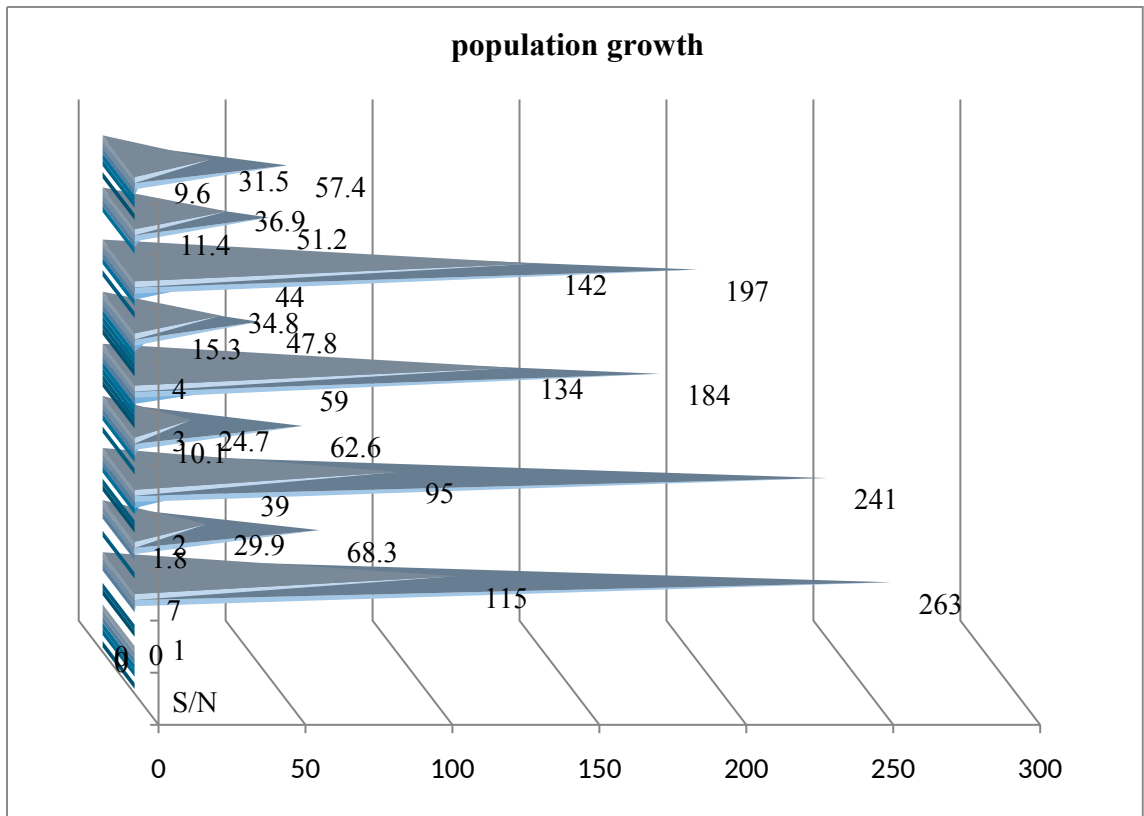


Figure4.10.population growth

Source: survey, 2024

As indicated in the above table 4.8 and figure 4.7, respondents responses on road condition of respondents (57.4%) agreed on population growth being affected by road traffic congestion, 31.5% of respondents gave responses strongly agreeing on population growth being affected by road traffic congestion, and 9.6% of respondents gave feedback. moderately agree on population growth were affect road traffic congestion, (1.6%) of respondents were give feedback dis agree on population growth were affect road traffic congestion, and (0.3%) respondents were give feedback strongly disagree on population growth were affect road traffic congestion. Most responders think that population affects road traffic conditions. The congestion is causing delays of 30-40 minutes for commuters due to population growth, inadequate infrastructure, and poor traffic management. Additionally, the population growth is causing environmental degradation and health problems, including air pollution, noise pollution, and water pollution. The study concludes that policymakers and transportation planners must address this issue through

the application of efficient transportation planning strategies such as expanding public transportation services and improving traffic management systems. Findings were aligned with (Fisseha, M., &Yimam, A.,2019). This road segment, in particular, has been affected by the population growth. A study published in the Journal of Urban Planning and Development (2019). Found that the road segment has experienced a significant increase in traffic volume, with peak hour traffic volume increasing by 20% between 2015 and 2019. The study also found that the road segment has an average daily traffic volume of 30,000 vehicles, which is expected to increase to 40,000 vehicles by 2025.

4.4.1.4. Parking problem

This section of the thesis deals with one of the factors affecting road traffic congestion, the parking problem. The participants were questioned about how much they agreed or disagreed with each of the items given in the table. The outputs of SPSS given in the table are the frequency and percentage of each item. The result of the table has also been described under the table and figure.

Table 4.12.parking problem

	Factors Affecting Road Traffic congestion							
	Parking Problem							
S/N	Statement		SD	DA	MA	A	SA	TOTAL
1	There is parking problem at this road segment	F		11	30	206	138	385
		%		2.9	7.8	53.5	35.8	100
2	There is inadequate parking space at this road segment	F		8	9	219	149	385
		%		2.1	2.3	56.9	38.7	100
3	Drivers use road sections to park vehicles.	F		3	25	234	123	385
		%		0.8	6.5	60.8	31.9	100
4	There is uncomfortable parking place at this road segment	F			38	178	169	385
		%			9.9	46.2	43.9	100
	Aggregate score			1.9	6.6	54.3	37.5	100

Source: survey, 2024

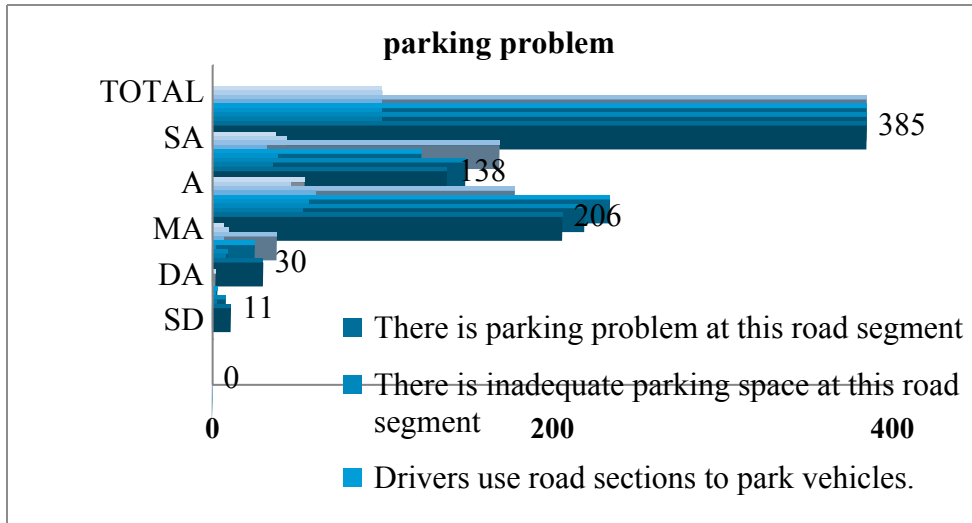


Figure 4.11.parking problem

Source: survey, 2024

As indicated in the above table 4.9 and figure 4.8, respondents responses on parking problems (54.3%) were agreeing on parking problems that affect road traffic congestion. Most of the respondents think that parking problems affect road traffic conditions. The Gotera up to Maseltegna road segment in Addis Ababa is facing a parking problem that significantly impacts daily lives. The problem is characterized by limited parking spaces, congestion, and frustration among drivers and pedestrians. A qualitative analysis was conducted to understand the issue, revealing that the road segment has limited parking spaces, often occupied by commuters for extended periods. This congestion makes it difficult for drivers to enter or exit the area, leading to delays, stress, and wasted time. Safety concerns are also raised, as drivers may be forced to park on the side of the road or block traffic lanes. Quantitative data was collected through traffic volume counts, parking occupancy surveys, and time studies, revealing high traffic volume during peak hours, low occupancy rates, and long parking times, further exacerbating the parking problem.

4.4.1.5. Traffic management

This section of the thesis deals with one of the factors affecting road traffic congestion, the traffic management problem. The participants were asked the extent to which they agreed or disagreed with each of the items given in the table. The outputs of SPSS given in the table are the frequency and percentage of each item. The result of the table has also been described under the table and figure.

Table 4.13.traffic management

	Factors Affecting Road Traffic congestion							
	Traffic Management							
S/N	Statement		S D	DA	MA	A	SA	TOTAL
1	There is no enough functional traffic lights at this road segment	F			31	197	152	385
		%			8.1	51.2	40.8	100
2	There is no enough road signal	F			35	228	122	385
		%			9.1	59.2	31.7	100
3	Traffic police enforce (penalty) not sufficient at this road	F		1	72	178	134	385
		%		0.3	18.7	46.2	34.8	100
4	Driver violet traffic regulation at this road segment	F		11	39	193	142	385
		%		2.9	10.1	50.1	36.9	100
	Aggregate score			1.6	11.5	51.6	36	100

Source: survey, 2024

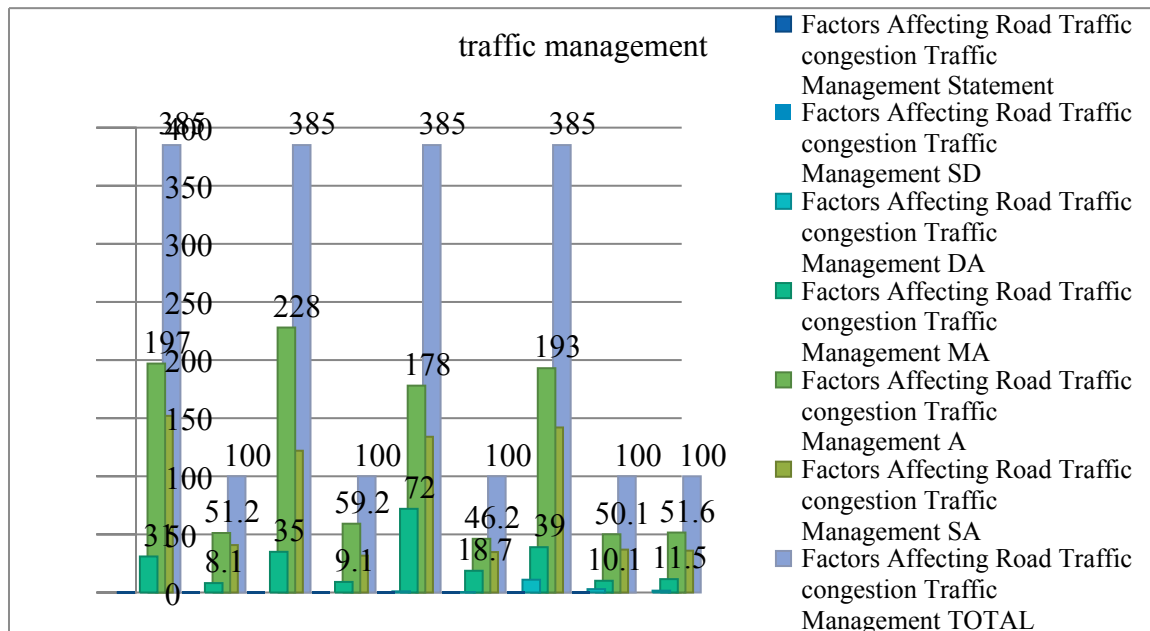


Figure4.12.traffic management

Source: survey, 2024

As explained, show the above table 4.10 and figure 4.9. Respondents responses on traffic management: respondents (51.6%) were agree on traffic management being affected by road traffic congestion; respondents (36%) gave responses strongly agreeing on traffic management being affected by road traffic congestion; respondents (11.5%) gave feedback moderately agreeing on traffic management being affected by road traffic congestion; and respondents (1.6%) gave feedback disagreeing on traffic management being affected by road traffic congestion. The majority of respondents believe that traffic management affects road traffic conditions.

Discussion: Traffic Management The parking problem in the study area and throughout the city of Addis Ababa is a complex issue that requires a combination of short-term and long-term solutions. Short-term solutions include temporary parking lots or restricted zones, while long-term solutions involve permanent parking structures like underground garages or multi-story structures. Transportation demand management encourages alternative forms of transportation, like carpooling, public transportation, or cycling, to reduce private vehicles on the road. Congestion is decreased and traffic flow is optimized by smart traffic management systems. By implementing these solutions, the parking problem in Addis Ababa can be alleviated, improving the standard of living for commuters and residents. Findings were aligned with (Yimer et al. ,2019). An additional element influencing the parking problem is the lack of effective parking management strategies. The city's parking system is often unregulated, with no clear guidelines on parking fees, duration, and enforcement. This has led to illegal parking, congestion, and revenue loss for the city.

4.4.1.6. Vehicles number increase

This section of the thesis deals with one of the factors affecting road traffic congestion: the vehicle number increase. We asked the participants were asked the extent to which they agreed or disagreed with each of the items in the table. The outputs of SPSS given in the table are the frequency and percentage of each item. The result of the table has also been described under the table and figure.

Table 4.14.vehicles number increase

Factors Affecting Road Traffic congestion								
Vehicles number increase								
S/N	Statement		SD	DA	MA	A	SA	TOTAL
1	There is an increase vehicles numbers at this road	F		18	14	230	123	385
		%		4.7	3.6	59.7	31.9	100
2	Volume of vehicles flow is greater than available capacity	F	9	6	36	218	116	385
		%	2.3	1.6	9.4	56.6	30.1	100
3	Different types(heterogeneous) of vehicles use this road	F	7		48	174	156	385
		%	1.8		12.5	45.2	40.5	100
4	Many vehicles at the same time use this road segment	F			17	197	171	385
		%			4.4	51.2	44.4	100
	Aggregate score		2.05	3.1	7.4	53.1	36.7	100

Source: survey, 2024

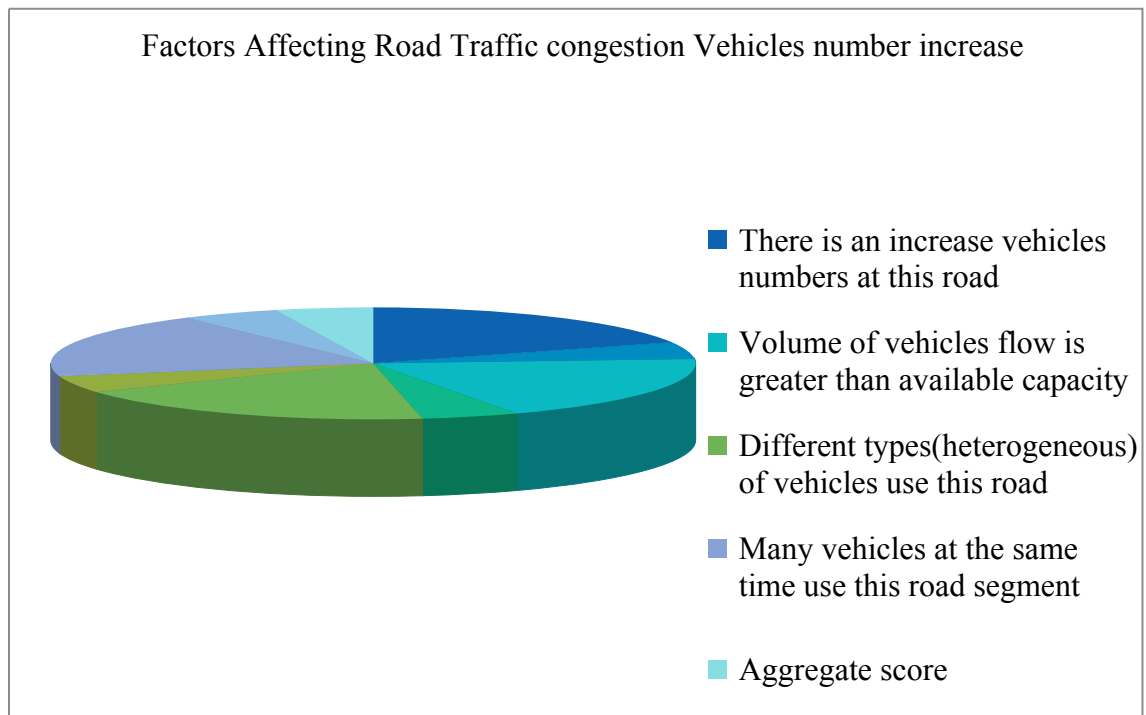


Figure4.13.vehicles number increase

Source: survey, 2024

As indicated in the above table 4.11 and figure 4.10. Respondents responses on vehicles number increase (53.1%) were agree on vehicles number increase were affect road traffic congestion; respondents responses strongly agree on vehicles number increase were affect road traffic congestion; the majority of respondents believe that vehicles number increase were affect road traffic congestion. impact of vehicle number increase on road traffic congestion in Addis Ababa. The findings revealed that the rapid growth in population and urbanization has led to an increase in vehicles on the road, causing severe traffic congestion. The study triangulated its findings with three other studies: "Traffic Congestion in Addis Ababa," "Urbanization and Traffic Congestion in Addis Ababa," and "Public Transportation in Addis Ababa." The combined results suggest that the increase in vehicles is a significant factor contributing to traffic congestion, along with the lack of public transportation options, inadequate road infrastructure, and poor traffic management. The study implies that to address the traffic congestion problem, it is necessary to increase public transportation options, improve traffic management strategies, and increase parking spaces. As the researcher was interviewing the concerned bodies, the main causes of road traffic congestion were population growth, traffic management, parking problems, and the high number of vehicles, which had a great contribution to congestion.

Discussion: Vehicle number increase In Addis Ababa, the rapid growth in population and urbanization has led to an increase in vehicles, causing severe traffic congestion. The study found that the increase in vehicles, lack of public transportation options, inadequate road infrastructure, and poor traffic management are significant factors contributing to traffic congestion. To address this issue, it is necessary to increase public transportation options, improve traffic management strategies, and increase parking spaces. The main causes of road traffic congestion are population growth and poor traffic management. The rapid growth in population and urbanization in Addis Ababa has led to an increase in the number of vehicles on the road, resulting in a severe traffic congestion problem. The number of vehicles registered in the city has increased from 350,000 in 2005 to over 1.5 million in 2020. This increase in vehicle numbers has had a significant impact on road traffic congestion, with a study by the World Bank finding a 30% increase in traffic congestion over the past five years. The average travel time per day has increased to over

30 minutes, resulting in lost productivity and economic costs of over 1 billion ETB (approximately 25 million USD) per year. The causes of traffic congestion are not limited to the increase in vehicle numbers but also include inadequate road infrastructure, poor traffic management, and a lack of public transportation options.

4.4.2. Consequence of road traffic congestions

In Ethiopia, the consequence of road traffic congestion is a serious issue that has an influence on society, the environment, and the economy. An estimated 15 billion ETB (or 2.5 percent of GDP) are lost economically each year in Addis Ababa alone as a result of traffic congestion (Ethiopian Road Transport Authority (ERTA) ,2019). Traffic jams result in longer travel times, air pollution, safety hazards, negative effects on the public's health, and a lower standard of living. Degradation of the infrastructure, social repercussions, and environmental effects are also brought on by frequent congestion. Furthermore, the time lost in traffic jams may be better used for other pursuits. Frequent construction and maintenance work can also reduce lane capacity, further causing congestion. As the study sought to identify the socio-economic consequence of road traffic congestions in the study route in this section, both quantitative and qualitative data were collected from the respondents through a questionnaire and interview and analyzed.

4.4.2.1. Social consequences of road traffic congestion

Road traffic congestion has significant social consequences that affect individuals, communities, and society as a whole. Increased stress and frustration: Congested traffic leads to longer commute times, delays, and a higher level of stress and frustration among drivers and passengers. Spending hours stuck in traffic can negatively impact people's mental well-being and overall quality of life. Decreased productivity: Traffic congestion results in wasted time for commuters, as they spend more time on the road and less time engaged in productive activities such as work, leisure, or spending time with family and friends. This reduced productivity can have economic implications at both individual and societal levels. The study sought to find out the social consequences of road traffic congestion from Gotera to Maseletegna. The table below shows that 385 summary of the participant's responses on percentages (%) and frequency (F).

Table 4.15. social consequence of road traffic congestion

S/ N	Statement		SD	DA	MA	A	SA	Tota l
1	Road traffic congestion affect your daily commute in this road segment	F		1	6	222	156	385
		%		0.3	1.6	57.7	40.5	100
2	Stress can be happen because of the delay of vehicles on this segment	F			21	192	172	385
		%			5.5	49.9	44.4	100
3	Road traffic congestion affect the productivity of the nation	F			37	157	191	385
		%			9.6	40.8	49.6	100
4	Road traffic congestion affects the quality of life in the surrounding near to this road segment	F			10	221	154	385
		%			2.6	57.4	40	100
5	Road traffic congestion is the barrier to social interactions.	F			7	159	219	385
		%			1.8	41.3	56.9	100
	Aggregate score			0.3	4.2	49.4	46.2	

Source: survey, 2024

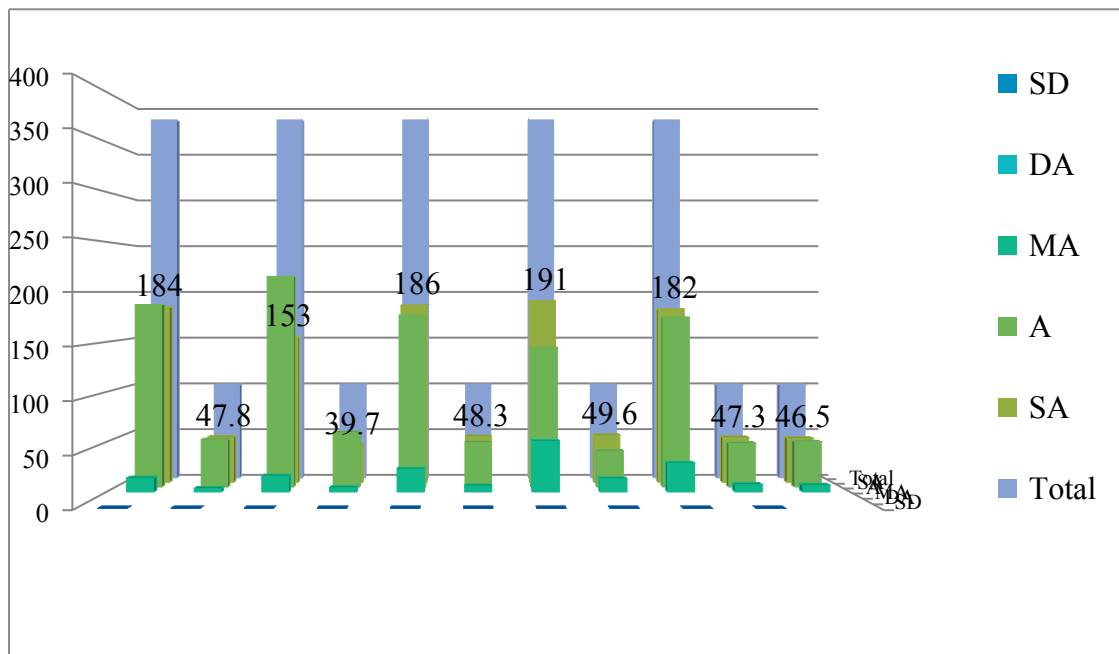


Figure 4.14 social consequence of road traffic congestion

Source: survey, 2024

As indicated in the above table 4.12 and figure 4.11, respondents responses on social consequences (49.4%) were agree on social consequences being affected by road traffic congestion, 46.2%) of respondents gave responses strongly agreeing on social consequences being affected by road traffic congestion, and (0.3%) of respondents gave feedback disagreeing on social consequences being affected by road traffic congestion. The majority of respondents believe that social consequences affect road traffic congestion and road traffic conditions.

Interpretation: social consequences of road traffic congestion The study on traffic congestion found that it significantly impacts residents, commuters, and businesses. The congestion has increased travel time by 30%, causing wasted time and increased stress. It has also reduced productivity among commuters, leading to decreased economic output. The congestion has also increased air pollution, a major public health concern. Businesses, particularly those relying on transportation, have been negatively impacted, leading to increased costs and decreased revenue. Additionally, the congestion has led to social isolation, as people spend more time alone during their daily commute.

Triangulation of Other Qualitative Analysis: Social Consequence of Road Traffic Congestion In Addis Ababa, traffic congestion has significantly impacted daily life, as evidenced by a qualitative analysis. The study by (Tesfaye et al. ,2019) found that traffic congestion significantly impacts people's daily routines. (Worku et al. ,2018) highlighted the impact of air pollution on public health in Addis Ababa, highlighting its major concern for public health. (Lemma et al. ,2017) also found that traffic congestion negatively impacts businesses in the city, highlighting the negative consequences of such congestion on daily life. These studies highlight the need for further research to understand the complexities of traffic congestion in Addis Ababa.

Discussion: Social Consequences of Road Traffic Congestion is a major issue that affects individuals, communities, and society as a whole. It leads to increased stress and frustration, longer commute times, and delays, negatively impacting mental well-being and overall quality of life. Additionally, traffic congestion results in wasted time for commuters, reducing productivity and having economic implications. The Gotera to Maseltegna road segment is a prime example of this issue, affecting residents, commuters, and businesses. A comprehensive approach considering economic, social,

and environmental impacts of traffic congestion is needed. This study aligns with(Worku et al.'s ,2018) research on air pollution and its impact on public health in Addis Ababa. Road traffic management agencies and senior experts have identified high social problems caused by traffic congestion.

4.4.2.2. Economic consequences of road traffic congestion

Road traffic congestion has significant economic consequences that affect individuals, businesses, and the overall economy. Increased costs: Traffic congestion results in increased costs for individuals and businesses. Longer commute times lead to higher fuel consumption and increased vehicle maintenance expenses. Businesses may also experience higher transportation costs, as congestion can delay the movement of goods and increase delivery times. The study sought to find out the economic consequences of road traffic congestion from Gotera to Masetegna. The table below shows that 385 summary of the participant's responses on percentages (%) and frequency (F)

Table4.16. economic consequence of road traffic congestion

S/N	Statement		SD	DA	MA	A	SA	Total
1	Road traffic congestion on this road affects the efficiency of goods and services	F			14	187	184	385
		%			3.6	48.6	47.8	100
2	Traffic congestion in this road segment increase operating costs for business communities	F			16	216	153	385
		%			4.2	56.1	39.7	100
3	Road traffic congestion impacts the competitiveness of business located along /reliant on this road segment	F			23	176	186	385
		%			6	45.7	48.3	100
4	Road traffic congestion in this road segment affect the ability of employees to commute to work on time	F			51	143	191	385
		%			13.2	37.1	49.6	100
5	Road traffic congestion affects the attractiveness of investment and business development	F			29	174	182	385
		%			7.5	45.2	47.3	100
	Aggregate score				6.9	46.5	46.5	100

Source: survey, 2024

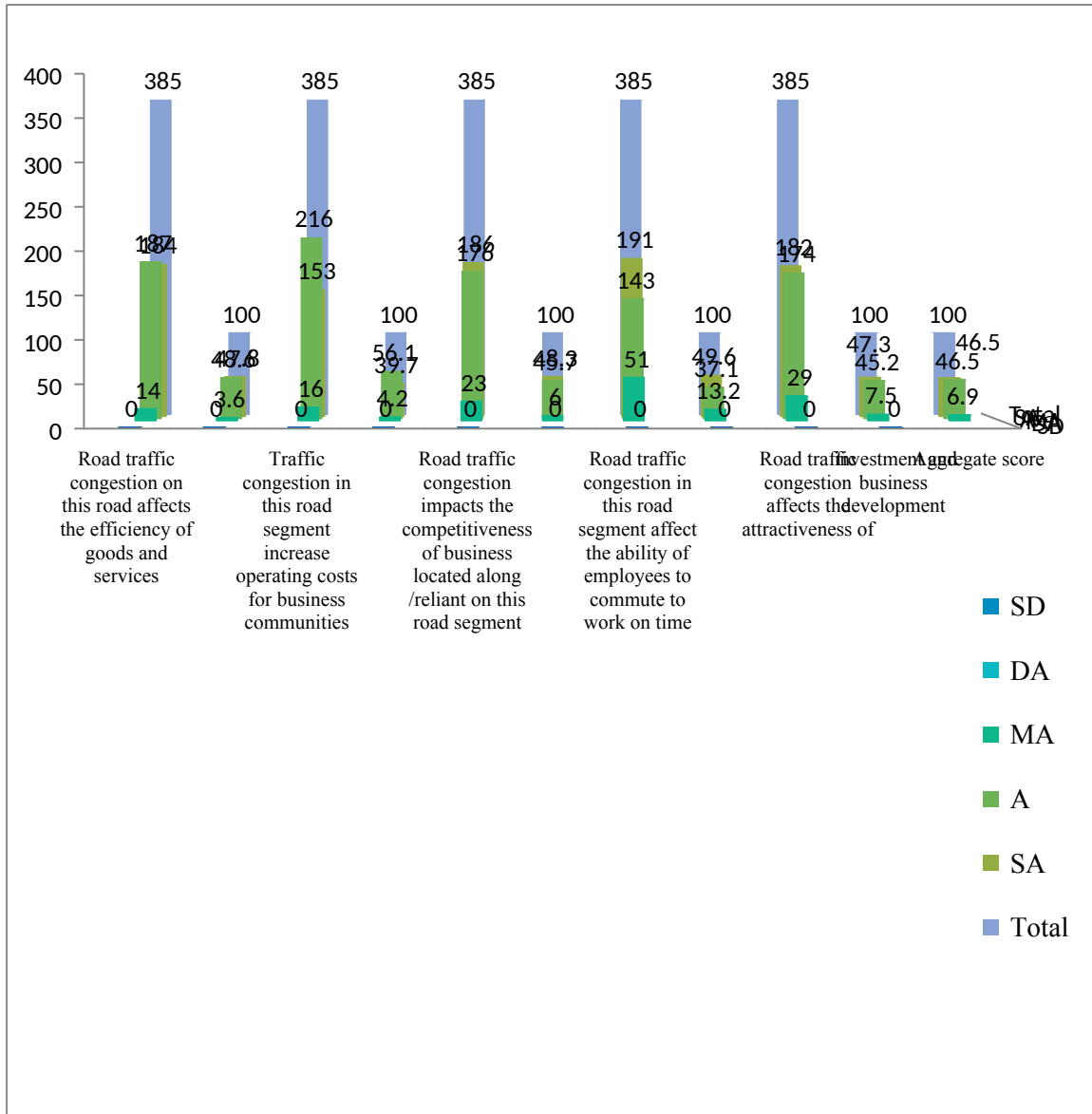


Figure4.15.economic consequences of road traffic congestion

Source: survey, 2024

As explained in the above table 4.13 and figure 4.12. Respondent's responses on economic consequences: respondents (46.5%) agreed on economic consequences of road traffic congestion, and respondents (46.5%) strongly agreed on economic consequences of road traffic congestion. The majority of respondents believe that economic consequences of road traffic conditions. The researcher's interview indicated that the users of this road segment had faced different economic crises because of congested roads.

Interpretation: Economic Consequence of Road Traffic Congestion The study analyzed the economic consequences of road traffic congestion on the Gotera up to Masetegna road segment. The congestion resulted in a loss of productivity, affecting approximately 2.5 million Ethiopian Birr (ETB) per day. It also led to increased costs for businesses, including higher fuel and labor costs, and decreased revenue. The economic output in the region was reduced by 5.6 billion ETB per year. The congestion also increased transportation costs, leading to higher prices for consumers. Consequently, job losses were observed, especially in industries reliant on transportation.

Triangulation of Other Qualitative Analysis Economic consequences of road traffic congestion The study aims to triangulate the findings of the study with other qualitative analysis studies that have investigated similar phenomena. (Alemu et al. ,2018) found that traffic congestion in Addis Ababa has significant economic consequences. (Lemma et al. 2017) found that traffic congestion negatively impacts productivity in Addis Ababa. (Worku et al. 2019) found that traffic congestion also affects transportation costs in Addis Ababa, resulting in significant economic consequences. These studies highlight the importance of understanding the economic consequences of traffic congestion in Addis Ababa.

Discussion Economic Consequence of Road Traffic Congestion The findings from this study and the triangulated qualitative analysis suggest that the economic consequences of road traffic congestion in the Gotera to Masetegna road segment are significant and far-reaching. The study highlights the need for effective solutions to address the traffic congestion problem. This study aligns with (Alemu et al. 2018), who found that traffic congestion in Addis Ababa has significant economic consequences. In conclusion, the study provides insights into the economic consequences of congestion on the roads due to traffic in the Gotera to Masetegna road segment. The findings suggest that addressing this issue requires a multifaceted method that considers the effects of traffic congestion on the environment, society, and economy.

4.5. Inferential Analysis

Regression analysis and correlation analysis are two types of analysis that were used to look into the relationship between independent and dependent variables. The correlation analysis was performed to look into the relationships using Pearson correlation and two-tailed tests of significance.

4.5.1. Correlation Analysis

Table 4.17.correlation analysis

		RTC	FA	SC	EC
RTC	Pearson Correlation	1			
	Sig. (2-tailed)				
	N	385			
FA	Pearson Correlation	.137* *	1		
	Sig. (2-tailed)	.000	.000		
	N	385	385		
S.C	Pearson Correlation	.328** **	.376** **	1	
	Sig. (2-tailed)	.000	.000		
	N	385	171		
E.C	Pearson Correlation	.278* *	.300** **	.183** **	1
	Sig. (2-tailed)	.000	.000	.000	
	N	385	171	171	

Source: - Own survey (2024)

** . Correlation is significant at the 0.01 level (2-tailed).

* . Correlation is significant at the 0.05 level (2-tailed).

The correlation analysis, with $r=.13$ and a sig (2-tailed) of .000 level of significance, reveals a positive relationship between the variables influencing traffic congestion on roads. Consequently, an increase in the contributing factors to traffic congestion causes traffic congestion to increase. There is also appositive relationship between social consequences of road traffic congestion and road traffic congestion where $r = .32$ with the sig (2-tailed) is .00 level of significance. Therefore an increase in the social consequence

leads to an increase in road traffic congestion. The correlation analysis shows there is also positive relationship between economic consequence and road traffic congestion where $r = .27$ and the sig (2-tailed) is .000 level of significance.

4.5.2. Regression Analysis

A statistical technique called regression analysis is used to forecast a dependent variable's value based on independent variables. It is an effective tool for forecasting future events and modeling relationships. There are different types of regression analysis, including simple linear regression, multiple linear regression, nonlinear regression, and logistic regression. The regression equation, $y = \beta_0 + \beta_1x_1 + \beta_2x_2 + \dots + \epsilon$, is used to analyze data and find the best-fit line or curve that explains the relationship between the independent and dependent variables. Common errors in regression analysis include multicollinearity, outliers, and assumptions. Therefore, inferential statistics were used to determine the differences in the dependent variable. In particular, linear regression analysis was used for the study to determine the effect of the independent variables on the dependent variables.

Table 4.18.model summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.773 ^a	.597	.561	.391	

Source: survey, 2024

a. Predictors: (Constant), Factors affecting Road Traffic Congestion, Social Consequences, Economic Consequences

b. Dependent Variable: Road Traffic Congestion

From the above table, we can understand that the explanatory capacity of independent variables on the dependent variable (road traffic congestion) is important at adjusted R square of .561. Therefore 56.1% of road traffic congestion is explained by the above three independent variables (factors of road traffic congestion, social consequences, and

economic consequences). Therefore, we can say that those three variables are relatively important for road traffic congestion in these road segments. Whereas 43.9% of road traffic congestion was determined by the variables that were not included in the study.

Table4.19.analysis of variance

analysis of variance						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1940.399	3	388.280	43.378	.000 ^b
	Residual	1476.929	165	8.95		
	Total	3418.327	385			
a. Dependent Variable: Road traffic congestion b. Predictors: (Constant), Factors affecting road traffic congestion, Economic consequences, social Consequence,						

Source: survey, 2024

According to the findings in the study as above, The significance level for the regression model was.000. Which indicates that the regression model is perfect for predicting road traffic congestion given factors affecting road traffic congestion, social consequences of road traffic congestion, and economic consequences of road traffic congestion? This is because the p value was less than 0.05, which was used as an indicator of statistical significance.

CHAPTER FIVE: SUMMARY, CONCLUSION AND RECOMMENDATIONS

This chapter presents a summary of the research's major findings, conclusion of the study, recommendations, and finally suggestions for future research in the area.

5.1. Summary of the main findings

The study attempted to examine the socio-economic consequences of road traffic congestion in the gotera to maselitegna road segment. The researcher used both descriptive and explanatory research design types, and this study used mixed (both quantitative and qualitative) research approaches.

Both probability and nonprobability sampling designs were used in the investigation. Sources both primary and secondary were used to gather data. Primary data was collected through structured questionnaires containing closed-ended questions. The questionnaires were administered to the sample in the study area and were arranged using a Likert scale of 1 to 5. The organization had a total target population of over 100,000, and the sample size was the entire target population (385).

The researcher used both probability and non-probability sampling designs. For probability sampling designs, simple random sampling was used to determine the sector for questionnaires. For non-random sampling designs, convenience sampling techniques were used. This is the method of collecting information from the sections of society that are convenient to provide the necessary information. The researcher collected data from primary sources through a questionnaire and interview prepared based on the literature review to collect quantitative and qualitative data used to achieve the objectives of the study. After the data was collected, the data analysis and interpretation of the collected data were carried out. Before conducting the final reliability test, it was conducted, and the flow reliability statistics report had a Cronbach's alpha score of 0.82.

The data obtained were collected, organized, named, labeled, coded, and analyzed using SPSS version 25, and descriptive statistics such as frequency, percentage, and inferential

statistics related to regression and interview data reporting differences were presented in narrative form. Based on the analysis, summary, main findings, and conclusions are made, and finally recommendations can be made.

The demographic characteristics of the respondents were calculated as the majority of the respondents were male (60.8%), the majority of the respondents were between 31 and 40 (49.4%), and the majority of the respondents were bachelors (34.8%). And most of the respondents had 6–10 years of driving experience (28.6%).

Mode of travel using daily activities: Most of the respondents (42.6%) responded that they used public transport. Regarding the presence of road traffic congestion on this road section, 81.1% of respondents agree on road traffic congestion. Most of the respondents who were concerned about the congestion on this section of the road answered the severity of the congestion. As for the daily commute from home to work, the average distance traveled is over 12 kilometers per day. The majority of the respondents answered that congestion is high on these road sections during peak hours. Regarding the level of frustration caused by the congestion on this part of the road, it was very high.

Most of the respondents agreed that the general result of road traffic congestion in this section of the road is the delay of vehicles, the congestion that occurs during that time, the road construction activities contributing to traffic congestion, and the behavior of drivers. Traffic congestion Most of the respondents cited road conditions, population growth, parking problems, traffic management, and the high number of vehicles as reasons for road traffic congestion. Most of the respondents stated that road traffic congestion has a social and economic impact on society.

The results of the regression analysis showed a correlation of $R = 0.646$ between the study variables and explained 56 (56%) of the variance in the independent variables of this road traffic congestion, namely the causes of road traffic congestion, the economic effects of road traffic congestion, and the social effects of road traffic congestion. The model shows that the remaining variance can be explained by other variables.

5.2. Conclusion

The situation of road traffic congestion in Addis Ababa has created significant socio-economic challenges for the city. Truck drivers and public transport vehicles predominantly use the heavily congested Gotera Complex to Maseletegna Road corridor during peak office hours, causing frustration among commuters. Key contributors to this congestion include poor road conditions, rapid population growth, insufficient parking, inefficient traffic management, and the growing number of vehicles.

This congestion has led to substantial social and economic crises, including delays, wasted fuel, reduced productivity, increased vehicle operating costs, and heightened pollution. The consequences extend to health problems, psychological stress, and environmental degradation due to increased emissions from idling vehicles. Traffic congestion also affects education, business, and social interactions, as individuals face delays in reaching workplaces, schools, and community activities, leading to financial losses and reduced quality of life. Sustainable solutions, including investment in efficient infrastructure, multimodal transport systems, behavioral changes, and collaboration between government agencies, private sectors, and civil society, are essential to mitigate these issues.

The study further highlights that more than 91% of respondents agreed on the adverse impacts of traffic congestion, underscoring its socio-economic consequences. Road congestion has also significantly increased accidents, resulting in fatalities, injuries, and property damage. The findings emphasize the urgent need for coordinated strategies to address the challenges of urban traffic congestion.

5.3. Recommendations

Based on the findings of the study, the following recommendations are proposed to address the socio-economic consequences of road traffic congestion on the Gotera to Maseletegna road segment in Addis Ababa:

Problem Identification:

- 🚧 The Gotera to Maseletegna road segment is one of the most congested areas in Addis Ababa, with an average daily traffic volume of over 10,000 vehicles per hour.
- 🚧 The road segment is characterized by poor road conditions, inadequate infrastructure, and inadequate public transportation services, leading to traffic congestion and its associated socio-economic consequences.
- 🚧 The congestion has significant impacts on the city's economy, environment, and residents' quality of life.

Overcome the finding:

1. Improve road infrastructure:
 - ✓ Actor: Addis Ababa City Government (AABC)
 - ✓ Strategy: Upgrade the road segment to a high-capacity highway with dedicated lanes for public transportation.
 - ✓ For Whom: Benefit: All residents of Addis Ababa, especially those who use the road segment regularly.
2. Enhance Public Transportation Services:
 - ✓ Actor: Addis Ababa City Government (AABC) and private bus operators
 - ✓ Strategy: Introduce an efficient and reliable public transportation system, including buses and minivans, to reduce private car usage.
 - ✓ For Whom: Benefit: commuters who rely on public transportation, particularly students, workers, and low-income households.
3. Promote sustainable transportation options:
 - ✓ Actor: Addis Ababa City Government (AABC) and private stakeholders
 - ✓ Strategy: Develop pedestrian-friendly and cycling infrastructure, as well as bus rapid transit (BRT) systems, to reduce reliance on private cars.
 - ✓ For Whom: Benefit: Environmentally conscious residents and those who prioritize health and wellness.
4. Traffic Management Systems:
 - ✓ Actor: Addis Ababa City Government (AABC) and traffic management agency

- ✓ Strategy: Implement intelligent transportation systems (ITS) to optimize traffic signal timing, monitor traffic flow, and manage traffic incidents.
- ✓ For Whom: Benefit: All road users, including commuters, tourists, and businesses.

5. Public Awareness Campaigns:

- ✓ Actor: Addis Ababa City Government (AABC) and private stakeholders
- ✓ Strategy: Launch public awareness campaigns to educate residents about the importance of traffic rules, road safety, and sustainable transportation options.
- ✓ For Whom: Benefit: All residents of Addis Ababa.

5.4. Suggestions for Further Studies

This study was conducted to examine the socioeconomic consequences of road traffic congestion in Addis Ababa from Gotera up to Masetegna road segments; only other researchers should do it on other road segments. The sample was drawn from only this road segment; this study may be limited to generalizing the findings to other road segments in Addis. So, future research should have to draw samples of respondents from different road segments in Addis for the sake of comparing and generalizing the results of the study.

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APPENDICES

APPENDIX I:QUESTIONNAIRE

KOTEBE UNIVERSITY OF EDUCATION

Graduate Program (MSC) IN TRANSPORT PLANNING AND MANAGEMENT

Survey Questionnaire

Dear Sir/Madam

The objective of the questionnaire is to examine **socio economic consequence of road traffic congestion in Addis Ababa**. This questionnaire is prepared to be filled by drivers and vehicle users of the city in this route. The study is purely for academic purposes. It is not meant to evaluate your opinion in any way what so ever. Your response will be strictly confidential to provide insight into the issues under study and thereby suggest possible solution to them. Your responses will be treated with uttermost confidentiality. In view of this therefore, I wish to kindly request you to fill the questionnaire attached. Please respond to the items in the questionnaire completely and as truthful as possible. Your responses are very important for the researcher to accomplish the research study.

General directions: do not write your names or any identifying information on the questionnaire.

Thank you for your cooperation!

Section A: Socio - economic and Demographic variables of respondents (please tick
√)

1. Sex

Male

☐

Female

☐

2. Age Category:

Below 30 years ☐ 31 – 40 years ☐ 41 – 50 years ☐ above 50 years ☐

3. Educational Level:

Below Certificate ☐ Certificate ☐ Diploma ☐ BSC/BA ☐

4. Experience of driving

Below 2 years ☐ 3- 6years ☐ 7-10 years ☐ above 10 years ☐

Part- B: Information pertaining to the study

1. Respondents' response on the status of road traffic congestion

 Please answer the following questions by ticking (✓) in the appropriate box and write other specific.

1. What is the mode of travel you most often use in your day to day activity?

Personal/private vehicle ☐ Public transport ☐ Taxi ☐ other ☐

2. Is there vehicle congestion along the street?

Yes ☐ No ☐

3. How do you see the current vehicle traffic flow along the street road congestion?

Sever congestion ☐ Low congestion ☐ No congestion ☐ medium congestion ☐

4. How long you travel average distance from home to work?

1- 3 km ☐ 4-6 km ☐ 7- 12 ☐ above 12 km ☐

5. How would you rate the level of congestion during peak hours in this road segment?

Very Low ☐ Low ☐ Moderate ☐ High ☐ Very high ☐

6. How often do you feel frustrated or annoyed due to traffic congestion in this road segment?

Very Low ☐ Low ☐ Moderate ☐ High ☐ Very high ☐

Please read the given statements that contain 1-5 scaled numbers having scored each and choose only one number according to your level of agreement and tick the number. To be clear and suitable, the numbers of this questionnaire are represented as follows: 1= Strongly Disagree; 2= Disagree; 3= moderately agree; 4=Agree; 5=strongly Agree

2. Respondents' response on the factors affecting road traffic congestion (Please tick (√) the appropriate choice)

	Road Traffic congestion					
SN	practice of road traffic congestion	5	4	3	2	1
		SA	A	MA	D	SD
1.	There is heavy delay of traffic congestion in this road segment.					
2.	The level of congestion during peak hours in this route is high					
3.	The volume of vehicles on this road affects travel times in this segment					
4.	The construction of road activities contributes to congestion of road segment.					
5.	The behavior of drivers contributes to road traffic congestion					

SN	Road condition	5 SA	4 A	3 MA	2 D	1 SD
1.	There is insufficient road width at road segment					
2.	imbalance between demand and supply of road space					
3.	This road segment is uncomfortable for travel					
4.	There is illegal goods exchange (trade on road)					
5.	There is insufficient pedestrian road on this road segment					
SN	population growth	5 SA	4 A	3 MA	2 D	1 SD
1.	The size of population is increased in this route					
2.	The demand for transport has increased at this road segment					
3.	More peoples live and work on this road segment					
4.	There are high numbers of Pedestrian movement on this segment					
SN	Parking problem	5 SA	4 A	3 MA	2 D	1 SD

1.	There is parking problem at this road segment					
2.	There is inadequate parking space at this road segment					
3.	Drivers use road sections to park vehicles					
4.	There is uncomfortable parking place at this road segment					
SN	Traffic management	5 SA	4 A	3 MA	2 D	1 SD
1.	There is no enough functional traffic lights at this road segment					
2.	There is no enough road signal					
3.	Traffic police enforce (penalty) not sufficient at this road					
4.	Driver violate traffic regulation at this road segment					
SN	Vehicles number increases	5 SA	4 A	3 MA	2 D	1 SD
1.	There is an increase vehicles numbers at this road					
2.	Volume of vehicles flow is greater than available capacity					
3.	Different types(heterogeneous) of vehicles use this road					

4.	Many vehicles at the same time use this road segment					
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3. Respondents' response on the consequence of road traffic congestions (Please tick (√) the appropriate choice)

SN	Social consequences of road traffic congestion	5 SA	4 A	3 MA	2 D	1 SD
1.	Road traffic congestion affect your daily commute in this road segment					
2.	Stress can be happen because of the delay of vehicles on this segment					
3.	Road traffic congestion affect the productivity of the nation					
4.	Road traffic congestion affects the quality of life in the surrounding near to this road segment					
5.	Road traffic congestion is the barrier to social interactions.					
SN	Economic consequences of road traffic congestion	5 SA	4 A	3 MA	2 D	1 SD

1	Road traffic congestion on this road affects the efficiency of goods and services					
2	Traffic congestion in this road segment increase operating costs for business communities					
3	Road traffic congestion impacts the competitiveness of business located along /reliant on this road segment					
4	Road traffic congestion in this road segment affect the ability of employees to commute to work on time					
5	Road traffic congestion affects the attractiveness of investment and business development					
SN	ROAD TRAFFIC CONGESTION	5 SA	4 A	3 MA	2 D	1 SD
1	Road traffic congestion affects the productivity of the people					
2	Road traffic congestion increase operating cost					
3	Road traffic congestion reduce the social interaction of the community					
4	Road traffic congestion were the cause of car accidents					

APPENDIX II

KOTEBE UNIVERSITY OF EDUCATION

DEPARTMENT OF TRANSPORT PLANNING AND MANAGEMENT

Information Letter

Research Title: socio economic consequence of road traffic congestion

Participation in this research requires you to take part in a face-to-face interview. Your opinions are extremely valuable so please understand that there aren't wrong or right answers to the interview questions. It is your understanding of socio economic consequence of road traffic congestion on Gotera to Maseltegnaroad segment which I will be looking for. The questions should take approximately 30 minutes to answer. Please note that your participation in this research is completely voluntary. You are free to withdraw at any time. If at any stage you feel uncomfortable about the questions that I ask during the interview then let me know and we can move on to the next question or finish the interview if that is what you wish. With your consent the interview will be recorded to ensure accuracy of the interview data. I will inform you when the recorder is being turned on or off. Please be assured that all information collected from this interview will remain strictly confidential, and participants and business names will not be revealed. If you have any questions or would like further information about this study please do not hesitate to contact me.

Make interview points/guide

1. How do you see the status of road traffic congestion of this road segment?
2. What are the causes of road traffic congestion of this road segment?
3. What are the socio economic impacts of road traffic congestion of this road segment?