Assessing the Role of Adama City's Public Transport Hub in Facilitating Inclusive and User-Friendly Services

By:-Besufekad Hussen Engida

A Thesis Submitted to the Department of Architecture

School of Civil Engineering and Architecture

Presented in Partial Fulfillment of the Requirement for the Degree of Master's in Urban Planning and Design

Office of Graduate Studies

Adama Science and Technology University

November, 2024

Adama,Ethiopia

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DECLARATION

I hereby declare that this Master Thesis entitled "Assessing the Role of Adama City's public Transport Hub in Facilitating Inclusive and User-Friendly Services" is my original work. That is, it has not been submitted for the award of any academic degree, diploma or certificate in any other university. All sources of materials that are used for this thesis have been duly acknowledged through citation

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I/we, the advisor(s) of this thesis, hereby certify that I/we have read the revised version ofthe thesis entitled "Assessing the Role of Adama City's public Transport Hub in Facilitating Inclusive and User-Friendly Services" prepared under my/our guidance by Besufekad Hussen submitted in partial fulfillment of the requirements for the degree of Mater's of Science in Urban Planning and Design Therefore, I/we recommend the submission of revised version of the thesis to the department following the applicable procedures.

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APPROVAL SHEET

I/we, here by certify that the recommendation and suggestion given by the thesis review committee are appropriately incorporated into final thesis/dissertation proposal entitled entitled "Assessing the Role of Adama City's public Transport Hub in Facilitating Inclusive and User-Friendly Services" by Besufekad Hussen Engida

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We, the undersigned, members of the Board of Examiners of the thesis by Besufekad Hussen Engida have read and evaluated the thesis entitled "Assessing the Role of Adama City's public Transport Hub in Facilitating Inclusive and User-Friendly Services" and examined the candidate during open defense. This is, therefore, to certify that the thesis is accepted for partial fulfillment of the requirement of the degree of Master of Science in Urban Planning.

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LIST OF ABBREVIATIONS

MTHs	Multimodal transport hubs
LRT	Light rail transit
TOD	Transit-oriented development
CSA	Central Statistical Agency of Ethiopia
LODSM	Line-Oriented Departures Setting Method
BBTAS	Bangkok Bus/taxi Transit Analytical System
GoDEA	Goal programming and data envelopment analysis
AVL	Automatic vehicle location
COD	Crowding-over-distance
MTA	Mass Transit Administration

ABSTRACT

This research analyzes the public transportation hub in Adama City, focusing on challenges, accessibility, inclusivity, and the hub's impact on the community. Through a detailed examination of the taxi transportation system, several challenges are identified, including limited infrastructure, safety concerns, congestion, and environmental impact. The study highlights that inadequate infrastructure, such as insufficient taxi stops and poorly maintained roads, impedes the efficiency of the service. Additionally, the lack of security measures at the hubs poses safety risks for passengers, exacerbated by traffic congestion and rapid urbanization. From an economic perspective, public transport hubs in Adama City fail to promote economic growth as expected, with issues such as illegal tariff charges and inadequate support for tourism and commerce. The hubs do not enhance property values or stimulate job creation, missing opportunities for smart city development. Socially, the transportation system does not cater to vulnerable groups like the elderly and people with disabilities, who struggle with accessibility due to poor location and design of hubs. The research further addresses the geographical and physical accessibility of these hubs, finding that while the general locations are adequate, their specific placements contribute to traffic congestion and safety hazards. The hubs also lack essential facilities such as shaded areas, cafes, and proper traffic management systems. To improve the transportation hubs in Adama City, the study recommends a multifaceted approach involving better infrastructure investment, enhanced safety measures, strategic hub location planning, and more inclusive design. This would ensure that the hubs serve the community efficiently and contribute to the city's economic and social development.

CHAPTER 1: INTRODUCTION

1.1. Background of the study

Public transport hubs form as the areas for easily accessed by the residential. The location of hub should be close with other interconnected link. This will minimize the fare rates that need to be paid by the passenger to reach their next modes. Travelling using public transport is cheaper as compared to the private vehicles. For those people who face in financially challenged living in this urban area, public transportation can be the best economical vehicles to be used. A public transport hub is a place where the passengers are exchange between vehicles or transport modes. Public transport for road and waterways include bus, taxi, motorcycle, rickshaw, bicycles, ships and ferry while transport hubs include bus stations, taxi stations, bus stops and ferry terminal. The public transports capacity demand in Northern Peninsular Malaysia is rising rapidly due to the increasing in population of the State. Public transport will be chosen by the people who seek for a freedom, opportunity and those who simply cannot afford to have their own-private vehicles (Azfizan et. al, 2013).

A transport hub is an infrastructural element of the planning structure of a city for transport and public purposes, which performs the functions of distributing passenger flows between modes of transport and directions of movement, and also provides passengers with additional services in parallel Competently organized, including in a design context, transport hub is a point of attraction for the citizens and tourists. (Dubna ,2019)

Public transport hubs are critical nodes in urban and regional transportation networks, facilitating the whole transfer of passengers between various modes of transport, such as buses, taxi, trains, and bicycles. As cities grow and populations increase, the role of these hubs becomes ever more crucial and mandatory for the community in promoting sustainable, efficient, and accessible urban mobility.

The concept of a public transport hub has evolved significantly over time. In the early 20th century, transport hubs primarily focused on facilitating the movement of people through different modes of transport. With the advent of automobiles and the rise of suburbanization in the mid-20th century, the focus shifted to road networks and car-centric infrastructure.

However, the late 20th and early 21st centuries have seen rebirth in the importance of public transport hubs, driven by increasing urbanization, environmental concerns, and the need for sustainable transportation solutions.

Addis Ababa, Ethiopia like other cities in the developing world, has continued to battle mobility issues as its public transportation services are insufficient to meet the changing needs of its diverse population and economic activities. The fast growth of mobility demand precipitated by rapid urbanization and the service void left by the sole conventional public transport provider/Anbessa city bus/often contribute to the mushrooming of privately run Para transit minibus taxi transport systems. The Para transit minibus taxi service has become the dominant mode of public transport in the city. As Ethiopian Roads Authority (2005) reveals Anbessa city buses provide 40% of the public transport of the city, while minibus taxis account for 60%. Another study by the World Bank (Citation2002) also found that minibus taxis contribute 73% of the total modal choice of a city. A recent study by the Addis Ababa City Administration Road and Transport Bureau (Citation 2018) reveals that there is a high demand for public transportation in the city whereby the modal share of public transportation is 31%. Walking predominates with a modal share of 54%; and private automobiles and taxis with a 15% share.

However, the service provided by Para transit minibus taxis is poor in quality to satisfy the needs of the public and experienced several operational constraints. It has been a day-to-day experience for passengers queuing for several minutes at terminals waiting for a taxi, breaking up long routes into shorter ones, arbitrary tariff increments, and overloading by Para transit minibus taxi operators. According to Tilahun (Citation 2014), the service is mostly demand-driven that picks up or drops off passengers on an ad hoc basis. The city's transport office has been drafting several laws and rules intending to improve service provision.

Taxi transport, a vital component of urban mobility, provides flexible and on-demand transportation services that bridge the gap between public transit and private vehicle ownership. Taxis play a crucial role in the transport ecosystem, offering a personalized and often more convenient alternative to buses, trains, and trams. This section explores the concept of taxi transport, its historical evolution, operational models, technological advancements, regulatory frameworks, and its significance in modern urban environments.

Now a days Adama city faced with huge challenge of public transportation system emanating from fast expansion of the city and huge population flow from rural to urban due to economic and social factors that enforce the population to immigrate to the city. This large expansion of the city and the population needs enough accessible and inclusive public transportation system to satisfy the need of the society. Public transportation by its nature has wide and different stakeholders such as the city administration by developing transportation infrastructures, transport authority by managing the transportation services and others like transport service providers, transport associations, and the public transport service users itself has a large contribution in failure and success of the city public transportation systems.

The Adama city public transports are mainly attached on the taxi transportation system. The city administration was began to deliver bus transport service specially in pick hour from 2010 to 2013. Since early 1994 the administration stop delivering the service this results the taxi transportation remain the only option to the city community

1.2 Statement of the problem

Urban transportation hubs are essential for enabling the smooth movement of large populations within cities. However, many cities, including Adama, face significant challenges that undermine the efficiency and effectiveness of these systems. Adama, with its high level of societal mobility, particularly relies on public transportation, including mini-bus taxis and buses. Despite this, the city struggles with major issues such as traffic congestion and overcrowding, inadequate infrastructure, poor connectivity, technological gaps, safety concerns, environmental impact, and a lack of accessibility. These challenges stem largely from the absence of sufficient, well-designed, and strategically located public transportation hubs.

Although various studies have addressed different aspects of the transportation sector, such as transportation service management and the economic impact of transportation systems, there remains a critical gap in research specifically focused on the challenges of public transportation hubs in Adama, particularly with regard to taxi transportation. The aim of this

study is to comprehensively analyze these challenges and propose practical solutions to improve the efficiency, safety, and overall user experience of public transportation hubs in Adama, with a specific focus on the taxi transportation system.

1.3 Objective

1.3.1 The general objective

The general objective of the research is evaluate the effectiveness of public transportation hubs in Adama city in providing accessible, inclusive, and user-friendly transportation for the city's diverse population.

1.3.2 Specific objective

The specific objectives of the study are to:

1. Identify the challenges of public transportation hub in Adama city
2. Analyze the accessibility and inclusivity of public transportation for city's diverse population.
3. Analyze the positive and negative Impacts of the transportation hub on the daily lives of the community.

1.4 Research Question

On the basis of the stated specific objectives, the following research questions are developed in the study.

1. What are the main infrastructure and operational challenges encountered by public transportation hub in rapid growing of Adama city?
2. What are the barriers to implementing inclusive and accessible public transportation hubs, to ensure equitable access for all public transport users of Adama city?
3. How can affect the public transportation hub in day to day life of Adama city community

1.5. Significance of the study

The significance of this research was its contribution to both academic understanding and practical implications. The study brings lots of benefits to different stakeholders involved in the transportation sector. First it helps Adama city Transport bureau, Adama City Administration Transport authority, and Transport Planning and Management office to improve their practices. In addition to this, the final report of this research helps for transport policy makers as a tool or input for their decision making. It also helps the researcher to gain deep knowledge about the public transport hub problem and will also serve as a work of reference for other researchers.

1.6 Scope of the study

Conceptually, the study was delimited to assess the Role of Adama City's public Transport Hub in Facilitating Inclusive and User-Friendly Services and Structural related factors related to public transport hub by focusing (minibus taxis) public transportation system in Adama . This study was geographically delimited to Adama city. Methodologically, and pertinent data was gathered through questionnaire, interview and personal Observations from different respondents in all parts of the city

1.7. Limitation of the study

On the study different external and internal challenges are faced. The first limitation was a lack of secondary data sources, Unwillingness of government officials, drivers and public transport users to disclose information and to fill the questioner and respond to the interview. In addition, the researcher faced some other challenges related to Unavailability of related data source or literature review

1.8 Operational definitions

A **public transport hub** is a designated physical location where multiple modes of public transportation (such as buses, trains, trams, subways, ferries, taxis, or bike-sharing services)

converge, allowing passengers to transfer efficiently between different transit lines or systems. It typically includes facilities for boarding, alighting, ticketing, and waiting, along with amenities such as information displays, seating, shelters, restrooms, and connectivity services. The hub is managed to ensure smooth operation, safety, and coordination of transit schedules, serving as a central point to facilitate the movement of people within a city or region.

Congestion and Overcrowding: Managing high volumes of passengers, especially during peak hours or special events, can lead to overcrowding, making it difficult to ensure smooth movement and efficient transfers.

Coordination across Multiple Modes: Integrating schedules and services from various transportation providers (buses, trains, trams, etc.) is complex, and any delay or disruption in one mode can have a ripple effect on the entire hub.

Safety and Security Threats: Ensuring passenger safety and security requires constant vigilance against potential threats such as theft, vandalism, accidents, or even terrorist activities, which requires comprehensive surveillance and response systems.

Maintenance and Infrastructure Upkeep: Regular maintenance is crucial to keep facilities clean, safe, and operational. However, maintenance activities can disrupt services, especially in older hubs with outdated infrastructure.

Technological Integration: Implementing and maintaining advanced technologies (such as real-time information systems, ticketing solutions, and data analytics) can be challenging, especially if there is a need to integrate with legacy systems.

Accessibility: Ensuring that the hub is fully accessible to people with disabilities, the elderly, and those with special needs can be difficult, requiring continuous upgrades and monitoring to maintain compliance with accessibility standards.

Managing Emergencies: Responding to emergencies such as accidents, medical incidents, power outages, or natural disasters requires well-developed contingency plans, trained staff, and effective communication systems.

Environmental Sustainability: Reducing the environmental impact of operations, such as managing waste, energy consumption, and emissions, poses a challenge, especially in older hubs not designed with sustainability in mind.

Financial Constraints: Managing budgets for infrastructure upgrades, maintenance, staffing, and technological investments can be challenging, particularly when funding is limited or fluctuating.

Passenger Satisfaction: Balancing operational efficiency with passenger comfort and experience is a challenge, especially in providing amenities, accurate information, and responsive customer service.

Adaptability to Changing Demand: Hubs need to be flexible to adapt to fluctuations in passenger numbers due to changing travel patterns, population growth, or unforeseen events like pandemics, which can suddenly alter demand.

Coordination with Stakeholders: Managing relationships and coordination with multiple stakeholders, including transport operators, government agencies, vendors, and local businesses, can be complicated, requiring effective communication and collaboration.

1.9 Thesis Organization

This study is organized in five chapters. Chapter one deals with introduction and background of the study and includes, statement of the problem, objective of the study, significance of the study, scope of the study and limitations of the study. Chapter two reviews both theoretical and empirical studies related to the study. The third chapter discusses research methodology including research design, data sources, methods of data collection, target population and sampling, and d methods of data analyses. Chapter four deals with data presentation and interpretations of the collected data. The last chapter presents summary, conclusion and recommendation.

CHAPTER 2: LITERATURE REVIEW

2. 1.Theoretical framework

2.1.1 Introduction

Public transport is one of the facility that are provides either by government or private sector with the aim of improving social welfare. However providing equitable and efficient public transport for the ever increasing the demand with limited resource available is the challenge in developing countries. This need to evaluate current public transport infrastructure and efficiency is crucial to maintain, expand and exposition of public transport facility in developing country.

Literature related to some of the important areas of public transportation system (bus/taxi) has been reviewed and presented in this chapter. The public transportation operation planning process includes four basic components performed usually in sequence (Ceder 2002). These are network route design, frequency determination and setting timetable, vehicle scheduling and crew scheduling.

The basic functions of network route design are as follows:

1) Identification of the location of the origins and destinations

2) Establishing relationship between those origins and destinations with transit stages

3) Identification of transit service schedules, vehicle locations, and transfer points

4) Identification of optimal paths.

Apart from network route design, it is necessary to evaluate the performance of the routes as well as the depots periodically in order to monitor their performance and take corrective action if required. The literature related to some of the aspects of the basic functions has been reviewed and presented in the following sections.

2.2.1 Network Design and Route Evaluation

The general network design problem is to determine the basic route design, adding new links or expanding the old ones in the existing network. The network design problem of urban transportation consists of minimizing some objective function, subject to the equilibrium

constraint such as minimization of overall time or cost measures. In several countries / cities, the public transport is run by transport corporations funded by the government. As such in designing the transport network, apart from economic measures, the public interest is very important. Route evaluation should be an ongoing process so that corrective measures, if any, required improving the quality of service and reducing operating costs can be taken. The information from route evaluation may also lead to possible network route re-design. The literature related to network design and route evaluation is presented in this section.

Ceder and Wilson (1986) described the bus/taxi network design problem, summarized the different approaches that had been proposed for its solution and proposed a new approach incorporating some of the positive aspects of prior work. The proposed approach is intended to be easier to implement and less demanding in terms of both data requirements and analytical sophistication than previous methods. An algorithm is presented that can be used to design new bus/taxi routes taking into account both passenger and operator interests; however, this algorithm focuses on only a single component of the overall bus/taxi operations planning process.

Bookbinder and Desilets (1992) proposed that the transfer optimization in a transit network to minimize the overall inconvenience to passengers. Bus/taxi trips are scheduled to depart from their terminal so as to minimize some objective function measuring their inconvenience. A mean disutility function is defined here which is used to evaluate the inconvenience under random bus/taxi travel times of a transfer connection. This disutility function g (w) is some function of waiting time, which gives the desirability of a waiting time w, as perceived by the user. To obtain a heuristic solution, an iterative improvement procedure is used. This procedure starts with an initial solution and looks for improvements by changing the departure times for each route from a set of possible starting times, until no further improvement can be obtained. This method from the perspective of the user reduces the inconvenience caused by the transit system.

Quak (2003) in his work on “Bus/taxi line is planning”, discussed in detail bout (designing routes and setting timetables) of bus/taxi transit planning. He adjusted the objective function of Ceder et al. (2001) and constructed a different heuristic to set the departure times.

This is based on Line-Oriented Departures Setting Method (LODSM), i.e., to synchronize departures from the point of view of routes instead of the nodes.

Borvornvongpitak and Tanaboriboon (2005) developed a Computerized Bangkok Bus/taxi Transit Analytical System, (BBTAS), to enhance the performance evaluation of the existing bus/taxi system in Bangkok. The bus/taxi performance indicators are classified into three performance measurement groups and each group was broken down into the performance class and sub-class. The weights of each performance class and sub-class were conducted mathematically to describe the bus/taxi operating performance level. The Analytical Hierarchy Process (AHP) was applied for weighing the bus/taxi performance class and sub-class. Finally, the computerized BBTAS package was developed to evaluate the performance of all bus/taxi routes in Bangkok. This was demonstrated by applying to a real case involving 88 non-air-conditioned bus/taxi routes in Bangkok.

Yasushi et al. (2005) have emphasized the need to consider not only the evaluation of the economic viability but also the comprehensive characteristics of bus/taxi routes. They have developed methods for comprehensive evaluation of efficiency using Data Envelopment Analysis and evaluated efficiency of bus/taxi routes in a city.

Hwe et al. (2006) proposed to reduce traffic congestion and to increase bus/taxi occupancy by merging bus/taxi routes. The analysis showed that merging will lead to an overall benefit for all parties, including government, bus/taxi operators, and passengers. The actual merging decisions, which routes to merge and at what frequencies bus/taxies should run, are determined by a mathematical model. The model also shows quantitatively the benefits of merging routes and the impact of other factors.

Chintan et al. (2007) have assessed performance taking into consideration the service providers, the users and the societal perspectives. Using Data Envelopment Analysis (DEA) model, they evaluated the performance of route.

Sheth et al. (2007) used DEA to evaluate the performance of routes considering the service providers, the users and the societal perspectives. Charnes et al. (1978) have used goal

programming and data envelopment analysis (GoDEA) for measuring the efficiency of decision-making units for target-based multi-level planning. Their approach enables the decision maker not only to optimally allocate resources across the transit network but to achieve targets for societal variables that represent the environment in which the bus/taxi services are provided.

Huang et al. (2007) have developed a model to evaluate existing bus/taxi routes and relocate transit resources in Bejing city using AHP. The developed a comprehensive bus/taxi route evaluation standard according to the status quo of Beijing transit system, which includes more than one category and more than 10 criteria in total consisting of qualitative and quantitative attributes.

Lin et al. (2008) developed and demonstrated a quality control

Framework for bus/taxi schedule reliability. Automatic vehicle location (AVL) devices provide necessary data; DEA yields a valid summary measure from partial reliability indicators; and panel data analysis provides statistical confidence boundaries for each route-direction's DEA scores. If the most recent DEA score of a route direction is below its lower boundary, it is identified as in need of immediate attention.

Fan and Mumford (2008) have developed a met heuristic approach to the urban transit routing problem. This urban transit route problem (UTRP) was to devise routes for public transport system. This met heuristic framework for solving it consists of a representation scheme, an initialization procedure, and simple neighborhood moves. They introduced a simplified model of the UTRP, which allows concentrating on the key issues of minimizing travel time and the number of transfers simultaneously.

Ibeas et al. (2010) developed a bi-level optimization model for locating bus/taxi stops to minimize the social cost of the overall transport system. The work takes into account possible changes in demand due to different bus/taxi stop locations considering congestion on bus/taxies, interaction with private traffic, operational variables (fleet, frequency, operator budgets), and the socio-demographic characteristics of each zone in the urban area.

2.3 Headway /frequency

The basic issue in the planning of urban public transport is the determination of headways or inter-dispatch times (time between successive departures). Headway depends on frequency of bus/taxies operating in a route. During each session i.e. distinct time-period whose demand characteristics are constant, the following trade off must be considered. Dispatching too many vehicles on a route causes high operating costs, while too few vehicles may result in unsatisfactory levels of service. An appropriate policy on headways will help to balance resources between lines (routes) in peak-demand hours and will influence the total number of bus/taxies acquired by a transit company. Previous practice in industry usually bases the planning of headways upon satisfying service criteria on a "most-congested segment". This approach reduces the problem from that of studying a route to that of a single segment (stop), but thereby fails to account for other important information about the line's characteristics.

Byrne (1975) built a model of a transit system in polar coordinates with radial transit lines in order to find the line positions and headways which minimize user (travel time) and operating costs in response to a general population density both with and without a constrained fleet size. It is found that the optimum line location is related to the population density and the circumferential access. The optimum headway depends upon the tributary population, the operating cost and the change in operating cost due to changes in headway. Simplifying the problem by assuming a uniform population density, it is found that the optimum headway depends upon the average headway and the deviations of the reciprocal speed from the average reciprocal speed. Further, when the fleet size is constrained; the optimum headway depends not only on these, but also on the variance of the headway and the covariance of the headway and reciprocal speed among the lines.

Grosfeld-Nir and Bookbinder (1995) developed two new service criteria which consider the line as a whole: (1) "crowding-over-distance" (COD) takes into account discomfort resulting from a vehicle carrying too many passengers, and the corresponding distance travelled; and (2) "probability-of-failure" (POF), the frequency with which a waiting passenger fails to board due to lack of space. COD was analyzed using simulation POF was related to a time-dependent markov chain that is "inhomogeneous" in terms of distance along

the route. Optimal headways are those which dispatch the smallest number of bus/taxies while meeting the particular service criterion. Models based on each of the two criteria are illustrated and applied to a number of routes of the Israeli transit company.

Van Oudheusden and Zhu (1995) described the trip frequency scheduling by taking into account the present practices, limited bus/taxi fleet size, lack of parking spaces, the fluctuating traffic conditions throughout the day, and the special feature that bus/taxies and crews are not pre-assigned to specific trips by the beginning of the daily operation. An integer programming model was developed and two heuristic methods, one of which is based on linear programming and the other being a straightforward derivation of common bus/taxi operation practice, are presented. The resulting methodology was tested on two selected bus/taxi routes in Bangkok and extensive comparisons are made. In this case study, it appears that schedules can be designed which simultaneously reduce exploitation costs and improve service to the public. The methodology allows the bus/taxi company to systematically plan all its bus/taxi frequencies and to allocate bus/taxies to routes in a much more efficient way than at present.

Kim et al. (2005) made an attempted to develop a signal priority strategy to improve bus/taxi service quality while inducing a little additional delay in general traffic by restricting target bus/taxies for priority. The effectiveness of this strategy is evaluated using microscopic simulation model, PARAMICS. The results show that this selected signal priority strategy reduces bus/taxi travel time and improves regularity of bus/taxi headway, compared with fixed signal control. Furthermore, it may regulate bus/taxi headway more powerfully and induce less delay to general traffic than non-selected signal priority.

Zhao and Zeng (2006) proposed a methodology for optimizing transit networks, including both route structures and headways. Given information on transit demand, transit fleet size and street network in the transit service area, the methodology seeks to minimize transfers and total user cost while maximizing service coverage. The goal is to provide an effective mathematical solution procedure with minimal reliance on heuristics to solve large-scale transit network optimization problems. These researchers describe the representation of the transit route network and the associated network search spaces, their presentation of route

network headways and the associated search spaces, the total user cost objective functions, and a stochastic global search scheme based on a combined genetic algorithm and simulated annealing search method. The methodology has been tested with published benchmark problems and applied to a large scale realistic network optimization problem. The results show that the methodology is capable of producing improved solutions to large-scale transit network design problems.

Chen (2007) has considered the problem of computing multiple

Headways for a single bus/taxi line to maximize the expected daily profit. The stochastic bus/taxi-line model assumes that (1) the passenger arrivals follow a Poisson process with possible reneging; (2) the number of alighting passengers at each stop follows a binomial distribution; and (3) the bus/taxi travel time follows a Weibull distribution. The objective function, the expected daily profit defined as the ticket revenue minus the operating and customer waiting costs, is discontinuous at changes in the bus/taxi frequency. For this stochastic optimization problem, they propose a retrospective optimization algorithm that can handle both homogeneous and non-homogeneous Poisson arrivals. Simulation results are discussed.

2.4 Time Table Propagation

The literature review in the document discusses various methods and approaches for constructing bus timetables to meet the demand associated with the public transportation network. Here are some key points from the review:

Cedar (1986) discussed methods for constructing bus timetables using passenger load data. He aimed to achieve six major objectives, including evaluating alternative timetables in terms of required resources, improving bus departure times based on passenger demand, providing alternative timetables for specific scheduling situations, permitting direct bus frequency changes, allowing the construction of timetables with headway smoothing techniques, and integrating different headway setting and timetable construction methods.

Palma and Lindsey (2001) analyzed optimal timetables for a given number of vehicles on a single transit line. They considered two models: the line model and the circle model. The analysis involved determining which individuals would travel on which vehicles and

minimizing total schedule delay costs based on individual behavior. This approach is useful for reducing rider delay costs.

Ceder et al. (2001) addressed the problem of generating timetables to maximize synchronization of buses in a network. They aimed to maximize simultaneous bus arrivals at transfer nodes to minimize passenger waiting time. The problem was formulated as a mixed integer linear programming problem, and a heuristic algorithm was developed for efficient solution.

Ceder (2001) proposed bus timetables with even headways to improve service reliability and minimize resources. The method focused on aligning vehicle departure times with passenger demand, using an automated approach and informative graphic techniques for scheduling.

Ceder (2002) suggested three procedures for better matching passenger demand with timetables while minimizing the number of departures. These procedures aimed to achieve evenly spaced headways, even loads at max load points, and desired on-board passenger occupancy levels.

These studies highlight the importance of optimizing bus timetables to meet varying public transportation demands efficiently and effectively.

2.5. Vehicle Scheduling

The main function of vehicle scheduling is to schedule vehicles to trips according to given timetables. The scheduler's task is to list all daily chains of trips for a vehicle, ensuring the fulfilment of the timetable requirements and the operator requirements (refuelling, maintenance, etc.). The major objective is to minimize the number of vehicles required.

Wren (1972) developed a computer program which takes the list of bus/taxi trips to which vehicles are to be allocated as input and produce a schedule covering these trips. At intermediate stages of the solution process infeasible schedules are produced using fewer vehicles than would be necessary for a feasible schedule. These schedules can be revised by the management by incorporating any revisions desired. The method is heuristic, the

objectives being first to minimise vehicles, and second, to minimise empty mileage. The solution is optimal, or near optimal and successful applications were described.

Sinclair and Oudheusden (1997) have developed a minimum cost network flow model to deal with the problem of bus/taxi trip scheduling in heavily congested cities. Real instances of scheduling problems in Bangkok were analyzed and solved by means of a particular network formulation. The produced solutions are at least as good as those generated by known procedures. The modeling technique can be easily extended to situations more complex than a single bus/taxi route, and can be useful in less congested urban environments than Bangkok. The approach also illustrates how goal programming principles can be applied in a network model.

Lee and Khoo (1997) discussed how a simulation model of a bus/taxi route, embellished by neural network, was created to model the historical pattern of the inputs (namely, passenger loads and road condition) that affect the overall scheduled terminus-to-terminus time. Thus, in a case study of bus/taxi route running from a suburb to the city centre, it was found that the neuro simulation model could predict the cumulative terminus-to-terminus times better than a conventional simulation model could. A software module, embedded into the neuro simulation model for purposes of speed regulation, was able to minimize the deviation of the bus/taxi service from schedule. When intentional delays were further introduced into the bus/taxi route, it was discovered that the speed regulators were more effective, the longer the delay, and the further the bus/taxi travelled into the bus/taxi route. There is potential in applying neural computing in a dynamic bus/taxi scheduling problem such as the one discussed here.

Haghani and Banihashemi (2002) proposed a heuristic approach fo solving a large-scale vehicle-scheduling problem with route time constraints In this work a new formulation for multi-depot vehicle scheduling (MDVS) and multi-depot vehicle scheduling problem with route time constraints (MDVSRTC) have been proposed. For real-world application, they have proposed a solution procedure that reduces the size of a large-scale problem by decreasing the number of trips and by decreasing the number of variables.It is shown that the solution obtained from the proposed strategy has decreased the number of vehicles required and also the operating costs.

Shrivastava and Dhingra (2002) in their study on operational integration of suburban railway and public bus/taxies, developed coordinated schedules of the Bombay Electric and Suburban Transport (BEST) bus/taxies. The coordinated schedules of BEST bus/taxies have been determined for already developed feeder routes of two stations using the schedule optimization model (SOM). The objective function of the SOM is the minimization of transfer time between the two services and vehicle operating costs of BEST bus/taxies. The objective function and constraints make the problem non-linear and non-convex with a large number of variables, making it difficult to solve by classical approaches. Therefore, the genetic algorithm was used for optimization.

Haghani et al. (2003) discussed a comparative analysis of three vehicle scheduling models. These models include a multiple depot and two single depot vehicle scheduling models. The multiple depot model is originally proposed by two of the authors in an earlier paper. The two single depot models are derived from the multiple depot model and are in fact special cases of this model. This analysis is performed by solving the blocking problem for the operation of the Mass Transit Administration (MTA) in the city of Baltimore, Maryland. Results obtained from the three models are compared with each other and the original MTA schedule. These comparisons show that, under certain conditions, a single depot vehicle scheduling model performs better

Soehodho and Kusuma (2003) developed an optimization model for scheduling of a public transport system. The model is capable of determining the location of a transfer point applied at one of bus/taxi stops along a two way lane service route to seek a schedule that minimizes a combination value of user's objective and operator's objective, constrained with an operational condition to keep an acceptable level of service. User's objective deals with the total average passenger waiting time, and operator's objective deals with a number of vehicles required in operation. This optimization is carried out through a heuristic process combined with a selection technique.

Verma and Dhingra (2006) developed optimal integrated schedules for urban rail and feeder bus/taxi operation. It consists of two parts: train scheduling sub-model and schedule coordination sub-model, which are formulated as combinatorial type optimization problems. The objective function for train scheduling sub-model is fixed as minimization of sum of

operating cost of trains (operator cost) and total waiting time cost of passengers boarding the train (user costs) subject to load factor and waiting time constraint, whereas the objective function for schedule coordination sub-model is fixed as minimization of sum of total operating cost of feeder bus/taxies (operator cost), total transfer time cost for passengers transferring from train to feeder bus/taxies, and total waiting time cost of passengers boarding enroute (user costs) subject to load factor and transfer time constraint. The coordination is done for two cases; Case 1 for mixed fleet bus/taxies, considering all types of bus/taxies and Case 2 for single-decker fleet bus/taxies, considering only standard single-decker bus/taxies. The results are compared to adopt the best strategy. Thane City, which is a part of Mumbai Metropolitan Region, India, is taken as the case study. The coordinated feeder bus/taxi schedules were found to be optimum for the mixed fleet bus/taxi case.

Kliewer et al. (2006) described vehicle scheduling problem, arising in public transport bus/taxi companies, which addresses the task of assigning bus/taxies to cover a given set of timetabled trips with consideration of practical requirements, such as multiple depots and vehicle types as well as depot capacities. An optimal schedule is characterized by minimal fleet size and minimal operational costs, including costs for unloaded trips and waiting time. This paper discusses the multi-depot, multi-vehicle-type bus/taxi scheduling problem (MDVSP), involving multiple depots for vehicles and different vehicle types for timetabled trips. They used time–space based instead of connection-based networks for MDVSP modelling. This lead to a crucial size reduction of the corresponding mathematical models compared to well-known connection-based network flow or set partitioning models. The proposed modelling approach was useful in solving real-world problem instances with thousands of scheduled trips by direct application of standard optimization software.

Sun et al. (2008) discussed Scheduling combination and Headway optimization of Bus/taxi Rapid Transit. A model has been established to minimize passenger travel cost and vehicle operation cost with constraints on passenger volume, time and frequency. The scheduling combination was composed of normal, zone and express scheduling. The model was solved by genetic algorithm of variable–length coding. The result showed savings of 62% cost. The sensitivity analysis has been done by changing traffic

2.6. Observation from the Literature Review

From the overall review of literature related to the transit network planning process, the following observations are made.

Through urban public transport sector there are different challenges related to public transportation service and infrastructure different researchers mainly focus around the time scheduling of the arrival and departure of the public transportation system

The main gap I understand from different researches, most of the research focuses on the timing, road network, transportation root and pedestrian walkway. In this research paper I will try to fill the gap I have observed around the public transportation hub facility concerning the location where the hub should locate, the facility that the hub include to increase the satisfaction of the hub, the accessibility and the inclusivity of the hub infrastructure in addition to this the I have seen the gap on the research's to study the influence of hub to the public transport users

2.7 Empirical literature review

These studies highlight the diverse methodologies and approaches used in evaluating and improving bus transit systems, ranging from performance measurement to efficiency analysis and route optimization.

Additionally, the literature review in the document emphasizes the importance of considering various perspectives, such as economic viability, societal impacts, and stakeholder interests, in evaluating bus routes and transit systems. The use of mathematical models, DEA, AHP, and other analytical tools is prevalent in the literature to address challenges in transit planning and optimization.

Furthermore, the review points out the need for more research in the field of bus transport systems, especially in countries like India, where unique challenges such as narrow and congested roads exist. There is a clear indication of the scope for further research to address these challenges and improve the efficiency and effectiveness of bus transit systems.

Overall, the empirical literature review provides valuable insights into the methodologies, challenges, and opportunities in the evaluation and optimization of bus transit systems, emphasizing the importance of considering multiple perspectives and utilizing analytical tools for decision-making and planning.

Modern transport need to be efficient, sustainable and functionally integrated to meet passenger's demand. According to Aldukali Salem I. Amselati, et.al (2011), the factors like travel time and travel cost, distance from home to public transport and distance from home to work are the factors contributing that influence the users shift from private vehicles to public transport in Malaysia. Hence, the hub transport should improve the service quality to attract more passengers shifting to public transport modes.

According to Tony (2006), transportation system may include nodes, terminals and locations. These three components can be optimizes, functionally linked and better managed by configuring and reorganizing the core relationship components. The most important hub transportation characteristics is that it is design to cater the need of communities from starting point of origin to other end destinations. In identifying potential transport hub location, a number of characteristics need to be considered. Those characteristics are hosts of one or more modes of transit, considered for enhances transit service, has an interregional destination, has market demand to attract supportive levels of mixed-use or intensive development and has land available for different types of development in and around transport hub (Woxenius J., 2002). These theories of transportation system demonstrate that nodes are essential components to be interlinked with networks. Figure1 below shows the transportation system in concepts.

Many cities in this world have in place well planned integrated transport facilities. Heathrow Hub is one of the most representatives of 'hub and spoke' arrangement of air transport network which maximizes Heathrow Airport's connectivity to existing and future rail network. Moreover, China is also ranked among the busy and efficient hub (Tony, 2006,). In Malaysia, the KL Sentral has already served the largest railway station in Southeast Asia and also designed as intermodal transportation hub. Users who using their own private vehicles in everyday life plying the concept of a direct connection or 'point-to- point' while users that using public transportation already practiced the use of 'hub and spokes'

A point-to-point concept connects different places in direct ways and there are number of links which results in increasing the traffic congestion. In application of hub system, the direct links are split into separate connections in order to increase accessibility for the public transportation such as buses and taxis. By using those public transport users may get the benefit in reduction of travel cost and helps in minimizing the traffics congestion and pollution. A transport hub is a key location where several routes and means of transport converge and diverge (Starkey P., 2007).

CHAPTER 3: MATERIALS AND METHODS

3.1. Description of the study area

Adama City, also known as Nazret, is geographically situated in the Great Rift Valley of central Ethiopia, within the Oromia Region. It lies at approximately 8.54°N latitude and 39.27°E longitude, at an elevation of around 1,712 meters (5,617 feet) above sea level. The city is about 100 km (62 miles) southeast of Addis Ababa, the Ethiopian capital, and is strategically positioned along key transportation routes, including the Addis Ababa-Djibouti Railway and the Addis Ababa-Adama Expressway. This location makes Adama a crucial connection point between Ethiopia's central, eastern, and southern regions.

Adama City covers an area of approximately 133.5 square kilometers (51.6 square miles). This expansive area accommodates the city's rapidly growing population, industrial zones, educational institutions, residential neighborhoods, and commercial districts. Adama's significant land coverage, combined with its strategic location, makes it one of the largest and most important urban centers in Ethiopia's Oromia Region.

Adama is divided into 14 sub-cities (known as Kifle Ketemas), each with its own local administrative office. These sub-cities function as the primary administrative units, handling local governance, service delivery, and development activities. Each sub-city is managed by a Sub-City Administrator who is responsible for implementing policies, coordinating public services, and ensuring effective management within their jurisdiction. The sub-cities are further divided into Woredas (districts) or Kebeles (neighborhoods). These smaller administrative units handle grassroots-level governance, local service delivery, and community affairs. Each Woreda or Kebele has its own administrative representatives who report to the sub-city administration and coordinate activities like public health, education, security, and infrastructure maintenance.

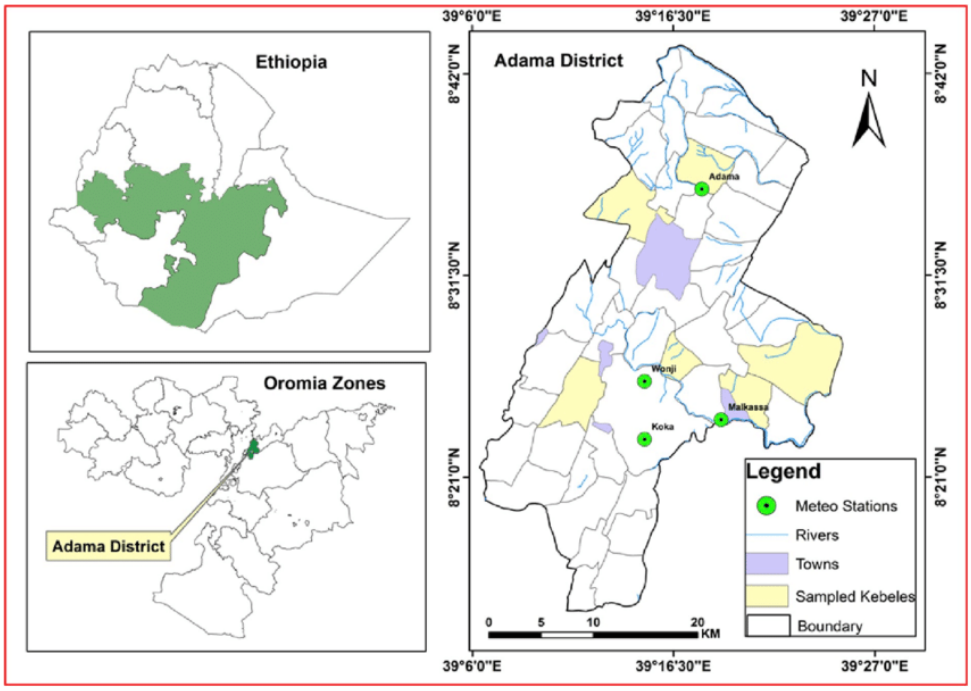


Figure 1 Location Map of Adama city

(Sources Ethio GIS, Adama city Administration, 2024)

3.2. Demographic characteristics of Adama city

Based on the 2007 Census conducted by the Central Statistical Agency of Ethiopia (CSA), this city has a total population of 220,212, an increase of 72.25% over the population recorded in the 1994 census, of whom 108,872 are men and 111,340 women. With an area of 29.86 square kilometers, Adama has a population density of 7,374.82; all are urban inhabitants. A total of 60,174 households were counted in this city, which results in an average of 3.66 persons to a household, and 59,431 housing units. The four largest ethnic groups reported in Adama were the Oromo (39.02%), the Amhara (34.53%), the Gurage (11.98%) and the Silte (5.02%); all other ethnic groups made up 9.45% of the population. Amharic was spoken as a first language by 59.25%, 26.25% spoke Oromo and 6.28% spoke Guragiegna; the remaining 8.22% spoke all other primary languages reported. The majority of the inhabitants said they practiced Ethiopian Orthodox Christianity, with 63.62% of the population reporting they observed this belief, while 24.7% of the population were Muslim, and 10.57% were Protestant.[1]

3.3. Case Study Area Selection Criteria

Adama city is one of the biggest and highly developing city in Ethiopia Adama City was specifically chosen for this study for several fascinating reasons. Firstly the city is now a days implementing smart city development program. the concept of smart city is very challenging and impossible without the accessible and inclusive public transportation system due to this reason this research will contribute and support the city administration development program in addition to this the taxi transportation of the Adama city is very wide and multi direction as compared to the surrounding city finally the proximity to the researcher and availability different sources to the research also taken to the consideration generally even if there are other reasons those are the main reason to select the Adama city to the study.

3.4. Research Design

Adama City, a rapidly growing urban center in Ethiopia, relies significantly on taxi services as a primary mode of public transportation. Ensuring that taxi hubs in Adama are inclusive and accessible is vital for improving the mobility and quality of life for all residents, particularly marginalized groups. This research aims to evaluate the inclusivity and accessibility of taxi public transportation hub facilities in Adama City.

To understand about the public transport hub in international level literature done about, Review of international and local accessibility standards relevant to taxi hubs, Ethiopian accessibility guidelines and best practices from other cities. And analysis of research on public transportation accessibility, with a focus on taxi services and hubs in Local Context to overview of Adama City's urban infrastructure and demographic profile to understand specific local needs and challenges.

This study will use a mixed-methods approach combining quantitative and qualitative data collection.

Quantitative Data: Distribute structured surveys to passengers and service providers. Questions will cover perceptions of accessibility, satisfaction with current facilities, and specific barriers encountered.

Qualitative Data: Conduct semi-structured interviews with a subset of passengers, service providers, and advocacy groups to gain in-depth insights into personal experiences and systemic issues. And Questioner questionaries' also distribute to collect different data mainly from users pf public transport persobal **Observational of** passenger interactions with facilities to identify real-world challenges and areas where improvements of public transportation also can be made.

Quantitative Analysis: Use statistical methods to analyze survey responses and audit results. This includes calculating the percentage of compliance with accessibility standards and identifying statistical correlations between accessibility features and user satisfaction.

Qualitative Analysis: Employ thematic analysis to interpret interview and focus group data, identifying recurring themes and insights related to accessibility barriers and facilitators.

Expected Outcomes

- **Barrier Identification**: Comprehensive understanding of accessibility and inclusivity barriers faced by different user groups at taxi hubs in Adama City.
- **Evaluation of Accessibility Features**: Assessment of the effectiveness of current accessibility features and services.
- **Recommendations**: Practical recommendations for improving inclusivity and accessibility at taxi hubs based on empirical data and stakeholder feedback

3.5. Data Type and Sources

To achieve the major objective, the study used hybrid data from secondary and primary sources. Primary data was collected from urban communities, Adama city transport agencies, taxi transport associations and Taxi transport service providers/Taxi drivers in the study area, The primary data collection methods included field surveys, structured questionnaires, in-depth

interviews with Taxi drivers. Secondary data was collected from books, journals, official reports, websites, legal documents, and aerial photographs, structural plans of the sub-city, Landsat imagery, and previous study documents.

3.6. Software and Materials Used

The following materials and software were used for the accomplishment of this study:
Materials used:
GPS: GPS was used for collecting different points, which were utilized for ground trothing.

Photo camera: A photo camera was used to take pictures during the field observation.

The software used for this study included:

ArcGIS 10.8: This was used to analyze all the GIS work in the thematic layers.

MS Excel: These were used to calculate ad develop different tables

MS Word: This was used to write the entire research work and for printing.

3.7. Sample size determination

The data collected to analyses to this thesis is collected from different stake holders in different data collection techniques using interview questioner and personal observations the summary of the stakeholders and data collection techniques are summarized bellow

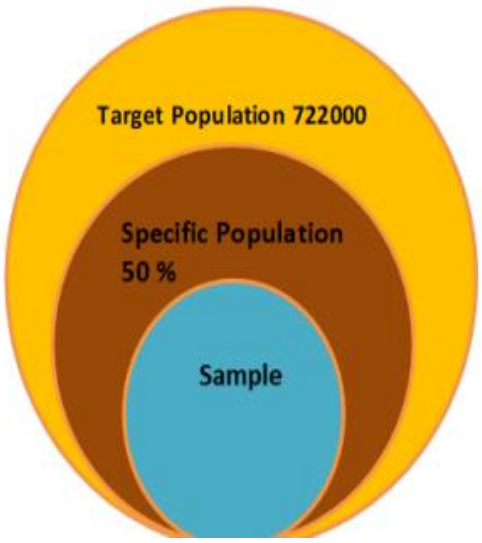
Target population	Adama city residence and transport service providers	
Specific population	Passengers and Users of public transpor like Taxi and Bus in Adama city	
Sample	Transport service providers and Pick hours transport users like private and public employees, students and other users	

Figure 2 Sample Population

The total population expected to use the public taxi transport is taken as 50,000 from the total population of the city this figure is taken from Adama city transport offices. Base on the total population the sample size are determined bellow

In adama city related to taxi associations there are three taxi owner associations in adama taxi with around 780 minibus taxies those taxi association and taxi contributions are summarized bellow

S.No	Name of Taxi oener Association	Number of Taxi Owner In Association
1	Melba Taxi oener Association	175
2	Nib taxi Taxi oener Association	389
3	Fiker Taxi oener Association	216
Total		**780**

Table 1 Taxi Associations in Adama city

$$\text{Sample size} = Z^2 \times P \times \frac{(1-P)}{M^2}$$

Where,

S = sample size for infinite population

Z = Z score

P = population proportion (Assumed as 50% or 0.5)

M = Margin of error

Note: Z score is determined based on the confidence level.

Confidence Level	Z-score
80%	1.28
85%	1.44
90%	1.65
95%	1.96
99%	2.58

Table 2 Confidance level

No of population = 50,000

Confidence level = 95%

Standard deviation = .5, and

Margin of error = +/- 5%.

Based on the above the calculated sample size is :

$S= ((1.96)^2 \times 5(0.5))/ (0.05)^2 = 384$

3.8. Methods of Data collection

A comprehensive data collection strategy is essential to gather relevant and accurate information for studying the public transport hub in Adama City. Below are the techniques that will be used

3.8.1 Questioned

To collect basically the taxi users behavior about public transportation hubs questionaries' used to different parts of the society indifferent time interval (morning, afternoon, and evening)

3.8.2 Interviews

To gather in-depth qualitative insights into the operations, challenges, and potential solutions for the transport hub, Semi-structured interview guides with open-ended questions was conducted from Key stakeholders such as city planners, transport authorities, public transport operators, and Adama city taxi associations and taxi users

3.8.3 Direct Observations

To understand the real-time functioning, efficiency, and challenges of the public transport hub direct personal observation was taken to understand Traffic flow, commuter behavior, waiting times, safety measures, peak hours, and overall infrastructure condition. Researchers will visit the transport hub at different times of the day (morning, afternoon, and evening) to observe and record observations systematically using observation checklists.

3.8.4 Document Review

To collect existing data and information related to the public transport system in Adama City different secondary data sources are use such as Government reports, Adama City urban planning documents, transport policy documents, related previous studies, and statistical data to identify trends, policies, and gaps in the current transport infrastructure.

These data collection techniques will provide a comprehensive understanding of the public transport hub in Adama City, capturing quantitative data for statistical analysis and qualitative insights for a deeper understanding of the issues and potential solutions.

Respondants stakeholders	Data collection technique	
Taxi drivers	Questioner	Interview
Public transport users/taxi	Questioner	
Taxi Asosiations		Interview
Adama City Transport Offices	Interview	

Table 3 Data collection technique

The respondent are informed about the peruse of the data before collecting the necessary data from the respondent and I assure the confidentiality of the data .

3.9. Privacy

In the process of data collection the privacy of the respondent are respected from different acts such as recording or photographing individuals in a way that could compromise their privac

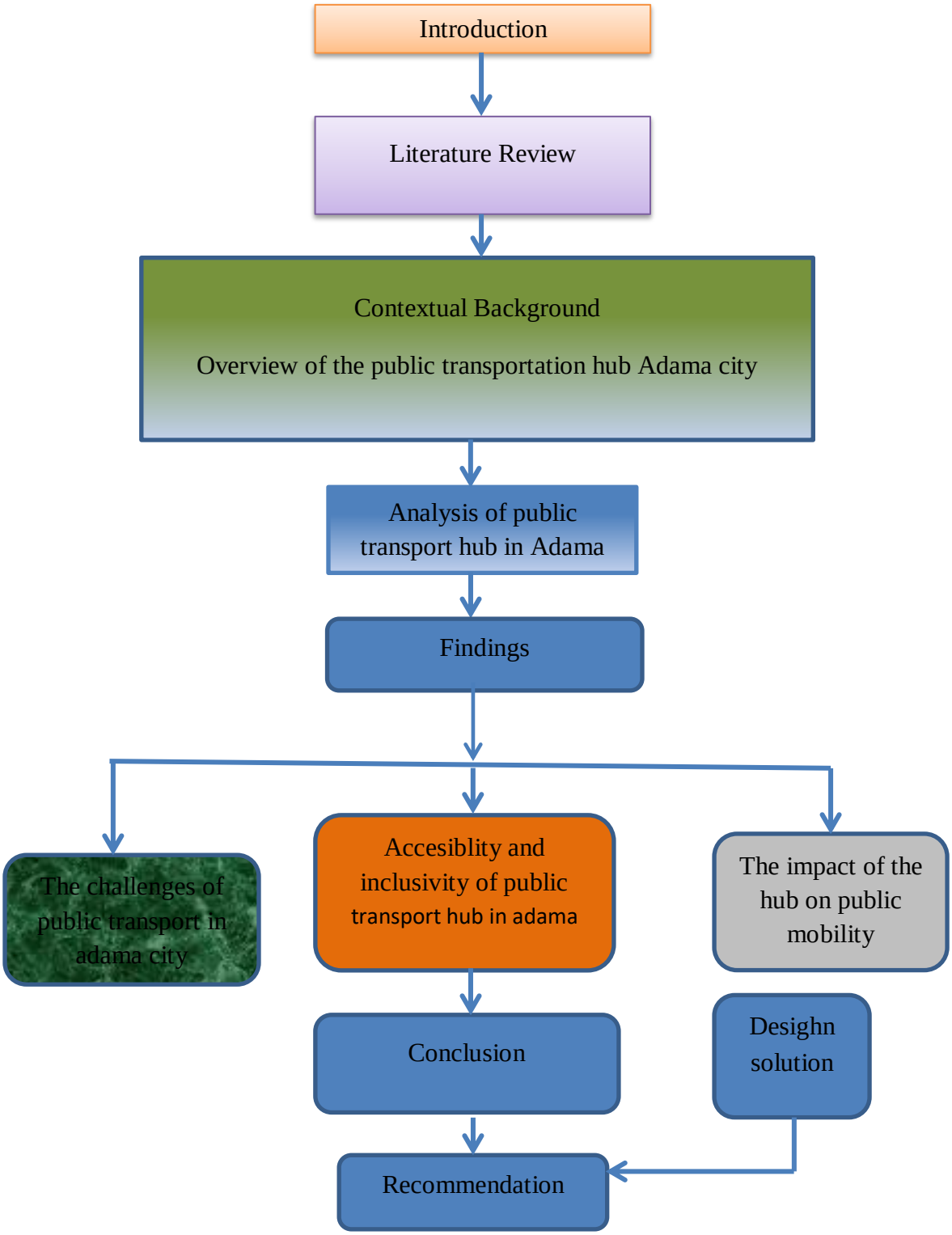
3.10. Respect for Diversity

Public transportation hubs are often diverse places due to that I undertake the research on the way that respects and includes all segments of the population.

3.11 Transparent Communication

I try to communicate the purpose and goals of the research to the public and relevant authorities. Because Transparency helps build trust and allows individuals to make informed decisions about their participation

3.12 structure of the thesis



CHAPTER 4: RESULTS AND DISCUSSION

4.1 Background of the Respondent

Demographics are statistics that describe populations and their characteristics. Demographic analysis is the study of a population-based on factors such as age, race, and sex. Demographic data refers to socioeconomic information expressed statistically, including employment, education, income, marriage rates, birth and death rates, and more. Based on the different demographic characteristics of the city residence questioner are distributed to collect the necessary data to the study. From the total distributed 490 questioners 384 which is 96% from the distributed questioners. According to Sataloff and Vontela (2021), the ideal range for response rate should be above 60%, hence the response rate can be considered as acceptable. Given these benchmarks, a response rate of 75.2% falls within the acceptable range for further analysis.

A survey was conducted with the aim of covering the on three current taxi hubs which are Mebrat Hayle post office and Warka taxi hubs on taxi transport users and taxi drivers by questioner the total respondent on the hubs are summarized below.

Taxi root	the perpose use taxi transportation				total
	Public/private company	Educational	commertioal perpose	other social activity	
Awra Godana to Bolle	24	18	12	8	**62**
Awra Godana to college/ASTU	10	6	18	2	**36**
Awra godana to Amede Kela	10	16	39	4	**69**
Post office-tekur abay to Bolo	1	10	6	2	**19**
National to Tikur abay	2	6	18	10	**36**
Warka to Adama korkoro/duket	14	18	24	6	**62**
Warka to kidane-mhret church	18	16	4	6	**44**
Warka to koka terning/Nahmald	6	4	2	4	**16**
Old Menahrya to pikok menahrya	6	2	14	18	**40**
	91	**96**	**137**	**60**	**384**

Table 4 Occupational behavior of respondents

4.1.1. Age, Gender and Marital Status of the Respondent

The "Background of the Respondent" section typically provides a detailed demographic and personal profile of the individuals participating in a survey or research study. This section generally covers aspects such as: The age range of the respondents can offer insights into the generational distribution, Whether the respondents are male, female, or identify differently, Information about the respondents' education, such as whether they have completed primary, secondary, or higher education, The types of employment or roles the respondents occupy, or if they are students, retirees, unemployed, etc, Household or personal income, which may influence the respondents' perspectives on certain issues, Geographical location, such as the area where the respondents live or work, which could impact their experiences and views, Whether they are single, married, or have another family structure, For studies involving local communities, the length of time respondents have lived in a certain area, for the purpose of the study I have focused on the demographic characteristics of Age, Gender, Occupation, of the respondent the general demographic characteristics of the respondents are summarized bellow

According to the data presented in figure bellow the age of the majority respondents fell within the age range of 18-25 this indicate that the majority taxi transportation users are the young part of the city community which represent around 31% of the total respondents and the least respondent age of the community is the age more than 66 years this indicate that the old age group does not use the taxi this indicate that the taxi transportation service is not convenient for the old age group.

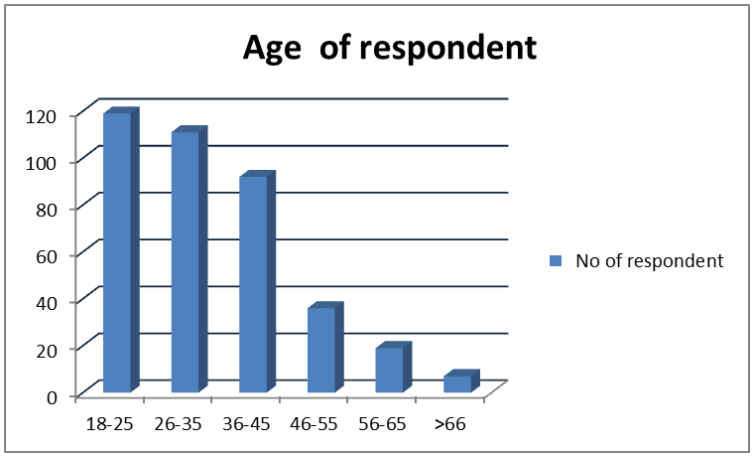


Figure 3 Age catagory of respondant

4.1.2 Employment Conditions of the Respondents

Based on the findings presented below the occupational background of the respondent are almost similar and there is no wide gap between occupation this indicate that all occupational category uses the taxi transportation servis to move from home to work and back to home.

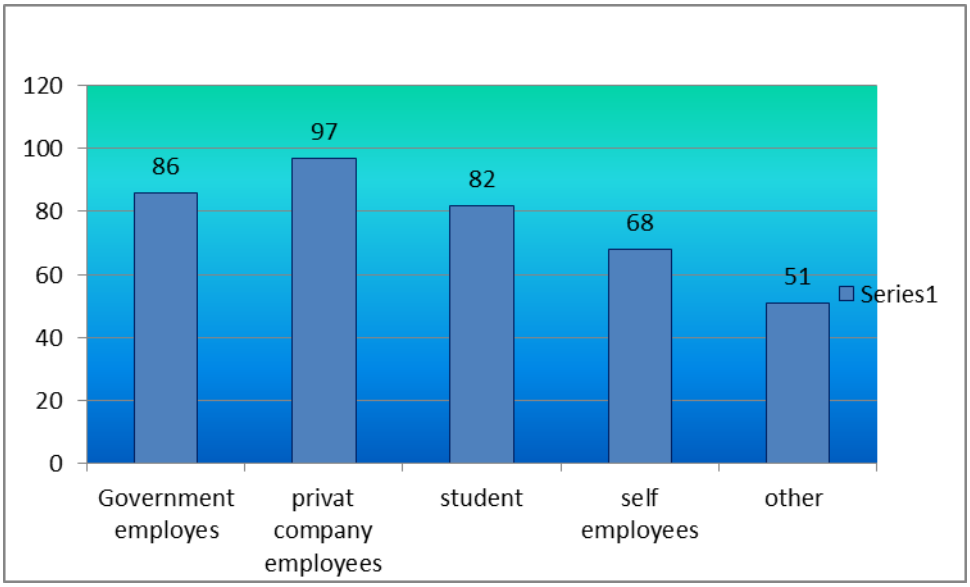


Figure 4 Occupation of respondents

4.1.3 Gender Conditions of the Respondents

When we evaluat the gendar category of the respondant as the acupational vatagory it has same the male vatagory cover 55 % of the total population and 44% the femals cover this indicat tht bothe uses taxi transportation service eqeutably

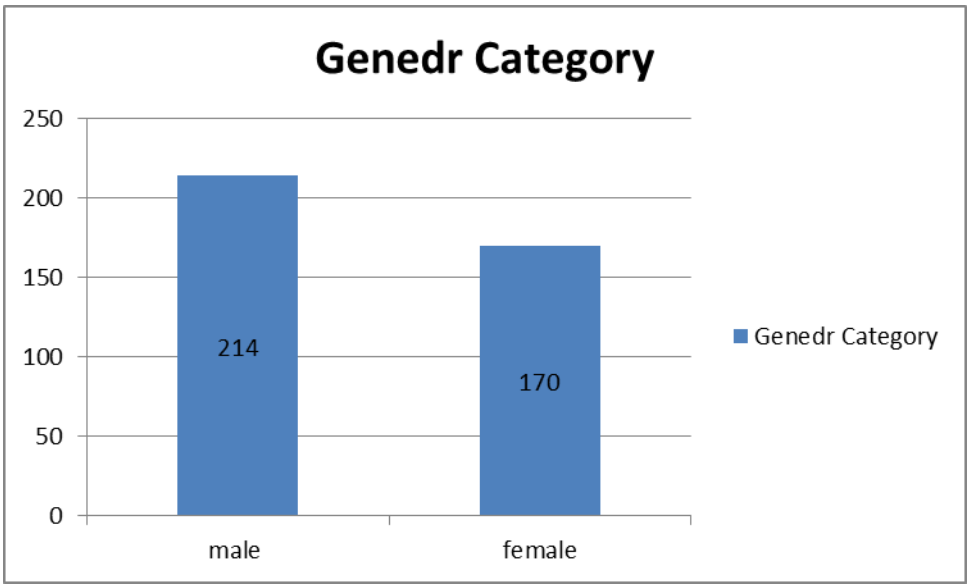


Figure 5 Gender category of respondents

4.2 Public transportation in Adama city

Public transport in Adama City, Ethiopia, relies on various modes, including minibuses, Bajaj (three-wheeled motorized vehicles), and buses, with plans and ongoing efforts to expand and improve infrastructure to support the city's rapid growth. These systems are run by a combination of private operators and government entities. For an expat living in Adama, it’s entirely possible to get around comfortably without a car, relying on these public transportation options and walking. However, it’s important to understand the nuances of each system to navigate the city effectively.

A taxi transportation hub typically refers to a centralized location where taxis congregate to pick up passengers. These hubs are often strategically located in busy areas such as airports,

train stations, market centers, bus terminals, or city centers to facilitate easy access to transportation for travelers.

Taxi transportation hubs can vary in size and amenities. Some may simply be designated areas where taxis queue up to pick up passengers, while others may have facilities like waiting areas, information desks, or electronic signage to assist passengers in finding taxis or determining fares.

The concept of a transportation hub is to streamline the process of connecting passengers with taxis, reducing wait times and providing a convenient and efficient way to access transportation services.

In the context of Adama city there is no specifically designed public transportation hub infrastructure with additional different facilities, instead of that based on different criteria traditionally there are some specified location that used as a taxi hub with different challenges.

4.1.1 Minibuses

Minibuses, locally known as “line taxis,” are the most common form of public transportation in Adama. These vehicles, which can carry up to 12 passengers, operate on fixed routes throughout the city. They’re a cheap and efficient way to get around. However, they can be crowded, especially during peak hours, and may not be the most comfortable option for longer journeys. Safety can also be a concern, as drivers often drive fast and aggressively to maximize their earnings. Despite these drawbacks, minibuses are a reliable and convenient way to get around Adama, and are used by locals and expats alike.

4.1.2 Taxis

Taxis are another popular form of transportation in Adama. They’re more expensive than minibuses, but offer a higher level of comfort and convenience. Taxis can be hailed on the street or booked in advance, and fares are usually negotiated before the journey begins. While taxis are generally safe, it’s advisable to use a reputable company or book through a hotel to ensure a reliable service. For women traveling alone or late at night, taxis are often the preferred mode of transportation.

Transportation Characteristics in Adama.

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

Table 5 Transportation characterstics in Adama

Source: Adama Transport Agency, 2014/15

4.2 The challenges of public transportation hub in Adama city

4.2.1 Limited Infrastructure:

The city have highly inadequate infrastructure to support an efficient public transportation system in the city. The taxi service providers give their eservices in through challenges. This could include insufficient Taxi stops, poorly maintained roads, resulting in inefficient service and longer travel times.

Road Types and cost of computation.

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

Table 6 Road Taype and cost computation

Source: Adama City Municipality, 2012

4.2.2 Safety Concerns:

Safety is the basic and the main issue in every aspects of life without safety the community does not perform its day to day activity. In Adama city public transportation the issue of safety is very challenging and the main problem to the society especially on the area of taxi hub mostly occur accidents, theft, and harassment, on the passengers due to unavailability of security office on the hub to secure society from ant types of harm.

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

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

Year	Death	Annual Change in %	Slight Injury	Annual Change in%	Serious Injury	Annual Change in%	Property Damage	Annual Change in %
2004/2005	10	9.8	11	6.7	05	4.6	38	9.4
2005/2006	16		13		08		60	
2006/2007	13	15.5	07	7.3	13	12.7	42	8.8
2007/2008	28		19		23		50	
2008/2009	35	28.1	65	25.6	34	24.7	99	20.6
2009/2010	39		27		36		116	
2010/2011	24	22.7	52	30.9	41	34.6	125	27.4
2011/2012	36		59		57		161	
2012/2013	31	23.9	56	29.5	29	23.4	175	33.8
2013/2014	32		50		37		177	
Total	264	100.0	359	100.0	283	!00.0	1043	100.0

Table 7 Road Traffic accident situation in Adama city

Source: Adama Traffic Police Department.

Figure 6 Post office taxi stations

The Distribution of Hot Spot Areas of Road Traffic Accidents

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

Source (Ethiopian Roads Authority, 2012).

Accident hot Spot Areas.

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

Table 8 Accidental hot spot Areas in Aama city

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

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

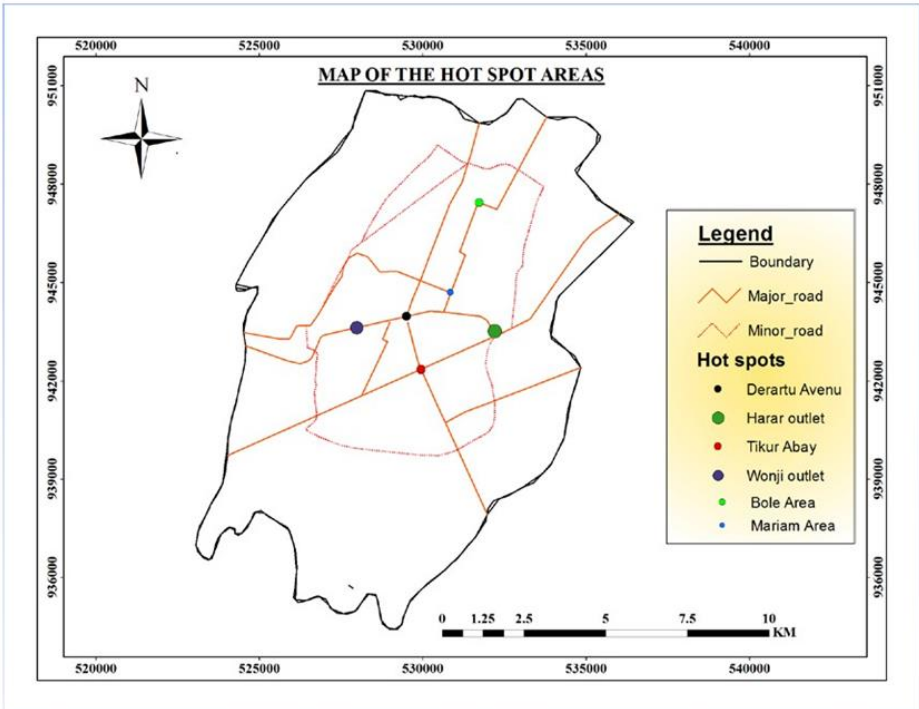


Figure 7 Map of the hot spot area

4.2.3 Congestion:

Adama City experiences significant traffic congestion, especially during peak hours. On the morning from 1:00 to 3:00 and afternoon 9:00 to 1:00 local time Public transportation hubs may struggle to efficiently manage the flow of vehicles and passengers, leading to delays and frustration among commuters.

Figure 8 Warka taxi station

4.2.4 Urbanization and Population Growth:

Every infrastructure that are built has to be consider the current population as well as the population growth .the growth of population has high impact on the service of the infrastructure as well as the life expectancy on the infrastructure. Rapid urbanization and population growth in Adama City may strain existing public transportation infrastructure and services, increasing demand for reliable and efficient transportation solutions.

Trends of population growth of Adama City between 1986 and 2022The last Ethiopia national population and housing surveys were conducted in 1994 and2007, and the possible projection was made for 2022. The population in Adama City increased from 115,693 (1986) to 328,137 (2022), implying that the population has nearly tripled (2.84 times) in the past 36 years.

year	1986	1996	2006	2016	2022
Growth rate(%)	3.18	3.17	2.77	2.71	2.50
Population	115693	161437	214318	281850	328137

Table 9 population growth in Adama city

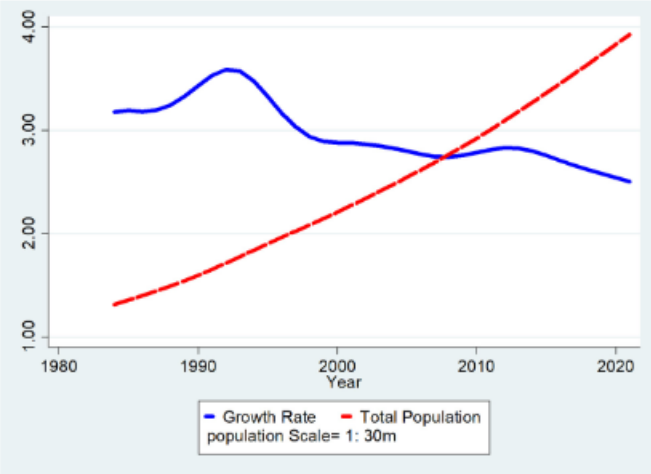


Figure 9 Adama city population gowth rate

Source: Messay MULUGETA June 24, 2024 Dynamics of Urbanization and Its Effects on Rural Livelihoods: Evidence from Adama City and Adama Rural District, Ethiopia

4.2.5 Environmental Impact:

Now days sustainability is basic element in every human life activity transportation is one of the major factor that affect our environment. The Public transportation hubs may contribute to environmental pollution through different directions such as vehicle emissions and noise pollution. Implementing measures to promote sustainable transportation options, such as by

adding infrastructures like toilet on the hub to the divers as well as to the public, can help mitigate these impacts.

4.2.6 Limited Funding:

Funding constraints may limit the ability of local government to invest and expansion in improvements to public transportation infrastructure and services. Securing adequate funding and exploring alternative financing mechanisms can help address this challenge.

4.2.7 Existing structure:

The existing structure in the city is one factor that challenges the city administration to build and expand the current taxi hub to standard multi functioning hub.

Generally addressing these challenges requires a multi-faceted approach involving collaboration between government agencies, transportation authorities, urban planners, and the community to develop and implement sustainable solutions that improve the accessibility, efficiency, and safety of public transportation hubs in Adama City.

4.3 The impact of good public transportation hub in the society

Urban public transportation has a major impact on the community either directly or indirectly the influence of transportation is multi-dimensional by its nature human being by its nature move from one place to another place to perform its day to day activity like economic social activities. Any element that affects the mobility of the society has great impact on day to day life of the community. On the other and public transportation hub must give proper service to the community to deliver expected service the hub mist be fulfill necessary infrastructure and facility, it must be accessible for every part of the society and safe in every dimensions the fulfillment of those element as well as the lack of those element has a great impact on the community in this search explore findings related to the impact of the public transport hub by focusing taxi transportation.

4.3.1. Economic Impact of public transport hub on the community

Increased Accessibility:

Public transport hub infrastructure improves accessibility by connecting different areas within a city or even across surrounding neighboring regions. This connectivity makes it easier for people to access jobs, education, healthcare, and other services, thereby facilitating economic activity. The Adama city public transportation hubs are not on the right track to facilitate and improve the economic values of the community it has an adverse impact in economic aspects of the users contribution to illegal transport tariff charge since most hubs are not comfortable tu the service providers like Post Office hub and Warka hub.

Stimulating Economic Development:

Proper designed and managed hubs often act as focal points for economic development, attracting businesses, retail establishments, and real estate investment. Businesses tend to cluster around transport hubs to take advantage of the high foot traffic and accessibility they offer.

Increased Property Values:

Properties located near public transport hubs often experience an increase in value due to their proximity to transportation options high economic activity and accessibility to basic government and private services. This can lead to high land values to the community and higher property tax revenues for local governments. When we evaluate the Adama city hub the land value near to the hubs are very high as compared to the other location.

Tourism and Commerce:

Adama city is knows in a national level as the confrere center this opportunity considers as a center of conference truism center the current adama city hublic transportation service and hubs are not capable to accommodate this high conference tourist. Hubs that properly designed and administered can significantly boost tourism and commerce by facilitating the movement of people and goods within the city. This influx of tourists can stimulate spending on accommodation, dining, entertainment, and shopping.

Job Creation Opportunity:

Currently the unemployment rate in our county is expected to 3.4% this much of unemployment rate are expected in Adama city. The expansion and constructing public transport hub in the city create employment opportunities directly, through jobs such as ticketing agents, security personnel, maintenance staff, and indirectly, by supporting businesses that cater to commuters and travelers.

Smart city Development;

Now a days Adama city administration implementing smart city development strategy to improve the life of the community. Urban transportation facility is one of the basic elements that the government working on it making the transportation system smart has a great impact on the society as well as to the government in different economic directions.

4.3.2 Social Impact of public transport hub on the community

Public transport hubs have several social impacts on society, influencing various aspects of community day to day life and interaction. Here are some of the key social impacts of public transport hub:

Enhanced Mobility and Accessibility:

Public transport hubs improve mobility for people from all walks of life, including those without access to private vehicles. This enhanced mobility promotes social inclusion by ensuring that individuals can access essential services, education, employment opportunities, and recreational and other social activities.

Reduced Social Isolation:

Reliable and accessible public transportation can help combat social isolation, particularly among vulnerable populations such as the elderly, people with disabilities, and low-income individuals. The Adama city public transportation hubs are not accessible for such parts of the community since all hubs are on the side of road it is very challenging for elder and disable community. An accessible hub provides opportunities to engage with their communities, attend social gatherings, and access support networks.

Equitable Access to Opportunities:

Every infrastructure that are built by the government has to be equitably distribute to all the community since the community is a sources of finance .Public transport hubs help bridge the gap between different socio-economic groups by providing affordable and accessible transportation options. This ensures that all members of society, regardless of their income level or geographic location, have equal access to essential services, education, and employment opportunities. This also creates the belongingness of the infrastructure.

Urban Revitalization and Place making:

Well-designed public transport hubs in Adama city can act as catalysts for urban revitalization, transforming neglected areas into vibrant, attractive and livable spaces. They attract investment, spur economic development, and create opportunities for place making initiatives that enhance the quality of life for residents.in the context of Adama city there are place that use as a hub but still the places are not vibrant especially at the destination point of every root.

4.4. Accessibility and inclusivity of public transport hub in Adama City

Accessibility refers to the degree to which something is easily reached, approached, or obtained without challenge for everyone who needs it. In the context of public transport hubs, accessibility encompasses several aspects:

4.4.1 Physical Accessibility Adama city hub

Public transport hubs should be physically accessible to all individuals, including those with disabilities or mobility impairments. This includes features such as ramps, elevators, tactile paving, and designated parking spaces to ensure that everyone can navigate the facility safely and independently. Not only to the community have the hub also accessible to the taxi service providers by facilitating enough and proper infrastructures liked road, car washing amenities, Garage and other facilities.

Most of the Adama city public transport hub facilities are not accessible Bothe the communities as well as to the service providers. The challenge of accessibility begins from the location that the hubs are there. The primary hubs that accommodate a huge amount of passengers with traffic jam hubs like Post office hub, Warka hub, Wonji Mazoriya and Mebrat

hayl hubs are located in challenging place that are not comfortable to handle the traffic and the passengers flow

The main challenges related oo physical accessibility of the hub around the Adama city hubs are;

Location of the hub

All Adama city hubs are located on the road of the city there is no designated place specifically to the hubs this results the traffic jam on the roads and expose the society to different problems such as safety problem related to theft, environmental problems during harsh sun and rain exposure during rainy season since there is no any shed prepared to the passengers and traffic accident

Additional facility

Installing additional hub facility like shade, café and restaurant, shopping center, car wash, security office is the basic element that fulfills the hub. The Adama city hubs are giving the service with the absence of such infrastructure these results different social and economic impacts on the community.

No	Name of the hub	additional hub services				
		shed	caffe	shops	Governmetn Oficals office	car wash
1	Mazoriya					
2	Warka/Adama Rass					
3	Post Office					
4	Mebrat Hayl					
5	Zero arat					
6	Hani kek bet					
7	Tadese Debele/Amede					
8	Tekur abay					
9	Duket					
10	Aba Gada Hall					

Table 10 Additional Facility of hub

Traffic management system

Traffic management can have a significant impact on public transport hubs in various ways such as; Effective traffic management can improve the flow of vehicles around public transport hubs, reducing congestion and allowing taxis to move more freely, assure the safety of the hub, improve economic benefit if the society,

In general, traffic management plays a crucial role in enhancing the functionality, accessibility, safety, and sustainability of public transport hubs, ultimately contributing to a more efficient and integrated transportation system.

4.4.2 Geographic Accessibility of public transport hub in case of Adama city

Public transport hubs should be strategically located to serve a broad population base and provide convenient access to key destinations such as residential areas, commercial districts, educational institutions, healthcare facilities, and recreational venues. Geographic accessibility ensures that people can access transportation services without facing significant travel distances or barriers. In addition to that public transport hub refers to how easily people can reach the hub from various locations within its vicinity.

There are several factors influence geographical accessibility of public transportation hub such as

Location of the hub

The hub's location relative to residential areas, commercial districts, educational institutions, and other key destinations impacts its accessibility. Hubs situated in central locations or near densely populated areas tend to be more accessible to the community. Based on the above parameters Adama city public transportation hub locations are good as a general in selection of the location in respect to proximity to the commercial center, social service organizations and recreational area even though the site is on proper location specifically the place the hub established are mostly in wrong point.

For instance the general location of the post office hub is on proper area as the ares commercial recreational and other services the site in general correct but the specific hub location which are currently serving beside to the Commercial Bank of Ethiopia is wrong die

to different reasons such as the area is on street, even there is no any space to the community to move.

Transport Network

The availability and connectivity of transportation modes such as buses, from the hub affect its accessibility even thou currently there is no any public transportation hub either than taxi such sa rail way the infrastructure that has been built consider the future A well-integrated network with multiple routes and frequent services enhances accessibility.

Distance from the community

The distance people need to travel to reach the hub from their starting point ot the residential areas of the community affects its accessibility. Shorter travel distances typically result in higher accessibility, especially for pedestrians, elderly community and disabilities.

Affordability of the transportation tariff

Affordability of transportation services is one element to measure the accessibility of transportation services, particularly for low-income individuals and families. Public transport tariff should be reasonable and affordable, ensuring that transportation remains accessible to all members of society, regardless of their financial means. As a result of public hub in Adama city there is increment of the tariff in charge of pre-determined tariff of the line especially in the pic hour.

Safety and Security of the Adama city hub

Accessibility also encompasses safety and security considerations, ensuring that public transport hubs are safe, well-lit, and free from hazards or crime. Adequate lighting, surveillance cameras, emergency call buttons, and trained personnel contribute to a secure environment that promotes confidence and trust among users.

4.4.3 Inclusivity of public transport hub in case of Adama city

Inclusivity in the context of public transport hubs refers to designing and operating these hubs in a way that ensures they are accessible and welcoming to people from all backgrounds,

abilities, and circumstances. Either to the resident of the city or the new comers which does not know the city. Here's how inclusivity can be measured in public transport hubs:

Accessibility for People with Disabilities:

Inclusive public transport hubs should provide features such as ramps, elevators, concrete paving, and designated parking spaces to accommodate individuals with disabilities or mobility impairments. These facilities ensure that everyone can navigate the hub safely and independently.

Consideration for seniors and Vulnerable Populations:

Public transport hubs should be designed with the needs of seniors, children, pregnant women, and other vulnerable populations in mind. This may include providing seating areas, restrooms, and amenities that cater to their specific requirements of those parts of the community.

4.5. Adama city taxi root analysis

Analyzing the taxi routes in Adama City (also known as Nazret), Ethiopia, involves understanding various aspects such as the city's layout, transportation needs, and the efficiency of the routes. Here are some key points to consider:

4.5.1 City Layout and Road Network

- **Main Roads and Arterial Routes**: Identify the major roads and highways in Adama. Understanding how these roads connect different parts of the city is crucial for analyzing taxi routes.
- **Residential and Commercial Areas**: Analyze how well taxi routes cover residential neighborhoods, business districts, and key commercial areas. Efficient routes should provide easy access to these zones.

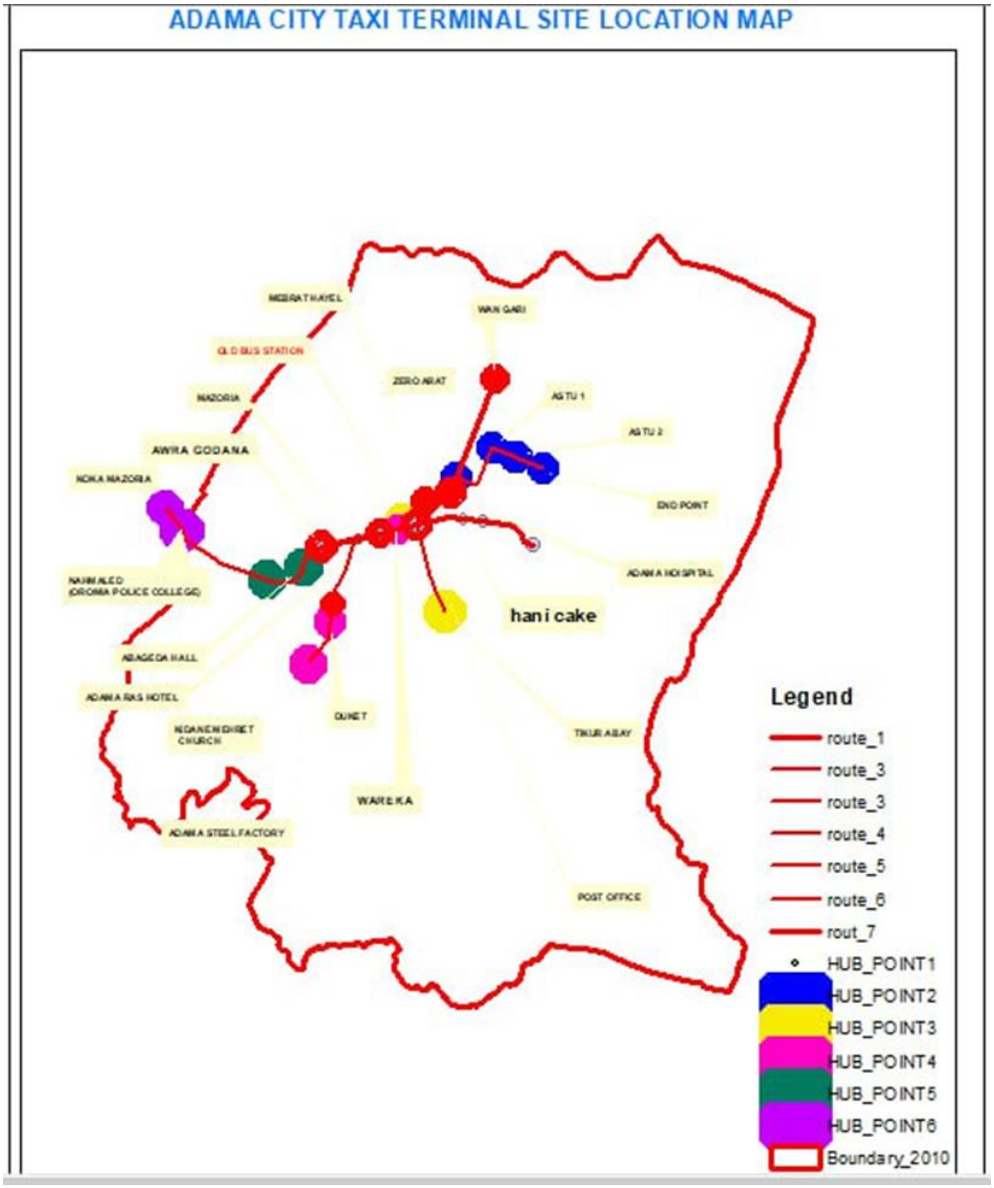


Figure 10 Adama city taxi terminals location map

4.5.2. Taxi Routes and Coverage

- Route Map: Review a map of current taxi routes. This includes identifying major routes, their starting and ending points, and any major intersections they cover.
- Coverage and Frequency: Evaluate whether the taxi routes adequately cover the entire city and how frequently taxis run on these routes. Areas with high demand should have more frequent services.

4.5.3. Passenger Demand

- Peak Hours: Analyze passenger demand during different times of the day. Taxi routes may need to be adjusted to accommodate higher demand during peak hours.
- Popular Destinations: Identify popular destinations such as markets, schools, hospitals, and government offices. Routes should be designed to efficiently service these high-traffic areas.

4.6 Adama city taxi transportation streams

Currently in Adama city there are around ten minibus taxi transportation lines those lines have around five main initial point those pointes are cyrrently used as a tasi transporation hub those pointes are;

1. Awra Godana /General Tadessa square
2. Warka/odda
3. Post office
4. National/Genb
5. Old bus station

Based on this main initial hub there are four main taxi transportation root most of the population and majority of the taxi providers are gives their service in this root based on the analysis around 83 percent of the taxi transport service providers use this root those lines are;

4.4.1 Awra Godana to Bolle

This line is the main and the longest distance in Adama city taxies root and cover large transportation demand. Throughout in this root there are six points that are used as a taxi hub that are determined by the Adama city administration. Those hubs are a types of that does not have any facility for the public those points are:

- Mazoriya
- Warka/Adama Rass
- Post Office
- Mebrat Hayl

- Zero arat and the end point of bolle
- Wangari

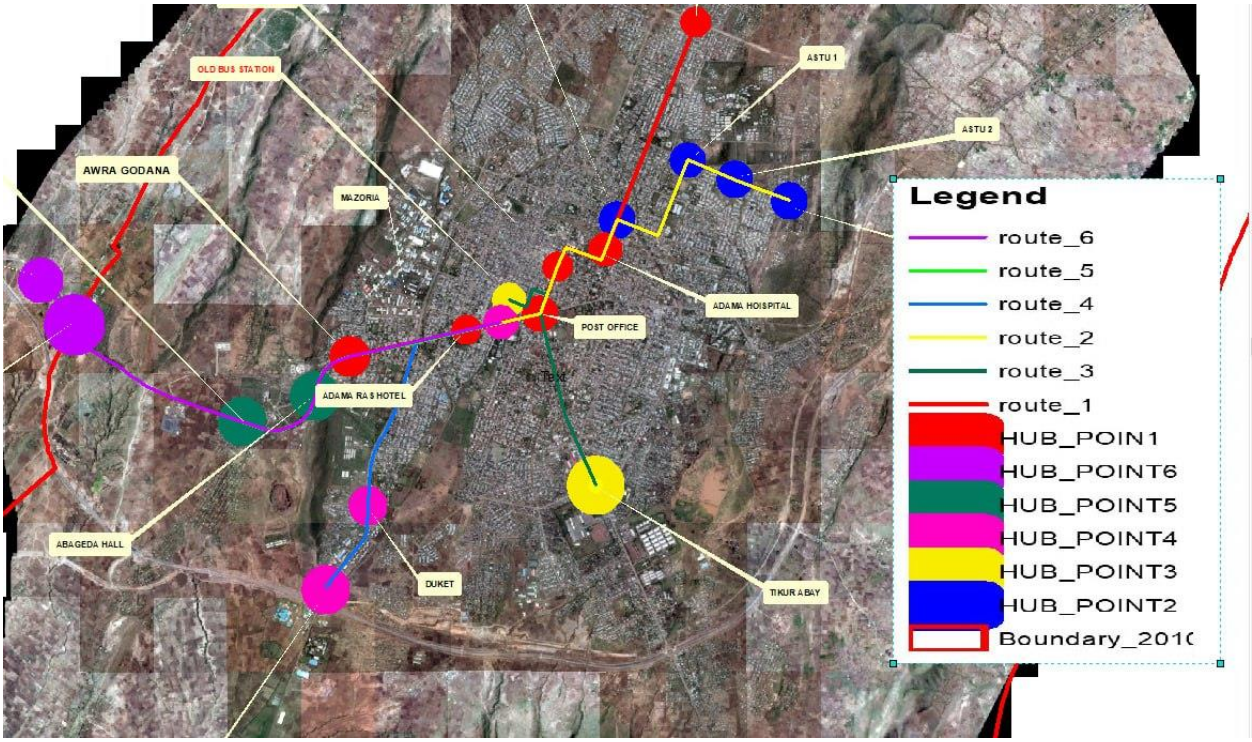


Figure 11 Awra godana/G Tadese to bolle taxi root map

4.4.2 Awra Godana to college/ASTU

It is the longest distance which covers around 7.2 km with a five fermata it busy line specially at pick hours as of any line of Adama city one thing different this line is it is also busy in weekend days due to high mobility of Adama science and technology university students at the week end time.

As we have seen in the terminals point it is the same line with the bole line the passengers has an option to use both line up to Zero Arat points

The main points that the taxi pick and drop passenger in this line are;

- Mazoriya
- Warka/Adama Rass
- Post Office

- Mebrat Hayl
- Zero arat and the end point of bolle

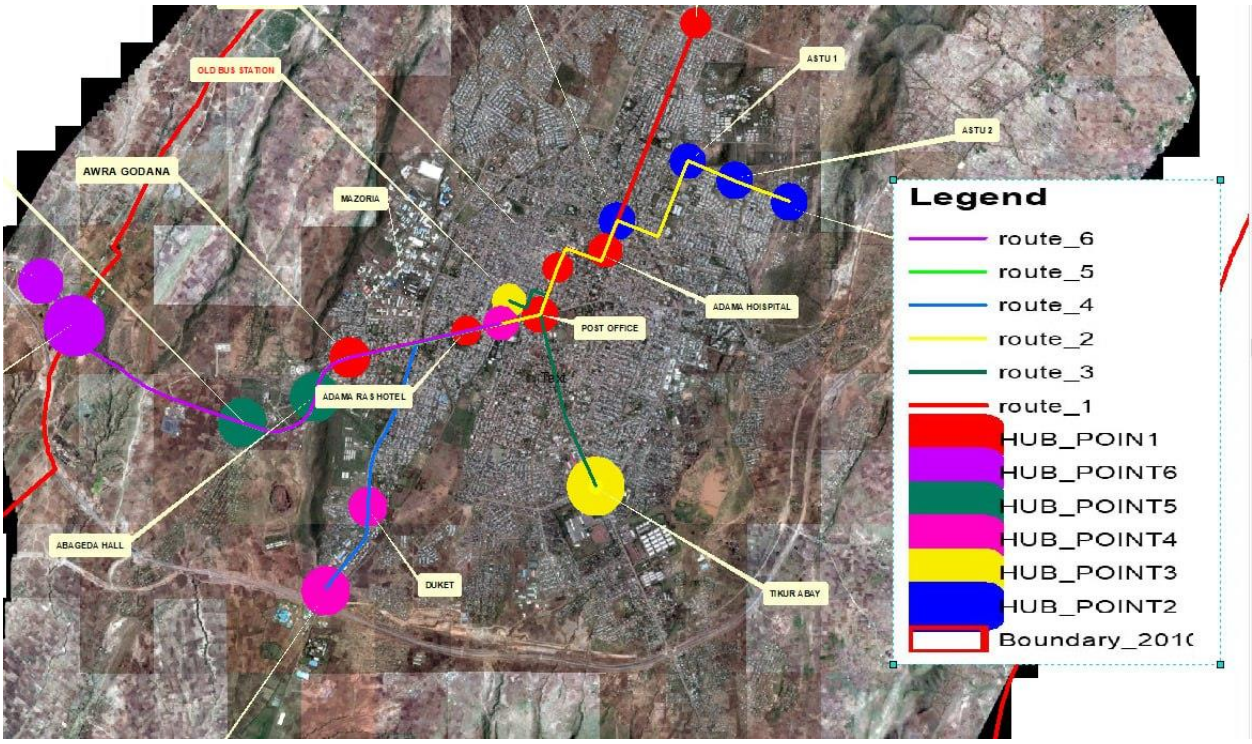


Figure 12 Awra godana to ASTU taxi toot map

4.4.3 Awra godana to Amede Kela

This is the third longest and large number of people is used specially the customer that comes from the periphery of Adama city for different activities like to market and different social activities

As of the above two main roots of Adama city taxi root this root also has some shared taxi hubs with the above two roots which are Awra Godana to Bolle and Awra Godana Adama science and Technology university taxi root those shred hubs are:

- Mazoriya
- Warka/Adama Rass
- Post Office
- Hani kek bet
- Tadese Debele/Amede
- Amede kela

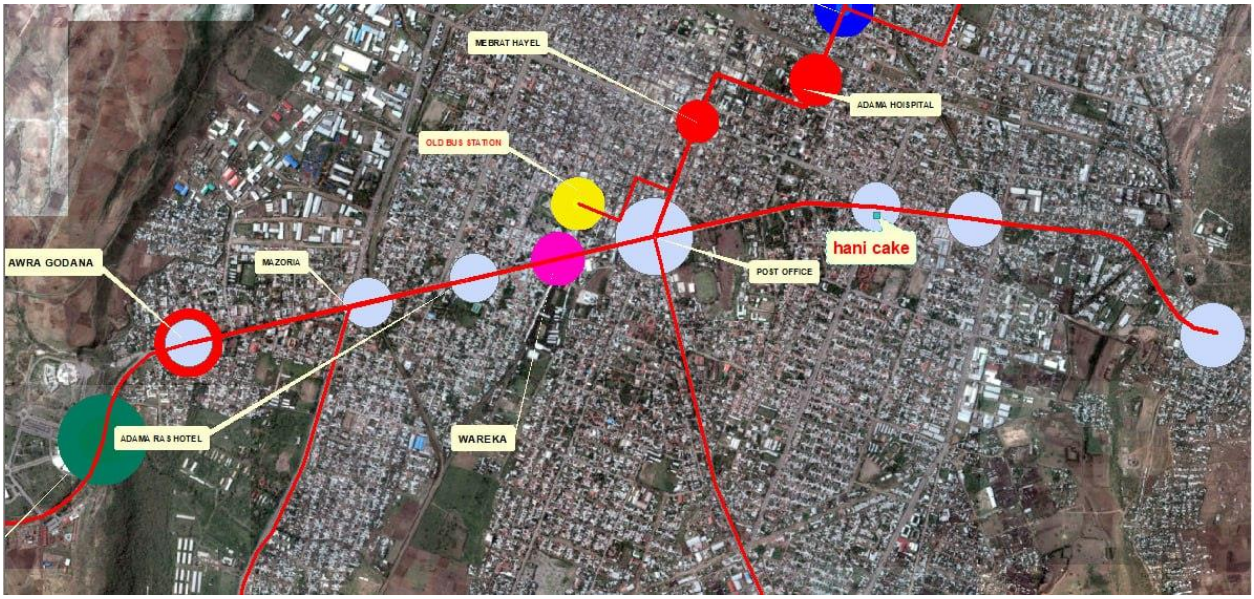


Figure 13 AWra Godana to Amede kella taxi root

4.4.4 Post office - Tikur Abay transport – Bollo

This is the taxi roots run from post office to Tikur Abay transport this root mostly transport passengers to the Adama migira bus station unlike the other root there is no any point that are uses as a hub in this root

4.3.5 . National/old bus station to Tikur abay

This transportation line is the new that began in the last four years due to the establishement of the new bus station for the east and south esat direction of Ethiopia in this line less taxis are serving because of less mobility and the passengers has another option since it is near to post office

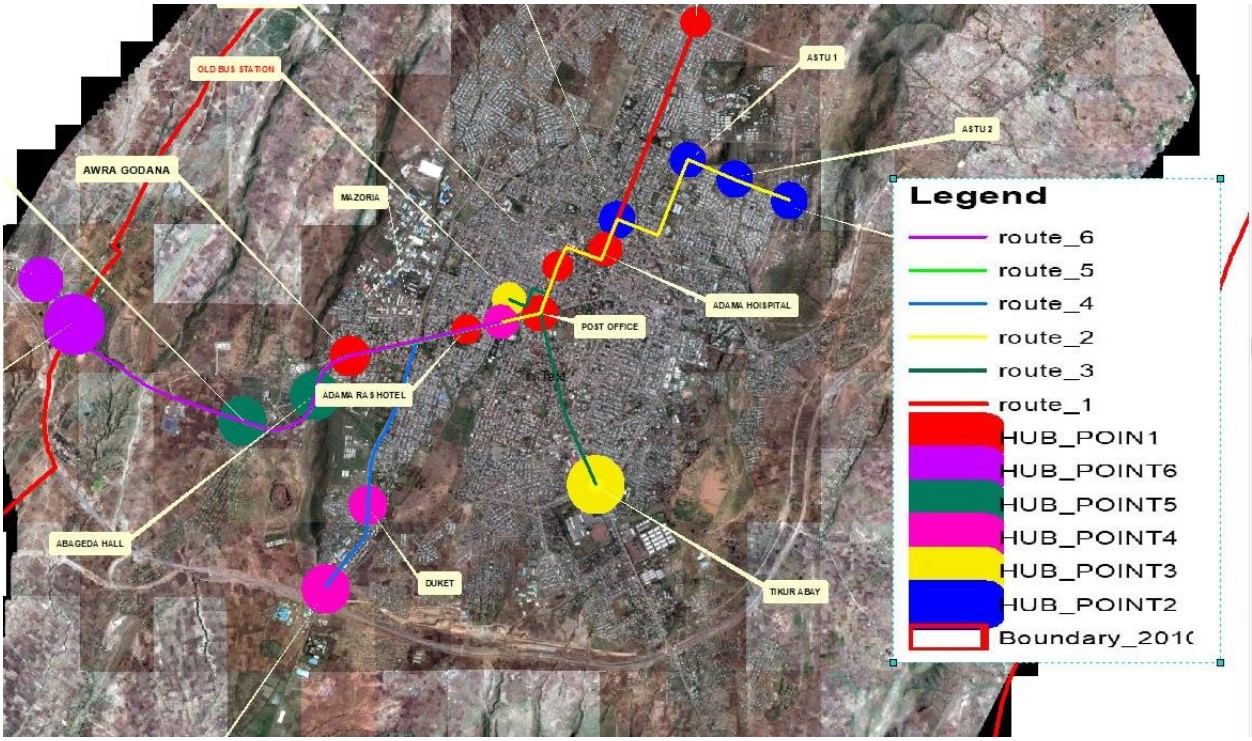


Figure 14 Old bus station to Tekur Abay taxi root

4.4.6 Warka to Adama korkoro/duket

This is the transportation streams that the southern part of the city travel to the central part of the city and to day to day activity.it has high travelers especially in pick hour of the day at work entry time and work live time. There are no specific fermatas between initial and final points of these streams.

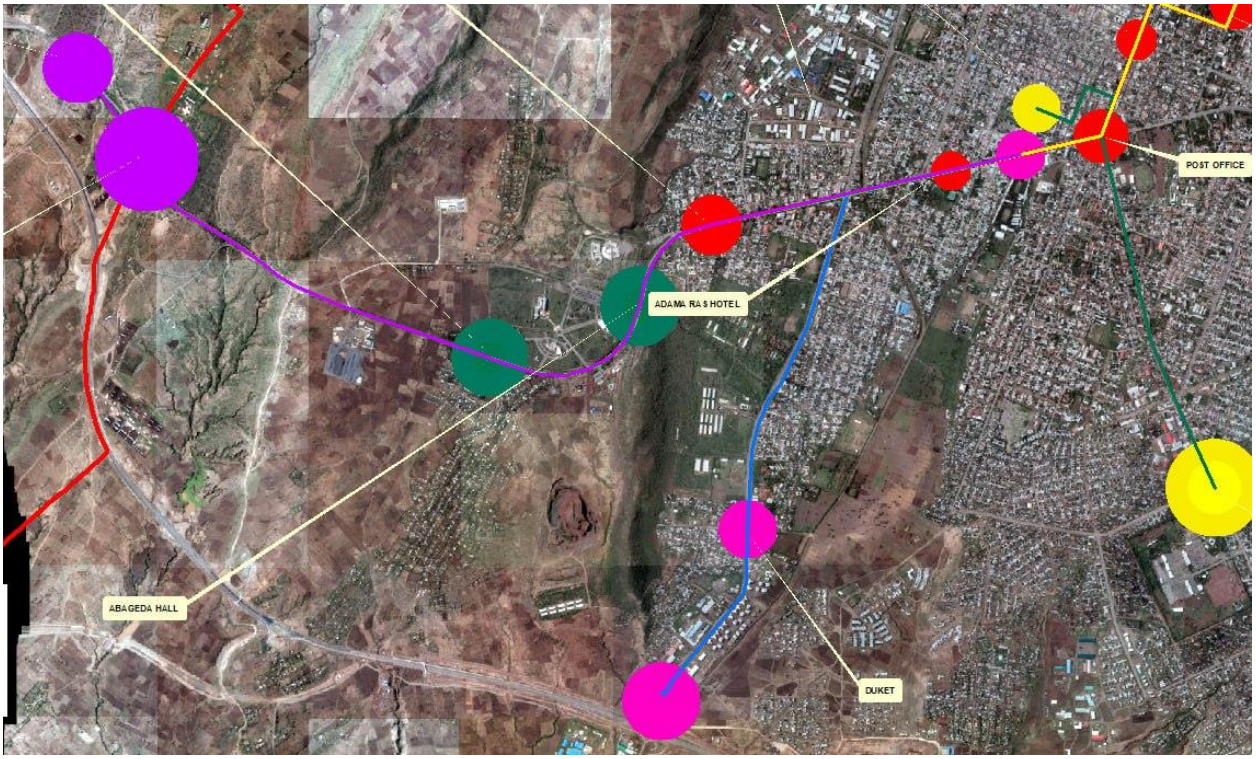


Figure 15 WArka to Duket Adama korkoro Taxi root

4.4.7 Warka to kidane-mhret church

This is the taxi streams that transport the western part of the adama city to the central part of the city. In addition to that there will be occasional passengers that use this line when there is a meeting in Gelma Abageda hall and religious ceremony at the Ethiopian Orthodox Tewahdo Church kidane Mherat church.

Figure 16 Warka to Kidane mhret Church Taxi root map

4.4.8 Warka to koka terning/Nahmald

This line is the same line with that of Warka to kidane-mhret church from the initial point to the church it uses for mainly to transport the western periphery of Adama city to the central parts

Figure 17 Warka To Nahmald Taxi Root map

4.4.9 Old Menahrya to pikok menahrya

This line is created due to maintenance of adama city bus station and by following the transfer of bus station to the temporary pikok bus station it is by its nature temporary line and will be out of service when the previous bus station construction complete

Figure 18 Old Bus station to Pikok bus station taxi root map

4.5 Summary of the transportation streams

Generally Adama city taxi transportation root are starts at the center and radiate to different parts of the city for different social and economic activities the characteristics of the passengers are differed in different roots major caragoriea are wfrom work to home frm hom to school and diffrenet social activities the general categorical analysis to the passengers are summarized bellow

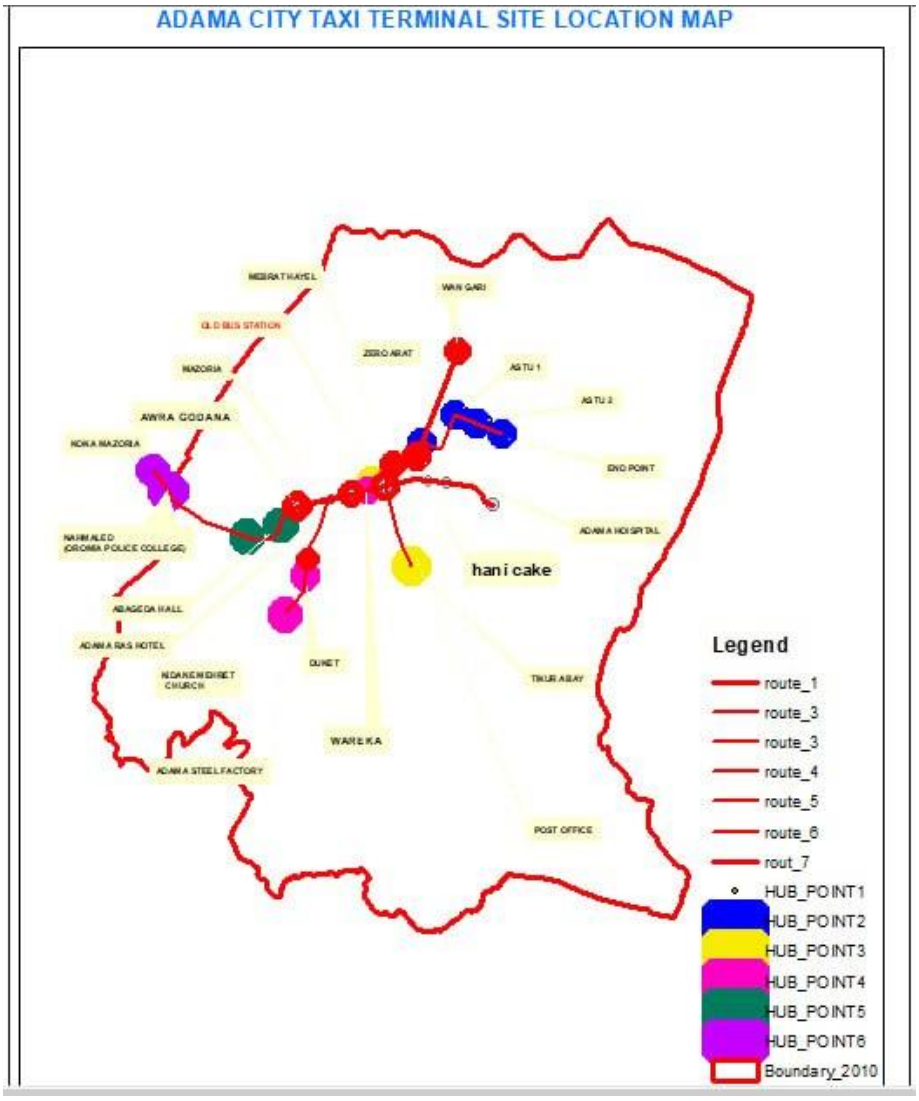


Figure 19 Major Adama city Taxi Root Map

4.6. The analysis of taxi fermatas

As we have discussed the taxi transportation line of the Adama city there are a number of overlaps on the line this overlapping results sharing of fermatas that the passengers can drop from the taxi and take taxi to different directions. This overlapping of the fermatas can result a large number of minibus taxi can stop to drop and to pick this can Couse huge number of passengers can exist at the same time in one specific place. The general analysis of the fermatas is summarized below in table.

A No	Taxi root	Initial hub	The Intersaction hub on the root														
1	Awra godana to Bole	Awra Godana		Wonji Mazoriya	Warka	Post Office	Mebrat Hayl		Zero Arat								
2	Awra Godana to college/ASTU	Awra Godana		Wonji Mazoriya	Warka	Post Office	Mebrat Hayl		Zero Arat	Wan Gari							
3	Awra godana to Amede Kela	Awra Godana		Wonji Mazoriya	Warka	Post Office		Tadese Debele									
4	Post office - Tikur Abay transport - Bollo	Post Office				Post Office					Tikur Abay	Bollo					
5	National/old bus station to Tikur abay	Old Menaherya									Tikur Abay						
6	Warka to Adama korkoro/duket	Warka			Warka								Duket	Adama Still Factory			
7	Warka to kidane-mhret church	warka	Awra Godana		Warka										kidanmhret church		
8	Warka to koka terning/Nahmald	warka	Awra Godana												kidanmhret church	Nahmald	
9	Old Menahrya to pikok menahrya	Old Menaherya				Post Office											Pickok bus station
	Number of frequency		2	3	5	5	2	1	2	1	2	1	1	1	1	1	1

Table 11 the relation of taxi hub/Overlapping

The above hub analysis indicate that there are a hub that has a number of frequency the hub Warka and Post Office shows that five taxi root must cross those hubs to reach to their final this indicate that this point is a primary point that need a taxi hub primarily.

On the second stage there is one point that the three taxi roots cross to reach to their final destination hub which is Wonji Mazoriya hub

On the tertiary stage thera are a hub that has two frequencies which are Awra Godana ,Mebrat Hayl,Zero Arat, tikur Abay,and Kidamnhiret Church. Thos hubs are the tericiary stage hubs.

Finallt there are a point thar the roots can cross only on one point either as crossing point or final destination points thos points areTadese debell/Amede,Wan gari,Bollo,Duket,Adama Still Factory,Nahmald or Oromia Police College,and tickok Bus station

5 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

A well-developed public transport hub facility stands as a motto to a community's commitment to sustainability, accessibility, and progress. As we conclude our exploration, it becomes evident that such hubs serve as more than mere intersections of transportation modes; they are dynamic centers fostering connectivity, economic growth, and social cohesion. The benefits are manifold reduced traffic congestion, improved air quality, enhanced mobility for all citizens, and strengthened community ties. As we look to the future, investing in the expansion and enhancement of public transport hubs emerges not only as a practical necessity but as a visionary step towards building inclusive, thriving cities for generations to come.

Due to the vast challenge of the city public transport infrastructure and management system this sector is becoming pushing behaviors in the existed public taxi service providers and discouraging for the new comers that need to involve in this business this behavior results that the shortage of public transport service since the government is unable to fulfill the demand of the society this results different impact on the community such as

The criminal acts on the taxi hubs also become another challenges specially on the pic hour due to shortage of taxi services specially on the hub Warka.Post Office and Mebrat Hayl points.This forces the community to use another expensive mode of transport like contracting private vehicles.

Traffic accident also another challenges that the society facing due to unavailability of proper public transport infrastructures

Environmental impact is another factor that Adama city public transportation hubs are facing today since there is enough facility in the hub like toilets the service provider as well the community uses the periphery of the street this results environmental pollution that causes health problem on the whole community of the city

Moreover, this study highlights the need for continued investment and strategic planning in the development and maintenance of public transport hub facilities in Adana city. As urban populations continue to grow and environmental concerns intensify, the significance of these

hubs as sustainable transportation solutions cannot be overstated. Governments, urban planners, and stakeholders must collaborate to ensure that these facilities are designed and managed effectively to meet the evolving needs of diverse communities.

5.2 General Recommendation

Based on the findings and analysis presented in this thesis on public transportation hub facility in the case of Adana city, several recommendations emerge to enhance the effectiveness and impact of such infrastructure. However, the suggestions that are forwarded herein are aimed at giving broader and more general guidelines to better suit this issue role toward maximizing accessibility inclusivity and safety of the city hub infrastructure.

5.2.1 Integrated Planning Approach:

Working with the collaboration between urban planners, transportation authorities, and other relevant stakeholders to ensure that public transportation hub facilities are seamlessly integrated into broader urban development plans. This approach should prioritize connectivity with existing transportation networks and urban amenities to maximize accessibility and convenience for users.

5.2.2 Transit-Oriented Development (TOD):

Encourage transit-oriented development around the hub to promote mixed-use neighborhoods with convenient access to public transportation. Collaborate with local governments, developers, and community stakeholders to cover the construction of residential, commercial, and recreational facilities within walking distance of the hub. Foster vibrant public spaces and pedestrian-friendly environments to enhance the overall urban experience.

5.2.3 Accessibility and Universal Design:

Ensure that the hub is accessible to all individuals, including those with disabilities, elderly passengers, and families with young children. Implement universal design principles throughout the facility, including ramps, elevators, tactile paving, and clear signage. Provide designated waiting areas and amenities to accommodate diverse passenger needs.

6.2.4. The concept of the design

A design concept is the core idea driving the design of a product, explained via a collection of sketches, images, and a written statement. This helps the designers and, later, the developers stay on track throughout the creative process, ensuring they bring a product to market with value to target users. Based on this idea the main concept in the design of public transportation hub facility in the case of Adama city is

- The location of the hub must be near to different commercial centers, other ode of transportation near to government and social areas
- Tha area of the hub must be enough to add the different facility in the hub
- The hub has to be near on the area that currently used hubs
- The hub must accommodate different facilities like shelter, cafe and restaurant,
- The hub design must be uniform in every aspect on form, service and texture and fit in every location

Based on the above conceptual frame-work the research also tray to recommends the design solution.

5.2.5 The recommended site for the public transport hub

Based on the above general analysis four basic fermatas are must have taxi hubs to facilitate the transportation system of the city in addition to the initial and destination points of the streams and to serve the society safely from different social and economic problems. The major points that are identified are

1. Mazoriya
2. Warka/Adama Rass
3. Post Office
4. Mebrat Hayl
5. Adma korkoro

Wonji Mazoriya

This is the center of the six transportation lines this indicate that there are high mobility of the society as well as high taxi jam at the point due to this reason there must be transportation hub for the taxi service providers to serve the society safely in the absence of any car accident and as well the public to use the taxi services in a safe way from different social and economic problems.

Warka/Adama Rass

This is the another point that the taxi hub must be built in large scale with different facility like shop shelter car wash and cafes now a days the terminal gives its service in highly condensed manner that face the taxi service providers for traffic accident and in the way that the passengers face fo different problem like theft rain and harsh sun shine without any shelter .

Figure 20 Proposed Warka Taxi HUb location

Post Office

This station was giving relatively good services for both service providers as well as for the passengers but currently because of different reason the place is changed to to beside the commercial bank of Ethiopia on the road. This results very difficult situation for both parties it is very uncomfortable to drop and pick passengers and creates disappointment by the society

Figure 21 Proposed Post Office Taxi HUb location

Mebrat hayle

This is the point that two main Adama city taxi streams can shears and the busiest fermata with large number of passengers next to post office fermatas special in pick house time due to the central part and the most commercial area this terminal most of the passengers move to this area for commercial purposes.

Figure 22 Proposed Mebrat hayl Taxi HUb location

Adama korkoro

Adama korkoro is a point in which currently use as the termination point of the taxi root from warka to duket-adama korkoro. Based on the data collection the respondent this poin has a apotentiol to expand to different direction sucha as adama korkoro to wonji gefersa, adama korkoro to St Mikael church to bollo. And adama korkoro to pikok- post office.

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