



Addis Ababa University
College of Technology and Built Environment

**Assessment of Vehicular Parking Space Problem on Urban
Transportation: The case of Bole sub-city, Addis Ababa**

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A Thesis Submitted to the College of Technology and Built Environment, School of Built Environment of Addis Ababa University, in Partial Fulfillment of the Requirements for the Award of Master of Science Degree in Urban Design and Development

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Declaration

I, the undersigned declare that, this research is the result of my own original work and has never been presented in any university/institutions for any degree or other purposes. All materials used from other sources other than my own idea in this study are duly acknowledged & properly cited.

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Approval

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Abstract

Lack of parking spaces in global context is a complex problem that affects the urban transportation in cities. High population and rapid urbanization coupled with augmentation in the quantity of vehicles have advanced the pressures in parking spaces, which has resulted in a massive urban transportation problem and inefficiencies. The primary objective of this paper is to assess the reason behind the inadequate parking facilities especially off-street parking areas that lead to different types of urban transportation problems. This paper examines the reasons and effects of parking space shortages on the urban transportation in Bole Sub City, Addis Ababa. To measure the main factors the study employed primary and secondary methods of data collection and field observations. The collected data were analyzed both qualitatively and quantitatively, to support the findings, the study incorporated qualitative interviews with stakeholders. Key findings of the research revealed that shortage of parking spaces are some of the factors that cause traffic congestion, decrease in road capacity, increase in the travel time, and deterioration in the safety of the pedestrians. There is also illegal and double parking behaviors that increase the number of traffic flow delays and reduce the effectiveness of the public transport. The paper concludes by stating that to overcome the problem of parking shortages, integrated urban planning, policy reform, and investment in structured parking facilities are necessary. This effort shall play a key role in enhancing the traffic condition to enhance urban mobility, and sustainable transportation development in the fast expanding cities such as Addis Ababa. The results can be used by urban planners and policymakers to reduce the problem of parking-related transportation issues.

Keywords: *vehicular parking shortages; impacts on urban transportation; adequate parking facilities; urban mobility*

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Acronyms

AACRA	Addis Ababa City Road Authority
AASHTO	American Association of State Highway and Transportation Officials
AATMA	Addis Ababa Traffic Management Agency
AATAA	Addis Ababa Transport Authority
CSA	Central Statistical Agency
CBD	Central Business District
ERA	Ethiopian Road Authority
E.C	Ethiopian Calendar
G.C	Gregorian calendar
FTA	Federal Transport Authority
PN	Parking Number
PMT	Parking Meter Technology
P&R	Park and Ride
POS _s	Parking Occupancy Surveys
TPC	Theoretical Parking Capacity
UTS	Urban Transport Study
FGD	Focus Group Discussions
VAP	Vehicles Accumulation Profile

CHAPTER ONE: INTRODUCTION

1.1 Background of the Study

The world's urban centers are undergoing an increase in growth and development due to the rising population, sound economic growth, and changing lifestyles. The contemporary technological solutions and emerging patterns of planning are critical in reducing parking issues and meeting other amplified community objectives, including livability and improved transportation in the urban setting (Ibrahim, 2017). The rapid urbanization often poses a daunting challenge in the development of urban infrastructure, especially in understanding how to accommodate the continuously growing number of vehicles. An important issue that is faced in most cities, such as Bole sub-city of Addis Ababa is the lack of parking space in vehicles. An example of this issue solution is the offer of an alternative to traditional parking, which is to utilize the vertical space fully and is essential in the areas with limited land coverage (Manukhina, 2017).

In Africa the lack of parking availability has severe implications on the movement of people in a city and the transportation system in general. This imbalance in parking demand and supply in urban centers highlights a rather common urban crisis: the cities have infrastructural facilities that are constantly becoming insufficient in relation to the increased number of vehicles that are being purchased and used. The limited parking space poses serious barriers as the number of residents and businesses continue to depend more on transportation and necessitate more movement which only worsens the gridlock in the city and compromises easy flow of transport networks in the city. Not only does these overloads the daily commuter routines, but also has broader societal and economic implications, affecting a range of aspects, including local business and environmental health.

Addis Ababa has an average vehicular ownership growth rate of 11.4% a year (Federal Transport Authority, 2016). This drastic growth in vehicles has not been matched with an equally increased parking facilities, resulting in serious shortages, particularly in places with high demand, like Bole, which is a commercial and transport nexus. Current parking facilities in Addis Ababa are inadequate in most cases with structural inefficiencies, particularly in highly in-demand areas. Predominating the supply of parking in the city is on-street parking, which is often abused and not sufficient to meet the demand. That is why it leads to illegal and parallel parking practices that reduce road lanes and significantly exacerbate traffic jams (Journal of Urban Development Studies, 2022; Shiferaw, 2014). Meanwhile, there is a low

density of off-street parking lots and they are not usually used even when some commercial property owners turn on the basement parking lots into shops or other activities, reducing the parking area even more (Asfaw, 2025).

This kind of acute shortage of parking upset the traffic flows, stretch the commuting time, and cause safety risks to both drivers and pedestrians (Shiferaw, 2014; Core.ac.uk, 2022). Its consequences are more far-ranging as it hinders the accessibility of commercial areas, the functioning of enterprises, and the worsening of the environmental environment due to increased vehicle performance because people spend more time trying to find parking (Journal of Urban Development Studies, 2022; Shiferaw, 2014). More so, the lack of a unified government policy and strategic planning of parking organization hinders the creation of effective solutions since parking is an undeniable aspect of urban mobility and economic activity (Journal of Urban Development Studies, 2022;) Recent urban development projects like the Addis Ababa Corridor Development Project though good in improving traffic navigation and accessibility to the public transit have failed to sufficiently solve the issue of parking availability and affordability. More than three-quarters of drivers continue to complain of parking challenges and they consider the charges to be prohibitive (Frontier Africa Reports, 2025). This dilemma highlights the dire need to combine holistic measures comprising of legislative, economic, engineering, and technological solutions to increase and streamline the supply and management of parking in the Bole sub-city and thoroughly evaluate its implications on the transportation in the city. Through analyzing demand and supply of parking, and the consequent effects on traffic jams and urban mobility, this study seeks to present very important information that would inform policy and planning intervention to alleviate the problem of parking in Addis Ababa and enhance the effectiveness of transportation system in the city. The modern studies, without any doubt, show that one of the root causes of the increased number of vehicles on the roads is the blistering urbanization and a higher population growth rate that contribute to the increased use of motor vehicles in most of the urban centers, with Bole sub-city of Addis Ababa being not an exception. Although this has increased demand, conspicuous to this demand has been the development of urban infrastructure, particularly parking space. Such an endogenous imbalance has resulted in a major shortage of vehicular parking places, which, as such, has triggered a spiral of urban problems: Traffic Congestion: Inadequate parking facilities force the vehicles to consume desirable street space and shared space, and thus, augment the existing traffic jams. Researchers at the Transportation Research Board (TRB, 2020) develop

a close relationship between poor parking and ubiquitous gridlock in cities. Degraded Urban Mobility: Lack of organized and proper parking facilities significantly interferes with a smooth movement of the private and the public transport systems, which in turn reduces efficiency of movements. The studies conducted by Jones and Brown (2021), prove that parking shortages are becoming the number one cause of delays in the urban transit. Unfavorable Socio-Economic Effect: It is not only the absence of appropriate parking facilities that irritate day-to-day commuters but also has a negative effect on the local businesses by frustrating ease of access, possibly leading to a financial explosion in their operations.

The long-standing problem of the parking crisis is a reflection of the larger problems caused by the inefficiency of the city planning and failure to enforce certain policies. In short, the main problem that this research is expected to reveal is that the problem of inadequate synchronization between the increasing demand of vehicular parking and the much slower improvement of infrastructural development in Bole sub-city is inherent. The paper will aim to delve into these dynamics in detail to provide practical information to urban planners and policy makers in order to reduce these alarming issues.

1.2 Statement of the Problem

According to recent studies, like a case study on Characteristics and Effects of on-street Parking in Addis Ababa (2023), Evaluation of Parking problems for transportation system in Addis Ababa and Examination of On-Street parking and traffic congestion problems in Lokoja, one of the main causes of the increase in vehicular parking shortage in most urban centers is the rapid urbanization, population growth and rapid increase in car ownership causing imbalance between demand and supply. Although this demand is rising, infrastructural development and parking premises has been left behind. (H. Ibrahim 2017) Studies in Addis Ababa also show a persistent mismatch between vehicle growth and parking supply, with parking demand far exceeding available formal spaces (Eyasu, 2020; Abu, 2019). This imbalance has led to a high deficiency of vehicular parking spaces which in its turn has caused a chain of urban problems; Traffic Congestion due to lack of adequate parking facilities causes cars to take up the streets and open areas contributing to traffic snarls. A research by the Transportation Research Board TRB, (2020) shows that there is a high correlation between poor parking and gridlock in cities. Add to that there is no systematized parking available, which also interferes with the free movement of

personal and civic means of transport, which reduces the efficiency of mobility. A lack of parking is a major cause of delays in transit systems in cities. Regarding Socio-Economic Impact, the inadequate parking infrastructure not only inconveniences for the commuters but also has a negative impact on the local businesses in that it makes them less accessible and may raise their dissatisfaction on the problem. (Jones and Brown, 2021) .. Besides, Urban Planning and Policy has been challenged with Problems such as continuing parking crisis which indicates larger problems regarding the shortcomings of parking policy and deficiencies in the implementation. These global case studies and frameworks underscore a common theme: these kinds of discrepancies in the supply and demand of infrastructures are barriers to sustainable urban development and sustainable mobility in urban transportation.. This paper aims at exploring these dynamics in details and test the current parking policy against the findings by relevant evaluating criteria to present practical recommendations to the urban planners and policymakers. Few studies address behavioral factors like driver awareness of shared parking or equity for parking users, while real-time analytics for demand forecasting are untested. Rapid urbanization. Nation wide or multi-year tracking beyond Addis Ababa corridors is rare, limiting scalability. Moreover, public-private partnerships for supply expansion are undeveloped, mirroring broader transport financing shortfalls. Overall, the main issue that this paper is dealing with is the lack of correspondence between the fast rate of growth of the vehicular parking demand and the lower rate of infrastructural growth including reform on current parking policy of the city and proper exercise of law enforcement on the off-street parking provisions.

1.3 Objectives of the Study

1.3.1 General Objective

In this study, the researcher attempts to comprehensively analyze the root causes of the limited car parking facilities and their consequent effect on traffic in BOLE sub-city.

1.3.2 Specific Objectives

In order to fulfill this overall objective, the research examined the following specific objectives:

- To identify the key causes of vehicular parking space shortage, including the elements of demographic pressures, infrastructural inadequacies, and the current policy limitations.
- To assess the consequences of the parking deficit in urban transportation.

- To test the efficiency of the existing parking policy on the issue of the parking shortage.

1.4 Research Questions

In order to support this research question by determining the limited number of vehicle parking and its effects on transportation in the cities in the BOLE sub-city, the following research questions will form the foundation of this study:

1. Why is there a problem of shortage of vehicular parking in BOLE sub-city?
2. What are the effects of low supply of parking spaces on the urban transportation system, in terms of the traffic congestion and effectiveness of the mobility?
3. To what extent are current parking policy efficient in reducing the parking shortage and what suggestions can be offered in enhancing urban mobility?

1.5 Significance of the Study

This study is rather significant due to a number of reasons

Policy and Planning Relevance: This study can provide important insights to policy makers and urban planners by identifying the key factors that have contributed to the problem of parking shortage. The acquired insights will be used as the guideline to develop strong urban planning strategies and update policies that would help to alleviate common parking issues with the help of modern global research. **Improvement of Urban Mobility:** The paper investigates the immediate consequences of inadequate parking of the urban transportation, especially in terms of traffic jams and the efficiency of movement in general. Understanding such dynamics would be important in coming up with effective solutions that may maximize the performance of the urban transit systems and greatly reduce the day-to-day travel hindrances. **Social-Economic Consequences:** In addition to the immediate impact of the shortage of parking facilities on transportation, there are much farther-reaching societal and economic consequences to the lack of parking facilities.

1.6 Contribution to be a Benchmark to Future Research

Improved parking facilities can revive accessibility of the local business, increase the value of the property in the community and add a lot of value in overall well-being of the community.

This study can therefore support the efforts that enhance economic success and increase city infrastructure.

This study provides a comprehensive analysis of the parking shortage in Bole sub-city, forming a background reference for future research in similar urban settings. It actively contributes to scholarly debate on urban infrastructure issues and offers valuable insights for empirical research and policy studies. The research successfully bridges the gap between infrastructural demands and urban development policies, contributing to sustainable metropolitan growth and improved quality of life for city residents

Finally, this research aims at bridging the gap between the infrastructural demands and the urban development policies, and thus achieving the sustainable metropolitan growth and the high quality of life of people living in the city.

1.6 Scope and Limitations

1.6.1 Scope of the Study

The given study mainly explores the causes of parking ineffectiveness of vehicles and its consequences on urban transportation in BOLE sub-city, which is considered one of the most densely populated and rapidly growing areas of Addis Ababa. The study will include specifically: Geographical Area: The research is limited to the BOLE sub-city where it has been examined key areas where parking problems are most acute such as commercial centres, residential areas and major roads specifically Bole woreda 3 which has been considered a length of 364 meters of on street parking place. Thematic Scope The study examined the cause of parking crunch, its role in urban mobility, and the effectiveness of current policies and planning systems. Time Frame: The study will largely use information that is between the past five to ten years since it will demonstrate the rapid urbanization and the increasing need of vehicle housing in the city. Methodological Scope: The research took a hybrid approach in terms of methodology in that would be conducted using both quantitative data (like numbers of observations made on traffic flow and parking capacity) and qualitative data (like surveys and in-depth interviews with some strategic stakeholders such as motorists, entrepreneurs and municipal strategists).

1.6.2 Limitations of the Study

Despite its comprehensive approach, this research can be limited by the following limitations: Data Availability: The lack of reliable and up-to-date official sources on the availability of parking systems and street movement could force to rely more on fact-finds and interviews with primary stakeholders. Generalize ability: Since the city of this study is mainly localized in BOLE sub-city, then the results might not fully be generalized or transferred to other cities

with various demographic characteristics and infrastructure conditions. Time and Resource Constraints: The vast amount of fieldwork and data collection work can be limited by budget and time constraints that can limit the depth of the analysis that is possible. Policy Dynamics: These policies of metropolitan planning are amended on a regular basis; therefore, findings in regard to the efficacy of policy might soon become outdated as new interventions are implemented within or after the study time. Despite these limitations, the research will provide useful insights into the problem of urban transportation, as well as become the means of promoting sustainable answers to parking and transportation in BOLE sub-city.

1.7 Organization of the Study

The whole research is well organized into five chapters. Chapter one provides the groundwork by introducing the necessary background data, clarifying the main problem statement and presenting the research aims and questions on which the research is directed. Chapter two will be devoted to the review of the current literature, summarizing the relevant studies on the immense impacts of the lack of parking spaces of vehicles in urban transportation, and specifically how it leads to accelerated traffic congestion and reduced efficiency of mobility in general. The third chapter outlines the research methods, including the research framework, data collection methods, and the methods of data analysis of the origin of the problem of vehicle parking shortage and their complex consequences. It strictly outlines the qualitative and quantitative paradigms followed, the tools applied in processing the data and the reason as to why Bole sub-city is the main focus. Chapter four presents a comprehensive description of the geographical place where the study took place, including its environmental and social aspects. It combines the empirical and research-based data obtained in various sources, including surveys, interviews, and document reviews, which offers a detailed study of the issue of vehicular parking shortage and the variety of its consequences.. Lastly, the fifth chapter sums up the main findings of the research and creates practical, evidence-based recommendations that can be offered to municipal strategists, legislative organizations, and development specialists, which will also ensure that the information gained during this study can contribute to the future operations and policies.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

The fact that has led to high shortage of vehicle parking space in urban centers has become a major issue in modern urban and transport planning. This literature review is to be conducted thoroughly to investigate the basic reasons of parking deficits and the consequences (subsequent) to the transportation systems in the city. To do that, the review will rely on a broad pool of insights and findings of many scholarly articles and empirical research performed in the field. More than that, it will extensively examine the possible solutions and new ways of going about these urgent issues to bring relief to the urban planning discourse at the helm of the discussion. The challenge that lack of vehicle parking is too complex in Ethiopian cities the issue is multiplied by a number of factors which include urban sprawl, poor urban planning practices, and a noticeable car ownership growth. The proliferation of urban sprawl as a result of ineffective land-use policies and intense population growth has contributed to horizontal expansion of urban areas thus encroaching upon areas that could be used to construct important parking structures, (Adam and Shibeshi, 2023) and (Hirpa et al. 2023) shows. Also, the evident increase in the ownership of vehicles, partially attributed to the economic growth and improvement, enhances the already excessive demand of parking places and facilities in these urban settings (Alam et al., n.d.). All these interrelated factors, coupled with the current shortcomings in parking control systems, are significant contributors to exacerbation of the current parking shortage in a number of urban environments in Ethiopia.

2.1.1 Parking Concepts

Occupancy: This is a term that is used to refer to the ratio or percentage of the total parking spaces in a certain area or facility that are actually being utilized at the particular moment. To be more exact, parking occupancy is the total number of vehicles parked in the premises of the facility at a certain time frame. The occupancy rate, hence, could be described in terms of the average number of vehicles parked in the designated space within that location, which are legal. Remarkably, more than 85 percent occupancy rate normally indicates significant issues with the parking facilities at that region as reported by the FIG Congress in 2010.

Availability (Vacancy): Availability, or occasionally referred to as vacancy, is the percentage of the parking spaces in a specific location or facility which are empty or unused at a specific time. It is literally the opposite of occupancy which is determined by subtracting

occupancy percentage of 100 percent. This indicator is especially useful because it depicts the experience of drivers who are actively seeking a parking space, and thus it shows how easily available the parking spaces are under the current occupancy.

Parking Capacity The term "parking capacity" is descriptive of the optimum level of the on-street parking facilities which are heavily used but still accessible to the motorists in the normal way so occupancy rates of on-street parking facilities that are nearly 100% is undesirable as it implies that there is a big lack of vacant parking spots. In areas where there are few on-street places to park and the off-street parking is too costly, motorists usually have to engage in a process known as cruising - going around an area seeking an empty on-street parking place. More so, it is more likely that the lure to park unlawfully can heighten under such circumstances. The experts of parking have settled on the 85 percent on-street parking occupancy rate as a key threshold in the determination of practical capacity (Parking 101, 2010). The occupancy rate of about 85 per cent will provide one vacant parking space per block, which will get rid of the cruising and will generally ensure that a parking space will be found without much struggle. Turnover: is the number of times that a single parking space is used by various vehicles over a certain period. It is commonly quantified as vehicles per hour or over another given period of time.

Turnover is averaged over spaces of the same category i.e. having the same time limits in any area and a consistent analysis is possible. This measure is a major pointer to the productivity and efficiency of a parking space in general by showing the number of users served effectively by the parking space to the given time.

Duration: defines how much time the vehicle of a specific person spends in a particular spot. It has the standard form of the average duration of parking sessions of individual occupants in a given region over a selected period of time. This is an important indicator of the effectiveness of parking time restrictions and their application in that locality.

Parking meter: a parking meter is equipment that is utilized to charge the right to park a vehicle in a specific place within a limited number of times. Parking meters are also used as a strategic instrument by municipalities to execute their comprehensive on-street parking strategies, which in many cases coincide with their overall traffic and urban movement objectives, and which also bring revenue to the local governments.

Meter Productivity: is the measure of the ratio between the amounts of hours in which a parking meter is capable of earning revenue. As an illustration, when a metered space is to be paid 10 hours a day, 70 percent productivity will imply that on a certain day the space was practically used to provide seven hours of paid parking. Occupancy of metered hours having a large proportion of the productivity rate may indicate the possible existence of such problems as the inability to enforce parking regulations or the high number of legal parking sessions without making payments.

2.2 The relevance of Vehicle Parking in Urban Areas

Car parking is important to the efficient operations of urban landscapes and their sustainability. It is one of the major elements of the city planning, transport infrastructure, and environmental management. Parking activity is more than mere space allocation of vehicles; it plays the critical role in determining traffic movements, air quality, economic well-being, and well-being in general in the city context. This section justifies the significance of vehicle parking in cities basing on the results of different scholarly works and research researches.

2.2.1. Parking supply and congestion

In large populated urban areas, the supply and access to parking areas are directly linked to the congestion levels of traffic that are taken through the region. As an example, when parking spots are in short demand, cars are frequently required to explore the city streets in a frenzied attempt to find appropriate parking places, which always makes the process of traffic distribution in the urban environment more active and less efficient (Celic et al., 2024).

Moreover, the transport infrastructure that serves the purpose of parking is also critical to the successful urban planning efforts, since it is an efficient way to address the transport demand, at the same time increasing the accessibility of essential facilities and services in the urban regions (Phuc& Huong, 2023). But it is interesting to note that development and maintenance of parking systems usually receive insufficient attention as compared to other essential components of the urban transportation systems, which causes many issues such as unlawful parking, traffic accidents, and waste of social spaces to benefit society (Phuc&Huong, 2023).

Parking facilities form an element of the intricate framework of urban transport, acting as a beginning and an end of the majority of routes, which people make when visiting metropolitan regions. These infrastructures serve as a very important connection point

between various means of both private and public transport and, therefore, provide ease of movement to the commuters as they use city travel (Phuc& Huong, 2023).

2.2.2 Parking Management Technological Advances

Introduction and implementation of new technological solutions has radically altered the management of parking and made it much more convenient and efficient. Smart parking systems based on state-of-the-art Internet of Things (IoT) technologies, such as sensors, mobile apps, and real-time data analytics have become the new strategies to address the multi-faceted issues related to urban parking. This type of system allows the drivers to locate and reserve a parking spot conveniently, decreasing the duration of time spent on searching the available parking spot and, at the same time, lessening the issue of traffic congestion that plagues cities (Hassan et al., 2024; Sethi and Ravi, 2024; Dalal et al, 2023). Smart parking systems based on the IoT technologies can be an example, where infrared sensors and mobile apps help users obtain real-time data about available parking spaces in the area and alleviate the Besides, such advanced systems have adjustable price schemes, either increasing or decreasing the parking rates accordingly to the fluctuating demand during rush times, thus maximizing the revenue, as well as effectively eliminating traffic congestions in high density zones (Hassan et al., 2024)(Kumar and Varshney, 2024).

2.2.3 Environmental impacts

The inadequate vehicular parking facilities have a highly influential and extensive effect on the environment globally and in the case of Ethiopia, in particular. Such a scenario results in increased traffic congestion coupled with aggravated air pollution and poor land utilization, therefore, increasing the various urban mobility challenges facing the city.

The search of a parking space causes an increase in congestion, which in turn contributes to further emissions and deteriorates the efficiency of urban transportation (Aftab et al., 2020).

Ineffective Land Utilization: The competition to get a parking spot causes a drop in free space that is then used to support the development of green zones and natural habitats (Aftab et al., 2020).
Heightened Traffic Congestion: The competition to find parking space leads to an increase in congestion,

With the expansion and development of cities, the necessity of parking services is increasing significantly, which, in turn, leads to a chain of harmful environmental impacts that have to be addressed as soon as possible.

2.2.4 Policy and Regulatory Frameworks

Developing sound and well-organized parking policies is of utmost importance in the effort to deal with the complex and varied issues that are present in urban parking settings. In order to streamline the management of parking assets, a number of strategies have been proposed. These include ensuring that the level of parking offer is diversified, that they have market-responsive pricing schemes, that they make proactive advocacy of the concept of shared parking, and that this is backed up by recent research (Phuc& Huong, 2023; Sun, 2024). Such all-round policies do not only enhance the operational effectiveness of the currently available parking infrastructure but also fit perfectly well within the larger urban development objectives. More so, these objectives are the minimization of traffic congestion and the encouragement of eco-friendly means of transport modes which benefit all the people in the society (Phuc& Huong, 2023). In addition, effective regulatory measures, including zoning policies and special parking prohibitions, are also critical and instrumental in regulating the urban parking systems. To give an example, limiting the access of private vehicles in specific metropolitan areas and, at the same time, promoting the increased usage of potential alternatives to a personal vehicle, the municipal authorities can alleviate the range of problems linked to the lack of parking space and its ineffective utilization (Sun, 2024).

2.2.5 Case Studies and Best Practices

The importance of vehicular parking in the urban environment has been highlighted with numerous case-studies, which simultaneously sheds light on effective approaches and strategies to address multiple issues related to parking. As an example, the adoption of intercept parking solutions in Rivne has significantly helped in decreasing traffic jams, at the same time encouraging more people to use public transportation as an alternative means of transportation (Nykonchuk et al., 2023). In much the same manner, the effective implementation of dynamic pricing schemes in the city planning of the urban setting of Casablanca has significantly contributed to the overall efficiency of the parking management process and has played the major role in the traffic control by carefully regulating the time in which the parking is provided and the availability of the parking (Jioudi et al., 2019). In the people republic of China, there have been a series of ingenious solutions proposed as solutions to the chronic challenges that have been facing urban parking, which include the creation of intelligent multi-level car parks, the implementation of tidal parking solutions. These gradual interventions can not only be used to ensure maximum utilization of the

available parking spaces but also actively promote sustainable means of transportation which is in line with ecological goals (Sun, 2024).

2.3 Causes of Vehicular Parking Shortage

2.3.1 Rapid Urbanization and Increased Vehicle Ownership

The widespread problem of parking shortage in the African continent can be directly related to the increased rate of urbanization, and it happened in parallel to the rapid increase in the number of vehicles in the cities. With these metropolitan areas on a steady growth, the number of privately owned vehicles passing thoroughfares similarly experiences a significant growth and hence increased demand of proper parking facilities to absorb this growth. The scarcity of land that is allocated to the construction of parking facilities in congested urban areas contributes to the further development of this complex phenomenon, which complicates the situation (Attard et al., 2023; Boateng and Klopp, 2022). Moreover, the high number of used cars in the African situation is another contributing factor to the high number of parking problems facing most metropolitan areas today. The fact that second-hand cars are imported by richer countries has enabled more people to own cars, thus having a high number of vehicles in the roads. Nevertheless, this influx has triggered a frightening increase in the number of vehicles that is beyond the capabilities of the current parking facilities, making the issue of parking shortage even worse (Boateng and Klopp, 2022). Furthermore, it is important to note that socio-economic factors have a significant role to play in contributing to current crisis of parking shortages. The low purchasing capacity of a significant part of the African population is a critical impediment toward their access to new cars, which eventually leads to an increased dependence on older, less efficient used cars. This reliance is merely part of the further increase in the number of vehicles on the road, hence, straining the already limited parking facilities available in the urban areas, in which the expansion of urban areas, ineffective urban planning policies, and the rapid increase in vehicle numbers are especially prominent (Boateng and Klopp, 2022). Rapid population growth, which is the main cause of urban sprawl, has resulted in the lateral expansion of cities, thus, infringing land that would otherwise be used to build the much-needed parking facilities (Adam and Shibeshi, 2023; Hirpa et al., 2023). Moreover, the expansion of the number of vehicles, which is partly associated with economic development and the growth in disposable income of the population, also makes the problem of parking spaces even more pressing, and it has become a major issue in the work of both urban planners and local governments (Alam et al., n.d.). The complexity of the combination of all these factors, as well as the existence of suboptimal

parking management systems, explains the urgency of the problem of parking shortage that is currently plaguing urban environments across Ethiopia. Besides these issues, the acute lack of funding in the well-developed systems of transportation forces a significant part of the population to use personal cars extensively, which, consequently, increases the demand of parking spots, as well. This systematic underinvestment into the field of public transit is often an element of a historical trend in which the lack of funding to public transportation projects was historically an underfunding of the relevant measures, wherein it has unfortunately led to a culture of transport where, to a great degree, the utilization of a car is prevalent in most African cities (Attard et al., 2023; Boateng and Klopp, 2022). More so, the current reliance on second-hand cars also strengthens a car-based cycle of transportation to the exclusion of other forms of transport like public transportation, walking, and cycling, which may prove to be more sustainable. The increased use of personal vehicles has led to a substantial increase in the demand of parking spaces because more and more people prefer to use personal vehicles to meet their commuting needs, and this has further contributed to the overall crisis of parking deficit (Attard et al., 2023; Boateng and Klopp, 2022). The sudden increase in the number of privately owned vehicles, which has been accelerated by the continued economic growth and urbanization, has resulted in a high and high demand of parking space which in many cases exceeds the supply. This heavy demand leads not only to a serious shortage of parking facilities but also to a large number of related urban problems. To exemplify, the empirical investigations have indicated that the rapid growth of vehicle ownership has cost the generation of land-use conundrum in several cities where the distribution of space dedicated to parking is seriously limited, consequently worsening the general problem of parking shortage (Macea et al., 2022; Ibrahim, 2017).

2.4 Ineffective Land Use Planning

The entire problem of parking shortage in African continent can be greatly attributed to the increased rate of urbanization which has been occurring in parallel with dramatic increase in ownership of vehicles in urban centers. As these urban centers proceed to grow, so too is the volume of privately owned vehicles that cross through the thoroughfares which brings about a significant increase in the number of vehicles in terms of demand on proper parking facilities to support the growth. The limited access to areas where parking facilities can be developed in highly populated urban areas also complicates this complex phenomenon, which only increases the existing challenges (Attard et al., 2023; Boateng and Klopp, 2022). Moreover, the figure of used cars in the African setting is another factor that has led to the

high number of parking challenges that most cities are facing at the moment. The importation of second hand cars in the more wealthy countries have ensured that the ownership of cars by a much larger population is achieved, which means that vehicles are flooding the roads. Nevertheless, this influx has triggered a frightening increase in the vehicular density that is beyond the scope of the available parking facilities, which worsens the issue of parking shortages (Boateng & Klopp, 2022). Furthermore, it is important to note that the socio-economic variables have a significant role to play in the current crisis of parking deficits. The low buying capacity of a significant portion of the African community greatly retards their purchasing capacity of new vehicles and this translates to a high level of dependency on the old ineffective used cars. This dependency is only going to further increase the number of vehicles on the road, which is likely to cause further strain on the already limited parking space in urban areas, including urban sprawl, ineffective urban planning approaches, and the rapid increase in the number of vehicles, which should be highlighted in particular (Boateng and Klopp, 2022). Metropolitan areas have expanded horizontally due to urban sprawl mostly caused by the sudden increase in population and inadequate land-use policies which has subsequently incurred into encroachment on land that could have been developed into the provision of the much-needed parking facilities (Adam & Shibeshi, 2023; Hirpa et al., 2023).

The growth in the number of vehicles is another factor that contributes to the rise in parking requirements and poses a serious problem to both urban planners and local authorities (Alam et al., n.d.). This complex combination of these different factors coupled with the absence of the most appropriate parking management systems highlights the urgency of the parking scarcity challenge that the urban environment is experiencing across Ethiopia at the moment. The acute lack of investment in strong systems of public transportation, along with these issues, makes a significant part of the population, in turn, more dependent on personal transportation, which also, in its turn, increases the number of people who seek parking places. This long-term underinvestment in public transit is commonly a historical trend of under-investing in public transportation projects and, unfortunately, has contributed to a transport culture with a high level of automobile dependency in most of the cities of the African continent (Attard et al., 2023; Boateng and Klopp, 2022). More so, the existing reliance on used cars strengthens an already car-focused chain of movement, thus excluding other forms of transportation like a public transport system, walking, and bicycling that are usually more eco-friendly. This dependence on personal vehicles greatly increases the demand of parking places since more and more people choose to use personal cars to address

their commute need, which adds to the general crisis of a lack of parking spaces (Attard et al., 2023; Boateng andKlopp, 2022).

2.5 Discrepancy between Parking Supply and Demand

The fast increase in the number of privately owned vehicles, which is at large due to the continuous economic growth and urbanization, has come to a sharp and massive demand of parking space that often exceeds the supply. Such huge demand not only leads to extreme shortage of parking but also creates a number of other urban problems. As an example, it has been shown through empirical studies that the rapid growth in the number of cars has created immense land-use problems in many cities, where space allocated to parking is highly limited to the detriment of the general problem of parking capacity (Macea et).

2.6 Elevated Parking Costs and Traffic Congestion

The escalating cost of parking, combined with rampant traffic congestion, significantly worsens the existing scarcity of parking spots faced by urban residents daily. Motorists often dedicate considerable time and effort to finding available spaces, a quest that not only consumes more fuel but also substantially contributes to gridlock. (Ćelić et al. 2024) and (Ouhmidou et al. 2023). The absence of dynamic pricing systems for parking facilities is another key factor perpetuating urban parking shortages (Ibrahim, 2017).

2.7 Effects of Parking Shortage on Urban Transportation

2.7.1 Increased Traffic Congestion

When the focus is on Ethiopia, the profound lack of suitable parking facilities within the urban centers significantly affects the transportation of the city, thus the whole region becomes severely congested and both the operation and the efficiency are at a low level.

Meanwhile, with urbanization and the rise of the city, the need for parking infrastructure grows faster than the slowly existing supply, which leads to higher traffic jams and worsening of the environment. This paper is going to discuss the main impact of parking shortage on the urban transportation system of Ethiopia. That is to say, lack of parking infrastructure is making it so that vehicles are cruising on the streets in search of a parking space and it is actually the main reason for the increase of traffic congestion and delay (Faye et al., n. d.).

Congested traffic in Addis Ababa wastes peoples time, which is both a big inconvenience and an economic burden the value of time lost in traffic jams, comes up to 74% of the total cost of the traffic problem (Gunjo et al., 2024)

2.7.2 The implications of working time loss

Vehicular parking shortages in urban areas contribute greatly to working time loss, thereby impacting productivity and the overall economic performance of the country. When there is a shortage of parking space, it inevitably leads to more congestion, which subsequently means longer commuting time and eventually the loss of working hours. This problem can be dissected from different perspectives, as follows (Vianna&Young, 2014).

2.7.3 Safety and Environmental Concerns

The problem of proper vehicles parking places is omnipresent all over Addis Ababa, and it hinders the urban mobility of the city and the health of its people to a significant degree, posing a significant barrier to the health of the city residents. With the increased rate of urbanization in the city, the lack of adequate parking facilities worsens already existing congestion on the roads, which eventually results in a significant increase in road traffic injuries (RTIs) and at the same time the inability to use essential urban parks, which are very important to the community. Lack of parking spaces in front of the house encourages unpredictable driving habits that increase the likelihood of crashes and car fights for road users significantly (Faye et al., n.d.).

This environmental impact of this development is very severe because increased traffic congestion leads to increased emission of deplorable gases thus deteriorating the air quality in cities (Abeje, 2011). In addition, the lack of parking space promotes unlawful parking behaviors that hinder the free flow of vehicles thereby increasing the risk of road accidents (Getachew et al., 2016). Alarming, RTIs constitute 48 percent of emergency department visits in Addis Ababa, thus, the dire need to focus on the provision of parking infrastructure in the city to augment the challenges in accessing the important green lands among the locals. With the rate of urbanization increasing, a necessity of parking areas near parks gains more and more importance, yet, current parking areas are pathetically inadequate, so that the accessibility of local communities, who would like to use these undeniable recreational venues, becomes remarkably less accessible. This dilemma is also aggravated by a lot of

socio-demographic conditions, and the ubiquitous limitations of the current city infrastructure.

The constant lack of enough parking spaces around urban parks is a primary deterrent among residents, actively discouraging them to utilize such areas, which are vital in the leisure activities and making people mentally healthy (Azagew et al., 2020). The lack of efficient spatial use the inefficient and suboptimal use of urban space in the urban center of Addis Ababa is another key contributor to the existing urban parking issue since the average empty spaces of off-street and on-street parking are reported to be an astounding 90% and 80% respectively (Abu, 2019). The inefficient utilization and management of the available land and most especially in areas that feature high parking demand leads to acutely crowded parking conditions, which in turn extend the overall gridlock of the entire metropolis. Many urban areas, as well as those of Addis Ababa, face a strong deficiency in organizing the use of parking resources, which leads to the lack of use of the available publicly available space resources (Olatunji et al., 2024).

Diverse areas in Addis Ababa such as the major market centers, prominent schools and higher educational institutions generate substantial parking needs that have not been met, and hence the scarcity of effective space management models designed to handle such congested areas (Abu, 2019). It is worth noting that the underutilized spaces, particularly beneath the railway lines, are neither well managed nor attuned to the urgent requirements of urban residents, who need parking space, which, in its turn, creates the parking dilemma in the city (Belete, 2016).

The poor and unproductive use of land aggravates the issue of a continued shortage of parking, as the existing spatial planning is not optimized towards accommodating vehicles, which further causes a considerable divergence in the existing parking habits and demand (Belete, 2016).

Curbside Parking Problems The current usage of space has not been properly adjusted to meet the requirements of vehicles, which has contributed to the lack of organization and inconsistencies in current parking behaviors, which in turn have contributed to a severe lack of balance between supply and demand (Faye et al., n.d.). The fact that on-street parking (80) and off-street parking (90), which is even worse, are used at high rates reflects a dire need of finding a possible solution to the aging problem of city parking (Abu, 2019). The significant lack of the presence of modern parking guidance systems aggravates

the existing state of things since drivers have to rely on outdated means of locating parking, which is often time-consuming and inefficient (Olatunji et al., 2024).

The constant shortage of parking space is the direct cause of the increased traffic jams as people take unreasonable amounts of time searching parking space. Such a situation of the bottleneck will cause a domino effect, leading to massive gridlocks and longer travel times to all road users, which, in turn, will reduce the effectiveness of the entire transportation system (Farrukh et al., n.d.). Considering the Addis Ababa situation, the time loss suffered by motorists is a significant economic cost, with the lost travel time constituting unbelievable three-quarters of the congestion-related expenses borne by citizens (Gunjo et al., 2024).

2.7.4 Ethiopian Context Accelerated Urbanization

Rapid urban growth of Ethiopia which is estimated at 4.34/year greatly increases the demand of parking places. Unfortunately, this influx causes most of the times traffic jam and elevated pollution (Abeje, 2011).

One of the most important problems is the inadequate infrastructure, in which the lack of current parking facilities in such cities as Addis Ababa could hinder the proper transportation planning and contribute to a further increase in the use of personal vehicles (Voukas and Palmer, 2011). More so, such socio-economic upheaval due to poor parking facilities negatively affects the local businesses and the general quality of life in towns and cities (Olatunji et al., 2024). The long time spent by the drivers in seeking parking directly causes the consumption of more fuel and the emission of more pollutants, which in turn contributes to the worsening of the environmental degradation. This is especially frightening in urban areas where the air quality is already a serious health problem of the population (Celic et al., 2024; Ouhmidou et al., 2023).

2.7.5 Decreased Accessibility and Mobility

The availability of parking space is also a strong factor that can negatively affect accessibility and the ease of movement of the people who rely on their cars as a daily means of transportation. This may adversely affect the overall performance of the urban transport systems (Macea et al. 2022) and (Ibrahim 2017) reveal, sufficient parking is an important factor in ensuring a smooth urban transport system.

2.7.6 Economic Implications

Parking facilities of vehicles are essentially intertwined with the economic health and dynamism of the urban locations, which forms a key base to the commercial activity. In business districts, the availability and access of parking space will be critical in defining the accessibility of businesses by their customers, which will directly affect the number of pedestrians, their loyalty to businesses and their spending culture. (Jioudi et al. 2019) argue that an insufficient number of parking spots can discourage prospective visitors and shoppers to patronize local businesses leading to significant financial consequences of such businesses. In a social cultural view, parking resources management is the most effective way of providing equal access to urban space to the members of the community.

Proper and effective parking systems can help to eliminate social differences and provide affordable and convenient parking to every resident irrespective of their economic status (Jioudi et al. 2019) explain. Moreover, there are monetary effects of parking shortages. This additional traffic jams, combined with reduced ease of movement, may contribute to reduced productivity rates in the overall and increasing costs of operations, which are detrimental to both companies and personal commuters.(Dehghani and Soltani 2022) and (Farrukh et al. 2018).

2.8 Solutions to Reduce Vehicular parking crunches

2.8.1 Vehicular Parking Management Strategies

The issue of parking shortage is important in addressing and alleviating the problem posed by the problem of parking congestion in urban settings. Such solutions may involve the adoption of dynamic pricing models, which change the cost of parking depending on the current demand, the adoption of technological systems, which direct drivers to free parking spots, and the encouragement of alternative transportation methods that will reduce the use of personal vehicles (Kong et al. 2024) and (Celic et al. 2024).

2.8.2 Advanced Smart Parking Technologies

The implementations of the most innovative smart parking facilities including the intelligent parking system and real-time information platforms possess the potential to significantly improve the efficiency of parking management. This type of superior technologies can significantly reduce the time that drivers spend in finding parking spaces, and, at the same

time, maximize the use and the performance of available parking facilities, as noted by Sharma et al. 2023) and (Ouhmidou et al. 2023).

2.8.3 Interventions on Strategic Policies.

Government policies such as bringing about low emission zones and putting in place regulation on on-street parking are very important in addressing the problem of parking shortages in most areas. These policy actions are essential in relieving the huge strain on parking spaces, and also facilitating the need to use more sustainable modes of transport,(Gonzalez, 2024) and Phuc and Huong, 2023).

2.8.4 Collaborative Public- Private Partnerships.

Partnerships between the government and the commercial world are a viable and effective strategy of financing and managing parking spaces in the city. Such joint ventures will be able to effectively bridge the gap between supplied parking and the need to use it, ensuring that parking facilities are properly maintained and operate in an efficient and effective way that meets the needs of a community.(Dehghani and Soltani 2022) and (Farrukh et al. 2018).

2.9 Case Study and Real World.

2.9.1 Case Study: Vietnam

In a study, carried out in Vietnam, the rapid increase in the number of vehicles owned privately in Vietnam has contributed to a high level of parking problems. The research in the area suggested various policy suggestions, including increasing the diversity of parking spaces, the market-based nature of pricing structure, and promoting more frequent utilization of the public transport. Those efforts have managed to decrease the number of people who need parking spaces and improve urban mobility (Phuc& Huong, 2023).

2.10 Urban Transport and Conceptualisation of Parking Phortage.

Parking shortage is the condition, when the amount of parking spaces at the moment and place is not enough to satisfy the demand, the result is the competition of the parking space, the cruising to find one, and the spillage on the streets and sidewalks (Ibrahim 2017; Olaru et al. 2016). Parking is not a neutral service in the context of urban transportation, as it is a vital element of the transport system, which impacts trip generation, route choice, and mode choice (Ison 2020; Shoup 2011). A number of authors consider parking as a cross-sectoral problem, which is tightly connected to land-use planning, the policy of these public-transports, and climate-change mitigation policies (OECD 2019; Xia et al. 2023).

2.10.1 Empirical Evidence Implications to Policy.

Developing a synthesis of empirical research, a number of common policy implications can be identified. First, parking-supply planning cannot be done separately, but in conjunction with land-use zoning and transport-demand-management plans (Xia et al. 2023; Ison 2020). Second, complementary reforms, including variable-priced parking, better off-street parking in mixed-use areas, and enforcement of on-street parking regulations, can also minimize cruising, congestion, and emissions without having a serious negative impact on essential trips (OECD 2019; Shoup 2011; Liu and Murray-Turner 2017).

Third, both developed and developing-city experience indicates that reforms in parking can be more easily implemented in the short term than extensive land-use redesigns, as changing the supply and price of parking can be done at a smaller time and space scale (Xia et al. 2023; Ison 2020). Lastly, practical analyses of demand-based parking schemes (e.g. the SFpark scheme in San Francisco) demonstrate that the dynamic adjustment of meter rates can enhance the availability of parking spaces, positively, yet insignificantly, change the level of people riding transit, and decrease congestion, providing an example that can be followed by other cities (Liu and Murray-Turner 2017; Shoup 2006)

2.11 Parking Requirement and Standards

Generally, parking facilities are divided into two: On-Street Facilities: It entails parking facilities on the roads. These are further categorized as: Unrestricted Curb Parking: In which there are not certain restrictions to be followed regarding parking. Limited curb Parking: Regulated by a variety of limitations including enforcement measures, time restriction, signage or meters. Off-Street Facilities: This is exclusive off-road parking. These are mainly of two kinds, namely Surface Lots: Open-air parking lots. Multi-Floor Structures: Buildings that are constructed to be used when parking up and down.

2.11.1 Parking and Stopping Places Provision Standards

In the context of off-street carriageway stopping points, it is imperative to ensure that these facilities are strategically provided along major traffic corridors at intervals of approximately 400 to 500 meters, as well as at the terminal points of bus routes, thereby enhancing accessibility and convenience for users.

Types of On-Street Parking and Standards (UTS, 2005)

- i. The specifications for parallel parking require a dimension of 2.5 by 5.9 meters per vehicle, which translates to a parking number formula represented as $P.No. = LL5.9$.
- ii. For 30-degree angle parking, the required dimensions are 5 by 2.5 meters per vehicle, resulting in the parking number formula being represented as $P.No. = LL-1.255$.
- iii. In the case of 45-degree angle parking, the necessary dimensions also stand at 5 by 2.5 meters per vehicle, leading to a parking number formula denoted as $P.No. = LL-1.773.54$.

2.12 Parking Generation

In the transport world, trip generation is a very essential component that helps in planning and prediction of trip attraction and generation that is brought about by any particular development. A trip is described as a single one directional movement of a person, with a clear point of starting point and final point. The trip generation is a concept which involves the creation and attraction of trips depending on their sources of origin and destinations. These created trips are measured and used as a vital input in the modeling of the required parking needs or requirements and also the traffic flows which are affected by different developments. The generation of trips which leads to the generation of parking spaces is a fundamental need directly generated by the trip generation where parking generation denotes the resultant amount of parking spaces required by the attraction of trips. (Roess, R., Prassas, E., Meshane, W., 2004) and (Regidor, J., 2006) as an example, a residential condominium may directly affect the traffic in a distance of 10 kilometers. Conversely, the existence of a shopping mall would affect the traffic patterns in a large region, which has a radius of over 50 kilometers, as was observed in the above sources.

2.13 Parking Study

Before any strategies are pursued to improve the parking conditions, it is of paramount importance to obtain as much data on the availability of the parking spaces, the level to which the parking spaces are used, and the entire demand of the parking facilities. Further, the right estimation of the right parking fares is extremely vital. Parking surveys are specially crafted to consolidate and make available all such useful information. The parking facilities are usually designed in such a way to accommodate different kinds of visit. (Rush Moor Borough Council 2012) and (O'Flaherty 1997).

2.14 Parking Demand

Analysis various statistics are used in successful evaluation of the parking requirements in a specific locality.

2.14.1 Parking Accumulation

The total number of vehicles parked at a certain point at any given time is the parking accumulation which is usually given by use of an accumulation curve. The accumulation curve is a graphical representation that shows how many occupied parking bays are occupied with time hence giving information about the patterns and trends of parking. (Mathew,T. and Kirshanna, K., 2006)

2.14.2. Parking Volume

Parking volume is actually a term that describes the total sum of vehicles that are parked in a given place at a given time, which will actually be a measurable value of the presence of vehicles. However, it is important to state that this specific measure fails to consider the fact of the repeat cases of the same vehicles being parked, thus providing a unique picture of the parking action without duplication. (Mathew, T., and Kirshanna, K 2006)

2.14.3. Parking Load

The term parking load is used to represent the space that falls below the curve of the total number of parked automobiles throughout time. The calculation of this value can be done by a simple multiplication of the number of vehicles occupying the parking space at particular periods of time divided by the period of time. The use of parking resources with time is usually measured in terms of vehicle hours, which gives an understanding of the usage of parking facilities. (Mathew, T., and Kirshana, K., 2006)

2.14.4. Average Parking Duration

The average parking time may be defined as the mathematical ratio realized by dividing the total number of vehicle hours which summarizes the totality of the time that all vehicles are parked by the overall number of vehicles that are parked within that period during which the assessment is carried out. (Mathew, T., and Kirshana, K., 2006)

2.14.5. Parking Index

The parking index or also known as occupancy or efficiency is essentially identified as the ratio that compares the number of occupied parking bays in any given period to the general

number of parking spaces that are available to be used. This is a measure that is used as a collective measure of the efficiency of the utilization of the parking space and is calculable by a simple formula. The calculation of the parking index is stated as follows: (Mathew, T., and Kirshana, K., 2006) $\text{Parking Index} = (\text{Parking Load} / \text{Parking Capacity}) \times 100$.

2.14.6. The Parking Capacity Estimation.

Parking capacity determination may be performed using the two methodologies, with two different data sources that refer to the same geographical area. The former technique uses the Origin-Destination (O-D) survey data to determine the accumulation profile of the vehicles (VAP) and the theoretical maximum parking capacity. The second approach is field data collection which can be used in collaboration with the application of the geographic information systems; it allows carrying out the study of the parking potential comprehensively.

2.14.7. Parking Demand

The parking demand may be considered to be the quantifiable quantity of parking which is expected to be used at a particular point in time, at a particular place and under specific pricing conditions. Many factors affect this demand and some of them are the car ownership rates, frequency of trips, the mode of transport distribution, the length of parking and the geographical area which might be an urban area or a suburb. Also the quality of alternative travel routes which can be taken, the purpose of the trip which may be work, shopping or recreational may have a great influence on demand of parking as well as external factors like variation of fuel and road tolls which may affect the demand. Generally, the demand of parking is the highest during working days around office buildings and another peak at the weekend evenings at theaters and restaurants. This need is sensitive to fluctuation which is aligned with variations in transportation supply, patterns of land utilization and demographic changes. It is necessary to note that different kinds of trips will give different parking requirements and the set of various data types will allow defining both raw and actual parking needs, and the discrepancies existing between these two indicators should be paid close attention to concerning the current rules regarding parking. (Diallo, A., Morency, C. and Saunier, N., 2012).

2.14.3.1. Capacity determination from OD survey data

(a) The vehicle accumulation profile (VAP): The process of determining the vehicle accumulation profile is executed by adhering to the methodological framework established by

Morency et al. (2006). This approach facilitates the identification of the number of parked vehicles present in a designated area during specific time intervals. The accumulation of vehicles within a certain location adheres to the fundamental principles governing the arrival and departure of vehicles. By utilizing data obtained from O-D surveys, it becomes possible to delineate the vehicle accumulation profile based on variables such as the type of parking, the purpose of the trip, and the geographical origin of the vehicle movement. (b) Theoretical parking capacity (TPC): The theoretical parking capacity is a metric that is derived directly from the vehicle accumulation profile and signifies the maximum value of parked vehicles observed throughout the day. Additionally, it is feasible to capture the maximum value for each individual hour across the entire day, thus providing a detailed breakdown of parking capacity variations throughout different periods

2.14.3.2. Estimating the Capacity from the Field Data Collection

The estimating process of the raw parking capacity requires a careful and painstaking methodology, in which the analysis should be done in a clear and distinct manner, both when it comes to the estimation of the on-street parking facilities and the outdoor parking lots. In case of on-street parking capacity, it is essential to determine the number of spaces available in each specific area and this is done by calculating the length of the total length of the street that is allotted to the parking divided by the average length of a regular car. This computation offers background knowledge of the capacity of vehicles that may possibly park on the assigned parking slots.

2.15 Parking Survey

A parking survey is a planned process that is carried out in order to obtain the above parking statistics that are necessary in making informed decisions and planning. The most common type of survey used in the various approaches of conducting parking survey include the in-out survey, the fixed period sampling method and the license plate method of conducting the surveys. (Mathew, T. and Kirshana, K. in 2006)

2.15.1 in-Out Survey

Within the framework of the in-out survey approach, there is an initial number of vehicles occupying a particular parking lot which is conducted at the start of the survey time. After this first observation its attention is paid to the number of vehicles that come into the parking facility over a given period of time and to the relevant number of vehicles that come out of the parking lot within the same time period. After that, the occupancy level in the parking lot

is also recorded to have a full picture of the dynamics of parking. It is interesting to note that labor requirements in this type of survey are relatively low but a major restriction is that they cannot determine the time frame within which each individual vehicles occupies the parking space and thus there is no data in relation to the parking time and turnover rates and this issue has been expressed by (Mathew, T. and Kirshana, K., 2006. 2.16).

Conclusion

The literature review shows that vehicular parking shortage has significant impacts on urban transportaion, social networks, economic stability and general well-being of vulnerable populations, Effectivestrategies should prioritize adequate vehicular parking space provision to the transportation, to adequately support these the end users. In addition, implementing strong planning interventions, promotinga well-planned and integrated vehicular parking provision strategy that considers all stakeholders can foster the socio-economicdevelopment, improve smooth transportation and address challenges such as Policy & Planning, Urban MobilityandSocio-Economic

Future Research: Forms a reference point for empirical research and policy studies in similar urban settings and are critical to mitigate the negative impacts on the well being of the transportation system.

Having robust plans and support systems in place is essential to maximize the benefits of adequate vehicular parking provision whilst managing the difficulties.

Need: Comparative research across geographical and socio-economic challenges is needed to identify universal principles and strategies that can be applied across different contexts.

While the existing literature provides valuable insights into the impacts of vehicular parking problem, there are significant gaps that need to be addressed in future research.

Longitudinal and cross-sectional studies, as well as comparative studies across different contexts, are essential to develop a comprehensive understanding and effective strategies to the communities.

2.15.2 Theoretical Framework

Parking shortagesin urban area stem from imbalance between vehicle demand and available spaces. This theoretical framework outlineskey causes and effects, drawingon urban planning economics principleslike supply–demand dynamics.

Primary causes

Infrastructure development often due to poor land use and under estimation of future needs.

Inadquate pricing and regulations such as free or under priced curb side spots that encourages overuse and discourage turnover.

Poor law enforcement that allows building owners to repurpose the off-street parking.

Parking policy

Key Effects

Shortages lead to extensive cruising for parking spots. This triggerseconomic losses from weasted time and fuel, higher emissions,and environmental degradation.

Over-reliance on on-street parking which leads to illegal parking

Framework Model

Dimension	Causes
Demand-supply	Insufficient parking Facilities
Policy	Weaknesses in the current parking policies
Law	Poor enforcement

2.16 Conceptual Framework

A conceptual framework has been carefully constructed on a thorough examination of the available scholarly materials in order to take into consideration a multifaceted problem related to on-street parking facilities. This model outlines four main criteria that can be used in a detailed evaluation of these parking issues. The above requirements are critical in attaining sufficient parking space, setting up of efficient parking policies, introduction of a logical on-street parking pricing model, adoption of modern management strategies, and the creation of collaboration with both state and non-state organizations.

These pillars will be used to present and discuss our research findings visually as shown in the figure below. In particular, conceptual framework, which covers the existing problem of shortage of vehicular parking places and its consequences, comprises a variety of the problems:

Poor Law Enforcement:

The absence of strict implementation measures to the owners of the buildings to ensure they provide adequate parking space.

Insufficient parking Facilities:

Poor availability of parking lots that cannot serve the population

Vehicle-Space Imbalance

A poorly developed analysis of the effectiveness of the existing parking fee system, which does not allow it to control the demand effectively Weaknesses in the current policies.

Conceptual Model

Below is a visual representation of the conceptual framework. This model illustrates the relationships between Vehicular parking shortage and the two main variables: causes of parking shortage and impacts of parking shortage.

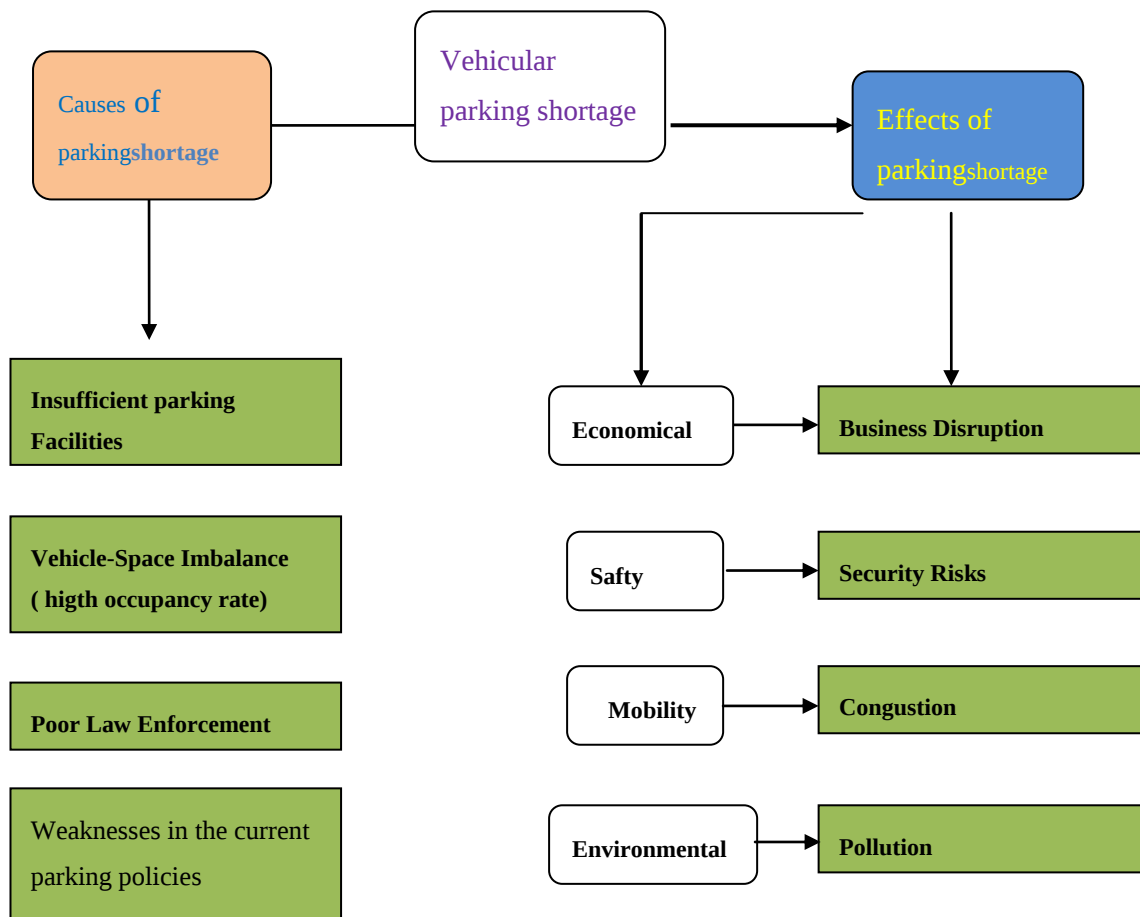


Figure 2.1 Conceptual frame work

CHAPTER THREE: RESEARCH METHODS AND MATERIALS

The purpose of this section is to give a clear description of the key points that define its design and methodology. Therefore, it also describes the sampling plan to be used in the study, the most effective method of collection of data that is both precise and methodical, and fully explains the diverse methods of data analysis that were used. As a matter of fact, all these are direct reflections of the research questions which were developed prior to the commencement of this research.

3.1 The Research Design

In this study, a deductive model of research had been well deployed through the use of both the qualitative and the quantitative research methods that are common academic research methods. Data collection involving field survey was an all-inclusive process that involved a wide range of variables, such as the exact location of parking facilities, their respective capacity, and the prevailing condition of the parking space available.

Organized interviews and detailed surveys have provided qualitative data that was examined to identify meaningful information. Statistical approach has been utilized, which enabled a conclusion regarding the population in general, using the results of the particular sample. The study was well structured to collect data and information by use of convenience sampling which is a non-probability sampling technique whereby the selection is done based on certain specific criteria. The researcher made a good decision by selecting units that were readily available, near to the researcher and easy to access in order to collect data. Convenience sampling implies that members of the sample are considered because they are available and willing to participate thus saving the researchers a lot of time and resources. In this case of academic writing, the researcher assumes that the selected parties are good representatives of the general population since it is believed that the same situation applies to all streets of an urban environment. This fact caused the researcher to make the wise decision of using one sample street in the Bole sub-city on this study.

3.2 Participants and Samples

The study focuses on who use the parking spot or in general drivers who come to the Bole sub city, who have experienced vehicular parking shortage. Using convenient sampling a total of **150 participants** were Selected and in this case convenience sampling means that participants

of such samples are chosen primarily because they are readily available and willing to be involved hence there is a saving of resources like time and money. These individuals are those who came to the parking place during field survey.

3.2.1 Criteria

The convenient sampling techniques that the researcher has used is also supported by other researchers such as Gall Borg and Goal (1990) .

Inclusion Criteria: Participants were eligible if they:

1. If they were willing to provide information on their consent..
2. Experienced parking shortage problem.
3. Who is driver or vehicle owner.

Exclusion Criteria: Participants were excluded if they:

1. Were unwilling to provide information on their consent.
2. Who are not drivers

3.2.2 Materials and equipment

I used the following materials and tools for the study:

- Surveys and questionnaires: I designed structured questionnaires to collect questionnaires on causes and effects of vehicular parking shortage.

3.2.3 Study area

Besides the above parking facilities, Addis Ababa has numerous parking lots that include on-street, off street, and parking complexes that are incorporated in different buildings. The master plan by the city is proactive in the sense that it involves the provision of more parking spaces that will be strategically directed towards reducing the persistent problem of traffic congestion that has disturbed the urban setting.

The reason why Bole Sub-City is selected for the study is summarized as follows

- It is one of the most densely populated and rapidly growing areas of Addis Ababa
- It is major commercial hub attracting diverse business activities and high vehicle traffic
- It represents typical parking challenges facing rapidly urbanizing African cities
- Its results can be replicated in other congested areas of the city and country.



Figure 3. 1: Location of Study Area

3.3. Sampling Technique

In most cases, once the data collection instruments were well composed and formulated, a pre, testing phase was done very well to determine whether the various items contained in the instruments could yield the intended and the relevant data that... To meet the multifaceted goals of the study satisfactorily, three distinct and different data collection techniques have been carefully selected and successfully employed as demonstrated in the data collection instruments; the first technique utilized was to carry out an extensive parking loads, and parking occupancy, the second technique employed was to administer questionnaires to drivers who used street as a car parking area during the surveying period which was the third technique to be adopted involved conducting in-depth interviews with the high ranking government officials in the different departments, namely, the Addis Ababa Transport Authority of Traffic Management Department, the Design sub-process office of Addis Ababa Road Authority.

3.3.1. Description of Study Area and Sampling frame

The Addis Ababa is the largest city in Ethiopia with a population of about three to four million people (CSA 2013) and covers a wide geographic size of 527 square kilometers. The city has a well-organized urban structure that is subdivided into 11 sub-cities and further into

116 woredas as the administrative entities. This city design has a total of 72 on-street parking service areas all being operated by 121 different parking businesses. These business entities have been properly spread over different geographical areas, such as Addis Ketema (21), Bole (13), Gullele (3), Ledeta (10), Nifasilke (7), Kolfe (3), Yeka (15), Akaki (1), and Arada (29) (Micro & Small Enterprises Development Office, 2005 E.C).

3.3.2 Sampling frame

The sampling frame utilized for the purposes of this research was meticulously concentrated on a singular sample derived from the Bole sub-city, specifically at one designated location, employing a judgmental sampling technique to effectively illustrate the pressing shortages of vehicular parking facilities. The selected study areas possess the capacity to accommodate a total of 67 vehicles simultaneously in one direction, and correspondingly, a complete set of 67 samples was systematically allocated to drivers utilizing the street for parking purposes during the designated survey period. The determination of the sample size was rigorously based on fundamental sampling principles, the anticipated level of accuracy, the specific type of research design employed, as well as the scope and inherent limitations associated with the thesis work being conducted.

3.4 Data Types and Sources

Quantitative Data Collection:

Field survey

- A comprehensive field survey that factored parked cars in the study street and 12 hours per day and five weekdays and two weekends.to determine the occupancy rate of the studied on- street parking.
- 150 participants (drivers) were administered in surveys to collect data on their perception concerning vehicular parking shortage and its impacts.

Qualitative Data Collection:

Semi-structured interviews were conducted with key informants, including , top officials of Addis Ababa Transport Authority, Addis Ababa City Road Authority and Addis Ababa Micro and Small Enterprises Development Office In addition these stakeholders were interviewed in detail on some important topics.

Data was also gathered from parking attendants working on the studied streets, particularly those who collect parking fees. For secondary data, relevant literature, books, academic journals, and official documents underwent careful review.

Sources of Data

In order to satisfy the research objectives effectively, the primary and secondary sources of data were used in a complementary way to complement the findings. Primary data were obtained by proper distribution of well-designed questionnaires to 150 drivers who used this on-street parking facilities. and subsequently it was carefully examined. The study took a mixed, methods approach, which can be characterized by a more in-depth approach to the issues under analysis and the possibility, at the same time, to review all the information obtained in more detail. This was a deliberate effort to get relevant data related to various sources.

3.5. Data Gathering Tools

The data concerning the major variables within the population were considered to explain the primary causes of the lack of vehicle parking facilities. Further, the research involved collecting information on the target population who were stakeholders in the industry. This population was comprised of car parking users and concerned bodies . The methodological approach that the study used entailed application of the instruments developed in three different forms: field survey of the selected areas, administration of questionnaire to road users at the study sites, and administration of interviews to the government officials. The tools were deemed appropriate in the study since they are likely to be more effective in eliciting the opinions of participants concerning the prevailing situation (Turner, 1993; Meriam, 1998).

3.5.1. Field Survey on Selected Areas

It was considered essential to conduct a detailed field survey in the chosen geographical regions to have the true assessment of the situation with the critical aspects of the overall parking capacity, existing parking load, and occupancy rates of the study locations. Thus, a sequence of pre-thought-out Parking Occupancy Surveys (POSSs) was conducted within the third week of November 2016 and had a time frame between 8 a.m. and 8 p.m. These were surveys with 3 different blocks of time; morning (8 a.m. to 12 p.m.), afternoon (12 p.m. to 6 p.m.) and one last session that ended at 8 p.m. This comprehensive analysis was conducted

over 12 hours, and on weekdays and weekends with 30-minute intervals depicting in-depth data collection in each period.

The researcher noted and documented the maximum volume of vehicle parking in 30-minute intervals within each of these intervals. The latter data were used to conduct the further analysis, which was done by splitting the total 12-hour period into four different periods. The number of vehicles in a particular area at a particular time was accurately measured. This approach was a very important approach to gather quantitative data on the areas of study, and in particular, when parking facilities were largely occupied or empty. Furthermore, the information regarding parking spaces included different qualities, including: the actual position of each parking space, its status, and type; the total amount of parking spaces available; and the appropriate number of vehicles parked in the research location at the two given periods of time. Moreover, the current parking behaviors and the administrative approach followed by supervisors were also well monitored and an analysis of the overall income earned through these parking behaviors. To facilitate the collection of POS data, a properly designed questionnaire was created and used the details of which are in the appendix of the study.

3.5.2. On street parking user questionnaires in the area under study

Under the umbrella objectives identified in this study, the core objective of the questionnaire was to obtain the pertinent information primarily by eliciting the opinion of the drivers and their experiences that were utilizing the car parking facility of vehicles during the survey periods. Of particular interest to this questioning was determining the primary causes that result into the unavailability of adequate parking spaces to vehicles and how the identified parking issues at vehicles have impacted the daily life of the respondents and the general city development. Inherently, the ideas and concepts that were incorporated into the questionnaire were based on the current state in the city that was achieved with the aim to responding to the established goals and finding the parking lots areas that still need additional development. Among other ways that the questionnaire was structured, three different parts were to be used, a) Part I: which comprises introductory questions; b) Part II:, which is primarily intended to collect information about the largest problems associated with street parking in the reviewed areas, taking into consideration the current state of car parking in the urban environment. and c) Part III: this is composed of open-ended questions that aim at drawing extensive information about the drivers who use the street in this specific case of the study (as

well as the city of Addis Ababa in general) regarding the different parking problems that are currently being experienced in the areas under study.

Field survey on sampled areas. It is considered that the introduction of the field survey on the basis of a specific geographical area selection is important with the aim of determining different significant variables, including the total parking capacity, the current parking load, and the occupancy rate of parking in the above-mentioned objects of the study. As a result, a course of well-designed Parking Occupancy Surveys (POSs) were implemented in the course of the third week of January in the year 2025, between the early hours of 8 a.m. and the evening at 8 p.m. These questionnaires were done at three different time slots, which were the morning slot that was between 8 a.m. and 12 p.m., the afternoon slot that was between 12 p.m. and 6 p.m. and finally the late evening slot that was between 8 p.m. and 12 p.m., in which a thorough assessment of all the 12 hours was undertaken considering the use of 30 minutes interval within each time slot to guarantee the collection of comprehensive data. Out of all these periods, the researcher concentrated on determining and documenting the highest volume of vehicular parking that took place during the 30-minute segments which in turn became the basis of other analytical procedures, by subdividing the total 12-hour duration into four different time periods. The analysis of the number of vehicles parked in a particular area at a given period of time was systematically taken into account. This approach to the methodology was used as a key approach to collection of quantitative data on the subject areas, specifically, when the parking facilities were mostly occupied or, on the contrary, fully empty.

3.5.3 Vehicular parking user questionnaires to the areas of study

Against the overall goals that were outlined in the framework of this research, the main aim of the questionnaire was to collect relevant data that was mainly aimed at capturing the views and the opinions of drivers who were actually using vehicular car parking facilities within the stipulated surveys periods. This question was especially interested in finding out the major reasons behind the lack of available parking spots in vehicles and the resultant implications that the lack of such parking spots has had on the study regions and the influence of the issues faced by the vehicular parking on their day to day lives, their transportation on the city and the overall growth of the city. The concepts and ideas included in the questionnaire were largely based on analysis of the existing state of affairs in the city, with the objective of addressing the targeted aims and determining the need areas that had to be developed in the

parking lots. The questionnaire was properly designed in three parts: a) Part I: which comprises of introductory questions; b) Part II: which is specifically aimed at soliciting information on the key issues to do with parking in the streets in the areas under study, considering the current situation in the area of car parking in the urban setting; and c) Part III: contains open-ended questions, which aim at free-flowing information of the drivers of the cars that are used in the streets under investigation, with regards to the different issues of parking problems that are currently present in the studied areas, specifically, and the city Interview with Governmental officials, Under this broad study, an in depth interview was conducted with the senior government officials who work in the Addis Ababa Transport Authority, specifically the Traffic Management department, Method of conducting interview with representatives of the Addis Ababa City Road Authority, Design Team Workers, and the officials of the Addis Ababa Micro and small entrepreneurs development office, specifically the Bole Sub city parking supervision office. All the necessary questions concerning the current parking policy and regulations were also discussed during the interview sessions; the system of managing on street and street parking and its cost; effectiveness of current parking arrangements; availability and practicability of the new parking places; evaluation of the current parking situation; and consult ability of the new parking management systems with the emphasis on the urban context of the city and creative thinking.

3.7 Data Analysis

3.7. 1 Data Presentation and interpretation

As it is observable in the discussion above, it is clear that the main tool used towards the objective of collecting relevant data to be used in the study was the questionnaire that was a key instrument in the process of data gathering. The information that was received following the administration of these questionnaires was then computed using the Statistical Software program me referred to as SPSS version 16.0 which enabled the collection of data to be analyzed strongly. The data obtained based on the questionnaires were analyzed through the application of the descriptive statistics through which frequency counts and percentages were the most significant measures. The data retrieved after the field survey were quantitatively represented by carefully computing different measurements, such as the rate of parking occupancy, average occupancy, parking volume, parking load, total parking load, the parking efficiency of the particular areas being studied. Moreover, the results formed out of the open-ended questions in the questionnaire, and those formed out of the interviews, were qualitatively described and the most important results were summarized exhaustively in a

clearer manner. The data collected during the process were shown in a variety of forms such as charts, graphs and tables so as to make the presentation easy to understand and to interpret the data better. As a result, the structured information, which was presented in the form of the table, figures, indices, graphs, and maps, has been subjected to a strict method of interpretation and analysis.

3.8 Validity and Reliability

Validation

For quantitative data:

- **Content Validity:** The survey instruments are developed after a comprehensive review of existing literature and consultation with experts to ensure they sufficiently cover the research objectives.
- **Construct Validity:** Statistical tests, such as factor analysis, are utilized to confirm that the survey items accurately measure the underlying constructs.
- **Pilot Testing:** The survey instruments are pilot-tested with a small sample from the target population to identify any issues and make necessary adjustments before full-scale data collection.

For qualitative data:

- **Triangulation:** Multiple data sources (interviews, FGDs, observations) are used to cross-verify findings and enhance credibility.
- **Member Checking:** Preliminary findings are shared with participants for feedback to ensure accurate representation of their perspectives.
- **Peer group Debriefing:** The research team engages in regular debriefing sessions to discuss emerging themes and ensure consistent interpretation of qualitative data.

Reliability

For quantitative data:

- **Internal Consistency:** The reliability of survey instruments is assessed using Cronbach's alpha to measure the internal consistency of the items.
- **Test-Retest Reliability:** A subset of participants is surveyed twice at different points in time to assess the stability of their responses.

For qualitative data:

- **Inter-Coder Reliability:** Multiple researchers independently code a sample of qualitative data and compare their coding to ensure consistency. Discrepancies are discussed and resolved to refine the coding scheme.
- **Audit Trail:** Detailed records of the data collection and analysis processes are maintained to provide transparency and allow for replication of the study

CHAPTER FOUR: RESULTS NAD DISCUSSIONS

The given chapter is devoted to the careful examination and the systematic representation of the empirical data that were collected with the help of multiple approaches being applied during conductive field researches, which were mainly associated with the distribution of questionnaires and the conduction of interviews with specific references to the burning problem of the lack of parking spots in one of the sections of the constantly changing city of Addis Ababa. Moreover, as well as the primary data that were carefully researched, some primary secondary data were also given a critical appraisal in the sense that analytical findings were generated. The analytic model of the current research was strictly designed and carried out in a systematic manner with the clear aim to respond to the research questions developed and at the same time connect with the overall objectives of the research study. Under this chapter, explicit presentation includes the response rate, demographic profile of the respondents, relevant findings of the survey, with detailed analyses and explanations as well as scholarly discussion.

4.1 Results of the Survey

All the information and data that were carefully collected in the survey process have been performed and divided into three various sections to make it clear and coherent. The results gained in the first part are logically detailed with the results of the survey with the help of the Field survey, and the second part forms the results of the data analysis, which was carried out through the distribution of questionnaires in the second part, and the third part is the summary and presentation of the results obtained after the interviews were conducted with government officials.

The main aim of this survey was to collect critical data that relate to the accumulation of parking, the volume of parking, parking load, average parking time, parking capacity, and occupancy rates in the specific thruway which started at the Bole GetahunBesha building and all the way to the newly built stadium around Bole. The survey methodology constituted an interactive approach (Study Area) to conduct a comprehensive survey of the data to determine sufficiently the amount of parking capacity. The field survey involved data collection that was specifically on-street parking. The field survey involved the data collection process, which involved important aspects that included the exact location, and the capacity, and the current conditions of parking spaces. The area of the designated study falls within the premises of Bole Sub-city, which has a length of 396 meters in one direction, and

792 meters in both directions of the areas researched. In this respect, some of the most important elements of the collected data were the capacity of the parking spaces, which is the number of vehicles that were parked at a certain point, the nature of the parking spaces (whether they were full, congested, or, vacant), as well as dynamic indicators of parking occupancy (full, congested, or, vacant). The information about parking occupancy was systematically gathered in three different periods 8:00 a.m. to 12:00 p.m. and 12:00 p.m. to 6:00 p.m. and 6:00 p.m. to 8:00 p.m. over a period of seven days(also included weekdays and weekends) in the month of November2024. Tables were created to facilitate organization and analysis of this numerical data as the parking occupancy survey (see the appendix to get the details).

4.2 Analysis of parking demand of the studied areas

4.2.1 Parking capacity of the studied Street

The general on-street parking capacity ability is also calculated in a systematic manner which involves the evaluation of the total number of accessible parking areas in a particular area one is interested in. Parking spaces are quantified by measuring the length of the street within which one can park and dividing the measure by the length of the average car length. Based on the standard and normative guidelines that are in line with the UTS, 2005, the following formula is used: Parallel parking takes space 2.5x 5.9m per car and therefore the number of parking spaces (P.No.) can be written as 5.9 as equation 1. As it was founded on the empirical evidence obtained in the course of studying the Addis Ababa City Roads Authority, the overall distance of the streets in the areas under consideration was calculated at 396 meters.

The parking capacity of these areas was therefore estimated to be 67 parking spaces in case of vehicles accommodating in a single direction and 134 parking spaces in case of vehicles accommodating in both directions. This means that the total number of vehicles allowed in the streets at woreda 3 areas is 134 in both directions at any given time. Besides, it is also interesting to note that the area discussed can be described as business districts in which a considerable amount of business operations has been reported. This area is also an attraction site to many customers who visit the regions due to different reasons, such as shopping, business-related events, professional assignments, and recreational tours that take place during the week. The designated study area is located in Bole Sub-city woreda-3, and has a total street length of 396 meters in one direction and a length of 792 meters in both directions

of the studied areas. Here, the gathered information included matters that were of importance to the park like the capacity of parking spaces, which determines the maximum number of vehicles that can be accommodated; the type of parking arrangement being used and the dynamic occupancy of the parking spaces that can be organized as full, congested or vacant.

The data of parking occupancy were collected in a systematic manner in three separate periods, that is, between 8:00 a.m. and 12:00 p.m.; between 12:00 p.m. and 6:00 p. m; and between 6:00 p. m. and 8:00 p. m, on seven days, including weekends in the month of November2024. Tables were developed to condense the result of the occupancy survey of the parking area to enable easier organization and analysis of this numerical data as seen in the appendix.

4.2.2. Parking Organization of the Street under Study

According to the guidelines established in the AACRA Manual (2003), it is outlined that two main types of on-street parking structures exist: that is, Curbside parallel parking and Curbside angled parking, both of which have their different functional areas in the field of urban planning and transportation management.

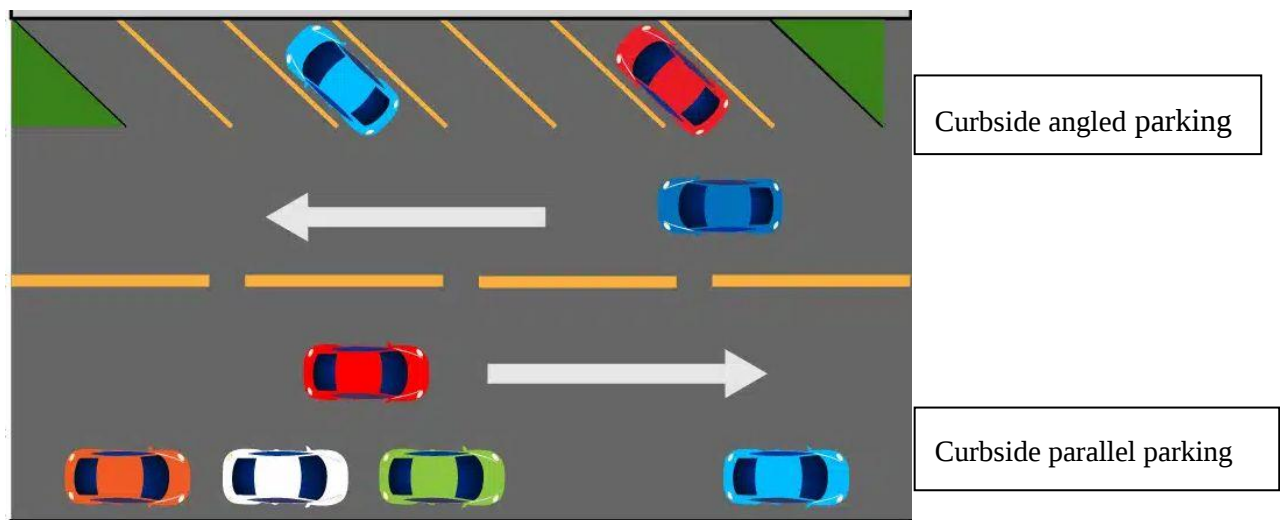


Figure 4.1 Parking types

Curbside parallel parking:

The Curbside Parallel Parking practice is usually carried comprise in keeping up with the direction of the current flow of traffic all in the presence of proper control measures to keep the order and safety. This is an ideal way of parking since it reduces the inconvenience and interference to the orderly flow and control of vehicular traffic within a specific road thus

providing an easy passage experience to all road users. It is notable that there is a high reduction in the overall amount of parking area that can be served within a given length of a roadway when compared to the other approach of the angle parking. Besides this, it is crucial to emphasize the fact that Curbside Parking has the very advantage of significantly reducing the rate of accidents that can take place not only in the course of parking but also in the further procedure of clearing the vehicles.

Curbside angle parking Curbside angle parking can accommodate a high number of vehicles per unit length of curb space as compared to the conventional process of parallel parking. Out of the two different varieties of on-street parking configurations discussed as distinctly above, i.e. Parallel Parking and Angled Parking; it is worth noting that the latter technique of the parallel parking was mostly used during the field survey that was undertaken in the present study. By using the formula as denoted by the below sample, it could be deduced that in the event that angled parking with 90-degree orientation were to be used in the areas under study, it would be able to accommodate a total of 158 vehicles at a given time which is an amazing 2.4 times higher than the capacity that the traditional parallel car parking technique would have accommodated. It is however paramount to note that angled parking will also require a broader roadway dimension to be used in the locations where it will be used which could be problematic in terms of space.

90° angle parking 5 x 2.5 m P.No. = $LL2.5$ equation 2

4.2.3 Determination of parking occupancy rate and parking load of the Studied Street

A parking lot becomes full when 85% of the parking spaces are taken by cars. Besides, a parking supply is most efficient when the occupancy is between 85% and 90%. If the occupancy rate goes above this limit, then it would be more troublesome for drivers to find a parking space. As a result, the parking supply can be considered as not enough or poor even though there are some spaces available in the entire parking system (Litman, 2013).

The following data are from the parking survey that was done on Monday and have been used to determine the sample parking demand. Actually, the data of the seven days of the survey were also examined in the same way and are shown in the following tables.

Occupancy rate (Parking index): The occupancy rate is the number of vehicles parked during each time interval divided by the total number of parking spaces available in

the area under investigation. For example, the occupancy rate for the time interval from 2:00 AM to 12:00 PM on the Monday period in question is $(137/140) \times 100 = 97.86\%$.

Average Occupancy: This measure is obtained by adding up the occupancy rates of each interval and then dividing the sum by the number of intervals analyzed. It was found that the average occupancy during the Monday survey for the whole surveying period was 97.38%.

Parking Volume: Parking volume is the total number of vehicles that were parked in the area under study over the one, hour duration, which is commonly referred to as parking turnover. On the Monday in question, during the data collection phase, a total of 3,366 vehicles were counted as being parked in the area under study over a twelve, hour period, which works out to be roughly 280 vehicles parked each hour on average ($3366/12 = 280$).

Parking Load: A very important parameter in comprehending vehicle accumulation is parking load. It can be determined through a simple mathematical operation wherein you multiply the number of vehicles accumulated in a particular time interval by the length of that time interval. This value is conventionally articulated in relation to the defined time interval. For example, the parking load during the first half hour detention can be calculated as (140 vehicles x 30 minutes), giving 4200 vehicle minutes. The Total Parking Load, which is essentially the sum of all the individual parking loads calculated for each time interval, totals 40740 vehicle minutes over a twelve, hour period; therefore, when this amount is divided for one hour, it comes to 40740 divided by 12, or 3395 vehicle minutes, which is equal to 113.16 vehicle hours when converted. Parking efficiency, as a measure, is accomplished by dividing the total parking load by the total number of parking spaces available; hence the formula is $(113 \text{ vehicles} \times 140 \text{ spaces}) \times 100$ which equals a parking efficiency rate of 80.71 percent. The previous parking demand study has been a thorough analysis of the parking features of the road sections within the studied areas. It points out that the parking demand is very high during the recorded periods and thus there are severe parking problems in the morning and afternoon times, which is the case for all weekdays and Saturdays.

Finally, the table presented below illustrates the comprehensive parking demand data collected throughout all surveyed durations during the field survey.

Table 4. 1: Recorded 12 hour street parking data on Monday November 11/2024 of studied area.

Monday	parking duration in Monday in different interval of time	Maximum Available parking space (parking capacity)	The maximum Parking accumulation in 30 minute duration for each interval during surveyed period	Occupancy rate	Parking Load
	8 am- 12 pm	140	137	97.86	16640
	12 pm - 6pm	140	133	95	15960
	6 pm - 8 pm	140	139	99.29	8340
	Total			97.38	40740

Table 4. 2: Recorded 12 hour street parking data on TuesdayNovember 12/2024 of Studied Area

Tuesday	parking duration in Monday in different interval of time	Maximum Available parking space (parking capacity)	The maximum Parking accumulation in 30 minute duration for each interval during surveyed period	Occupancy rate	Parking Load
	8 am- 12 pm	140	138	98.57	16560
	12 pm - 6pm	140	133	95	15560
	6 pm - 8 pm	140	136	97.14	8160
	Total			96.9	40680

Table 4. 3: Recorded 12 hour street parking data on WednesdayNovember 13/2024 of Studied Area

Wednesday	parking duration in Monday in different interval of time	Maximum Available parking space (parking capacity)	The maximum Parking accumulation in 30 minute duration for each interval during surveyed period	Occupancy rate	Parking Load
	8 am- 12 pm	140	136	97.14	16320
	12 pm - 6pm	140	133	95	15960
	6 pm - 8 pm	140	135	96.43	8100
	Total			96.19	40380

Table 4. 4: Recorded 12 hour street parking data on ThursdayNovember 14/2024of Studied Area

Thursday	parking duration in Monday in different interval of time	Maximum Available parking space (parking capacity)	The maximum Parking accumulation in 30 minute duration for each interval during surveyed period	Occupancy rate	Parking Load
	8 am- 12 pm	140	136	97.14	16320
	12 pm - 6pm	140	133	95	15960
	6 pm - 8 pm	140	131	93.57	7860
	Total			92.38	38940

Table 4. 5: Recorded 12 hour street parking data on FridayNovember 15/2024 of Studied Area

Friday	parking duration in Monday in different interval of time	Maximum Available parking space (parking capacity)	The maximum Parking accumulation in 30 minute duration for each interval during surveyed period	Occupancy rate	Parking Load
	8 am- 12 pm	140	132	94.29	15840
	12 pm - 6pm	140	129	92.14	15440
	6 pm - 8 pm	140	127	90.17	7620
	Total			92.38	38940

Table 4. 6: Recorded 12 hour street parking data on SaturdayNovember 16/2024 of Studied Area

Saturday	parking duration in Monday in different interval of time	Maximum Available parking space (parkingcapacity)	The maximum Parking accumulation in 30 minute duration for each interval during surveyed period	Occupancy rate	Parking Load
	8 am- 12 pm	140	136	97.14	16320
	12 pm - 6pm	140	129	92.14	15480
	6 pm - 8 pm	140	131	93.57	7860
	Total			94.29	39660

Table 4. 7: Recorded 12 hour street parking data on SundayNovember 17/2024 of Studied Area

Sunday	parking duration in Monday in different interval of time	Maximum Available parking space (parking capacity)	The maximum Parking accumulation in 30 minute duration for each interval during surveyed period	Occupancy rate	Parking Load
	8 am- 12 pm	140	138	98.57	16560
	12 pm - 6pm	140	134	95.71	16080
	6 pm - 8 pm	140	131	93.57	7860
	Total			95.95	40500

Critical Threshold: according to UTS Parking becomes full when 85% of spaces are occupied. Occupancy rates exceeding 90% indicate severe shortage and operational problems.

Figure 4.2being presented in the section below, it visually shows the extent to which the parking situation has been unlocked a percentage of the parking spaces that are either congested or fully in use during weekend days. The chart in the text identifies that the rate of congestion hit the highest point at the Monday of the study week over the entire day, basically due to people coming for business and shopping who mostly stayed the place in the morning time. At the same time, there was a clear visitor's peak at the street for recreational activities in the late afternoon. Whereas, the study period Sunday witnessed a significantly lower number of cars in the street thus there were more parking spaces in the morning than later on, which means the demand for such spaces was higher than the supply, which indicates that the business and commercial sectors did not show the same kind of intensity as seen during the first day; but, importantly, Monday afternoon and Saturday streets were basically very crowded with parking users who were attending entertainment from about 4:30 p. m. until the evening

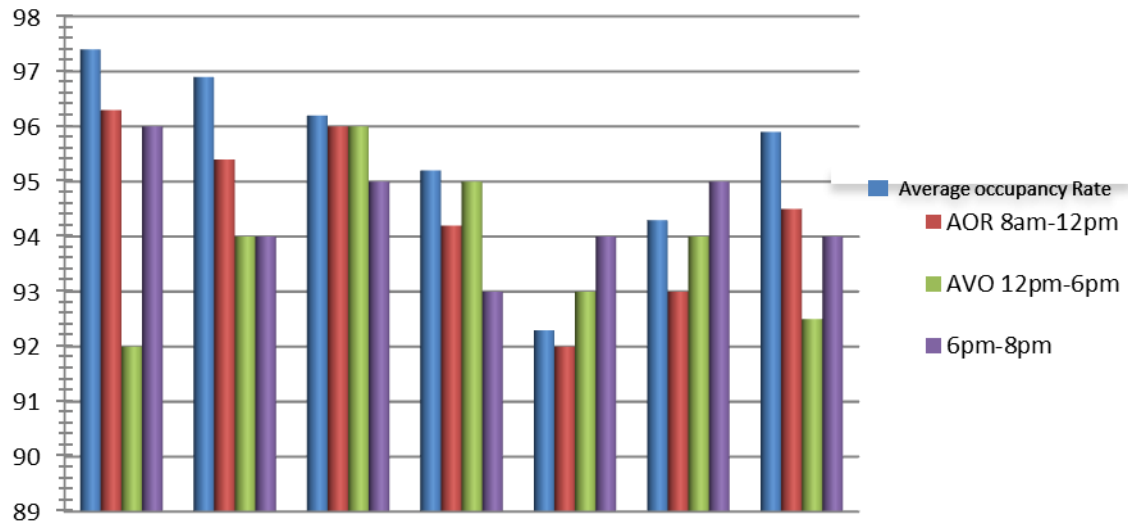


Figure 4. 2: The percentage of congested or fully-occupied parking spaces on the weekdays

Source: Field Survey, November 2024

4.3. Results of Questionnaires for drivers using the street during the surveyed period

4.3.1. General information of the respondents

Although it is important to recognize that the biograpy data of the respondents were not considered a significant variable in this study, a brief summary of their personal information has been carefully compiled and is disclosed below. Regarding the demographic issue of gender, as evidenced in Table 4.1, 56 respondents or 58.7% of the total sample, identified themselves as male, while 21 respondents, representing 41.3%, were female. In addition, the respondents were divided into different age groups; the Table 4.1 below shows that 12 respondents in the age group of 20 to 30 years correspond to 8% of all the respondents. Moreover, 44 respondents, or 29%, were in the age range of 31 to 40 years; 18.75% of the 28 individuals, belonging to the age group of 41 to 50 years; a large number of 41 person or 27.3 %, which is almost equal to the 31, 40 years category, are attributed to the ages of 51, 60 years and those beyond 60 years of age accounted for about 25 respondents, representing 16.7%. This demographic distribution clearly shows that the major groups of drivers who use the parking are mostly in the age range 31 to 40 and 51, 60 years.

Table 4. 8: Sex and Age of the Respondents

Gender			Age Group 20-30		
Sex	Quantity	%age	Sex	Quantity	%age
Male	89	59.3	Male	7	4.7
Female	61	40.7	Female	5	3.3
Total	150		Total	12	8.0
Age Group 31-40			Age Group 41-50		
Sex	Frequency	%age	Sex	Quantity	%age
Male	26	17.3	Male	16.0	10.7
Female	18	12.0	Female	12.0	8.0
Total	44	29.3	Total	28.0	18.7
Age Group 51-60			Age Group >60		
Sex	Quantity	%age	Sex	Quantity	%age
Male	24	16.0	Male	15.0	10.0
Female	17	11.3	Female	10.0	6.7
Total	41	27.3	Total	25.0	16.7

Table 4. 9: Parking Frequency of Respondents to the Study area

	Quantity	%age
Daily	75	50
Frequently	48	32
Some Times	25	17
First time to park here	1	2
Total	150	100.0

4.3.1.1 Educational attainments of the Respondents

The educational qualifications of respondents have been thoroughly analyzed in Table 4. 2. Their education level breakdown reveals that about 47 percent of the respondents have a College Degree, 22 percent have various types of Diploma, and another 15 percent have been identified as Certificate holders, along with 3 percent Masters Degree holders, and the last 13 percent are under the category of high school completed. This figure distribution clearly shows that the majority, a significant 84 percent of the respondents, have gotten

educational qualifications beyond certificates which in turn have increased their ability to understand and analyze the issues and challenges related to parking facilities. The education beyond certificate level, indicating high analytical capacity; Moreover, regarding their urban residences, it is very important to highlight the fact that the whole 100 percent of the respondents live in Addis Ababa city, indicating a high level of local engagement as they frequent the study areas more than 25 times within a single month, which underscores the assertion that a substantial number of parking users, engaged in various activities, are indeed inhabitants of Addis Ababa, and consequently, they possess a heightened awareness of the prevalent challenges affecting the streets in their locality.

Table 4. 10: Educational attainments of respondents participating in the study

Bachelors' degree	47
Master's degree	3
Diploma	22
Certificate	15
High school completed	13

4.3.1.2. Purpose of trip of the respondents to the studied area

Analysis of the data presented in Figure 4. 3 reveals a clear breakdown of the various reasons motivating the respondents to park their vehicle during the time of observation. In fact, a sizable 20 percent of the populations were primarily engaged in shopping activities while only 9 percent of their journeys were for the purpose of entertainment. The largest group, 46 percent, explained that their travel to the place was essentially for work as it is their workplace. Moreover, 23 percent went to the study area for different business purposes, and the remaining 2.0 percent represented visitors to the area for the first time. Thus, the areas under study have been confirmed as the main centers for commercial activities, service providers and shopping that naturally attract diverse clientele for such activities. Also, this pattern reflects a consistent trend that calls for the use of long, term solutions focused on providing enough parking facilities to meet the ever, increasing demand. The main goal of this study is to carefully analyze the behavior patterns in the locations under study and to find out what are the main reasons that most of the car users have for coming to the specified streets. This study shows that the areas were mostly visited by an average dominant majority of 73.3 percent of the respondents, who came either for business or for shopping purposes

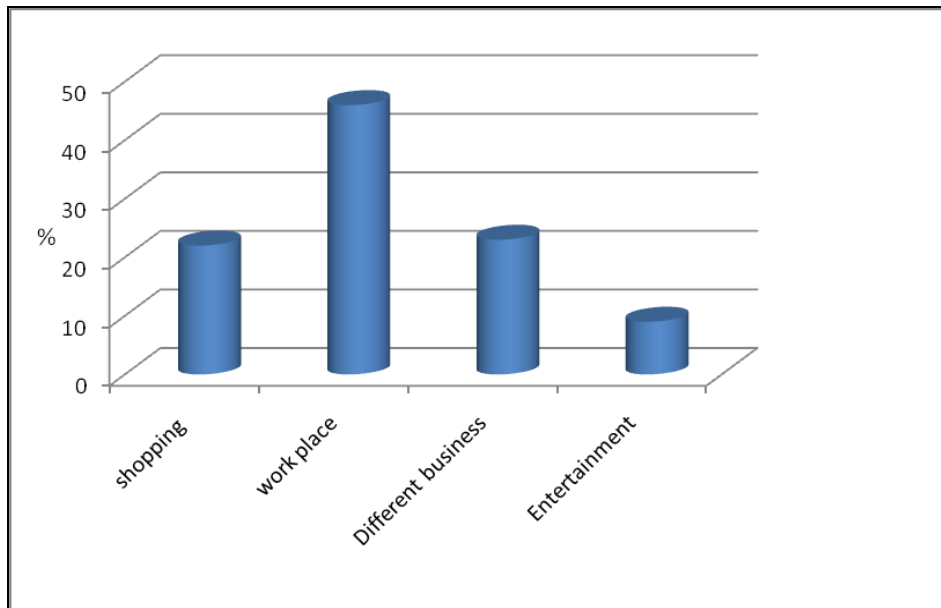


Figure 4. 3: Reasons for parking as provided by the respondents

Source: Field Survey, 2024

4.3.1.3. Parking Area selection of the respondents

A considerable proportion of the respondents expressed regarding their parking selection in the areas under investigation, attributing a multitude of factors, which include but are not limited to the inadequacy of available public parking spaces, the inconvenience presented by the existing parking options, and the inefficacy of the current parking configurations. It is noteworthy to mention that all respondents unequivocally provided negative feedback in response to the inquiries concerning why they donot park on off-street public parking.

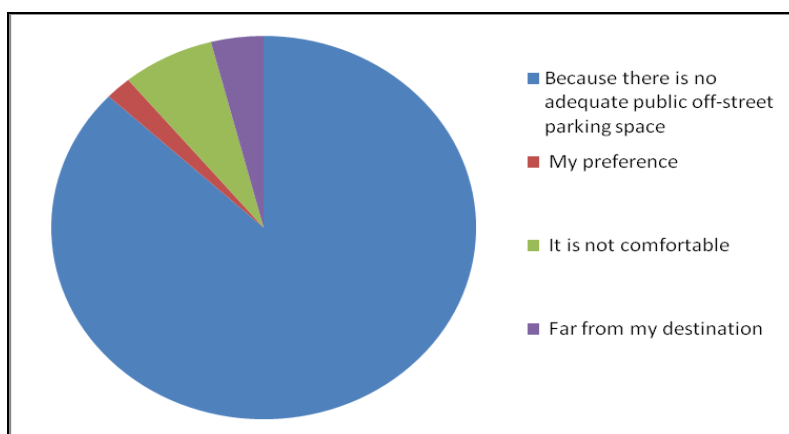


Figure 4. 4: Reasons for parking selection as provided by the respondents

4.3.1.4 Answer for the causes for the shortage of vehicular parking from the respondents

According to the figure below (Figure 4. 5), the different causes of shortage of vehicular parking facilities which the respondents have pointed out can be summarized as:, a great majority of 75 percent of the respondents mainly pointed to the persistent lack of adequate parking facilities as the cause while only a small group of 5.0 percent expressed their attitude that it is as a result of poor land use mismanagement, 10.0 percent followed who pointing imbalance between the number of vehicles and available parking space as the reason, 10.0 percent also referred to poor law enforcement on building owners to provide adequate parking space as one of the reasons of vehicular shortage of parking.

This statistical figure strongly argues that a major part of the respondents, to the tune of 75%, communicated that the parking spaces are not enough and also the parking options available are inconvenient thus they are suggesting that the streets at the environs are very much occupied with parked cars and in addition that cars block the pedestrian walk ways by parking illegally while alternative parking solutions that are more convenient seem to be completely non, existent in the areas under study.

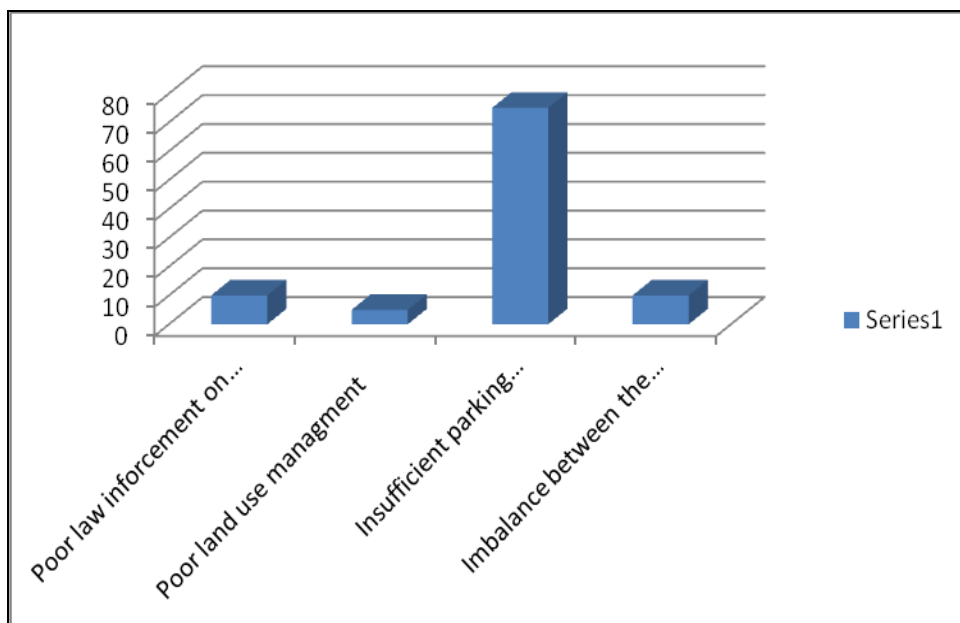


Figure 4. 5: Answer for the causes for the shortage of vehicular parking from the respondents

4.3.1.5. Response of the respondents on adequacy of vehicular parking spaces

The conduct of parking along the road and illegally has been widespread in the city of Addis Ababa, especially in the central business district area. This problem is mainly due to the

extremely limited number of parking spaces available. It is clear that all the respondents are unanimously agreeing that the parking spaces in the area under study are very far from being enough. This is the case as the number of vehicles in the city of Addis Ababa kept on increasing disproportionately over time. Figure 4.6 presented below illustrates that every respondent unequivocally answered "NO" when questioned about the availability of adequate parking spaces within the specified study area.

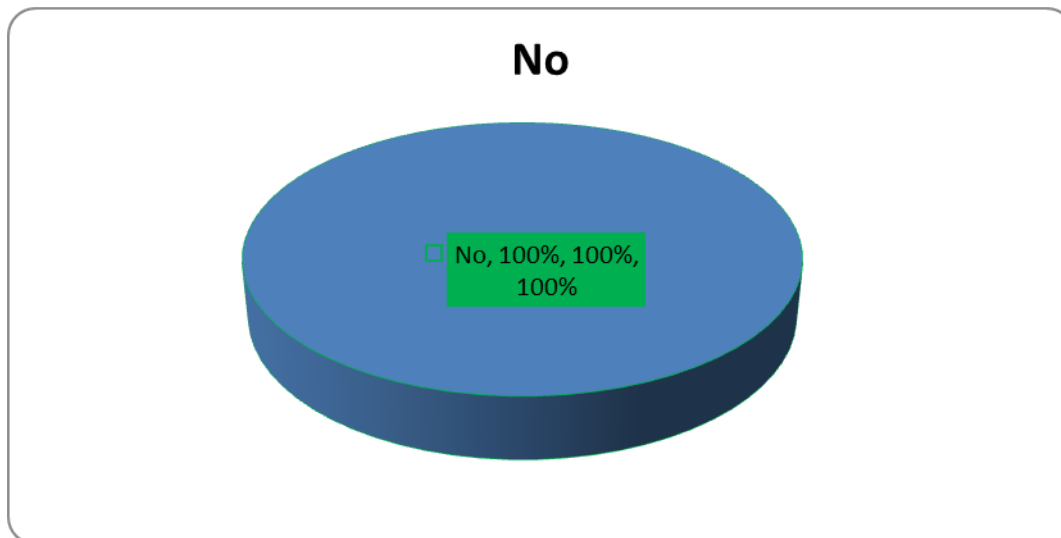


Figure 4. 6: Adequacy of vehicular parking spaces in the studied area

4.3.1.6. Lack of adequate Vehicular parking space and congestion

Figure 4. 7, presents that 96% of the respondents confirmed that the shortage of adequate parking spaces leads to street congestion. Only 4% disagreed with this statement which they argue that parking shortage is not only caused by lack of parking spaces but also by inadequate road infrastructure. This information reveals that the shortage of parking spaces is one of the main factors that lead to street congestion. In fact, once the parking spaces are occupied, vehicles that come after are forced to double park causing a narrowing of the street and hence a reduction in the vehicle, carrying capacity of the road especially during peak traffic hours. Figure 4. 6, presents the responses regarding the impact of the shortage of parking spaces on traffic congestion.

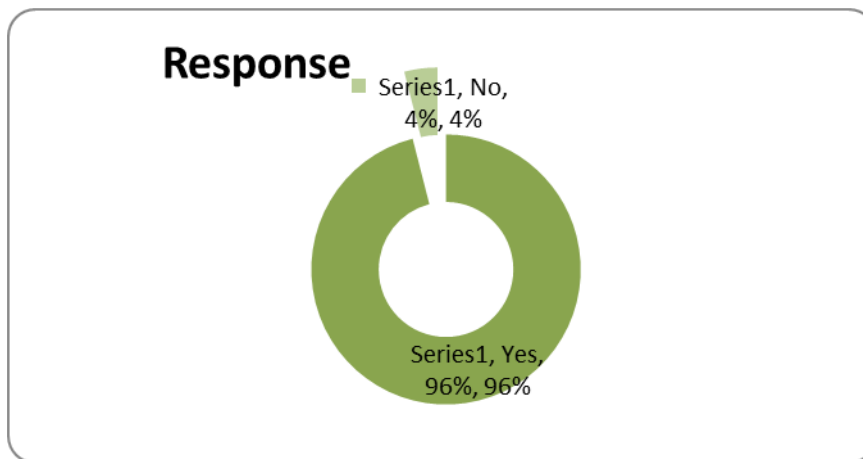


Figure 4. 7: Lack of adequate parking space and congestion

4.3.1.7. Frequency of Parking Activities among Survey Participants in the Designated Study Areas

The results as shown in the below Figure 4.8, revealed that 50.67% of the respondents said that they come to the study areas on a daily basis, 32% of the respondents declared that they visit these areas frequently, those who come to the area sometimes make up 15.0% and a very small number of the respondents 1% said that they come to this area for the first time; and the remaining 1.33% utilize the parking facilities available in the studied area during weekends exclusively. This data reveals that the majority of the respondents have shown a tendency to visit the study area on a daily basis and frequently, it can therefore be inferred that individuals who frequent the area more often are likely to have a deeper understanding of the various parking, related challenges that are present in the area.

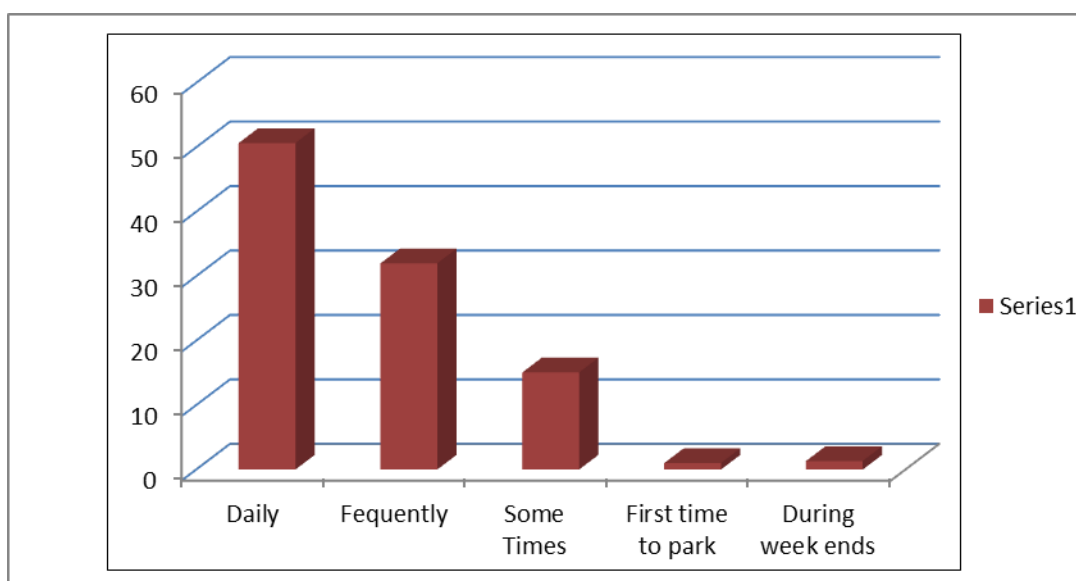


Figure 4. 8: The Frequency of Parking Activities in the Studied Streets

4.3.1.8. Duration of Time Spent Utilizing Parking Facilities

Figure 4. 9, below is a pictorial illustration for the time spent on vehicular parking by the respondents. From the figure, we can tell that 5 % of the respondents indicated vehicular parking to be of 10 minutes or less, 12 % showed 10, 30 minutes to be their parking duration, 62 % went further by stating 30, 60 minutes, and 21 % of them, explained that their parking time is more than one hour. This data thus reveals that most (62%) of the respondents generally spend between 30 minutes and one hour duration to park their vehicles while a minority (21%) spend longer than one hour.

This analysis implies that if adequately off street parking facilities are made available, parking users would tend to park in these designated (off street) areas thus reducing street congestion, paving the way for better traffic flow and safe parking in terms of theft.

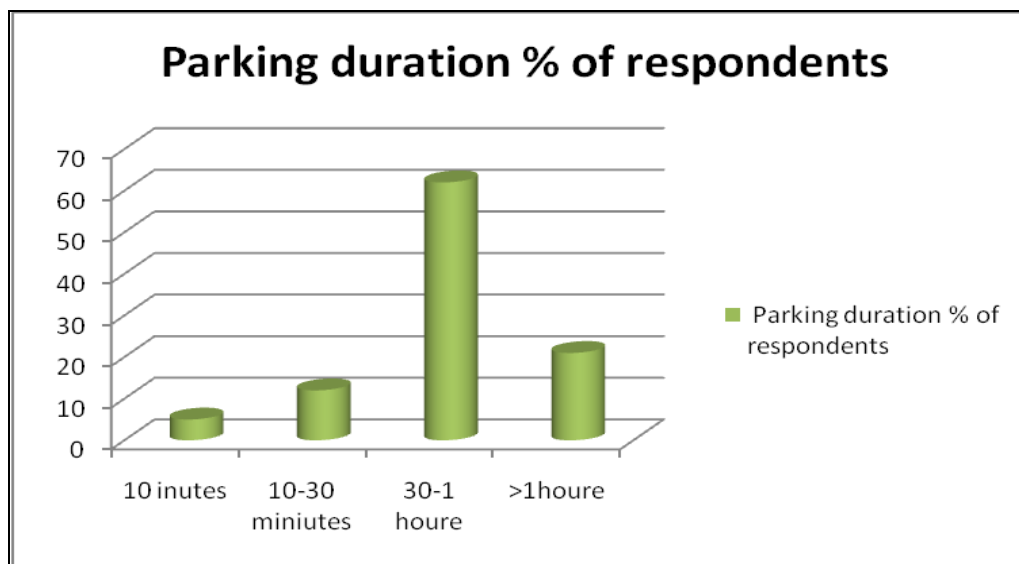


Figure 4. 9: Times Cars are Parked in the Parking space

4.3.1.9. Response of the respondents on challenge of finding parking space

As revealed in the chart shown in Figure 4.10 below, it is clear that the participants in the research had a tough time finding parking spaces in the areas of study. This is a reflection of the general lack of sufficient parking facilities in these areas, which has forced many people to go far to find a parking spot, hence they have wasted a lot of time, energy, and fuel. Besides, this issue might have a negative impact on the local businesses as well as their operations. They all described their cycling hardships and frustration as they were trying to get a parking spot in the study area.

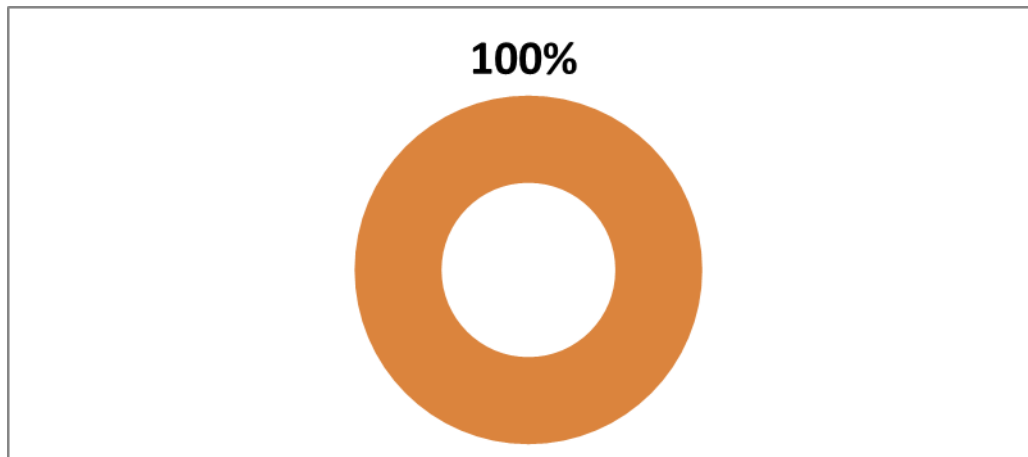


Figure 4. 10: Response of the respondents on challenge of finding parking space.

4.4 Testing the Current parking Policy

Drawing on the above findings of this research parking policy efficiency in Ethiopia especially in Addis Ababa appears to be operationally inefficient on several grounds. Figure 4.11 below shows the criteria, result and justifications to evaluate the parking policy.

Criteria	Result	Justification
Utilization	√ Efficient	High occupancy rate
Accessibility	× Inefficient	Difficulty in finding parking spaces
Enforcement	× Inefficient	Provision of offstreet parking is very low and illegal parking persists
Sustainability	× Inefficient	Increased fuel use and emissions
Traffic impact	× Inefficient	Causes congestion and delays

Based on the above the parking policy is operationally active but functionally inefficient. The parking policy in Ethiopia is partially efficient but largely inefficient due to high occupancy rate (near full use), poor turn over and management and weak enforcement and planning gap. This is also supported by The Addis Ababa Transport policy (2011) that identifies parking as one of the key infrastructural challenges and calls for expanded car parking facilities by private, public and public private partnership mechanisms in the city center and high traffic zones but the implementation has been slow the city continues to rely on fragmented youth association managed road side parking which limits revenue capture and enforcement. This gap between policy intent and operational practice reduces the efficiency of the parking system.

4.4.1 Justification of Efficiency gap

Lack of pricing mechanism

- No dynamic pricing so that long parking duration
- Users space occupancy longer than necessary

Over reliance on street parking

- Reduces road capacity
- Interferes with traffic flow

Weak Enforcement

- Regulations exist but poorly enforced
- Illegal Parking are common

Inadequate Infrastructure

- Limited offstreet parking supply
- Poor allocation of land

Absence of smart parking system

- No real time guidance system
- Drivers waste time searching for parking

4.5 Summary of Open-Ended Questionnaires

This qualitative inquiry was undertaken to comprehensively illuminate the multifaceted challenges associated with on-street parking availability. Data were systematically gathered from motorists utilizing street parking within the designated study areas, specifically focusing on the adversities and impediments encountered within the Bole locality of Addis Ababa city. The salient issues revealed by this investigation are delineated as follows:

- ❖ A pervasive shortage of sufficient parking provisions.
- ❖ The substantial depletion of critical resources, including time, physical effort, vehicular fuel, and associated operational costs, incurred during the protracted search for appropriate parking facilities.
- ❖ An insufficient supply of dedicated off-street parking infrastructure, which consequently necessitates motorists to resort to on-street alternatives.

- ❖ The impediment to local commerce and disruption of business operations attributable to vehicles being positioned directly outside commercial premises.
- ❖ The elevated vulnerability to security infringements and the potential pilfering of automotive constituents while vehicles are parked on public thoroughfares.
- ❖ The prevalence of illicit parking practices, stemming from the scarcity of formally sanctioned parking areas.
- ❖ The intensification of vehicular congestion, resulting from the practice of double parking.
- ❖ Augmented propensity for vehicular collisions occurring during parking-related maneuvers.

4.6. Results of Interviews with Government Officials

This qualitative inquiry sought to comprehensively elucidate the multifaceted challenges associated with the provision and accessibility of on-street parking within the Bole locality of Addis Ababa. The principal issues unearthed by this investigation are outlined below:

- A ubiquitous scarcity of adequate parking provisions.
- The substantial expenditure of vital resources, such as time, physical exertion, vehicular fuel, and related operational expenses, incurred during the protracted and often arduous search for suitable parking facilities.
- An inadequate provision of dedicated off-street parking infrastructure, which subsequently compels drivers to resort to curbside alternatives.
- The hindrance to local commerce and the disruption of business operations, stemming from vehicles being positioned directly outside commercial establishments.
- A heightened susceptibility to security breaches and the potential pilfering of automotive components while vehicles are stationed on public thoroughfares.
- The widespread occurrence of illicit parking practices, primarily stemming from the dearth of formally sanctioned parking areas.
- The exacerbation of vehicular congestion, directly attributable to the widespread practice of double parking.
- An augmented propensity for vehicular collisions occurring during parking-related maneuvers.

4.6.1. Contemporary Strategies for Parking Management

In relation to the contemporary technological advancements that pertain to parking systems, the feedback received from relevant officials predominantly centered around the various technologies utilized for parking as well as the mechanisms employed for the collection of parking fees, which, upon critical examination, do not appear to be particularly substantial, especially given that traditional Parking Meters are conspicuously absent from implementation and the prevalent system for fee collection relies on manual processes that involve the issuance of physical receipts. At this juncture, it is noteworthy to highlight that significant progress is being made in the development of smart parking solutions across diverse zones within the city of Addis Ababa. For instance, the construction of a state-of-the-art smart parking facility located in the Megenagna area, in close proximity to the Zef Mesh Mall, is completed, with plans that encompass both Building parking and Surface parking, designed to accommodate a collective parking demand of up to 140 vehicles simultaneously. Specifically, this facility aims to provide parking space for 90 vehicles at once within the Building parking segment, while simultaneously offering space for an additional 50 vehicles in the Surface parking area. Therefore, if construction of this kind of vehicular parking facilities continues within Bole sub city and other sub cities, it becomes reasonable to anticipate that this smart parking facility constructed in this area significantly alleviate the persistent parking challenges faced in the sub city.

4.6.2. The Adequacy and Efficiency of Current Parking Configuration

An assessment of the parking infrastructure in Addis Ababa, informed by official feedback, reveals significant concerns regarding its adequacy and operational efficacy. Officials highlight the accelerated expansion of the urban vehicle population, which is leading to an escalating demand for parking provisions at an alarming rate. This surge in demand demonstrably outstrips the capacity of existing facilities.

A critical observation is the pervasive underutilization of designated basement parking within numerous commercial and residential edifices. Instead of serving their intended purpose as vehicular accommodation, these spaces are frequently repurposed for alternative commercial enterprises. Consequently, motorists are compelled to occupy public thoroughfares, thereby exacerbating extant traffic congestion and operational challenges. This scenario invariably precipitates illicit parking practices, including double parking, which constrict already limited road carriageways, resulting in considerable inconvenience and hazard for pedestrians navigating these affected areas.

Findings against previous research

The finding of a **ubiquitous scarcity of adequate parking provisions** is consistent with both international and Ethiopian parking-policy research. Studies in Addis Ababa show a persistent mismatch between vehicle growth and parking supply, with parking demand far exceeding available formal spaces (Eyasu, 2020; Abu, 2019). Work on Ethiopian urban towns similarly attributes parking shortages to an imbalance between car-parking supply and demand, aggravated by rapid population growth and motorization (Teshome and Berhanu, 2025).

Substantial expenditure of vital resources such as time, physical exertion, vehicular fuel, and related operational expenses

During the search for parking aligns with earlier international analyses. Research on parking-related cruising indicates that searching for on-street parking increases journey time, fuel use, and operational costs (ITDP, 2024). In the Ethiopian context, assessments of Addis Ababa's car-parking system show that on-street parking congestion reduces travel speed, increases waiting time, and raises fuel consumption and operational costs (Mesfin, 2024).

The claim that **inadequate provision of dedicated off-street parking infrastructure compels drivers to resort to curbside alternatives** is also supported by prior scholarship. Parking-policy studies argue that either under-supply or mis-allocation of off-street parking leads to extensive use of curbside space (Ison and Mulley, 2014; ITDP, 2021). In Addis Ababa, the absence of clearly designated parking areas has long been documented as a central problem, with most parking occurring on streets and in congested corridors (Eyasu, 2020; Abu, 2019).

Finding that **on-street parking hinders local commerce and disrupts business operations** echoes international parking-policy reviews. Such studies show that poorly managed kerbside parking can block access to shops, reduce pedestrian flow, and harm local commerce (ITDP, 2024; Ison and Mulley, 2014). In Addis Ababa, analyses of road-network performance indicate that on-street parking reduces corridor capacity and worsens congestion around commercial areas, thereby indirectly affecting business operations (EthioInquiry Journal of Humanities and Social Sciences, 2023).

The pattern of **heightened susceptibility to security breaches and potential pilfering of automotive components while vehicles are stationed on public thoroughfares** is likewise corroborated by previous research. Road-safety and parking-security literature finds that vehicles left on public streets are more vulnerable to theft and vandalism due to limited lighting and surveillance (RoSPA, 2014). Ethiopian parking-performance studies similarly note that informal parking in uncontrolled spaces increases the risk of vehicle damage and theft, especially in high-traffic commercial districts (Mesfin, 2024; Eyasu, 2020).

The widespread occurrence of illicit parking practices stems primarily from the dearth of formally sanctioned parking areas is consistent with empirical work in Ethiopian cities. Studies in Addis Ababa and Adama report that illegal parking on sidewalks and roadways is a direct response to insufficient formal parking (Eyasu, 2020; Abu, 2019; Assessment of Parking Problems in Addis Ababa, 2019). Rapid urbanization and rising vehicle ownership have led to a critical shortage of parking spaces, pushing drivers to occupy sidewalks and roadways illegally (Eyasu, 2020).

The finding that **vehicular congestion is exacerbated by the widespread practice of double parking** is also supported by transport-planning and traffic-engineering literature. Analyses of on-street parking show that kerbside and double parking reduce effective lane width and increase congestion (RoSPA, 2014; ITDP, 2024). In Addis Ababa, studies on road-capacity loss indicate that on-street parking congestion reduces travel speed and overall corridor capacity (Mesfin, 2024). Media-based analyses of Addis Ababa's traffic also document how double-parking on narrow roads can effectively reduce a two-lane street to a single-lane corridor, paralyzing movement.

Finally, an **augmented propensity for vehicular collisions during parking-related maneuvers** is consistent with international road-safety evidence. Crash-dynamics and road-safety studies indicate that on-street parking and frequent parking maneuvers increase collision risk, particularly in dense urban corridors (RoSPA, 2014; PMC-based crash-dynamics study, 2025). In Addis Ababa, crash-dynamics research shows that on-street parking and damaged sidewalks elevate the risk of traffic crashes, especially for pedestrians and turning vehicles (PMC, 2025).

CHAPTER FIVE: CONCLUSIONS AND RECCOMENDATION

5.1.Discussion On Findings

The in depth study of field survey and qualitative data thoroughly reveals that there is a highly insufficient number of vehicular parking provisions. The deficiency in parking spaces is mostly during the hours of highest usage, especially on weekdays and Saturdays, when parking zones are always full.

Such a deep shortage of private space inevitably results in a very high percentage of people who double park and, thus, even worsen the problem.

Qualitative evidences that came from the questionnaires and interviews really support these quantitative findings.

A very large number of respondents, mainly those who were visiting for commercial purposes, agreed that the lack of parking was a critical issue. They blamed the scarcity of parking spaces on the small number of spaces, the locations being unsuitable for customers, and the arrangements being very poor. As many as 87 per cent said that they were very unhappy with the present facilities and they not only mentioned that there were not enough spaces, they also pointed to the regulation enforcement that is not very strict. Such a failure on the part of the authorities allows the owners to take the parking spaces that have been allocated for their use and use them for other purposes instead, thereby worsening the shortage even more. Most of the time, these permanently occupied places are the only few options available and, thus, the issue of urban congestion opens up profoundly. On top of that they have elevated risks of vehicle-related security incidents, including theft and vandalism, for street-parked automobiles, forced to unauthorized parking in restricted areas, driven by the acute scarcity of legitimate spaces and also it is one of the main reasons for double parking; thus, streets get highly packed and narrowed significantly during peak hours.

The main reason for people's heavy dependence on street parking is the conspicuous lack of sufficient off, street parking facilities and the understandable preference of drivers to be conveniently close to their destinations. According to the report, about 75 percent of the people interviewed say that they park on the street mainly because there is hardly any dedicated off street parking space available. In browsing for a parking place, people usually take quite a lot of time; nearly half of the people interviewed indicate that it can take them as long as 30 to 60 minutes. The prolonged period of parking searches, among other things, open the way for excessive wastage of a wide range of resources including, most importantly, the time which

could have been used productively, the personal energy, and the vehicle fuel especially if such incidents happened during peak weekday and Saturday hours. Simply put, the study results uncover a complex and multifarious crisis of on, street parking in the city of Addis Ababa. The main issues are:

- ✓ A critical shortfall of accessible parking bays.
- ✓ Substantial resource depletion (time, energy, fuel) incurred during the protracted search for parking.
- ✓ The compelling necessity for drivers to utilize street parking due to pervasive off-street parking inadequacy.
- ✓ Disruption to local commerce and pedestrian flow resulting from improperly positioned vehicles.
- ✓ Elevated risks of vehicle-related security incidents, including theft and vandalism, for street-parked automobiles.
- ✓ Prevalent unauthorized parking in restricted areas, driven by the acute scarcity of legitimate spaces.
- ✓ Aggravated traffic congestion and narrowed roadways, primarily attributed to double parking and inefficient vehicular maneuvering, leading to increased accident potential.
- ✓ An ineffective and underdeveloped street parking management framework, notably lacking systematic analysis of pricing structures and modern technological solutions for fee collection.
- ✓ The persistent repurposing of designated under-building parking facilities for alternative commercial ventures, further diminishing available off-street options and forcing reliance on illicit street parking.

5.2. Conclusions

The parking challenges in Bole sub-city are indicative of the wider issues confronting rapidly developing cities across Africa. Resolving this problem demands a comprehensive approach that integrates infrastructure development, policy adjustments, technological innovation, and inter-institutional collaboration. By considering parking as a crucial urban asset and managing it strategically, Addis Ababa can unlock significant advantages in urban mobility, economic vitality, and overall quality of life. This research endeavor's primary objective was to rigorously investigate the underlying causal factors contributing to the scarcity of automotive parking provisions, concurrently evaluating the consequential impacts this deficit exerts upon Addis Ababa's metropolitan transit infrastructure. To achieve this overarching aim, the research was structured around several pivotal objectives:

1. To ascertain the etiological elements and their resultant effects stemming from the dearth of vehicular parking spaces.
2. To identify the principal determinants contributing to the existing inadequacies in parking infrastructure.
3. To undertake a critical appraisal of the city's current parking regulatory framework.
4. To propose pragmatic, actionable solutions for immediate implementation within the local context, with the potential for broader adaptation and replication across other urban centers throughout the nation. Furthermore, a significant challenge arises from developers who contravene statutory requirements by failing to provide requisite off-street parking or by illicitly repurposing designated parking areas. Fundamentally, the issue at hand is that parking is inadequately perceived as a valuable urban commodity deserving of appropriate regulation. By recalibrating parking policy to acknowledge and manage parking as such, it can serve as a strategic instrument for urban planning, effectively shaping streetscapes and fostering integrated neighborhood development.

5.3 Recommendation

In view of the foregoing, the following recommendations have been forwarded:

- ✓ The city's master plan should proactively include provisions to establish additional parking areas, which are strategically aimed at alleviating the persistent issue of traffic congestion that has plagued the urban environment.
- ✓ The Addis Ababa City Roads Authority has to include design and construction of off-street and on-street parking facilities in its road construction projects.
- ✓ Angle parking should be encouraged instead of parallel parking to reduce congestion and utilize the parking space effectively.
- ✓ The Addis Ababa Transport Authority has to develop an integrated parking management plan including complementary strategies that meet the needs of a vehicular parking space.
- ✓ Formulate on-street parking policy including parking regulation time.
- ✓ Limit the maximum time a vehicle can park in more convenient spaces, to encourage turnover and shift long-term parkers to less convenient facilities and prohibit on-street parking on certain routes at certain times especially during peak hours to enhance traffic lanes.
- ✓ In most cases drivers use on-street parking because of lack of sufficient off-street parking spaces. Therefore, the concerned party should impose strict law enforcement on building owners to provide adequate parking space and not to use it for other purposes.
- ✓ Indicate vehicular parking places through signs, brochures and maps to facilitate in finding vehicular parking places and minimize loss of resources in respect of time, energy, fuel and environment pollution while looking for parking place.

References

- AACRA (2003) Addis Ababa City Road Authority Manual. Section 19. Addis Ababa: Addis Ababa City Road Authority.
- AASHTO (1994) A policy on geometric design of highways and streets. Washington, D.C.: American Association of State Highway and Transportation Officials.
- AASHTO (2001) A policy on geometric design of highways and streets. 4th edn. Washington, D.C.: American Association of State Highway and Transportation Officials.
- AASHTO (2004) A policy on geometric design of highways and streets. Washington, D.C.: American Association of State Highway and Transportation Officials.
- Campisi, T. et al. (2021) ‘Sustainable mobility promotion and urban space planning’.
- Dehghani, Y. and Soltani, A. (2022) ‘GIS-based fuzzy multi-criteria decision making for site selection’, Shiraz, Iran.
- Farrukh, M. et al. (2018) ‘Improved parking management systems and stricter enforcement of parking regulations’, Hyderabad, Pakistan.
- Gonzalez, L. (2024) ‘On-street parking regulation and low emission zones’, Madrid, Spain.
- Gonzalez, L. et al. (2022) ‘Parking demand management policies’.
- Ibrahim, M. (2017) ‘Car parking problem in urban areas: causes and solutions’. SSRN.
- Ison, S.G. (2020) Parking issues and policies: transport and sustainability. London: IET.
- Liu, Y. and Murray-Turner, P. (2017) ‘The effects of demand responsive parking on transit usage, parking availability and congestion: evidence from SFpark’, Journal of Transport Geography.
- Macea, L. et al. (2022) ‘Parking demand management policies’.
- Mavlutova, I. et al. (2023) ‘Sustainable mobility promotion’.

- Mersden, A. (2006) Parking challenges facing urban cities in Tanzania. University of Dar es Salaam.
- Mersi, A. (2014) ‘Empirical study of parking problem on university campus’, Journal of Transport and Urban Studies.
- Morency, C., Saubion, B. and Trépanier, M. (2006) ‘Evaluating the use of parking spaces in strategic urban areas using travel survey data’, in Proceedings of the 53rd Annual North American Meetings of the Regional Science Association International, Toronto, ON.
- Napier University (2008) An analysis of the city center car parking market. Edinburgh: School of Engineering and Built Environment, Edinburgh Napier University.
- OECD (2019) The environmental and welfare implications of parking policies. Paris: OECD Publishing.
- Olaru, D. et al. (2016) ‘Analyzing the elements related to parking demand’, Advances in Mechanical Engineering.
- Phuc, N. and Huong, T. (2023) ‘Diversifying parking supply, market-driven pricing mechanisms and promoting public transport’, Vietnam.
- Raza, M. et al. (2022) ‘Urban space planning’.
- Rocco, M. et al. (2023) ‘Smart parking systems’.
- Sharma, S. et al. (2023) ‘Smart parking systems’.
- Shoup, D. (2006) ‘Cruising for parking’, Transport Policy.
- Shoup, D. (2011) ‘The surging demand for parking’, Cities.
- Tang, Y. (2023) ‘Parking supply strategy, demand management and parking management strategy’, Ningbo, China.
- Varian, H.R. (2010) ‘Parking demand and pricing’, Transport Reviews.

Xia, X., Wang, Y. and Zhang, L. (2023) 'How does parking availability interplay with land use to affect traffic congestion? The case study of Xi'an, China', *Sustainable Cities and Society*, 88, p. 102126.



Appendix A

Questionnaires

Dear Respondents,

My name is KibreabAzene, a post graduate student at Department of Urban design and Development, Addis Ababa University (College of Technology and Built Environment). Currently, I am conducting research on "**Assessment of Vehicular Parking Space Problem on Urban Transportation: The case of Bole sub-city, Addis Ababa**". The successful completion of the study will qualify me for the degree of the Masters of Science in Urban design and development Program. The main objective of the study is to understand the current cause for shortage of vehicular parking and its effect on urban transportation at Bole area of the city and forward possible solutions for consideration by pertinent policy makers of the Addis Ababa City Administration. For successful completion of this study, your cooperation in filling this questionnaire is extremely valuable. Therefore, you are cordially requested to objectively fill the attached questionnaire by providing genuine information and frank opinion. The researcher also wants to assure you that the data to be collected from you will be used for this academic purpose only; and it's confidentially will be strictly kept. For any additional information, explanation and comments, you can leave your message through the following address:

Phone number: +251-911-791-572 and Email: kibrleabyhun@gmail.com Thank you in advance for your valuable cooperation.

Appendix B

Sample questions used in the field survey

When you park on-street parking space of this location, on average how long do you spend?

Do you think that there is a shortage of vehicular parking space in this area?

What do you think the cause for the shortage?

When you park on-street parking space of this location, on average how long do you spend?

Part I General Information

Sex:

Female ☐

Male ☐

2. Age in years:

20-30 ☐

31-40 ☐

41-50 ☐

50-60 ☐

3. Educational background

Certificate ☐ BA/BSC ☐ PhD ☐

.Diploma ☐ MA/MSc ☐ Other specify _____

4. Do you live in Addis Ababa City?

Yes (If yes, please go to question 12)

No (If No, please go to question 13)

Part II Parking Issues

1. Which of the following best describes why are you parking your car at this location today?

☐ Work or work-related

☐ Non- Work/Non-Business

☐ Business

☐ Entertainment Shopping

☐ Others _____

2. How often do you come to this place?

☐ Daily

☐ Frequently

☐ Some times

☐ First time to be here

3. Do you think that there is a shortage of vehicular parking space in this area?

Yes ☐

No ☐

4. If your answer is “Yes” What do you think the cause for the shortage?

Poor law enforcement

☐

Poor land use management

☐

Insufficient parking infrastructure

☐

Imbalance between number of vehicles and available parking facilities

☐

Rapid growth in vehicle owner ship

Others please specify_____

5. When you park on-street parking space of this location, on average how long do you spend? (Please tick in one of the following boxes)

☐

Up to 10 minutes

☐

10 – 20 minutes

☐

20 to 30 minutes

☐

30 minutes to an hour

All day (Note: These are shop owners in that area)

6. At what times of day are you most likely to park? (Tick all that apply)

☐

Between 8:00 pm and 12:00 am

☐

Between 12:00 am and 6:00pm

☐

Between 6:00 pm and 8:00 pm

7. Do you regularly find it difficult to find a space to park in this location?

☐

Yes

☐

No

8. What do you think the effect of shortage of vehicular parking space?

☐

Street Congestion

☐

Los of valuable time

☐

Theft of automobile and their parts

☐

Los of fuel

Other please specify_____

9. Why don't you park on off-street vehicular parking space?

☐

Because there is no adequate public off-street parking space

☐

My preference

☐ It is not comfortable

☐ Far from my destination

Other please specify_____

10. What do you think about the effects of parking shortage problems in the city of Addis Ababa in general and at Bole sub city area in particular?

11. What kinds of challenges do you face when there is no available parking space in Addis Ababa?

12. What kind of car do you usually drive: _____?

13. If you have any opinion please provide _____

Thank You.

Appendix C

Parking Occupancy Survey (POSs)

street_____

Side_____

Study Date

Data Collector_____

Direction of Travel_____

From_____

To_____

Day_____

Over all Peak Parking Utilizations for 12 hours (In four interval of time i.e. During Morning, Lunch period, Afternoon, Evening)

Morning period between (8:00 am - 12:00 pm) Interval	Parking Volume in 30 minute duration for morning hour	Lunch period between (12:00 pm - 3:00 pm) Interval	Parking Volume in 30 minute duration for lunch hour	Afternoon period between (2:00 pm - 6:00 pm) Interval	Parking Volume in 30 minute duration for Afternoon hour	Evening period between (3:00 pm - 6:00 pm) Interval	Parking Volume in 30 minute duration for Evening hour
8:00 am - 8:30 am		12:00 pm - 12:30 pm		2:00 pm - 2:30 pm		6:00 pm - 6:30 pm	
8:30 am - 9:00 am		12:30 pm - 1:00 pm		2:30 pm - 3:00 pm		7:00 pm - 7:30 pm	

9:00 am - 9:30 am		1:00 pm - 1:30 pm		3:00 pm - 3:30 pm		7:30 pm- 8:00 pm	
9:30 am - 10:00 am		1:30 pm - 2:00 pm		3:30 pm - 4:00 pm			
10:00 am - 10:30 am				4:00 pm - 4:30 pm			
10:30 am - 11:00 am				4:30 pm - 5:00 pm			
11:00 am - 11:30 am				5:30 pm- 6:00 pm			
11:30 am - 12:00 pm							

Appendix D
Publishable article

**Addressing the Vehicular Parking Crisis in Bole Sub-City, Addis Ababa:
Causes, Impacts, and Strategic Solutions**

By: KibreabAzene;BirhanuGirma (PhD)

Abstract

Addis Ababa's fast urbanization, particularly in the Bole sub-city, has led to a severe lack of parking spaces for cars, which has a significant negative influence on quality of life, economic activity, and mobility. This article summarizes current research findings, identifies key contributing factors such as policy gaps, infrastructure constraints, and demographic pressures and offers a number of practical suggestions. By focusing on proactive urban planning, infrastructure investments, regulatory reform, and institutional collaboration, the article presents a multi-layered approach to sustainable parking management.

Keywords: vehicular parking shortages, impacts on urban transportation, adequate parking facilities, urban mobility

Introduction

Ethiopia's capital and largest city, Addis Ababa, has grown significantly over the past 20 years. The Bole sub-city has grown into a significant commercial hub, drawing a significant increase in business activity, population growth, and car ownership. The infrastructure required to support this expansion, particularly in the area of vehicle parking, has not kept up with the area's rapid development. Because of this, there is a severe lack of parking spaces for cars all over the city, which has led to daily traffic jams, resource waste, and economic inefficiency. Inadequate parking causes people to rely more on driving their cars for transportation, which raises carbon emissions and makes cities less livable (King, 2021). The absence of adequate parking spaces for cars in urban settings significantly changes how cars move through an urban area by resulting in extremely crowded roads, longer commutes for people who travel in urban areas, and an excessive dependence on cars for transportation. A number of factors, such as the growing number of vehicles owned by individual urban residents, ineffective urban planning in the past and present, and inconsistent regulatory

policies, contribute to this imbalance between the current supply of parking facilities and future demand. The supply and demand for parking facilities are out of balance as a result of poor land-use planning and erroneous projections of future requirements (Amer et al., n.d.). This study's primary goal is to accomplish the following: Determine the underlying reasons behind Bole Sub-City's parking space shortage. Examine the social and economic ramifications of a parking shortage, assess the current parking management systems and policies critically, and offer evidence-based suggestions for creating sustainable parking systems.

This study's primary goal is to accomplish the following: Determine the underlying reasons behind Bole Sub-City's parking space shortage, analyze the social and economic effects of a lack of parking, critically evaluate the current policies and management systems for parking and Provide evidence-based recommendations for developing sustainable parking systems

The Main objective of this research is to: Identify the root causes of the scarcity of parking spaces in Bole sub-city, Analyze the social and economic effects of a lack of parking, critically evaluate the current policies and management systems for parking, and Provide evidence-based recommendations for developing sustainable parking systems

Methodological Scope

This research will follow a hybrid methodological design, using both quantitative and qualitative data to ensure that it is able to cover all the aspects of the subject, as it will use numeric observations related to the flow of traffic and the parking spaces, as well as using other forms of qualitative data, like opinions and observations of key stakeholders, like the users of vehicles, entrepreneurs, and planners, who will be asked to fill out questionnaires and share their opinions on how they have been affected by the shortage of parking spaces. The sample will be representative of the population of victimized parking users.

Table 1 Numerical representation

Gender			Age Group 20-30		
Sex	Quantity	%age	Sex	Quantity	%age
Male	89	59.3	Male	7	4.7
Female	61	40.7	Female	5	3.3
Total	150		Total	12	8.0
Age Group 31-40			Age Group 41-50		
Sex	Quantity	%age	Sex	Quantity	%age
Male	26	17.3	Male	16.0	10.7
Female	18	12.0	Female	12.0	8.0
Total	44	29.3	Total	28.0	18.7
Age Group 51-60			Age Group >60		
Sex	Quantity	%age	Sex	Quantity	%age
Male	24	16.0	Male	15.0	10.0
Female	17	11.3	Female	10.0	6.7
Total	41	27.3	Total	25.0	16.7

Numerical representation of the demographic distribution

The condition of Parking area congested or fully-occupied parking spaces on the weekdays.

Field data indicate that parking occupancy rates in Bole sub-city consistently exceed 90% during peak hours (800 a.m.–1200 p.m. and 200 p.m.–600 p.m.), far surpassing the optimal threshold for efficient parking management. This chronic over utilization leaves minimal room for turnover and forces drivers into illegal or unsafe parking practices.

Comprehensive descriptions of the percentage of the parking spaces that were either congested or totally occupied during the weekend were carefully categorized based on either Parking location or specific time intervals of the day. It is essential to note that, during the Monday of the considered period, the percentage of congestion reached its peak during the entire day, which can be attributed to the influx of visitors seeking services from business entities for either shopping or obtaining services, who mainly occupied the area during the morning hours, followed by the influx of visitors seeking entertainment services by utilizing the street during the latter part of the afternoon. On the other hand, during the Sunday of the considered period, the streets were found to have a significantly low number of parking

spaces during the morning, indicating that the number of required parking spaces exceeded the supply, which can be attributed to the fact that business and commercial activities were not intense during the morning, unlike the previous morning; however, it is essential to note that the streets, during the Monday afternoon and Saturday, were found to be significantly occupied, as they were mainly filled with parking users seeking entertainment during the period between 4:30 p.m. and the evening hours.

The average occupancy recorded within the Monday surveying period was determined to be 97.38%. **Parking Volume:** Parking volume is defined as the total number of vehicles parked within the particular area under consideration for the duration of one hour, which is commonly referred to as parking turnover. It was determined that within the particular Monday of the surveying period under consideration, the total number of vehicles recorded as being parked within the particular area under consideration for the duration of a twelve-hour period was 3,366, which is an average of 280 vehicles being parked per hour ($3366/12 =$ Parking Load:

The determination of parking load, which is an essential factor for understanding the accumulation of vehicles, is arrived at by carrying out the mathematical process of multiplying the number of vehicles accumulated within a particular time interval by the duration of the particular time interval under consideration. For instance, during the initial thirty-minute duration, the parking load can be determined as (140 vehicles x 30 minutes), which translates to a total of 4200 vehicle minutes. The total parking load, which encompasses a wide range of all the individual parking loads determined over the stipulated time intervals, amounts to a total of 40740 vehicle minutes when considered over a period of twelve hours. Consequently, when the total is averaged out over a period of one hour, the value is determined as 40740 divided by 12, which translates to 3395 vehicle minutes or, when further interpreted, 113.16 vehicle hours. In terms of parking efficiency, the value is determined as a product of dividing the total parking load by the total number of available parking spaces. The calculation is expressed as (113 vehicles x 140 spaces) multiplied by 100, which translates to a value of 80.71 percent. The analysis of the parking demand provided a detailed examination of the parking characteristics pertinent to the road segments within the studied areas and indicated that the demand for parking is elevated during the stipulated duration and particularly manifests as a high degree of parking demands during the morning and afternoon periods of all weekdays and Saturdays.

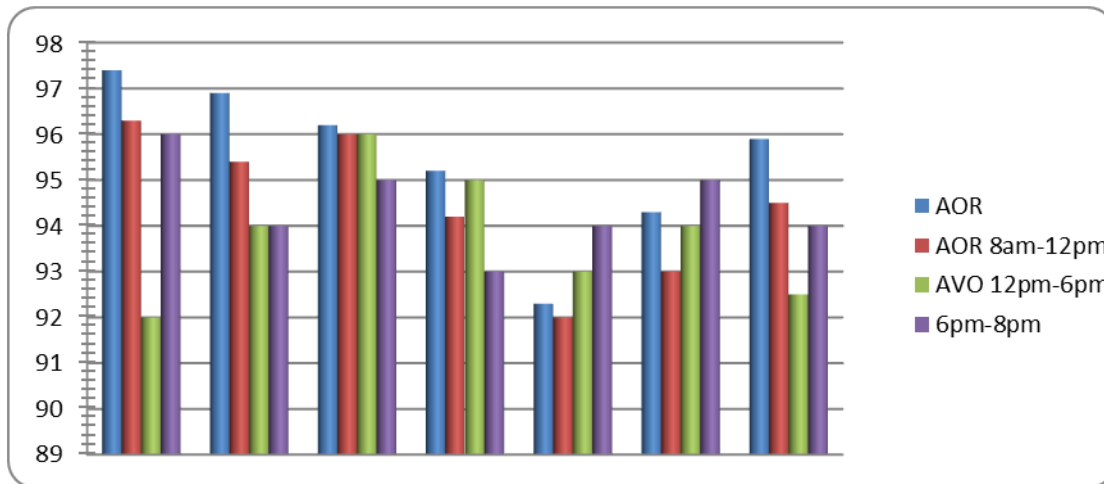


Figure 1. The percentage of congested or fully-occupied parking spaces on the weekdays.

Shortage of vehicular parking

Causes contributing to the shortage of vehicular parking facilities suggested by the respondents can be delineated as follows: while 75 percent of the participants attributed the causes of the shortage of vehicular parking facilities primarily to the insufficient availability of such facilities, 5.0 percent of the participants expressed their discontent with the current state of the issue due to poor land use management, followed by 10.0 percent who attributed the causes of the shortage of vehicular parking facilities to the Imbalance between the number of vehicles and available parking space, 10.0 percent attributed the causes of the shortage of vehicular parking facilities to Poor law enforcement on building owners to provide adequate parking space, This data compellingly indicates that a substantial majority of the respondents, amounting to 75 percent, attributed insufficient availability of parking spaces coupled with the inconvenient nature of the parking options provided, thereby suggesting that the streets in the vicinity are predominantly filled with parked cars, on the top that cars block by parking illegally on the pedestrian walk ways while alternative, more convenient parking solutions appear to be largely non-existent within the studied areas.

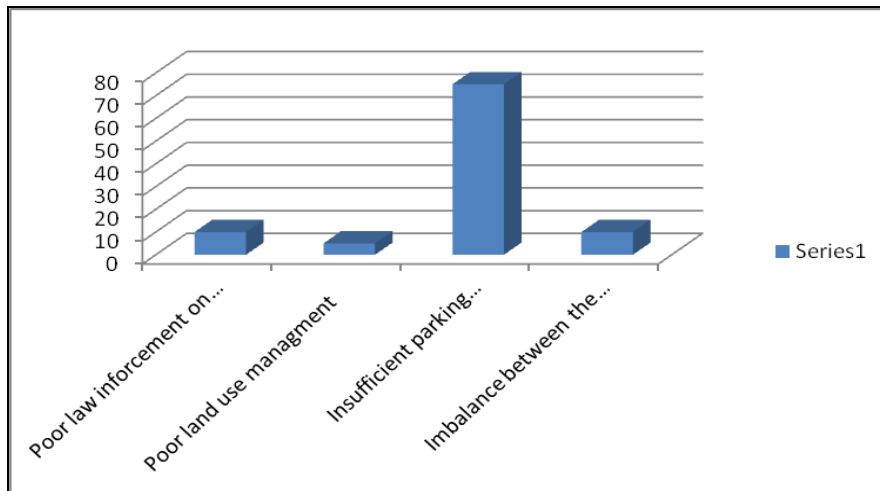


Figure2. Causes contributing to the shortage of vehicular parking facilities suggested by the respondents

Adequacy of vehicular parking spaces

It can be noted that all the respondents unanimously agreed 100% concurrence of the respondents that the parking spaces provided in the study area were grossly inadequate, and this could be attributed to the continued and disproportionate increase in the number of vehicles operating within the city of Addis Ababa over time. According to the data provided by the Federal Transport Authority (FTA), which recently revealed in its latest report in 2020 that Addis Ababa has over 630,440 vehicles, It amounts to over half of the cars registered in the entire country. As a result, the number of vehicles has been rising rapidly. As of mid-2019, a total of 596,084 vehicles were reportedly registered in Addis Ababa,⁵ an almost 40% jump from the 426,500 reported in 2015.⁶ More than half the 1.1 million vehicles registered in Ethiopia were in Addis Ababa, and the country imported 135,457 vehicles in fiscal 2019.

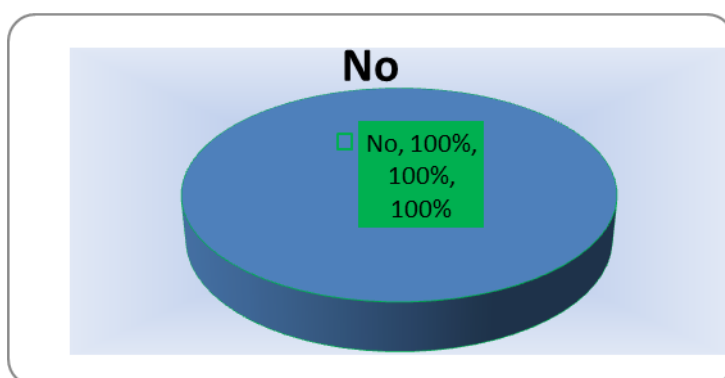


Figure 3. Adequacy of vehicular parking spaces in the studied area

Lack of adequate Vehicular parking space and congestion

The Problem of Parking Space Availability as an Urban Crisis

The lack of sufficient legally allocated parking spaces in urban centers has been a ripple effect of problems that have a great impact on the dynamics of urban traffic. As the population of urban centers continues to grow, with the number of people owning cars also increasing, it can be noted that there has been an increased demand for parking spaces, which has not been accommodated, and this has largely contributed to the widespread cases of illegal parking of vehicles.

While an overwhelming number of 96 percent of the respondents acknowledged the correlation between the lack of adequate parking spaces and the resultant street congestion, a mere 4 percent expressed their disagreement with the assertion, as they point out that the cause of Vehicular parking shortage is not only the shortage of parking space but also the lack of adequate road infrastructure. This indicates that the lack of sufficient parking spaces is a factor that contributes to the resultant street congestion, as the parking of the existing parking spaces by the vehicles forces other drivers to engage in the act of double parking, which constricts the width of the street carriageway, especially during peak hours. Figure 3. below illustrates the responses concerning the implications of inadequate parking spaces on traffic congestion.

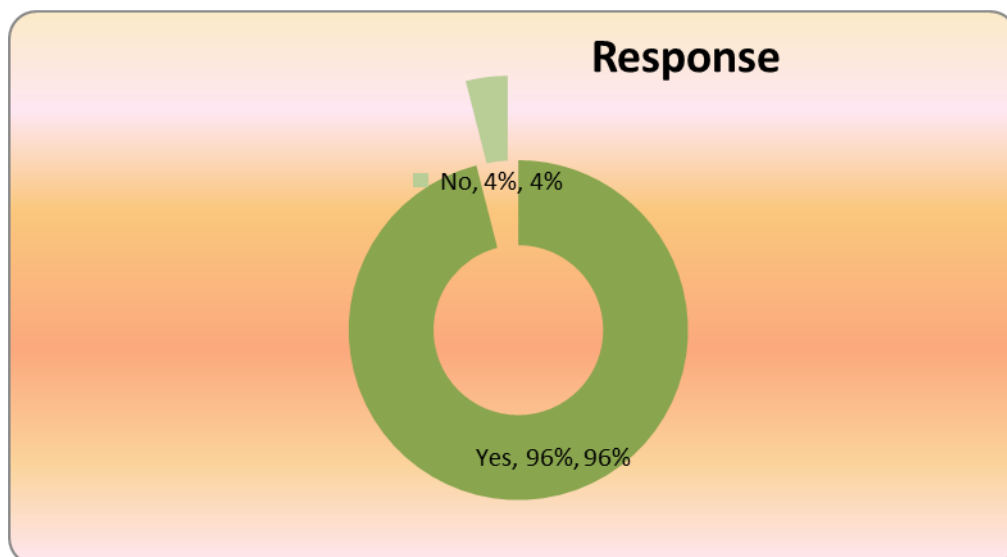


Figure 4. Lack of adequate parking space and congestion

Drivers typically spend half an hour to an hour looking for a parking place, and this time translates to lost productivity, fuel consumption, and wasted energy. These inefficiencies have a multiplier effect, resulting in larger economic and environmental impacts.

In the study, all participants encountered genuine challenges in searching for appropriate parking spaces within the boundaries. The shortage of parking spaces means that many people have to travel longer distances, resulting in significant losses of time, energy, and fuel. This is most likely affecting the daily activities of businesses close to the study areas as well. Each participant shared the experience of navigating through the study boundaries in search of a parking space.

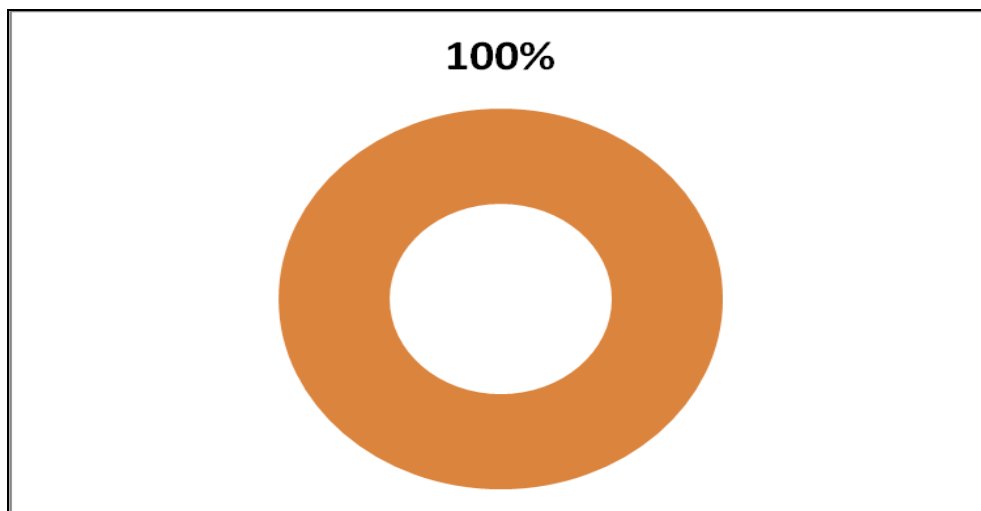


Figure 5. Response of the respondents on challenge in finding parking space.

Testing the Current parking Policy

Drawing on the above findings of this research parking policy efficiency in Ethiopia especially in Addis Ababa appears to be operationally inefficient on several grounds. Figure 4.11 below shows the criteria, result and justifications to evaluate the parking policy.

Criteria	Result	Justificaton
Utilaization	√ Efficient	High occupancy rate
Accessbility	× Inefficient	Difficulty in finding parking spaces

Enforcement	× Inefficient	Provision of off street parking is very low and illegal parking persists
Sustainability	×Inefficient	Increased fuel use and emissions
Traffic impact	× Inefficient	Causes congestion and delays

Based on the above the parking policy is operationally active but functionally inefficient. The parking policy in Ethiopia is partially efficient but largely inefficient due to high occupancy rate (near full use), poor turn over and management and weak enforcement and planning gap. This is also supported by The Addis Ababa Transport policy (2011) that identifies parking as one of the key infrastructural challenges and calls for expanded car parking facilities by private, public and public private partnership mechanisms in the city center and high traffic zones but the implementation has been slow. The city continues to rely on fragmented youth association managed road side parking which limits revenue capture and enforcement. This gap between policy intent and operational practice reduces the efficiency of the parking system.

Justification of Efficiency gap

Lack of pricing mechanism

- No dynamic pricing so that long parking duration
- Users space occupancy longer than necessary

Over reliance on street parking

- Reduces road capacity
- Interferes with traffic flow

Weak Enforcement

- Regulations exist but poorly enforced
- Illegal Parking are common

Inadequate Infrastructure

- Limited offstreet parking supply
- Poor allocation of land

Absence of smart parking system

- No real time guidance system
- Drivers waste time searching for parking

The phenomenon of double parking, where cars park abreast of one another in existing parking spots, has become increasingly commonplace, especially in congested residential areas. It has the effect of reducing wide roads to the status of one-lane roads, which can bring the whole traffic system to a grinding halt. People are taking advantage of the extra space to park their cars at fire lanes, bus stops, sidewalks, emergency lanes, and other unauthorized areas by engaging in the act of parallel parking.

Impact on Traffic Flow and Public Safety

The impact of the negative effects of illegal parking is most acutely felt during peak hours, especially when the roads are already congested. The act of illegally parking cars further congests roads that are already at maximum capacity, pushing the problem up and further increasing the problems of traffic, travel time, fuel consumption, and pollution. The risk of accidents is also higher because the illegally parked cars block the roads.

Enforcement and Regulation Challenges

Enforcement Hurdles

The problem is further compounded by the fact that the law does not seem to be effectively enforced, and there is a lack of political will to impose penalties for the act of illegally parking cars. The problem is further compounded by the fact that the law regarding the obligation of owners to provide enough parking spaces is not being effectively enforced. It is the opinion of many that many real estate developers are more concerned with providing maximum leasable space rather than providing enough parking space, effectively leaving the problem to be solved by the drivers who have no other alternative but to park illegally.

Insufficient Off-Street Parking

It is estimated that 75% of the population is forced to park their cars on the street because of the insufficient off-street parking. The owners of the buildings often use the allocated parking space for other business enterprises, which is against the law.

Effects on Businesses and Security

The act of illegally parking cars in front of shops and businesses has the effect of blocking the entrance to the premises, which has the effect of discouraging customers from entering the premises. The act of parking cars on the street makes the vehicles more vulnerable to theft and vandalism, which has the effect of compromising the safety of all the parties involved.

5.2 Conclusion

The parking problem in Bole sub-city reflects the larger challenges associated with urbanization in Africa. Addressing it will require a comprehensive approach: investing in infrastructure, regulating and modernizing laws, and leveraging technology and collaboration. If we recognize the value of parking and tackle it with a clear approach, Addis Ababa has a lot to gain. In addition, this study sought to rigorously identify the underlying reasons for the parking deficit for automobiles and, at the same time, evaluate how it affects the metropolitan transit system.

5.3 Recommendation

In view of the foregoing, the following recommendations have been forwarded:

- The city's master plan should proactively include provisions to establish additional parking areas, which are strategically aimed at alleviating the persistent issue of traffic congestion that has plagued the urban environment.
- The Addis Ababa City Roads Authority has to include design and construction of off-street and on-street parking facilities in its road construction projects.
- Angle parking should be encouraged instead of parallel parking to reduce congestion and utilize the parking space effectively.
- The Addis Ababa Transport Authority has to develop an integrated parking management plan including complementary strategies that meet the needs of a vehicular parking space.
- Formulate on-street parking policy including parking regulation time.
- Limit the maximum time a vehicle can park in more convenient spaces, to encourage turnover and shift long-term parkers to less convenient facilities and prohibit on-street parking on certain routes at certain times especially during peak hours to enhance traffic lanes.
- In most cases drivers use on-street parking because of lack of sufficient off-street parking spaces. Therefore, the concerned party should impose strict law enforcement on building owners to provide adequate parking space and not to use it for other purposes.

- Indicate vehicular parking places through signs, brochures and maps to facilitate in finding vehicular parking places and minimize loss of resources in respect of time, energy, fuel and environment pollution while looking for parking place.

Appendix E Maps of Study Area



Author's Note:

This comprehensive article draws upon extensive field research and detailed policy analysis conducted within Bole sub-city, Addis Ababa. The insights and recommendations presented are specifically crafted to inform and guide key stakeholders: government officials, urban development professionals, and the general public. Its primary objective is to offer a versatile model for tackling the complex issues surrounding urban parking, applicable not only across Addis Ababa, Ethiopia, but also in similar metropolitan areas worldwide.

References

- AACRA (2003) Addis Ababa City Road Authority Manual. Section 19. Addis Ababa: Addis Ababa City Road Authority.
- AASHTO (1994) A policy on geometric design of highways and streets. Washington, D.C.: American Association of State Highway and Transportation Officials.
- AASHTO (2001) A policy on geometric design of highways and streets. 4th edn. Washington, D.C.: American Association of State Highway and Transportation Officials.
- AASHTO (2004) A policy on geometric design of highways and streets. Washington, D.C.: American Association of State Highway and Transportation Officials.
- Campisi, T. et al. (2021) ‘Sustainable mobility promotion and urban space planning’.
- Dehghani, Y. and Soltani, A. (2022) ‘GIS-based fuzzy multi-criteria decision making for site selection’, Shiraz, Iran.
- Farrukh, M. et al. (2018) ‘Improved parking management systems and stricter enforcement of parking regulations’, Hyderabad, Pakistan.
- Gonzalez, L. (2024) ‘On-street parking regulation and low emission zones’, Madrid, Spain.
- Gonzalez, L. et al. (2022) ‘Parking demand management policies’.
- Ibrahim, M. (2017) ‘Car parking problem in urban areas: causes and solutions’. SSRN.
- Ison, S.G. (2020) Parking issues and policies: transport and sustainability. London: IET.
- Liu, Y. and Murray-Turner, P. (2017) ‘The effects of demand responsive parking on transit usage, parking availability and congestion: evidence from SFpark’, Journal of Transport Geography.
- Macea, L. et al. (2022) ‘Parking demand management policies’.
- Mavlutova, I. et al. (2023) ‘Sustainable mobility promotion’.

- Mersden, A. (2006) Parking challenges facing urban cities in Tanzania. University of Dar es Salaam.
- Mersi, A. (2014) 'Empirical study of parking problem on university campus', Journal of Transport and Urban Studies.
- Morency, C., Saubion, B. and Trépanier, M. (2006) 'Evaluating the use of parking spaces in strategic urban areas using travel survey data', in Proceedings of the 53rd Annual North American Meetings of the Regional Science Association International, Toronto, ON.
- Napier University (2008) An analysis of the city center car parking market. Edinburgh: School of Engineering and Built Environment, Edinburgh Napier University.
- OECD (2019) The environmental and welfare implications of parking policies. Paris: OECD Publishing.
- Olaru, D. et al. (2016) 'Analyzing the elements related to parking demand', Advances in Mechanical Engineering.
- Phuc, N. and Huong, T. (2023) 'Diversifying parking supply, market-driven pricing mechanisms and promoting public transport', Vietnam.
- Shoup, D. (2006) 'Cruising for parking', Transport Policy.
- Shoup, D. (2011) 'The surging demand for parking', Cities.
- Tang, Y. (2023) 'Parking supply strategy, demand management and parking management strategy', Ningbo, China.
- Varian, H.R. (2010) 'Parking demand and pricing', Transport Reviews.
- Xia, X., Wang, Y. and Zhang, L. (2023) 'How does parking availability interplay with land use to affect traffic congestion? The case study of Xi'an, China', Sustainable Cities and Society, 88, p. 102126.