Integrating Transport and Land Use Planning Strategies for Sustainable Development in Addis Ababa: The Case Study of Lamberet Round About (Northern Bus Station)-Wosen-Mesalemiya-Kotebe Metropolitan University-02 Kotebe Corridor

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Approval Page

This MSc. thesis entitled **"Integrating Transport and Land-Use Planning Strategies for Sustainable Development in Addis Ababa:** The Case Study of Lamberet Round about (northern bus station)-Wosen-Mesalemiya-Kotebe Metropolitan University-02 Kotebe Corridor" has been approved by the following examiners in partial fulfillment for the requirement of the degree of Master of Science in Urban Planning.

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Declaration

I hereby declare that the thesis entitled “Integrating Transport and Land-Use Planning Strategies for Sustainable Development in Addis Ababa: The Case Study of Lamberet round about (northern bus station)-Wosen-Mesalemiya-Kotebe Metropolitan University-02 Kotebe Corridor” has been carried out by me under the supervision of Dr.Dipl-Ing Berhanu Woldetensae, for the partial fulfillment for the requirement of degree of Master of Science in Urban Planning. I further declare that this work has not been submitted to any other University or Institution for the award of any degree or diploma; and that all the sources of the materials used in the thesis have been accordingly acknowledged.

Yigzaw Shewaye _____ _____

Signature Date

Confirmation

This is to confirm that the thesis entitled “Integrating Transport and Land-Use Planning Strategies for Sustainable Development in Addis Ababa: The Case Study of Lamberet Roundabout (northern bus station)-Wosen-Mesalemiya-Kotebe Metropolitan University-02 Kotebe Corridor” is an authentic work carried out by Yigzaw Shewaye under my guidance and supervision. This is the actual work done by Yigzaw Shewaye for the partial fulfillment of the requirement for the degree of Master of Science in Urban Planning from Addis Ababa University, Addis Ababa.

Dr. Dipl-Ing Berhanu Woldetensae _____ _____

Signature Date

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List of Acronyms/Abbreviations

AA	Addis Ababa
AACA	Addis Ababa City Administration
AACG	Addis Ababa City Government
AACRA	Addis Ababa City Roads Authority
AACATA	Addis Ababa City Administration Transport Authority
AAPADC	Addis Ababa Plan and Development Commission
AASHTO	American Association of State Highway Transportation and Officials
AATB	Addis Ababa Transport Bureau
AATMA	Addis Ababa Traffic Management Agency
AU	Africa Union
BRT	Bus Rapid Transit
CAA	Clean Air Act
ERP	Electronic Road Pricing
GDP	Gross Domestic Product
GHG	Green House Gas
LRT	Light Rail Transport
LTA	Land Transport Authority
LUTP	Land-Use Transport Planning
MRT	Mass Rapid Transit
NGO	Non-Governmental Organizations
PPH	People per Hectare
RTS	Rapid Transit System
SDG	Sustainable Development Goals
TAI	Transit Accessibility Index
TDM	Transit Development Management
TDR	Transfer of Development Rights
UNECA	United Nations Economic Commission for Africa

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Abstract

The integration of transport and land use is crucial for sustainable urban structures, but the study area as well as the city face challenges due to a lack of coordination between these sectors due to the traditional separation of sectorial functions into different government agencies, despite the city government's efforts. The objective of this study is to investigate ways of achieving sustainable development for integrated transport and land use planning strategies by evaluating the key elements and barriers to integration and proposing some possible solutions. The main research instruments used were document analysis and review, a questionnaire survey, and observation. Within these phenomena, varieties of socio-spatial data were collected from different sources and analyzed using various analytical techniques using ArcGIS and Excel. Then, the study analyzed and evaluated the key elements of integration; based on distribution of population density, land use mix, neighborhood design and layout, parking facilities, road accident, pollution, accessibilities, and assess way of integration development from secondary documents.in addition to this structured questionnaires were distributed to collect data from stake holders that involved in land use planning and transport planning in city administration. Density distribution is inversely related to both household ownership or uses and household annual vehicle traveled. There are several local streets that are directly linked and radiate with arterials, which may be due to poor road design or implementation. In addition, based on the accessibility indicator, the majority of the sub-city residents and study areas are disadvantaged and forced to walk more than the recommended standard value. The overall results obtained through the various analysis methods were used to develop further recommendations about how to integrate transport and land use planning strategies. *Diversity of land use categories should be practiced during new settlement, infill development and other development mechanisms by keeping mix ratio standard. The separation of the pedestrian from the vehicle by providing adequate sidewalks is critical to enhancing the safety, security, and convenience of pedestrian users. Providing spaces/access for street vendors is important to increase the existing walkway capacities. Integrating transport and land use planning should start with the early planning process. A coordinated approach to transportation and land use planning resulted for many benefits to the sub-city residents and likely to become attractive for development. So that the government and other stake holders should support these two sectors.*

***Key words**: Land use planning, Sustainable development, Integration, Transport planning*

Chapter One: Introduction

1.1. Background of the Study

Transportation and land use planning decisions interact. Transport planning decisions affect land use development, and land use conditions affect transport activity. These relationships are complex, with various interactive effects. It is therefore important to understand these in order to integrate planning, so individual decisions support strategic goals (Litman, 2010). The study by Litman (2009), explores the impact of transport planning decisions on land use, focusing on methods for evaluating these effects. Transport impacts residents and businesses through interactions in property, labor, and goods markets. Changes in transport can indirectly affect people or businesses. It's crucial to consider not only land-use consequences but also the implications for evaluating the influence of transport through different groups of people and organizations. Land-use is dynamic and influenced by demographics and development processes. Transport changes can extend beyond spatial scope, affecting accessibility and secondary effects. Locational changes occur through changing building occupation, affecting density and occupation nature(Department for Transport, 2014). Urban areas have more accessible land use and diverse transport systems, but slower and more costly automobile travel, while suburban and rural areas have less accessible land use and fewer travel options.

Land use planning aims to allocate land to meet economic and social needs while safeguarding future resources. It varies depending on the type of trip and the traveler. Improving land use mix and walkability can reduce automobile shopping and recreational trips, while increasing regional accessibility and improved transit can reduce automobile commute trips. Improving mix and workability reduces energy consumption, pollution emissions, and crashes, but has less impact on traffic congestion(Litman, 2005a).The integration of transport and land use is crucial for sustainable urban development. It requires a forward-looking vision, an institutional framework, and sustainable financial models. Effective planning reduces private motorized vehicle travel. Areas with good access to public transport and well-designed urban spaces that are walk-able and bike-able become highly attractive places for people to live, learn, play, work, and interact. Transport and land-use integration is one of the most promising means of reversing the trend of automobile-dependent sprawl and placing cities in developing countries on a sustainable

pathway. Such environments enhance a city's economic competitiveness, reduce local pollution and global greenhouse gas emissions, and promote inclusive development.

The way for successfully integrating transport and urban development remains complex. These factors include inherent characteristics of a city, such as natural and historical conditions; governance structures; institutional settings; transit investments, planning regulations, tax policies, and financial incentives; financing instruments; and market responses(Cervero *et al.*, 2013).

The lack of integration between land use and urban transport in Addis Ababa has led to unnecessary trips, congestion, costly fuel consumption, pollution, and low productivity. Despite improvements in roads and public transport services, the transport problem remains unsolved due to limited expansion of mass transit and walking and biking facilities in inner-city redevelopment areas. Promoting integration between transportation and land use can reduce travel needs and support sustainable modes(AATB and world resources institute, 2021).

This thesis study explores the complex process of transport and land-use integration in the study area, Yeka sub-city, for the reason that the study area is located in Yeka sub-city. It first identifies key elements of integration, barriers to integration, and opportunities for effective integration of transport and land use planning for sustainable development. It then recommends a set of planning strategies and implementation measures for overcoming these barriers and exploiting these opportunities.

To sum up**,** the integration of these two sectors is the most essential strategic initiative for developing more sustainable urban structures. The transport system is an important part of a city and success in insuring mobility can even be an indication of how well the city really is organized. Areas with good access to public transport and well-designed urban spaces that are walk-able and bike-able become highly attractive places for people to live, learn, play, work, and interact. Since Addis Ababa keeps expanding horizontally and because of an increase in the population, mobility in the city has become a big issue. And the failure to provide healthy public transport causes automobile-dependent and growing economic as well as environmental problems in the city. These points help to understand the need to integrate transport and land use planning strategies in urban areas. The study focused on how to develop mechanisms or solutions by identifying and evaluating the key elements of integration and the barriers to integration to have a sustainable transport system for a healthy environment and a smart city.

1.2. Statement of the Problem

Addis Ababa is the diplomatic capital of Africa since it hosts the headquarters of the AU and UNECA created in 1958 to encourage economic cooperation. Addis Ababa is the hub of the Ethiopian urban economy. The GDP of the city accounts for a significant share of the National GDP(AACPPO, 2012).As the result of this advantage of the city, the population of the city is increasing from time to time resulting in vehicle ownership increment. The present Addis Ababa is the result of addition and accretion of localities from time to time. It is not planned city from the beginning. Due to this, there are places without access for motorized transport. On the other hand, Addis Ababa is expanding horizontally to accommodate the ever-increasing population as a result of immigration from all corners of the country and natural growth; there is an increased demand for transportation in the city. So, having this population increment; urban sprawl; inadequate infrastructure for pedestrians, cyclists; shortage of funding for transportation infrastructure and services which among other things resulted in the public transport system that failed to match the increasing demand generated from sprawled settlement at the peripheries.

Currently in Addis Ababa, these two sectors, transport, and land-use planning, face various challenges. Most of the challenges arise due to lack of coordination between land-use planning and transport planning as a result of a traditional separation of the land use planning and transport planning functions into different government agencies, each responsible to a different minister. The majority of the city residents are suffering from the negative impacts of land use and transport intercourse that leads to: Congestion; increased trip length and travel times; energy consumption; increased GHG emissions and pollution levels;. Increasing reliance on private transport and the current public transport system is expensive, inefficient, ineffective and inaccessible. Spatial sprawl and increasing transport demand are concurrent trends that need coordination among actors and planning strategies for sustainable development. A few studies have been carried out on land use and transport interaction. However, very few papers have been written regarding the Ethiopian context, despite increasing the importance of integration as a regulatory measure. This research responds to a need to assess the key elements of integration in the Ethiopian context. Further, it examines major barriers of integration of transport and land use planning, and whether mechanisms exist to improve the integration of these sectors for an effective transport system.

1.3. Objective of the Study

1.3.1. General Objective

The general objective of this research is to investigate the land use planning mechanisms that lead to sustainable development through evaluating the key elements and barriers of integration.

1.3.2. Specific Objectives

1. To evaluate the key elements of transport and land use integration
2. To analyze the need for integrating the land use and transport policies in order to ensure sustainable development in Addis Ababa.
3. To identify the major barriers of land use and transport integration
4. To assess way of achieving sustainable development/ planning mechanism/ for integrated transport & land use planning strategies.

1.4. Research Questions

No.	Main Question	Secondary Questions
1.	What are the key elements of integration?	1.1. What is the impact of land use on transport?
		1.2. What is the impact of Neighborhood design and layout?
		1.3. What is the impact of transport on land use?
2.	How do we develop integrated transport & land use planning strategies that will lead to sustainable development?	2.1. How is transport and land use planning organized in Addis Ababa
		2.2. What are the major barriers of integration
		2.3. What are the enabling mechanisms/solutions / for the achievement of sound transport system through efficient integration of transport and land use planning strategies.

1.5. Scope of the Study

The thesis work was motivated by many problems that exist in Addis Ababa, as a consequence of its historical land use planning strategies and transport planning policies that were formulated independently from each other. Spatially, the scope of the research is limited to the selected sub

city and selected corridor of Addis Ababa. The study examines land use, transport routes, and infrastructure in Yeka sub-city and a specific corridor in the sub-city, focusing on limited land use types and their integration with transport infrastructure. It also examines major routes connecting these areas and the integration of transport and land use planning strategies. Thematically, the scope of the thesis work will bring best practices, regarding integrating transport and land use planning strategies, especially international experience and implementation strategies for the planning areas. The research is expected to review the international experience of integrating transport and land use planning and develop some recommendations that best fit for the City for the fulfillment of masters of degree.

1.6. Significance of the Study

This thesis work provides a significant contribution to generating some urban land use planning strategies and their integration into transport for the sustainable development of the city. Moreover, it renders academic advantages that would be used as a reference or guideline while designing urban land use and transport planning with effective integration into real and academic projects. The study is also significant in the sense that it is expected to create awareness in the area of land use and transport systems and their associated planning problems. Even though the study is limited to major land use and transport planning, it can serve as a preliminary study for further detailed land use and transport interaction studies. In addition to this, the study helps fully in the land use and transport planning process if it is accompanied by a detailed interaction study in the area.

1.7. Limitation of the Study

Due to externalities, the thesis faced the following limitations: Among all other limitations were difficulties in accessing updated information and relevant maps; a lack of properly organized secondary data in the related offices; and difficulty in measuring population data in the study area. As a result, these situations had their own direct and indirect impact on the thesis work over all processes.

1.8. Structure of the Study

The overall thesis work is organized into five chapters, as follows: The first chapter is more introductory, addressing the issues of: background, statement of the problem, research questions, aims and objectives, significance of the study, scope of the study, and structure of the document. The second chapter presents a review of the supporting existing literature. The third chapter focused on: research design and approach, data types, source of data and research instrument, research population and sampling design, data collection method, method of data analysis, method of data presentation, validation, and reliability. The fourth chapter addresses the issues of result and discussion, with an emphasis on quantitative and qualitative analysis of the collected data based on the stated objective of the thesis. The last chapter deals with the summary of conclusions, recommendations, and recommendations for future research on the thesis work.

Chapter Two: Literature Review

2.1. Introduction

The purpose of this chapter is to review the previous of researchers on integrating transport and land use planning so as to gain an understanding of the existing research and debates relevant to a particular area of study, and to present that knowledge in the form of a written report. Conducting a literature review aids building knowledge on a particular topic of the study area. It is important to indicate directions in identifying areas of previous research to prevent duplication and give credit to other researchers and identify gaps.

2.2. Definition of Land Use

The term 'land-use' is used throughout this paper to cover a range of human activities, the state of the built environment, and some aspects of the natural environment. 'Land-use' so defined is of relevance to 'transport' for at least three reasons:

- activities and the interactions between them generate the demands for transport;
- those activities and interactions are to a greater or lesser extent influenced by the availability of transport; and
- The linkages between transport and activities may be important to the appraisal of transport strategies - especially when trying to consider whether the transport system is providing the kinds of accessibilities that activities (i.e. people and businesses) require, rather than simply providing mobility(Department for Transport, 2014).

2.3. Definition of Transportation

Transportation: - Defined as the movement of people, goods, or services from one particular location to another through communication media (transport infrastructures) by using motorized or non-motorized vehicles. In other words, it is the means of conveyance or travelling from one place to another. But it is better to understand that movement is the most common element in any definition of transportation. It is the changing of the physical location of freight. passengers or

exchange of information and products must be moved to the location where they are needed(Asres, 2020).

Transportation System: - is a system for moving persons or goods consisting of three components: such as; the vehicle (equipment), the guide route is where the vehicles move along; The operations plan is the set of procedures by which traffic and vehicles are moved over the guide way. Transportation systems, either existing or envisaged for the future, can be classified according to these components and their relations to the larger economic, social, and physical systems in which they occur(Boyce, 1996). Transportation systems are critical to our daily lives. People use various systems of transportation on a daily basis to travel to and from work, school, visits to family and friends, attend business meetings, and medical emergency sites(CA workshop, 2015).

It is known that transport infrastructure plays a very important role in achieving a sustainable transport system. The integrated and connected transport infrastructure can facilitate the positive flow of traffic and mobility. On the other hand, the inadequate supply of infrastructure can be reflected by the problem of the cost of transportation and decreasing the financial capacity of users to access day-to- day activities. In the context of' Addis Ababa transport system, and transport infrastructure in terms of road length, road width and road side infrastructure are important indicators of efficiency and reliability of transport infrastructure and a clue roads to how transport infrastructure is integrated with land use planning in the city. The major problems observed in transport infrastructures are:

- High intensity of private vehicles on the roads/ car dependent society
- Poor mass transportation facilities,
- inadequate road capacity,
- Heterogeneous movement of traffic,
- High volume of traffic congestion and road side accidents.

The problems could be solved by proper planning and integration of the two important sectors in the city(Gidebo and Szpytko, 2019).

2.4. Definition of Sustainable Development

The most quoted definition for sustainable development is that presented in the 1987 United Nations General Assembly in the so-called Brundtland Report. According to Visser and

Brundtland (2013), report, Sustainable development was defined as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs” . Sustainable transportation is that which does not endanger public health or ecosystems, as it meets mobility needs consistent with the use of renewable resources below their rates of regeneration and the use of non-renewable resources below their rates of development of renewable substitutes. Sustainable transportation involves complex environmental, economic, social, and behavioral issues that are directly connected to the physical pattern of land use, financial arrangements, and a mobility management system(Pourmohammadi and Farid, 2011).

Having this sustainability concept in transport, sustainable transport could refer to any transport mode with a low impact on the environment by applying non-motorized transport and low-emission vehicles, avoiding fatal accidents, and reducing congestion. In this thesis report, the major focus is on the first dimension, environmental sustainability. Major transport externalities lie within such themes as energy consumption, emissions, and air pollution. The first formal response to policy regarding environmental sustainability was in the USA. The National Environmental Policy Act of 1969 and the Clean Air Act (CAA) of 1970 were major pioneering steps towards promoting sustainable developments(Llorca *et al.*, 2020).

As a result, to achieve the sustainability of transport, eco-friendly travel choices should be prompted and then adopted. Best examples of green travel behavior are: reducing driving distance, promoting active transport such as walking and cycling and promoting public transport. Hence investigating people’s travel behavior in a neighborhood and the factors affecting that behavior is inevitable in order to alter unsustainable travel options to sustainable ones(Llorca *et al.*, 2020).

Urbanization leads to increased resource use in cities, reducing emissions. High-density, mixed-use, and innovation hub cities can promote eco-friendly living. However, urban sprawl consumes Greenfields, environmental standards are often violated, and high living costs often make homes unaffordable for low-income households. In an effort to balance the environmental, social, and economic demands of resilient development, the United Nations has developed 17 Sustainable Development Goals.

- No poverty
- Zero hunger
- Good health and well-being

- Quality education
- Gender equality
- Clean water and sanitation
- Affordable and clean energy
- Decent work and economic growth
- Industry, innovation, and infrastructure
- Reduced inequalities
- Sustainable cities and communities
- Responsible consumption and production
- Climate action
- Life below water
- Life on land
- Peace, justice, and strong institutions
- Partnerships for the Goals

(Llorca *et al.*, 2020)

2.5. Land-Use and Transport Interaction

Cities grow whether or not they have planning; to fulfill the demands of a growing population for food, space, infrastructure development, and services, land use must shift in one way or another. As a result, spatial mobility is a distinctive aspect of contemporary society, providing numerous new avenues for human endeavor and commercial enterprise. This shows that transport and activity patterns are closely related issues as spatial distribution of different human activities leads to the need for travel and transport of goods. As a matter of fact, with every change in land use of an area, which could be in terms of intensity or type of use, there is also a corresponding change in the flow of people and goods to and from the site. Similarly, with every change in flow of people, vehicles and goods along routes adjacent to a site, there is a corresponding change in accessibility to the site and its attractiveness to current use, or for some other potential use. Furthermore, a considerable share of urban land is occupied for transportation use, which shows that transportation not only relates to land use but, also it is itself a land use(Dagnachew, 2007).

Land use and transportation are two sides of the same coin. Transportation affects land use and land use affects transportation. As a result, it is very essential to coordinate transportation and

land use planning decisions so they are complementary rather than contradictory. This indicates that transport planning decisions support land use planning objectives and land use planning decisions support transport planning objectives(Litman, 2005a).

Theories on the two-way interaction between urban land use and transport address the locational and mobility responses of private actors (households and firms, travellers) to changes in the urban land use and transport system at the urban-regional level.

Urban land use and transport are closely inter-linked. It is common wisdom among planners and the public. The spatial separation of human activities creates the need for travel and goods transport is the underlying principle of transport analysis and forecasting. Following this principle, it is easily understood that the sub-urbanization of cities is connected with increasing spatial division of labour, and hence with ever increasing mobility(Wegener and Fuerst, 2011).

The major theoretical approaches to explain this two-way interaction of land use and transport in metropolitan areas include technical theories, economic theories and social theories such as society and urban space(Wegener and Fuerst, 2011). The output of these theories of land-use transport interaction are summarized in Tables 2-1 and 2-2 in terms of anticipated impacts of essential factors such as urban density, employment density, neighborhood design, location, city size, accessibility, travel cost and time.

Table 2.1 Theoretically Anticipated Impacts of Land-Use

Direction	Factor	Impact on	Anticipated Impacts
Land use ⇓ Transport	Residential density	Trip length	Higher residential density alone does not mean shorter trips. A mixture of workplaces and residences can lead to shorter trips if travel costs are increased.
		Trip frequency	Little impact expected. If trips are shorter, more trips may be made.
		Mode choice	Minimum residential densities are a prerequisite for efficient public transport. More walking and cycling trips will be made only if trips become shorter.
	Employment density	Trip length	The concentration of workplaces in a few employment centers increases average trip lengths, while a balance between workplaces and residences would lead to shorter

			work trips only if travel becomes more expensive.
		Trip frequency	Little impact expected. If trips are shorter, more trips may be made.
		Mode choice	Concentration of workplaces in few employment centers may reduce car use if supported by efficient public transport. More walking and cycling trips will be made only if trips become shorter.
	Neighbourhood design	Trip length	Attractive public spaces and a variety of shops and services can induce more local trips.
		Trip frequency	More trips may be made, if trips are shorter
		Mode choice	Street layout, pedestrian spaces and cycling lanes could lead to more walking and cycling.
	Location	Trip length	More peripheral locations tend to have longer trips.
		Trip frequency	No impact anticipated.
		Mode choice	Locations close to public transport stations should have more public transport trips.
	City size	Trip length	Trip length should be negatively correlated with city size.
		Trip frequency	No impact expected.
		Mode choice	Larger cities can support more efficient public transport systems, so more trips should be made by public transport in larger cities.

Source : Wegener and Fuerst,2011

Table 2.2 Theoretically Anticipated Impacts of Transport

Direction	Factor	Impact on	Anticipated Impacts
Transport ⇓ Land use	Accessibility	Residential location	Improved accessibility to workplaces, shops, education, and leisure facilities attracts residential development, leading to higher land prices and faster development. Local improvements change the direction of new residential development, resulting in more dispersed development.
		Industrial location	Improved accessibility to motorways and railway freight terminals will attract and expedite industrial development, influencing the direction of new development.
		Office location	Locations with better accessibility to airports, high-speed rail railway stations and motorways will be more attractive for office development, have higher land prices. Improving accessibility locally will change the direction of new office development.
		Retail location	Improved local accessibility will enhance the appeal of a location for retail development, increase land prices, and accelerate development, reorienting new retail establishments.
Transport ⇓ Transport	Accessibility	Trip length	Locations with good accessibility to many destinations will produce longer trips.
		Trip frequency	Locations with good accessibility to many destinations will produce more trips.
		Mode choice	Locations with good accessibility by car will produce more car trips: locations with good accessibility by public transport will produce more public transport trips.
	Travel cost	Trip length	There is a strong inverse relationship between travel cost and trip length.
		Trip frequency	Travel cost and trip frequency have strong inverse relationship.
		Mode	There is a strong relationship between travel cost and

		choice	choice of travel mode.
	Travel time	Trip length	There is a strong opposite relationship between travel time and Trip frequency
		Trip frequency	There is a strong inverse relationship between travel cost and trip frequency
		Mode choice	Travel cost and choice of travel mode have strong relationship in between them.

Source: Wegener and Fuerst, 2011

2.6. Theory and Practice of Integrated Planning

There has been much discussion of integrated transport planning in international literature, with increasing reference to this approach in national transport policies and strategies. This development has been driven by the growing transport problems of traffic congestion and pollution, as well as the recognition that supply expansion alone may not be sufficient to meet foreseeable demands. As a result, transport planning is now expected to be multi-modal, bringing together a package of policy and operational measures. Efforts to improve transport capacity and manage demand have led to the emergence of more strategic forms of integration, particularly in the design of sustainable transport systems. This involves integrating land use and transport planning strategies and measures, which requires overcoming deep-rooted institutional and policy barriers, both nationally and within a particular region(Wegener and Fuerst, 2011).

2.6.1. The Need for Integrated Transport and Land –Use Planning Strategies

The need for better integration of these two sectors transport and land use planning is a long-standing issue in the literature. Something of a ‘break through’ came in the early 2000s when the Commonwealth sponsored the production of a National Charter for Integrated Transport and Land Use Planning(Commission, 2003). “Land use and transport planning has an important role to play in delivering social, economic, and environmental sustainability. Roads will continue to dominate as the means of movement for the majority of people and freight in Australia. Even so, by shaping the pattern of development and influencing the location, scale, density, design, and mix of land uses, planning can help to facilitate an efficient transport and land use system by:

- reducing the need to travel;
- reducing the length of journeys;
- making it easily accessible service for people;
- reducing the impact of transport on communities;
- improving freight access to key terminals and improved freight flows;
- providing efficient distribution of goods and services to business and community;
- providing a choice of travel modes; and
- Ensuring flexibility to meet the demands of a changing economy.

(Transport and Infrastructure Council, 2016)

Transport and urban development are two subjects that are mutually interacting. Transportation is required because of the distances between urban activities, but transportation technologies also have an impact on urban development and the distances between urban activities. It is obvious that transportation and urban development planning should be handled jointly if there is a two-way interaction between them. Transport can also be a tool for influencing urban development, making it a valuable planning tool for implementing urban plans. Planning for land use and transportation should therefore be closely coordinated.

2.6.2. Different Urban and Regional Planning Levels and Their Implication on Transport Planning

The process of globalization has brought significant changes to demographic boundaries, particularly in the last two decades. The majority of the world's population now lives on the periphery of metropolitan regions, with social, economic, and political activities centered around approximately 400 rapidly urbanizing areas known as global city-regions(Soja *et al.*, 2005).

Effective growth management in large urbanized areas should be seen from a regional perspective. So then, modern metropolitan regions may cover various previously independent cities which have expanded together and might include rapidly growing and sprawling peripheral lands which produce lots of incoming traffic. Traffic patterns are becoming more complex due to suburban travel. To plan future growth and alleviate congestion, it's crucial to examine the metropolitan region and manage planning policies at national, regional, and local levels, setting priorities for growth strategies(Broaddus *et al*., 2009).

Land use planning aims to structure urban development, but local issues require national and provincial strategies and resources to guide and support their implementation. For these reasons, decisions about land use and transport must be considered at regional, municipality and district levels(Rosanna and Chapin, 2004).

The subsidiarity principle suggests that lower government levels should make decisions on planning specifics due to their better understanding of the issues, ensuring that these decision-makers have the authority to create and execute Strategic Urban Development Plans for their communities(UN-HABITAT, 2007). Nevertheless, these decisions have to correspond to the national and regional decisions and priorities. In this context, vertical integration of different planning levels is indicated in Figure 2.1. The pyramid illustrates information transfer from top-down to bottom-up, with practical links between levels in mapping procedures, with lower level plans directing and providing feedback for upper scale plans(Rosanna and Chapin, 2004).

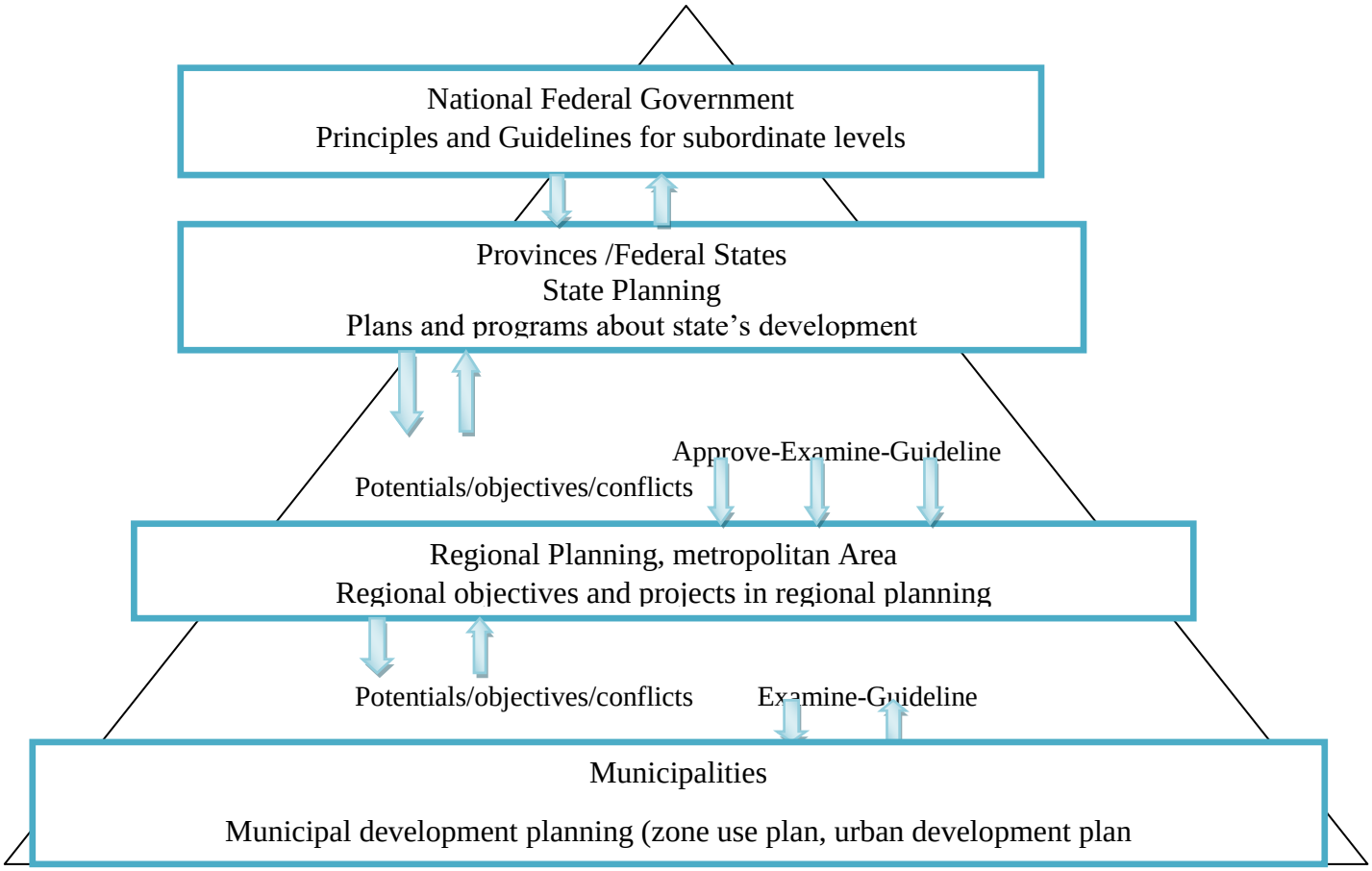

Figure 2.1 Vertical Integration of Different Planning Levels

Source: Rosanna and Chapin, 2004

The relationship between land use and transportation suggests that close coordination amongst the relevant agencies is critical. Metropolitan authority between the municipal and provincial levels may have been established as a result of city development. Accordingly, Petersen (2004) pointed out that these entities can be found with a variety of legal provisions, from the status of unofficial commissions that just offer a forum for discussion to full administrative levels that have a clearly defined authority to make decisions(Yaman, 2015).

According to Rosanna and Chapin (2004), stated that, cooperation between the different hierarchical levels must be provided based on the principle of 'counter-current'. For example, planning decisions on urban district level should be taken in with respect to the upper level and permission must be obtained from the upper to the lower level. The same situation prevails with the land use planning on municipal level towards the regional planning mechanism. If the municipal urban development plan corresponds to the regional development schema, then planning approval is guaranteed by the regional authorities. For regional planning, guidance will be given by spatial planning from the provincial level and so on(Yaman, 2015). Figure 2.2 below indicates the principle of overlaying of different land uses in urban planning.

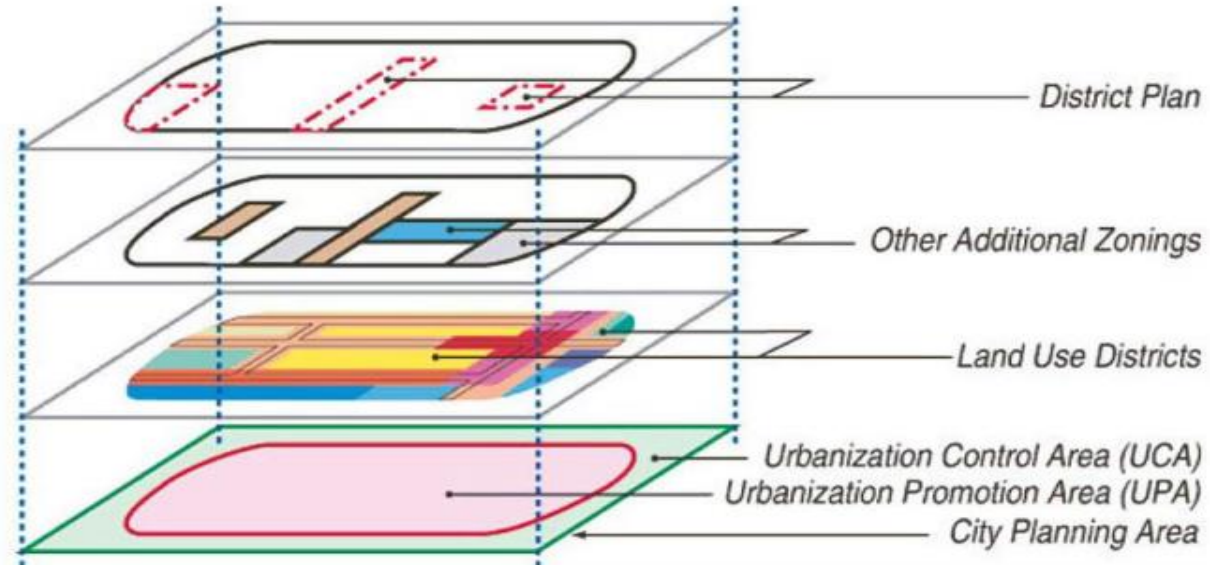

Figure 2.2 Concept of a Land-Use Planning System: Overlay of Land Use

Source: Rosanna and Chapin, 2004

As a result, transport planning decisions and land use planning principles should be coordinated to direct the spatial development within these types of development structure. Dispersed urban and regional development causes the investment priority for roads and weak land use interaction.

For example, due to strong planning structure in European and Japanese relatively prevents cities and regions from dispersed pattern of development when they are compared with the US cities. Thus, not only spatial development directs the urban growth but also infrastructure and transport investments influence it (Rosanna and Chapin, 2004).

To summarize overlay zones are useful and increasingly common tools employed by land use planners attempting to direct planning and land use controls at specific problems or issues. They should be carefully drafted to ensure that they achieve planning and policy goals and are not simply another layer of general zoning regulation. Planning overlays apply to make sure that any development is compatible with the land and the surrounding environment. Planning overlays outline the conditions your building needs to comply with, which can have a significant impact on your plans. This is important to remind you how the planning process is going on.

2.7. Integrated Land-Use and Transport Planning

Integrating land use and transport planning is crucial for people's access and movement, as per local and federal government guidelines. It requires a shift from viewing transportation as just routes to facilitating interactions and enhancing natural settings, preventing problems in work, play, and living areas. At first, it seemed unlikely that integrated land use and transportation planning would enhance the results of urban form out comes; to conquer the negative social impacts of 'transport systems'. As set out in the Climate Commission's advice, it is now also recognized as being a critically important part of reducing transport emissions and generally defined as a process of forming policies, objectives, design standards, investment decisions and operating protocols for both transport and land use system. Now a day its purpose is to shape better urban environments and accommodate the need for people and goods to interact, while minimizing the requirements of transport systems.

2.8. The Key Elements of Integration

The integration of land use with transportation systems has to happen at all scale or levels of planning and through multiple intervention mechanisms. To implement those multiple intervention first and foremost, one should know the elements of land use and transport integration. Most important elements of integration are listed below(Swamy et al., 2013).

- Enabling Urban Structure

- Complete network and complete streets
- Public Transit and its Strategic Alignment
- Transit oriented development and value capture
- Accessibility improvements in terms of local area plans
- Re-development & Re-vitalization & Transit
- Integrated Multimodal Transit Interchanges

The key elements of land use transport integration; among these key elements the enabling urban structure is the physical form of the city which is critical land use transport integration that has direct impact on travel patterns. Settlement Size; density distribution; mixed land use and activities and networks are the variables used to evaluate the extent of land use transport integration. To grasp the concept of high and low density in an Indian context, refer to the following density ranges.

Table 2.3 Density Ranges

Size of the city	High Density (PPH)	Reasonable Density (PPH)	Low Density (PPH)
Large cities / Metros	Above 125	Above 100	Below 100
Medium and Small size cities	Above 75	Above 60	Below 60

Source: Swamy *et al.*, 2013

But when we come to Addis Ababa city structure plan context, the land allocation proportion of the city should be guided by mixed residential density. "Mixed residential density is a concentration of inhabitants or housing units in a defined area". Based on the Structure Plan of the city, mixed residences are divided in to three zones based on their respective density. High density mixed residence is termed as greater than or equal to 150 housing units per hectare. And the proposed minimum gross densities for medium and low density mixed residences are 100hu /ha and 50hu/ha respectively(AACPPO, 2017). Density affects travel behavior through the following mechanisms:

• **Land Use Accessibility.** Land use patterns impact mobility and accessibility by increasing density, increasing demand for walking, cycling, and transit, and reducing travel time. Land use patterns that maximize automobile access lead to poor transit and non-motorized access, while transit-oriented development may increase traffic and parking congestion(Litman, 2005b).

• **Transportation Options.** Increased density leads to increase the number of travel choices accessible in an area due to economies of scale in providing facilities such as sidewalks and services such as public transit, taxis, and deliveries.

• **Reduced Automobile Accessibility.** Increased density tends to reduce traffic speeds, increase traffic congestion and reduce parking supply, making driving relatively less attractive than alternative modes.

Household Vehicle Ownership and Use by Land Use Formula

Household Vehicle Ownership = 2.702 * (Density)-0.25

Household Annual Vehicle Miles Traveled = 34,270 * (Density)-0.25 * (TAI) -0.076

TAI (Transit Accessibility Index) = 50 transit vehicle seats per hour (about one bus) averaged over 24 hours (Litman, 2005a).

2.9. Barriers to Integration

In spite the fact that the importance of integrating land use and transport planning is widely acknowledged, the delivery of integrated approaches remains problematic. A range of barriers to the effective integration hold up to hinder successful implementation. As the European Conference of Ministers of Transport (2002), notes that; Implementing integrated policy packages for sustainable urban travel has proven easier said than done. Outlining and effectively implementing sustainable policy strategies for urban travel involves bringing together the diverse and divergent interests of a great many actors in the urban transport system. These include government at different hierarchical levels, politicians, public sector transport and land-use planning agencies, environmental authorities and private sector transport operators and other service providers, as well as real-estate developers and the individual travelers who require co-ordination and co-operation between these stakeholders. Barriers to integration of land use and transport planning have been the subject of several research initiatives internationally.

According to Transport Agency (2007), the common barriers groups into four main categories: these are:

• **Legal and institutional barriers**, includes lack of powers or divided responsibilities for implementing land use or other policy instruments.

• **Financial barriers,** budget restrictions on total expenditure for implementing a strategy or limitations on the flexibility with which revenue instruments can be used to acquire land or invest in public transport infrastructure.

• **Political and cultural barriers**, public or pressure group opposition to certain policy instruments such as road pricing or land use regulation.

• **Practical and technological barriers,** including lack of tools, methods and/or skills needed to move from 'transport engineering' solutions toward the design and delivery of integrated land use and transport strategies.

2.9.1. Major Barriers for Transport and Land-Use Integration in Developing Countries

Many cities in the world have recognized the importance of public transport systems; especially because of increasing traffic congestion and environmental problems. Having these transport investments, they intend to reverse automobile-dependent patterns of urban growth. From the experiences of Ahmedabad and Bogota cases, integrating transport and land use can be difficult issues, particularly for cities in developing countries and they have to overcome multiple challenges. Although both Ahmedabad and Bogota had forward-looking, long-term plans, visionary leaders and world-class bus rapid transit systems, short-term demands for improving mobility override long-term visions for sustainable urban development and aim to improve mobility with the investments in bus rapid transit systems but it is not clear that these systems can reshape and transform urban growth(Cervero et al., 2013).

According to Cervero *et al* (2013), defined eight major barriers to transport and land use integration in developing countries.

2.9.1.1. Lack of Regional Co-ordination at the Metropolitan Level

The management of a metropolitan region is a complex task for government that's why it requires various governmental entities at multiple levels. Governments are responsible for coordinating and integrating regional, land-use and transportation plans. With the suburbanization and decentralization, national governments delegate some of their decisions-making powers to the local governments. However, coordination between local and national levels sometimes can be difficult, unless proper integrated planning systems exist. In addition,

political and economic competition between municipalities is sometimes preventing coordination of planning(Yaman, 2015).

2.9.1.2. Sector Silo Behavior and Practices at the City Level

Departments and agencies generally have different missions, management systems, budgets and staff profiles at the metropolitan level. Hence, these differences disrupt integration between land use and transport, Transport planners have little knowledge about urban planning and urban planners have little knowledge about transportation. Thus, making an integration and coordination of two can be difficult (Cervero et al., 2013).

2.9.1.3. Inadequate Policies and Regulations for Strategically Creating Articulated Densities

Most developing countries have higher population densities than land-rich countries like Australia and United States. Instead of the increasing density in built-up areas, spreading development to new areas was generally preferred in developing countries. Although it is known that density leads to the deterioration of urban service provision, but not necessarily true. For instance, Singapore with 7.025 people per square kilometer provides efficient and high-quality urban services and maintains good environmental condition(Yaman, 2015).

2.9.1.4. Restrictive National Regulations and Administrative Constraints

Certain national and local government regulations and administrative deficiencies adversely affect the smooth functioning of land markets. The result is the under- or oversupply of land, noncontiguous spatial development, and changes in land-use patterns that respond slowly to the values created by transit infrastructure. These regulations are major barriers to transit-oriented spatial development(Cervero et al., 2013).

2.9.1.5. Inconsistencies in the Planning Instruments and Deficiencies in their Implementation

Because of the inconsistencies in the planning instruments, decisions made about urban and transportation planning cannot be directly reflected in practice. Sustainable urban and

transportation development as well as long-term ambitions are adversely impacted by short-term needs for more mobility.

2.9.1.6. Inadequate Policies, Regulations, and Supporting Mechanisms for Redeveloping Built-up areas

In order to meet existing traffic demand and reduce congestion, priority within transport investments is given to urbanized areas, generally in developing countries. However, retrofitting these areas is more complex and difficult because of two main reasons. Firstly, private businesses or households mostly own the property; that's why the government has little control over this land, but transport investments can be used as a tool by governments. Secondly, the demolition of physical assets and their reconstruction in the redevelopment of existing areas requires substantial costs(Cervero et al., 2013).

2.9.1.7. Neglected Urban Design at Neighborhood and Street Level

Transport network shapes urban development and land-use patterns influence on travel demand whereas density and mixed-land use influence travel distances on urban area, where as distances between urban activities determine travel time and cost. In addition to, safe and smooth accessibility to transit stations (foot paths and cycle paths) and facilities like benches, parks and landscaping are important for making a good built environment(Yaman, 2015). The Urban Design Element focuses on the physical and visual aspects of a district, including buildings, streets, and open spaces, which shape perceptions of the city, creating connections, barriers, safety, or discomfort(National Capital Planning Commission, 2012).

2.9.1.8. Financial Constraints

Huge amount of capital investment is needed for integrating transport and land use. But in developing countries there is a financial constraint. These include budget restrictions limiting the overall expenditure on the strategy, financial restrictions on specific instruments, and limitations on the flexibility with which revenues can be used to finance the full range of instruments. Road building and public transport infrastructure is the two policy areas that are most commonly subject to financial constraints. Therefore, due to lack of enough budget difficult to have integrated land use and transport(Anthony D.et al., 2006). Transit companies may be compelled

to prioritize the cost of right-of-way acquisition over the long-term development potential of their areas due to limited financial resources, which can lead to a lack of strategic planning(Cervero et al., 2013).

2.10. Development of Integrate of Land Use and Transport Strategies

There are many ways that help for the development of integrated land use and transport strategies. These strategies have their own impacts in creating integrated land use and transport in urban development. According to Swamy (2012), the strategies are described below:

- Enabling Urban Structure
- Strategic Alignments
- Accessibility Improvements
- Complete Network & Streets
- Transit Oriented Development
- Integrated Transit Facilities
- Inner city and transit
- Financial /Legal Instruments

2.11. The Possible Land Use Planning Strategies for Sustainable Transport Demand

Land use planning strategies can be implemented at various geographic scales. For example, clustering a few shops together into a mall tends to improve access for shoppers when compared with the same shops sprawled along a highway which is typical scale of access management. Locating houses, shops and offices together in a neighborhood improves access for residents and employees named as typical scale of New Urbanism. Clustering residential and commercial buildings near transit centers reduces automobile usage, while Smart Growth involves concentrating housing and employment within urban areas to increase transit system efficiency. Although people sometimes assume that land use planning bears that all communities become highly urbanized, these strategies are actually quite flexible and can be implemented in a wide range of conditions. These conditions are:

- In urban areas they involve infilling existing urban areas, encouraging fine-grained land use mix, and improving walking and public transit services.

- In suburban areas it involves creating compact downtowns, and transit-oriented, walk able development.
- For new developments it involves creating more connected roadways and paths, sidewalks, and mixed-use village centers.
- In rural areas it involves making villages and handover basic walking facilities and transit Services. Various land use planning strategies are being promoted to help to achieve various planning objectives, as summarized below. These represents somewhat different scales, perspectives, and emphasis, but overlap to various degrees(Litman, 2010).

Land use planning strategies guides development in the direction of those strategic priorities identified by all stakeholders through a consultative process. It reflects the complex and continuous process of city change. According to UN-HABITAT (2007), The following attributes define a successful and comprehensive strategic planning process:

- It is oriented towards the future and attempts to foresee how the world could be different five to ten years from now.
- It is flexible and oriented towards the larger picture.
- It creates a framework for competitive advantage through definite analysis of the city,
- It is a qualitative, idea-driven process
- It allows a city to focus, because it is a process of dynamic, continuous self-analysis

Table 2.4 Land Use Planning Strategies

Strategy	Description
Smart Growth	Mixed, Multi-modal development and More compact,
New Urbanism	More compact, mixed, multi-modal, walk able development.
Transit-Oriented Development	More compact, mixed, development designed around quality transit service, often designed around transit villages.
Location-Efficient Development	Residential and commercial development located and designed for reduced automobile ownership and use.
Access management	Coordination between roadway design and land use to improve transport.
Street escaping	Making more attractive walk able and transit-oriented streets.
Traffic calming	Redesign roadway to reduce traffic volumes and speeds.
Parking management	encouraging more efficient use of parking facilities and reducing parking requirements

Source: Litman, 2010

2.12. Summary

This literature review has tried to review the previous studies of researchers on integrating transport and land use planning to gain an understanding of the existing research relevant to my particular area of study, and to present that knowledge in the form of a written report focusing on the following subscriptions. These are: definitions of land use; transportation and sustainable development; land use and transport interaction; Theory and practice of integrated planning; The need for integrated transport and land use planning strategies; Integrated land use and transport planning; key elements of integration; Barriers to integration; Development of integrated land use & transport strategies and possible land use planning strategies to have sustainable transport demand.

Land use is defined as the range of human activities, the built environment, and the natural environment's relevance to transport for some considerable reasons. Transportation is simply the movement of goods, people, and information from one place to another place and its system is simply the physical link connecting origin and destination. The most well-known definition of sustainable development is defined as “development that meets the needs of the present without compromising the ability of the next generation to meet their own needs”. But land use factors like density, mixed use and innovation networks in cities provide an opportunity to establish more environmentally sustainable forms of living.

Transportation and land use are two sides of the same coin. Because of this quotation, these two things are connected and have an impact on each other. Coordinating land use planning and transportation decisions is crucial, as they complement each other rather than conflict.

In response to growing transport problems such as traffic congestion, pollution, accidents, increasing travel distances and the realization that a reliance on supply expansion to meet foreseeable demand limits leads to much discussion of integrated transport planning in the international literature and increasing reference to this approach in national transport policies and strategies that include efforts to integrate land use and transport planning strategies and measures, which involve overcoming deep-rooted institutional and policy barriers.

The need for better integration of transport and land use planning is a long-standing issue in the literature. Land use and transport planning has a key role to play in delivering social, economic, and environmental sustainability. Land use planning has an impact on shaping the pattern of development and influencing the location, scale, density, design, and mix of land uses, and helps

to facilitate an efficient transport and land use system by reducing the negative impacts on land use and transport integration.

Over the past few decades, the issue of how we "integrate land use and transport planning" has been increasingly seen as an important issue. Integrated land use and transport planning was originally arguable to improve urban form outcomes; to reduce the negative social impacts of 'transport systems'. While good integration of land use and transport can be hard to define, we all tend to notice when it is not done well. Land use and transportation systems must be integrated at all planning scales and levels, utilizing a variety of intervention techniques. The review has outlined the key elements of land-use transport integration. Of these, the physical form of city transportation the enabling urban structure is one of the most important components since it directly affects travel patterns. The variables used to assess the degree of land transport integration are networks, activities, mixed land use, settlement size, and density distribution. But when it comes to Addis Ababa context, the land allocation proportion of the city should be guided by mixed residential density. These mixed residences are divided into three zones based on their respective density. High density mixed residence is termed as greater than or equal to 150 housing units per hectare. And the proposed minimum gross densities for medium and low-density mixed residences are 100hu /ha and 50hu/ha respectively. The delivery of integrated approaches continues to be problematic because a number of obstacles to successful integration impede their implementation. Research initiatives worldwide have focused on obstacles to the integration of land use and transportation planning.

According to Transport Agency (2007), the common barriers groups into four main categories: these are: These are: Legal and institutional barriers; Financial barriers; Political and cultural barriers and Practical and technological barriers but according to Cervero et al. (2013), defined eight major barriers to transport and land use integration in developing countries. As discussed earlier, land use planning strategies can be implemented at various dimensions. These geographic scales include street escape, traffic calming, smart growth, transit-oriented development, New Urbanism, access management, and location-efficient development. These strategies are very adaptable and can be used in many different situations.

2.13. Exciting Examples of Integrated Land-Use and Transport

2.13.1. Introduction

This section presents a variety of good practices for coordinated planning. The cases selected from around the world to demonstrate the various aspects of land use transport integration as mentioned in the previous section. The selection of the case studies is based on the literature review. The table below presents the case study cities based on the aspects of land use transport integration that was mentioned earlier. Of course, no two cities are exactly the same, but some are more alike than others. Because of their similarity in terms of population size, density and road network, Singapore and Curitiba have been chosen as the most exciting model cities for Addis Ababa.

Table 2.5 Comparison of Addis Ababa and Singapore

Major transport system parameters	Singapore	Addis Ababa	Similarity
Population (Million)	5.4	3.86	71.5%
Size of City	716 km²	527 km²	73.60%
Density	7542pp/ km²	7324 pp/ km²	97%
Road coverage (%)	12	13.5	88.89%

Source: Different Literature and Government Web Pages and Official Reports

Table 2.6 Comparison of Addis Ababa and Curitiba

Selecting Criteria for Best Exciting Example Cities			
Major transport system parameters	Curitiba	Addis Ababa	Similarity
Population (Million)	3.3	3.86	85.5%
Size of city	435 km²	527 km²	82.54%
Density	7586pp/km²	7324 pp/ km²	96.5%
Road coverage	14	13.5	96%

Source: Different Literature and Government Web Pages and Official Reports

2.13.2. Singapore

Singapore, with a population of more than 5·4 million in a land area of 716 km^2 , of which over 40% is greeneries, is ranked third in the world in population density(Seik and Hien, 2016). It has enjoyed robust socio-economic development due to prudent economic policies, land use planning and infrastructure development, including the safeguarding of land for future development. Here in Singapore public transport is recognized as the backbone of the transport system due to the land, and an integrated approach has been adopted for land-use and transportation. Planning in Singapore is done at a long-term level with a Concept Plan and at a medium-term level for 10-15years with a Master Plan. The Concept Plan 2011 is under review and the Master Plan 2008 is the current Master Plan. Both these plans are drafted with the vision of 'meeting immediate economic and social needs while maintaining a good quality living environment'(Authority, 2012).

Singaporeans and the city-state have long taken pride in their urban planning. Its geographic range is restricted because it is an island. Its ability to reclaim land inside its borders is limited; if it were to go outside, it would invade its neighbors' territory. In order to create compact development in its cityscape, it has therefore been designed for spot zoning and transit-oriented development, which collaborate with a multimodal transportation network that is strategically aligned and integrated.

2.13.2.1. Land-Use Transport Integration

Urban Structure

Singapore has been planned in a ring formation around the central catchment area. The urban center of Singapore is densely built, and the urban structure of Singapore has a series of radial and circumferential lines of the Mass Rapid Transit System and Light Rapid Transit feeder networks with major and minor sub-centre nodes at the intersection of the MRT lines. The railed-based transport includes mass rapid transit and light rail transit (LRT). The two modes complement to each other in the manner that MRT is the skeleton component that provides high capacity, mobility and travel time reliability for heavy transport corridors, LRT serves as feeders to the MRT network, and the bus system serves less heavy corridors to supplement both of them(Toan and Dong, 2020).This public transport network is essential to the spatial planning of

the city, and expansion of the public transport network is done in tandem with the future growth of the city, guided by the Concept Plan(Swamy *et al*., 2013).

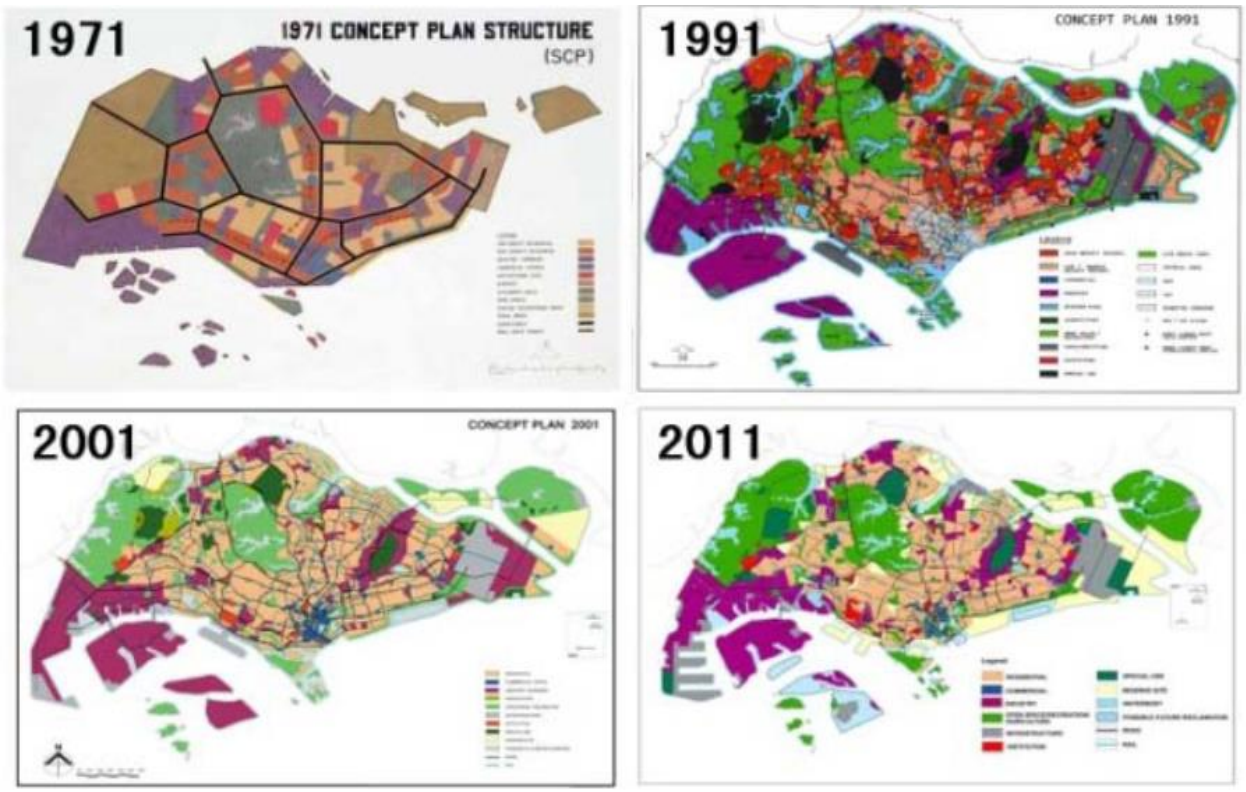

Figure 2.3 Singapore Concept Plan

Source: Meng *et al.*, 2021

Singapore integrates transportation and land use through integrated planning strategies, enhancing efficiency and fairness through strict traffic control policies and medium and long-term concept plans(Meng *et al.*, 2021).The Concept and Master Plans continue to be the foundation stones upon which Singapore's future is built. They are also the vehicles to translate plans into reality. The Draft Master Plan 2019 is the culmination of an extensive review of island wide plans carried out in consultation with residents, stakeholders and agencies. It focuses on planning for inclusive and green neighborhoods, rejuvenating familiar places, as well as building capacity and resilience for sustainable growth(Authority, 2019).

Strategic Alignment

With Singapore's growing population, travel demand is predicted to continue to rise. Road infrastructure in Singapore presently occupies about 12% of the available land, and competing demands for land development have limited the amount of additional land that can be used for road networks. Furthermore, the Land Transport Authority of Singapore acknowledges that expanding road area will not be a sustainable solution to issues like traffic. Strategic alignment of road and rail infrastructure routes will serve the maximum population. As Singapore's economy has developed in the last few decades, many global firms have set up their offices in the Central Business District, to serve which a dense rail network has been envisaged. The Concept Plan 2001 emphasizes public transit for job and workplace connectivity, with housing developments often located within 500m walking distance of LRT and MRT networks, highlighting a co-dependence between construction and expansion(Swamy *et al*., 2013).

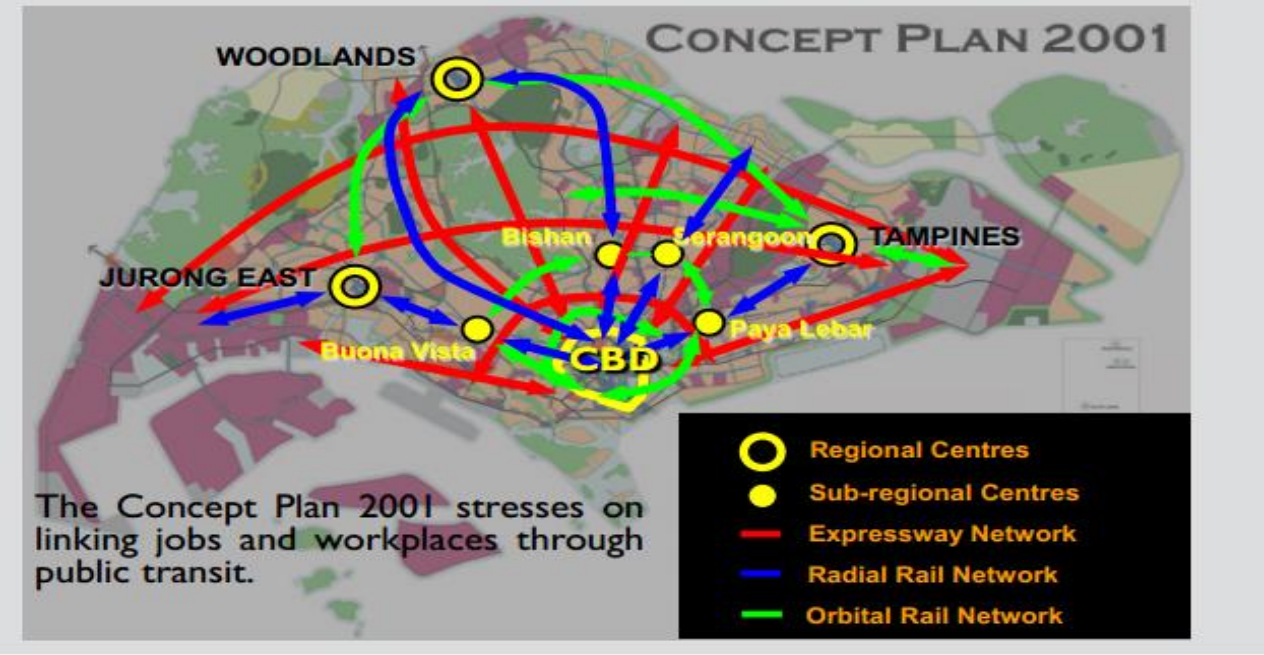

Figure 2.4 Strategic Alignments and Completing the Network

Source: Swamy *et al.*, 2013

The Rapid Transit System network will be increased to 278 km by 2020 and to 360 km by 2030 in order to enhance its spatial coverage and improve connectivity. Average journey times by public transport are estimated to be reduced to 1.5 times those by car from 1.7 times in 2008. The RTS operates on heavy-demand corridors for long trip lengths, while the trunk buses complement the RTS routes to ensure accessibility to the maximum population and avoid

duplication of routes. Also, greater priority is given to buses in order to reduce journey times and improve the reliability of buses in Singapore, and average bus speeds have improved due to measures like signal priority for buses at junctions, easy exit from bus bays, and full-day bus lanes in the city. Segregated bus lanes with a dedicated right of way have been planned in some corridors of the city. Overall, the LTA has planned a hub and spoke network of bus routes in order to optimize efficiency with a commuter-centric approach to planning in order to reduce journey times and improve transfers(Swamy *et al*., 2013).

Institutional Framework and Co-ordination

Singapore's integration of land use and transport is facilitated by government policies, planning, and management instruments, with a well-defined governance structure. Close interactions between government agencies, particularly the Land Transport Authority, Urban Redevelopment Authority, and Housing and Development Board, help solve integrated issues and facilitate operational interactions(Toan and Dong, 2020). The Singapore Urban Redevelopment Authority prepares the Concept Plans which is similar to master plan. This plan preparation also involves other agencies which work concurrently to prepare the sectorial plans. This process ensures an integrated planning process despite of the fact that different agencies are involved in the preparation of the detailed sectorial plans keeping in the overall concept plan objectives in mind(Swamy *et al*., 2013).

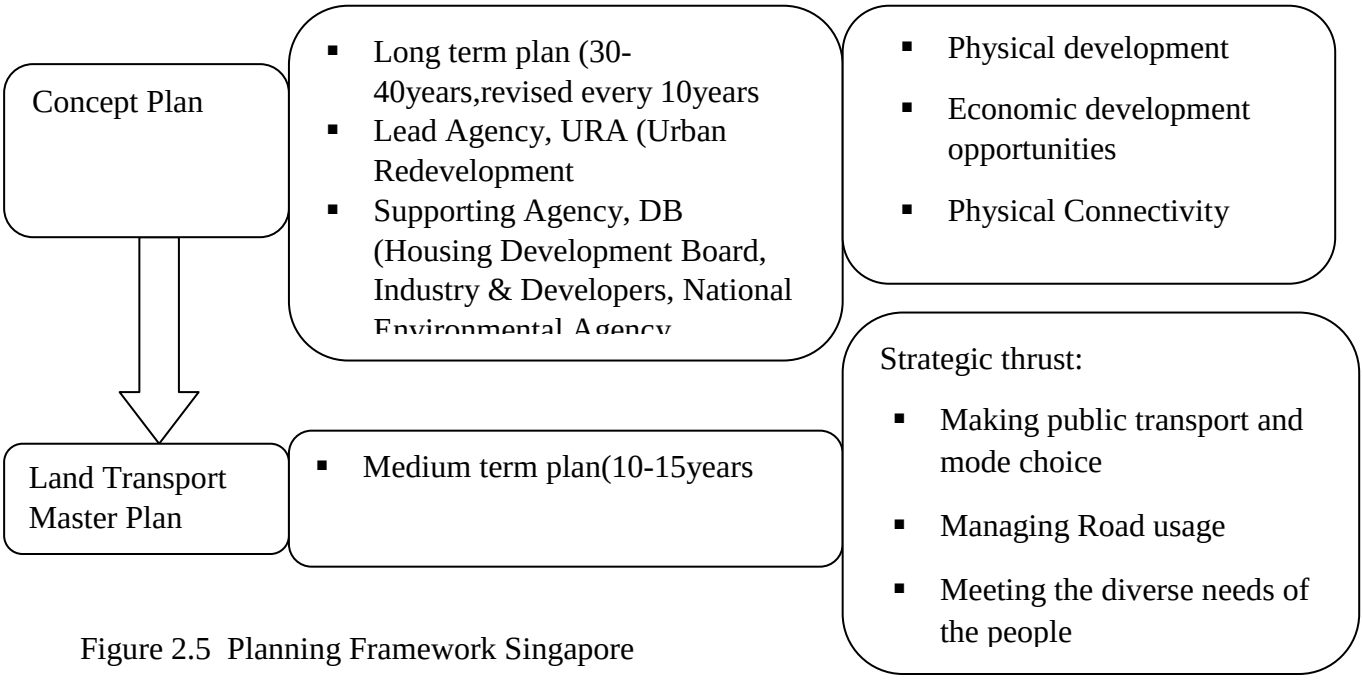

Figure 2.5 Planning Framework Singapore

Source: Swamy *et al.*, 2013

2.13.2.2. Key Lessons Learned From the Case Study in Singapore

According to Swamy *et al.* (2013), the following lessons can be drawn from experiences of Singapore city:

- Planning in Singapore is done at a long-term level with a Concept Plan and at a medium term level. Both plans are drafted with the vision of 'meeting immediate economic and social needs while maintaining a good quality living environment'.
- The urban structure of City has a series of radial and circumferential lines of the Mass Rapid Transit System and Light Rapid Transit feeder networks with major and minor sub-center nodes at the intersection of the MRT lines.
- Public transport is recognized as the backbone of the transport system due to the land, and an integrated approach has been adopted for land-use and transportation.
- The LTA assures Land use transport integration by preparing the transportation infrastructure plans at the same time when the land use plan is made.
- The Land Transport Authority of the City recognizes that increasing road space will not tackle problems like congestion sustainably.
- The LTA expand the MRT network substantially, amplify and improve bus services, while managing private transport demand through policies to manage the growth of the vehicle population and usage of roads through Electronic Road Pricing.
- Most housing developments have come up within 500 m walking distance from LRT and MRT networks,
- The Singapore Urban Redevelopment Authority, working in close consultation with the Land Transport Authority (LTA), for the sake of reducing travel distance, leading to 'a reduction of the workers' needs to commute, easing traffic congestion, and providing businesses with a nearby pool of workers.
- The LTA ensures Land use transport integration by preparing the transportation infrastructure plans at the same time when the land use plan is made.

2.13.3. Curitiba

Curitiba is the capital city of the State of Parana in southern Brazil. The city is located about 250 kilometers southwest of Sao Paulo, near the coastal mountain range(Rosanna and Chapin, 2004). The city of Curitiba, currently home to approximately 2 million people and at the center of a metropolitan region with 3.5 million people, has offered unique responses that bring together clear urban planning guidelines, international financial resources, increasing demographic demands, formulation of new urban paradigms, technological changes, and social contestations (Prestes *et al*., 2022). Its explosive growth over the past half century has required the city to demonstrate tremendous resourcefulness in tackling the accompanying problems of sprawl, congestion, environmental impacts, and social inequality(Gustafsson and Kelly, 2012). Curitiba, a city in Brazil, gained global recognition in the mid-1960s for prioritizing public transport over private in urban planning. This was evident in its laws governing land use and management techniques, which set the city apart from most others in Brazil during the 1970s and subsequent decades(Prestes *et al*., 2022).

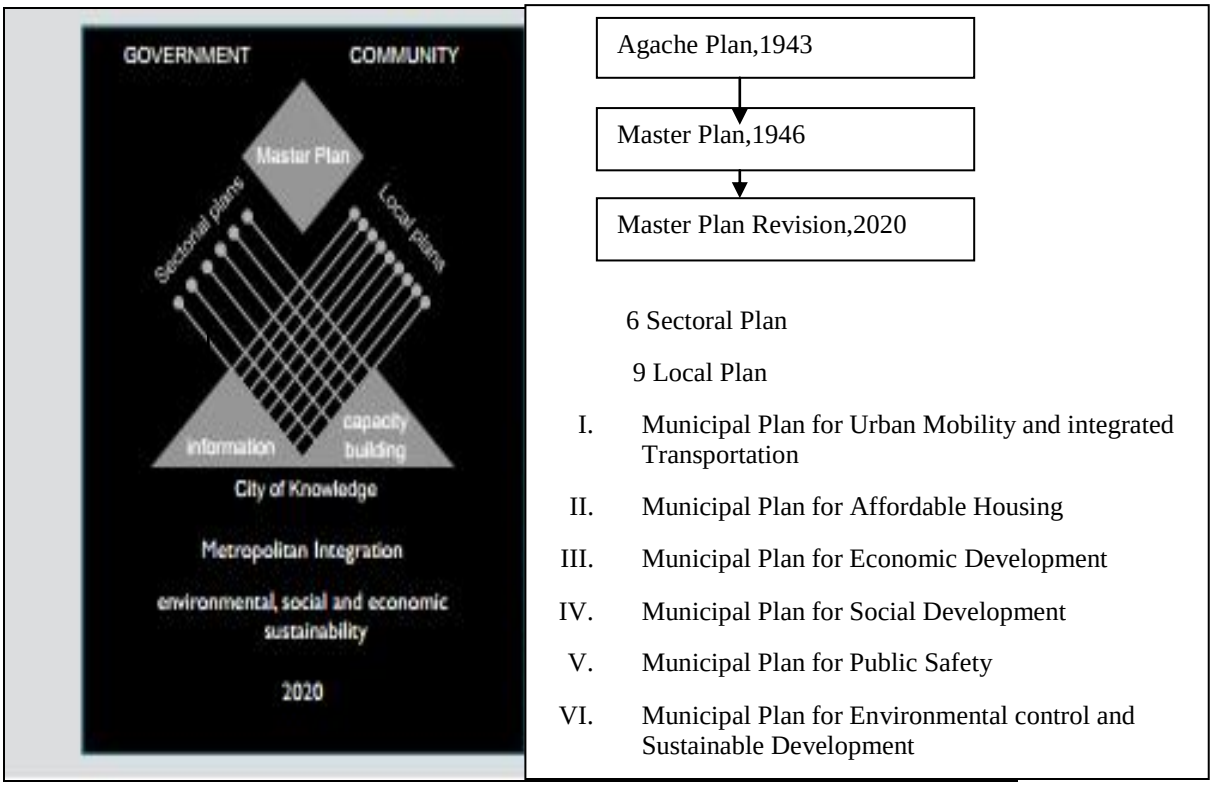

Figure 2.6 Planning Process in Curitiba

Source: Swamy et al., 2013

The planning and implementation of accessible public transport, land-use and road network concurrently, using instruments like Transit Oriented Development and Transfer of Development Rights have ensured elective integration of land use and transportation in Curitba (Swamy *et al*., 2013).

2.13.3.1. Land-Use Transport Integration

Network and Streets

In addition to public transport and land use, the street network system of Curitba is 'the third leg of the planning tripod'. The Agache Plan defined a street network with a radial layout for the city. In the Master Plan of 1965, the street network was then defined on the northeast-southeast axes, with linear expansion plans for the city. But the city showed spontaneous radial and concentric growth, resulting in a rise in transportation problems with increased circulation. A hierarchical and complete road network has been planned for the metropolitan region of Curitiba.

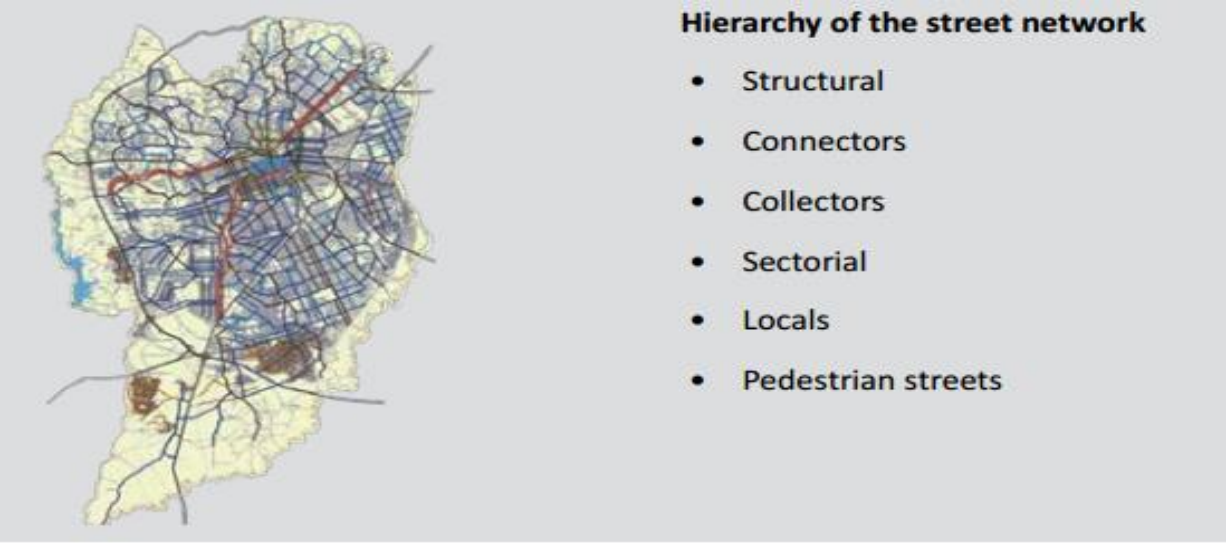

Figure 2.7 Complete Street Networks

Source: Swamy *et al*., 2013

Hence the city's street network has been planned to tackle congestion while keeping in mind people's aspirations of owning cars. The neighborhoods have been connected independent of the downtown area. A Central Slow Traffic Belt has been created to protect the pedestrians' interests. City's main streets within the Central Belt have been restricted to motorized vehicles. Moreover, existing streets or structural avenues have been connected by priority avenues, providing new alternatives for flow of traffic, without the need to pass through the downtown.

Old streets have been retained as access roads and collector roads accommodate local neighborhood traffic. An approximately 120 km Biking Path Network has been implemented in the '90's along railroads, riversides, and selected streets. Finally, a typical block of street network has three roadways, thus called a 'Trinary System'. The median bus ways and tube stations are on the central avenue which is dedicated to the BRT and the local traffic that accesses the buildings and parking. The parallel streets are used solely by high-speed traffic including direct buses, with each meant for traffic in one direction(Swamy *et al*., 2013).

The city revolves around five primary corridors of development that form an axis around the downtown area. Strategic zoning concentrates dense commercial development and high-rise buildings along each side of the corridors. As one moves further away from a central corridor, development loses height and density. Development corridors in cities guide urban growth by transitioning from commercial to urban apartment buildings and then to smaller residential homes. These corridors are part of a "trinary system" of three roads, including the BRT system. The central corridor features a bus way for exclusive use by buses, with traffic lanes on either side for access to businesses and services(Gustafsson and Kelly, 2012).

2.13.3.2. Key Lessons Learned From the Case Study in Curitiba

According to Gustafsson and Kelly (2012) and Swamy *et al*. (2013), the following lessons can be drawn from experiences of the city:

- Since the 1970s, Curitiba has been undergoing rapid urbanization, thanks to meticulous urban planning and the integration of its land-use and transportation systems.
- Curitiba's Bus Rapid Transit is a result of integrating spatial and transport planning to address urban growth pressures, resulting in an efficient transportation system that is a preferred mode of travel for most people(Vaglione *et al.*, 2013).
- City has a long history of planning since the 17th Century.
- In the 1970s, it was the first city to use the Bus Rapid Transit (BRT) concept with dedicated bus ways and feeder systems.
- Effective integration of land use and transportation in Curitiba is ensured by the city's use of transit-oriented development and transfer of development rights.
- The city's spontaneous radial and concentric growth caused transportation issues due to increased circulation.

- The neighborhoods have been connected independent of the downtown area. A Central Slow Traffic Belt has been created to protect the pedestrians' interests. Motorized vehicles have been prohibited on the main streets in the Central Belt of the city.
- Urban planning has been utilized by the city to guide public and private investments for the socio-economic development of the city.
- TOD is both a catalyst for development around transit nodes and a conservation tool by creating limited very high development axes.
- Building residential, business, and recreational areas in high-density areas near public transit nodes is a key aspect of transit-oriented development in cities.
- To enhance the quality of life for workers, industrial areas should be developed with residential zones surrounding them instead of mixing them.
- It is important to construct high-traffic areas such as shopping complexes, commercial centers, and high-rise residential areas in accessible distances from public transit stations.
- In Curitiba, the Transfer of Development Rights (TDR) mechanism is utilized to preserve natural and built heritage and support Transit-Oriented Development.
- TDR is a tool that can be used to enforce high density linear development along transit corridors.
- Most of the residential and commercial is mixed use development.

2.13.4. Summary

The analysis of world examples provides a better understanding of the necessity of transport and urban development integration in cities. The best examples are Curitiba, Brazil, and Singapore, which have benefited from strong regional visions and high-capacity transport investments that produced the desired urban form. Hence, it is clear that integration and coordination between transport and urban development should start at the regional level, and planning should be done at a long-term level with a concept plan and in the medium term. Furthermore, transport is an important tool for shaping urban development and making urban visions a reality

Chapter Three: Research Methodology

3.1. Study Area

Addis Ababa, the capital of Ethiopia, was founded in 1886 by Menelik II and Empress Taitu Betul. The city is the seat of several international organizations such as the African Union and the United Nations Economic Commission for Africa. Addis Ababa is a religiously and ethnically diverse city, home to over 21 different nationalities. As such, it exhibits cultural and religious diversity and has played a prominent role historically, politically, and diplomatically in the continent. The number of populations of Addis Ababa is increasing from year to year. Its population has nearly doubled every decade. It is currently thought to be 4 million. The number of projected population size of Addis Ababa was 2.79millions in 2008, 3.05 million in 2012, 3.43 million in 2017, 3.86 million in 2022, 4.28 million in 2027 , 4.70 million in 2032, and 5.13 million in 2037(Agency, 2013).

Addis Ababa is one of the fastest growing cities in Africa and a primate city in Ethiopia with an estimated population of around four million, which is roughly 25% of the total urban population of the country and more than ten times the population size of Adama(Erena D. et.al, 2017). With an estimated population of 4 million inhabitants, Addis Ababa is the single largest urban center in the country and it has shown an annual rate of population growth of 2.1%(Agency, 2013). Addis Ababa, the political capital and the most important commercial and cultural center of Ethiopia, Addis Ababa is sub-divided in to 11 sub-cities which in turn are divided to more than 100 kebeles where power is devolved to this smallest tier of administration. Like most of the other urban centers in Ethiopia, Addis Ababa's early development was spontaneous and without formal planning. The first master plan for Addis Ababa used a dual city approach, causing displacement of around 100,000 native people. Despite pro-modernization efforts, traditional administration and land distribution hindered the implementation. After independence, British and French consultants prepared master plans, but the city continued to expand along major transportation routes and around existing and new nodes(Erena D. et.al, 2017). But now a day, considering the vision of making Addis Ababa "Africa's diplomatic capital", the plan adapts the following five guiding principles:

- Compact and green development with good balance between open and green spaces and the built form;
- Mixity among income groups, housing typologies and land uses;
- Balanced growth through appropriate distribution of housing, economic activities and infrastructure;
- Efficient use of land in the city centre, along mass transit lines (along LRT, BRT and future Metro lines) and renewal of slum neighbourhoods; and
- Environmental sustainability through protection of the natural ecosystem(AACPPO, 2017).

This thesis was conducted in Yeka Sub-City in Addis Ababa, the second-largest and third-densely populated sub-city in the city, covering an area of 97.7 sq. km in the northern part of the city. According to the Agency (2013a), of Ethiopia, for the year 2017, the population of the Yeka Sub-city was 201,156 males and 233,443 females, which aggregated to 434,599 people living in the sub-city. The population density of the sub-city then was 4448 per sq. km. The sub-city is divided into 11 administrative woredas. The study area is specifically located at the Lamberet roundabout (northern bus station)—Wosen—Mesalemiya—Kotebe metropolitan University—02 Kotebe corridor. This study area also covers about 211.63 hectares. The reason or rationale behind choosing this part of the city, and particularly the corridor under reference, is that it has the potential to represent the identified problem at hand. Moreover, it has a large number of residential building developments and also squatter settlements surrounding the study area that have dramatically increased the number of households living in that area.

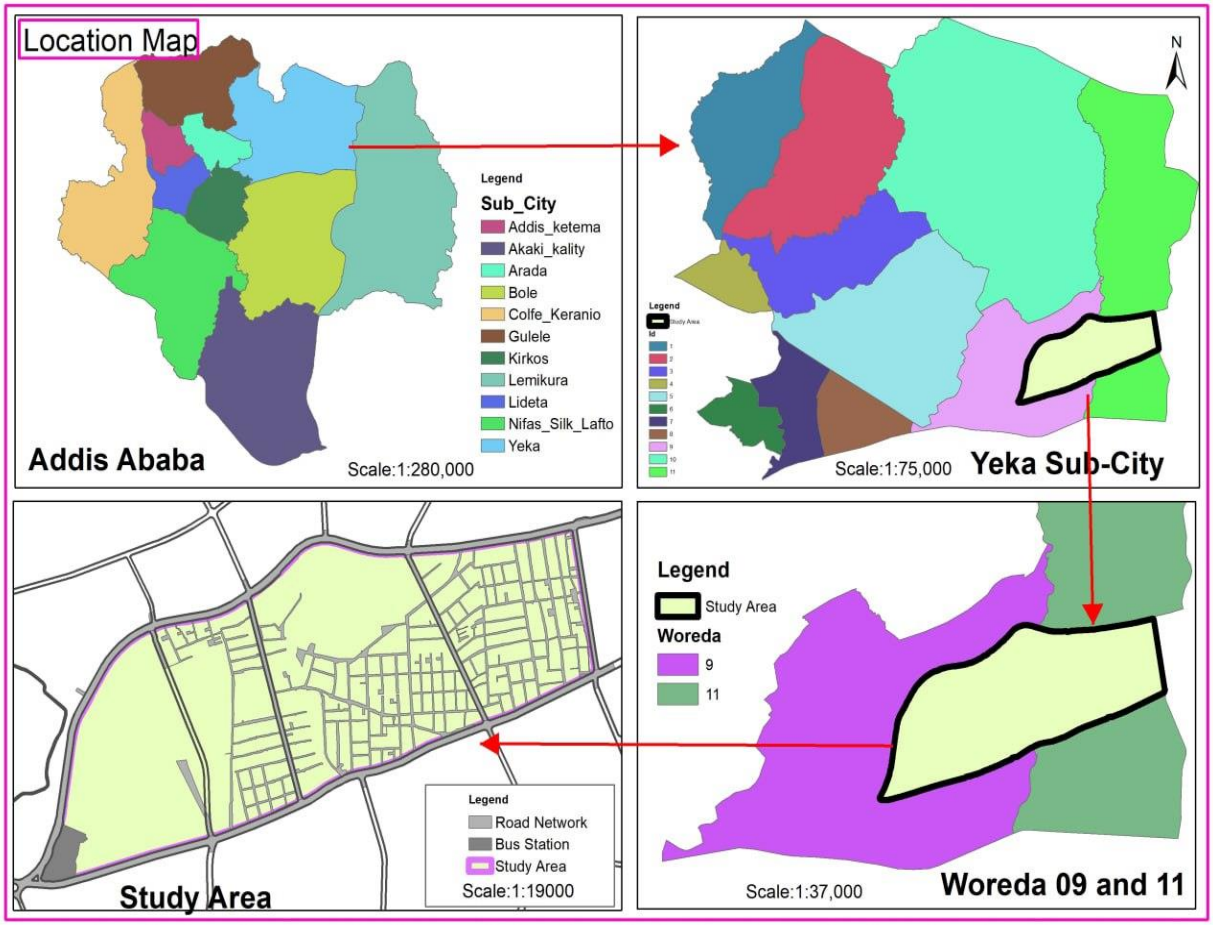

Figure 3.1 Location Map of the Study Area

Source: Own Development Using GIS Analysis, 2022

3.2. Demographic Characteristics of Study Area

Population size and density significantly influence transport and land use planning, directly influencing travel patterns and influencing city transportation systems. Studying these factors helps researchers understand how and why people travel, as population size is directly related to density, which affects per-household vehicle ownership or use.

3.3. Research Design and Approach

To achieve the general and specific objectives of the research that are set and defined in Chapter 1 of the paper, a descriptive research design was employed. This description research was used for observing and reporting the reality of the situation, as well as describing and analyzing the

key elements of transport and land use planning strategies. Deciding on which type of research to follow, depends on the purpose of the study and the type and availability of the information which is required(Naoum, 2007).

3.3.1. Research Approach

In this study both qualitative and quantitative methods were employed aiming at analyzing the current situation, to evaluate the key elements of integration and assess the barriers and opportunities for integrating land use. Primarily, a questionnaire survey will be conducted which will followed by an in-depth case analysis. The research comprises three phases. The pre-field work phase relied largely on literature and enabled to formulate the research problem and define the aim and objective of the study. The second phase involved field work where the required data was collected together with information pertinent to the research. The last phase involved data analysis where the impact assessment of land use planning on transport demand was analyzed and impacts were evaluated. The study examined Addis Ababa's transport and land use planning strategies using a case study approach, emphasizing the importance of systematic understanding through direct observation of trends and desk studies of organizational records. Finally, this was followed by thorough discussions in order to draw conclusions and to forward recommendations based on the findings of the study

3.4. Data Types

For this thesis work, both quantitative and qualitative data were used in order to provide an outstanding analysis.

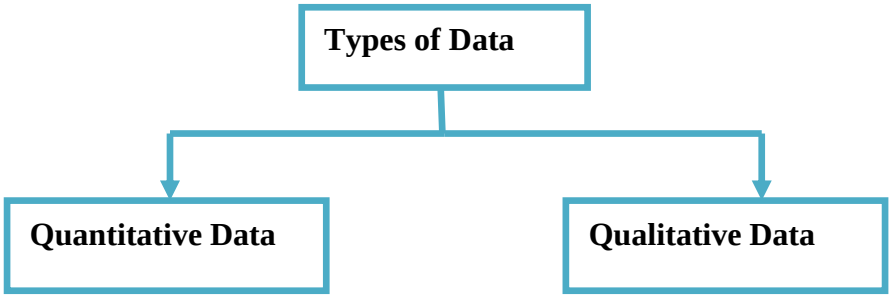

Figure 3.2 Types of Data

3.5. Source of Data and Research Instrument

3.5.1. Primary Data Sources

The source of the primary data was in the form of actual field observations to about the impact of land use on transport, the impact of neighborhood design and a questionnaire, designed to gather a large volume of data from professionals to answer the major barriers of integration and mechanism to enhance integration. This questionnaire survey was conducted to rank the problems in their order of significance and to seek any additional variables beyond those found out from the literature review. The answers to the structured part of the questionnaire are based on Likert'sscale of five ordinal measures of agreement towards each statement (from 1 to 5). The reasons for adopting this simple scale are:

- To provide simplicity for the respondent to answer, and
- To make the evaluation of collecting data easier

The respondents in this survey were professionals in land use planning and transportation planning. Certain case studies were also investigated to demonstrate the impact of land use planning on transport demand by undergoing site observation.

3.5.2. Secondary Data Sources

Secondary data, which involves information from published text such as research, Academic journals, government official reports, past dissertations and internet resources, document review; A review of the policy and organizational framework of the city was undertaken to identify how transport and land use planning organized in Addis Ababa.

Table 3.1 Secondary Data Collected from Authorities

No.	Data Type	Source	Format
1	Existing and Proposed Road Network Map	Addis Ababa Road Authority	Auto CAD and ArcGIS file
2	Socio- economic and Demographic Data	CSA	Excel
3	Land Use Map (existing and proposed)	Addis Ababa Plan Development Commission	Auto CAD and ArcGIS file

4	Addis Ababa City Master Plan Preparation, Issuance and Implementation Proclamation No. 17/2004	Addis Ababa Plan Development Commission	Pdf
5	A.A.C.A. Structural Plan Approval and implementation Regulation No. 16/2004	Addis Ababa Plan Development Commission	Pdf
6	A.A.C.A. Regulation to Prevent Illegal expansion of Land Possession and Construction on Illegal Possession Regulation No	Addis Ababa Plan Development Commission	Pdf
7	Summary report on Addis Ababa master plan	Addis Ababa Plan Development Commission	Pdf
8	Traffic Condition Data	Addis Ababa Traffic Management Agency	Excel
9	Annual Plan of the Two sectors (transport and land use planning)	Addis Ababa Transport Bureau and Addis Ababa Plan Development Commission	Pdf

3.6. Research Population and Sampling Design

The study focuses on Yeka Sub-city where large area coverage and large number of residential developments are witnessed. To conduct this study, non-probability sampling techniques were used. Purposive sampling from non-probability sampling was implemented in the study in order to gather qualitative responses, which led to better insights and more precise research results by identifying the people who were involved in land use planning, transport planning. Owing to the heterogeneous nature of the population, a stratified sampling technique was used to sub-group the population as follows: Land use planners, transport planners, road engineers, public transport operators etc.; and the general public or commuters. As much as possible attempts were made so that the samples drawn from the population are represented. These Participants of the research were selected randomly using small population size sampling method. According to

(C.R.Kothari, 2004), the appropriate formula derived in the determination of sample size based on small population is as follows:

$$n = \frac{Z^2pqN}{e2(N-1)+Z^2pq} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{[Eq]}$$

Where: - n= Sample size required

N= Number of populations

Z= Level of confidence considers 65% and the reading result taken from the Z chart is 0.39.

Pq= Degree of variability both taken 50%

e = Sampling error which shows precision taken 7%.

Table 3.2 Study Population Data

No	Sector Name	No of Staffs	
1	Addis Ababa Plan and Development Commission	176	
2	Addis Ababa Transport Bureau	260	
3	Addis Ababa City Roads Authority	203	
4	Addis Ababa Traffic Management Agency	189	

Therefore, the total staff number of each sector is presented on the above given table; the sample for this study is determined using the formula given below for each sector.

$$n = \frac{Z^2pqN}{e2(N-1)+Z^2pq} \ldots = 62$$

In this thesis study questionnaire were distributed to a total of 62 staff members of the above sectors.

3.7. Data Collection Method

The research followed a procedural approach, including questionnaire distribution, site observation, self-judgment, secondary data collection, and document review, to gather relevant data from both primary and secondary sources.

Primary data

- Questionnaires
- Personal Observation
- Taking Photo and Sketching Land Use types

Secondary Data

The Addis Ababa Transport Bureau and Plan and Development Commission provided data on land use, socio-economic conditions, transport network, and transport study report. Existing traffic conditions were obtained from the Addis Ababa traffic management agency. Secondary documents, such as research, city plan report, and academic journals, were also gathered using various techniques. Such as:

- Web Sites
- Archives

3.7.1. Quantitative Data Collection Method

- Searching and collecting existing documents of Addis Ababa Transport system component.
- Collecting the existing traffic condition of the City.
- Socio- economic and demographic data.
- Collecting quantitative data about transport infrastructures in Addis Ababa such as road and related road infrastructure.

3.7.2. Qualitative Data Collection Method

- Direct field observation of in the study area and taking pictures that shows traffic condition and other transport infrastructures
- Review some policies and regulations related to land use and transport planning issues
- Analyzing the existing land use map and its output and implications

3.8. Method of Data Analysis

Finally, the results of the questionnaires and case studies were analyzed using statistical techniques, and the results were used to form a basis for conclusions and recommendations.

Table 3.3 Research Question Versus Data Analysis Method

No.	Main Question	Secondary Questions	Variables	Measurement	Data Analysis method
1.	What are the key elements of integration?	1.1. What is the impact of land use on transport?	Urban form/enabling urban structure ▪ Distribution of population density ▪ Land-use mix	▪ The number of residents per hectare ▪ land-use mixing(Entropy Index)	Excel and GIS
		1.2. What is the impact of Neighborhood design and layout?	Existing Street Network ▪ Road density of the study area ▪ Pedestrian friendliness and cycling ▪ Strategic Alignment	▪ Internal connectivity ▪ road hierarchy and coverage of the city ▪ Ratio of road segments with pathways to overall network	Excel and GIS
		1.3. What is the impact of transport on land use?	▪ Parking ▪ Greenhouse gases from transport ▪ Accessibility ▪ Traffic noise ▪ Pollution ▪ Traffic congestion ▪ Traffic accidents	▪ Probability of finding a parking space in the city ▪ Air quality ▪ Average walking distance to specific land use in the city ▪ Average level of service (LOS) ▪ Number of traffic accidents	Excel and GIS
2.	How do we develop integrated transport & land use planning strategies that will lead to sustainable development ?	2.1. How is transport and land use planning organized in Addis Ababa	▪ land use planning and transport policy of the city ▪ Institutional Framework for LUTP in Addis Ababa city	▪ Focused area emphasis in the policies	Review
		2.2. What are the major barriers of integration	▪ Barriers for integration	▪ Degree of impacts	Excel
		2.3. What are the enabling mechanisms/solutions / for the achievement of sound transport system through efficient integration of transport and land use planning strategies.	▪ Alternatives of mechanisms/solutions	▪ Opportunities for integration	Excel

Besides, correlation analysis (Spearman's rank correlation coefficient) was used to identify the significant relationship between the respondents in this research.it does not depend on the subject matter only to show the perception relation among the respondents. The Spearman (rho) rank correlation coefficient for any two groups of ranking gave by the following formula.

$$\text{Rho (rcal)} = 1 - \frac{6 \times (\Sigma di^2)}{N(N^2 - 1)} \text{ ----------[Eq.]}$$

Where:

Rho (rcal) – Spearman rank correlation coefficient

di – Difference between ranks given by two respondents for each variable

N – Number of pairs of values in the data set(Weir, 2012).

In this section, respondents" responses was tested by correlation using Spearman rank correlation coefficients to see if there was a difference in ranking between two groups of respondents: transport bureau versus plan and development commission; transport bureau versus traffic management office; and plan and development commission versus traffic management office, on the different variables of integration barriers and their rate of occurrence. The purpose of a hypothesis test was to avoid being deceived by chance occurrences.

3.9. Method of Data Presentation

The data was analyzed using different software depending on the kind of information that was obtained, and it was then presented using different data presentation techniques. Tables, descriptive statistics and GIS output statics, line graphs, narrative explanations and maps were used to display results with respect to each of the questions of general information and integrating transport and land use planning strategies for sustainable development.

Table 3.4 Research Question versus Data Presentation Method

No.	Main Question	Secondary Questions	Method of data presentation
1.	What are the key elements of integration?	1.1. What is the impact of land use on transport?	Table, map, , line graph
		1.2. What is the impact of Neighborhood design and layout?	Table, map, photos
		1.3. What is the impact of transport on land use?	Table, map ,

2.	How do we develop integrated transport & land use planning strategies that will lead to sustainable development?	2.1. how is transport and land use planning organized in Addis Ababa	Table, narrative form
		2.2. what are the major barriers of integration	In tabular form; in graphical form,
		2.3. What are the enabling mechanisms/solutions / for the achievement of sound transport system through efficient integration of transport and land use planning strategies.	In tabular form, narrative form

3.10. Validation and Reliability

Validity of this quantitative and qualitative research is controlled by the use of triangulations design techniques. This is done by employing different data collection methods like, site observations, questionnaire and document review, and by varying other methods research factors like the location of observation and the respondents in different sectors that involved in transport and land use planning. As much as possible efforts have also been made to use the appropriate sampling technique and adequate sample size.

Reliability: The reliability of the data was also enhanced by collecting data from a number of different sectors and sources and tried to keep consistency of a measurement when using GIS software.

Triangulation

The study utilized multiple data sources to establish a chain of evidence, demonstrating the link between research procedures and concepts, thereby constructing validity. This explorative research also enabled triangulation, which can be done by data source, method, or data types (Miles and Huberman, 1994). Triangulation is widely used as multiple data gathering technique to investigate the same phenomenon.

Triangulation Design

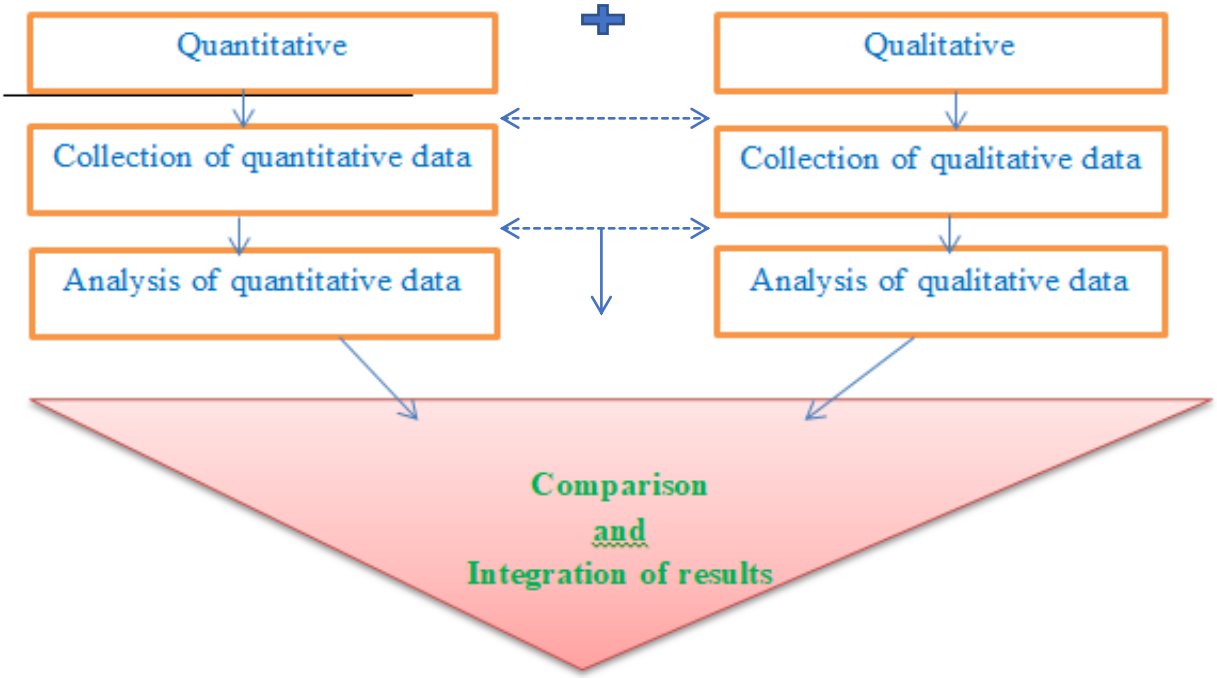

Figure 3.3 Triangulation Design

Chapter Four: Results and Discussion

4.1 Response Rate

For the survey, responses were received from the following sectors, for an overall response rate described in the table shown below.

Table 4.1 Response Rate of the Respondents

No	Respondents	Distributed Questionnaire		Returned Questionnaire		Unfinished Questionnaire		Analyzed Questionnaire	
		No.	%	No.	%	No.	%	No.	%
1	Transport Bureau	15	24.19	12	21.82	2	50	10	19.61
2	Plan and Development Commission	16	25.81	16	29.09	1	25	15	29.41
3	Traffic Management Agency	17	27.42	17	30.91	0	0	17	33.33
4	AACRA	14	22.58	10	18.18	1	25	9	17.65
		62	**100**	**55**	**100**	**4**	**100**	**51**	**100**

Note: -No=number and **%**=Percentage

4.2. Educational Level of Respondents

The respondent's educational level is shown in figure …below. From the figure 28(54.90%) of respondents have MSc and 23(45.10%) have BSc. Generally, 100 % of them have BSc and MSc. This indicates great confidence in their answers.

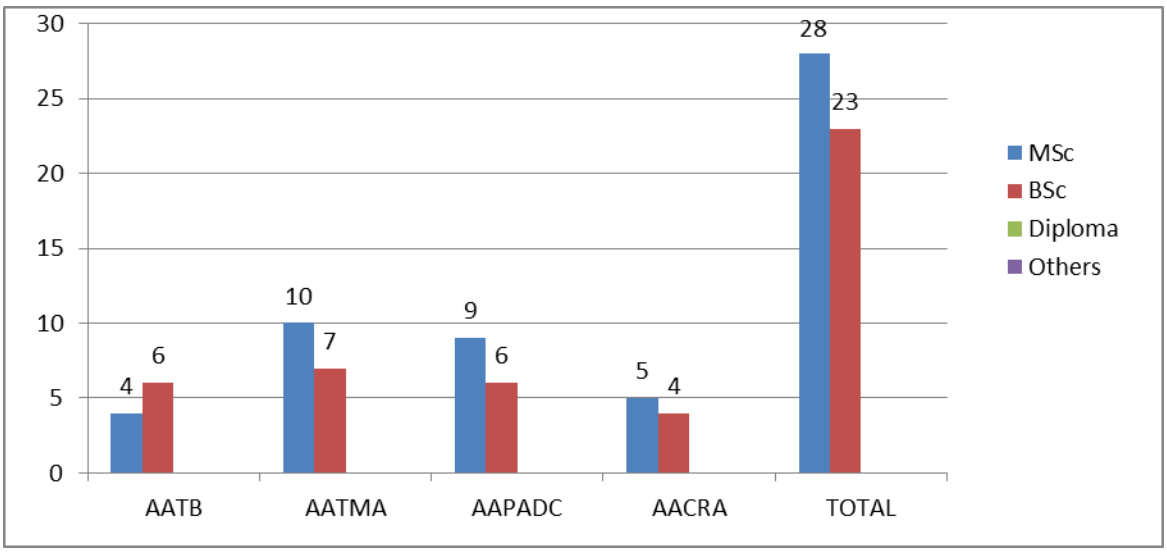

Figure 4.1 Educational Levels of Respondents

4.3. Years of Experience in Transport and Land-Use Planning Areas

Out of the 51 respondents, the data depicted below shows that 78.43% of the respondents had more than 5 years of working experience in transport and land use planning. This implies that the respondents have quite reasonable working experience to give unquestionable answers in the research area.

Table 4.2 Respondents Work Experience

Work Experience								
	Range							
Sector	< 1 year	1-3years	3-5years	5-10years	10-15years	15-20years	>20years	total
AATB			3	5		2		10
AATMA		3	4	5	3	2		17
AAPADC				7	3	3	2	15
AACRA			1	4	3	1		9
TOTAL	0	3	8	21	9	8	2	51

This section explores the integration of transport and land use planning strategies in Yeka Sub-City, focusing on key elements and assessing planning mechanisms for sustainable development. It reviews policy documents, practices, and non-statutory planning activities in Addis Ababa, aiming to identify barriers to integration and overcome them to achieve sustainable development. However, it draws on a range of documents and practices, identifying what policy and governance instruments are being used to integrate land use and transport planning and how well they work in practice.

4.4. The Key Elements of Land-Use and Transport Integration

The data analysis part looks at the practical land use development of a specific area and its impact on transport and vice versa, which is not limited to the formal development process of the study area, and compares it with its standards.

4.4.1. The Impact of Land-Use on Transport

4.4.1.1. Urban Form /Enabling Urban Structure

There are many elements that constitute the physical form of the city; the ones given below are critical to land use and transport integration. In this thesis report, an attempt was made to make an analysis of land use impacts on the transport system of the city.

4.4.1.1a. Distribution of Population Density

Density distribution of the sub-city and study area was analyzed below
Table 4.3 Density of the Sub- City and Study Area

sub city	Population estimate, 2022	Area (sq. Km)	Area in hec.	Population Density (peoples/sq. Km)	Density in hec.
Study area	15977	2.12	211.63	7536	76
Yeka sub-city	490003	97.7	9770.60	5015	50

Source: Own computation Using GIS Analysis, 2022

From the above statistical data analysis, the density of Yeka Sub-City and study area is 50 persons per hectare and 76 persons per hectare, respectively, so based on the structure plan of the city, it is in a low density categorization. Having this density dissatisfies the concept of compact development.

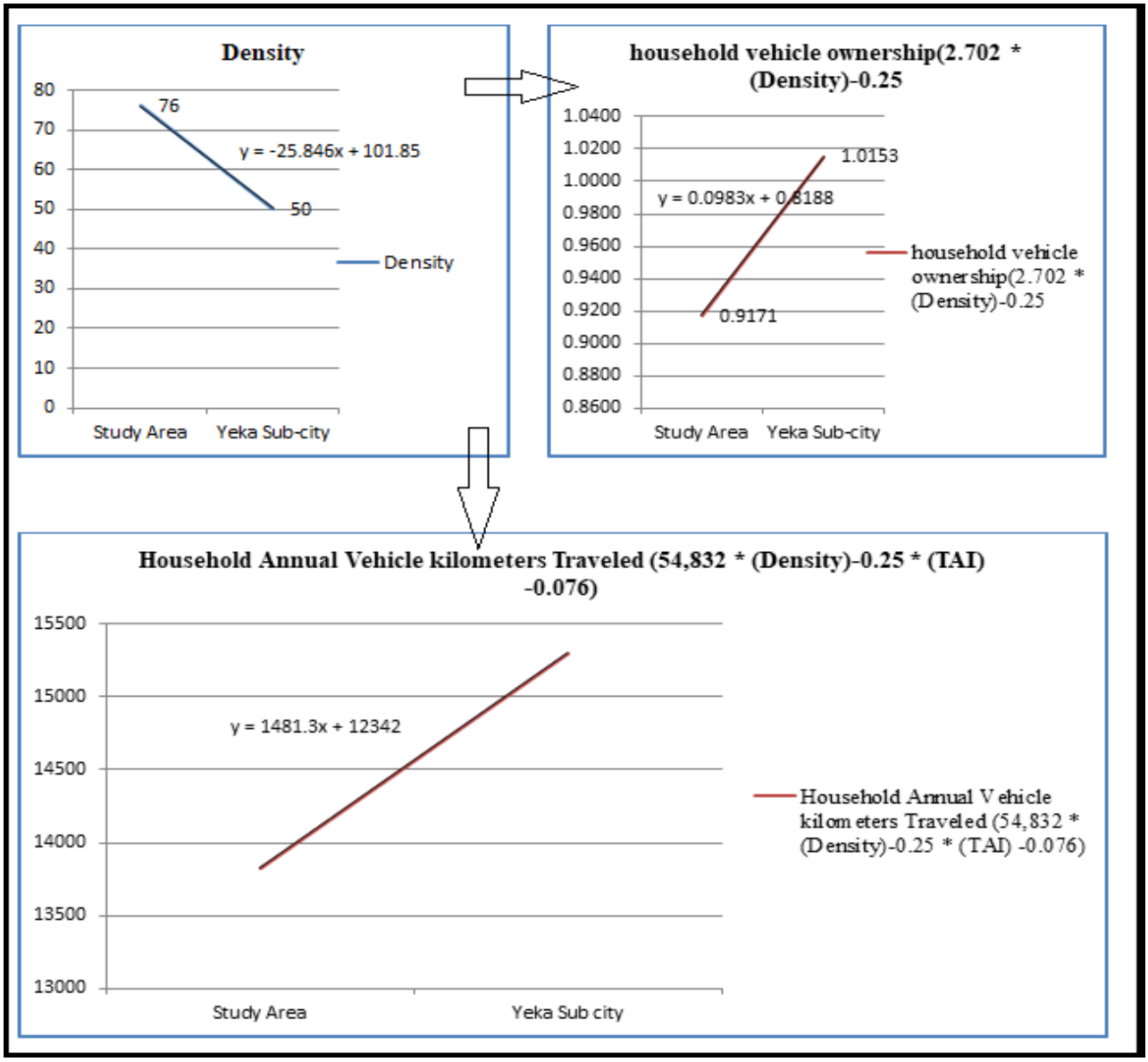

Figure 4.2 Relationship Density, Household Vehicle Ownership and Household Annual Vehicle Kilometers Traveled Line graph of the Study area and Sub -City

The above relationship analysis indicated that the line graph direction of density and household vehicle ownership were opposite in direction. The interpretation of the graph was that as density decreased, both household ownership and household annual vehicle kilometers traveled increased. For example, as density decreases from 76 to 50 persons per hectare, the average household vehicle ownership or use increases by about 10.7%. That is, density distribution is inversely related to household ownership or uses and household annual vehicle kilometers traveled.

Table 4.4 Household Vehicle Ownership and Annual Vehicles Kilometers Traveled at Different TAI

Household vehicle ownership and Annual vehicles traveled in killo meters			
Sub-city	Household Annual Vehicle killo meters Traveled 54832 * (Density)$^{-0.25}$ * (50) $^{-0.076}$)	Household Annual Vehicle killo meters Traveled (54832 * (Density)$^{-0.25}$ * (30) $^{-0.076}$)	Household Annual Vehicle killo meters Traveled (54832 * (Density)$^{-0.25}$ * (12) $^{-0.076}$)
Study Area	13794.60	14340.67	15374.92
Yeka Sub-city	15305.11	15910.98	17058.48

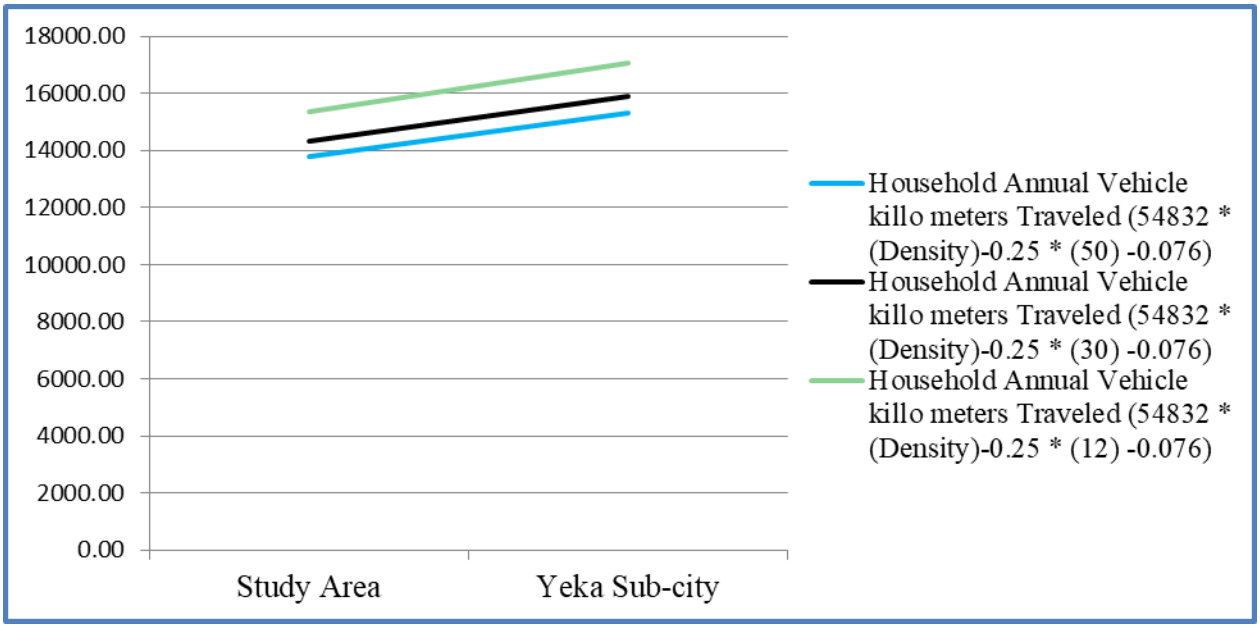

Figure 4.3 Household Annual Vehicle Traveled in Kilo Meters at Different TAI

The above household annual vehicle kilometers traveled analysis using the land use formula indicated that density and transit accessibility affected per-household annual vehicle kilometers traveled. For example, as density decreases from 76 to 50 persons per hectare, household annual vehicle miles traveled increase by about 10.7%. As the transit accessibility index increased, the household's annual vehicle travel decreased. It was found that reductions in residential density tend to increase vehicle travel distances and, as a result, tend to increase air pollution emissions.

Supporting argument to use land use formula, According to Litman and institute (2005), household vehicle ownership and Annual vehicle traveled using land use formula was calculated. But it was important to note that this formula was developed specifically for the United States and the accuracy of the formula may also vary depending on the specific area being studied and other factors that may affect vehicle ownership rates, such as income, age, and access to public transportation. According to litman (2005), described that International studies also indicate that increased urban density significantly reduces per capita vehicle travel. It was commonly used in transportation analysis for many countries, despite variations in development. In this thesis, the formula was used to demonstrate the inverse relationship between density and household vehicle ownership and annual vehicles traveled. While the constant value may be adjusted based on vehicle ownership rates, the implication of the formula remains consistent regardless of location.

4.4.1.1b. Land-Use Mix

In order to make the transport system efficient, it is important to start creating more activity centers and mix-use development. In this thesis analysis, the entropy index was used to analyze the land use mix ratio of the sub-city and the study area. This entropy index method was better suited than other methods like the Shannon-Wiener index (H') method. The entropy index method helps in the analysis of the diversity of land use types within an area. It ranges from 0 to 1, with higher values indicating greater diversity in land use types, and a lower land-use mix means that there is less diversity in land use types within an area.

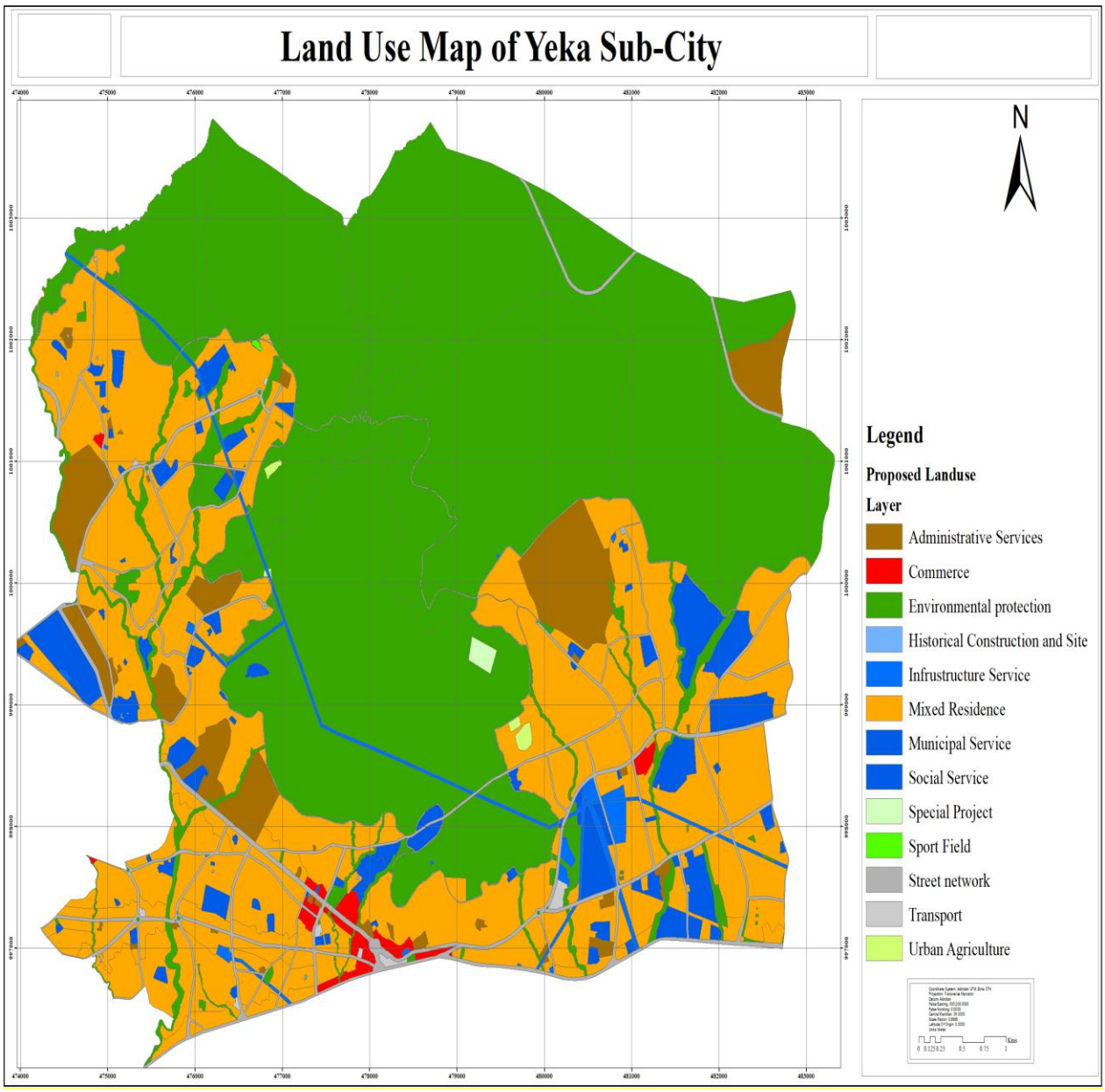

Figure 4.4 Land-Use Map of Yeka Sub-City

Source: Own Computation Using GIS and Addis Ababa Structure Plan, 2017

Table 4.5 Land Use Function Yeka Sub-City

SN	Land-Use Function	Area in Meter square	Area in hec.	Percentage	Land-Use Mix Ratio of Coverage (P j)	ln(P j)	P j ln(P j)
1	Administrative Services	2593286.76	259.33	2.654	0.0265	-3.629	0.096
2	Commerce	316700.89	31.67	0.324	0.0032	-5.732	0.019
3	Environmental protection	37315423.65	3731.54	38.192	0.3819	-0.963	0.368
4	Historical Construction and Site	6223.67	0.62	0.006	0.0001	-9.665	0.001
5	Infrastructure Service	666470.37	66.65	0.682	0.0068	-4.988	0.034
6	Mixed Residence	16752449.68	1675.24	17.146	0.1715	-1.763	0.302
7	Municipal Service	881109.73	88.11	0.902	0.0090	-4.709	0.042
8	Social Service	1794137.72	179.41	1.836	0.0184	-3.997	0.073
9	Special Project	59080.55	5.91	0.060	0.0006	-7.410	0.004
10	Sport Field	5419.4	0.54	0.006	0.0001	-9.803	0.001
11	Street network	37187318.68	3718.73	38.060	0.3806	-0.966	0.368
12	Transport	67850.37	6.79	0.069	0.0007	-7.272	0.005
13	Urban Agriculture	60493.02	6.05	0.062	0.0006	-7.387	0.005
Number of land use types(N)=13			**9770.6**	100.000	1.0000	**SUM**	**1.318**
						ENT	**0.514**

$$ENT = -\frac{\sum_{j=1}^{n} pj ln(pj)}{ln(N)}$$

Source: Own Computation Using GIS Analysis and Entropy Index Formula, 2022

From the above land use function mix ratio analysis, the land use mix ratio of Yeka sub-city is 0.514, which is categorized as a good performance range but still below the standard land use mix ratio (0.991), and the minimal range of good performance indicates that the less diversity of land use functions it impacts, increased traffic congestion, reduced walkability, increased energy consumption, and reduced social interaction, increases infrastructure construction costs and maintenance costs.

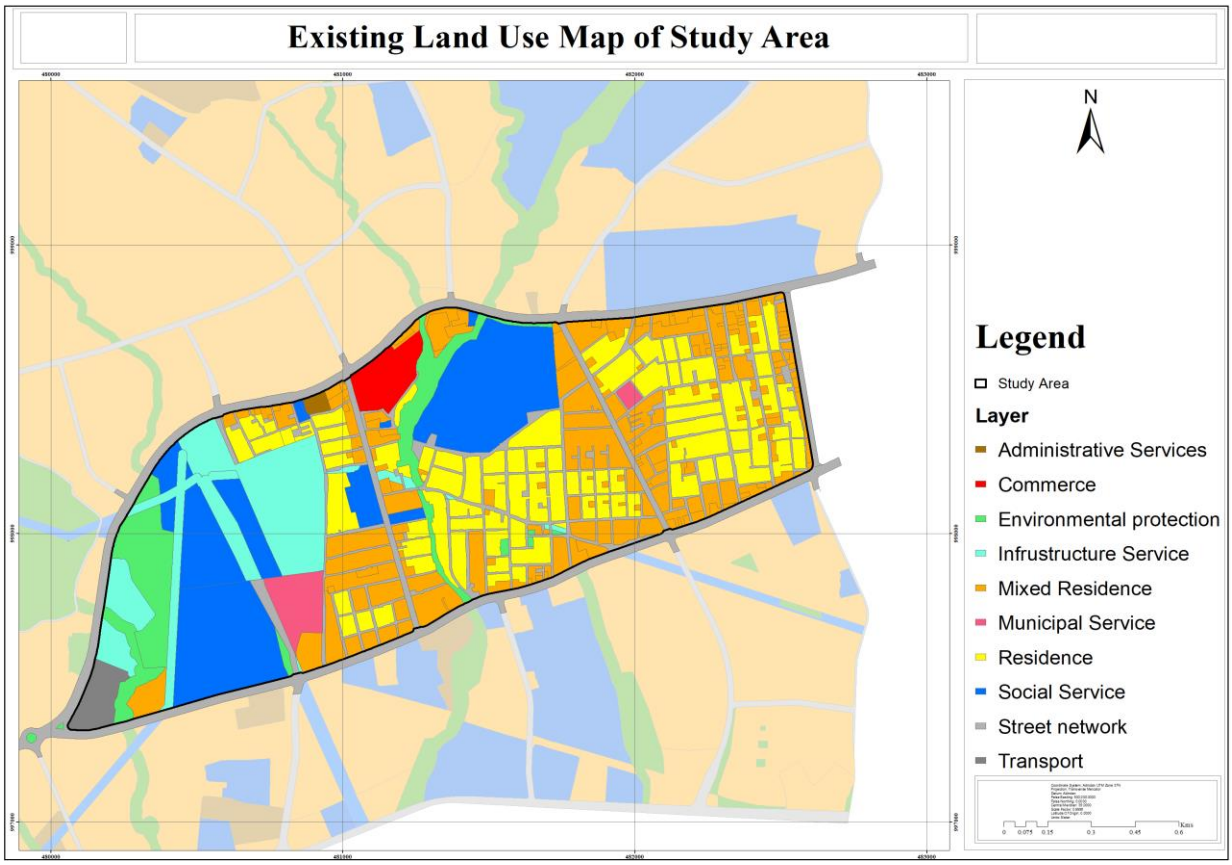

Figure 4.5 Existing Land-Use Map of the Study Area

Source: Own Computation Using GIS and Addis Ababa Structure Plan, 2017

Table 4.6 Land-Use Function of the Study Area

SN	Land-Use Function	Sum-Shape-Area	Area in hec.	Percentage	Land Use Mix Ratio of Coverage	ln(P j)	P j ln(P j)
					(P j)		
1	Administrative Services	5196.06	0.52	0.25	0.0025	-5.991	0.0150
2	Commerce	39648.6	3.96	1.87	0.0187	-3.979	0.0744
3	Environmental protection	147130.74	14.71	6.95	0.0695	-2.666	0.1853
4	Infrastructure Service	239699.18	23.97	11.33	0.1133	-2.178	0.2467
5	Mixed Residence	507252.01	50.73	23.97	0.2397	-1.428	0.3424
6	Municipal Service	4676.37	0.47	0.22	0.0022	-6.119	0.0135

7	Residence	469140.1	46.91	22.17	0.2217	-1.506	0.3340
8	Urban Agriculture	0	0	0			
9	Historical Construction and Site	0	0	0			
10	Social Service	390250.43	39.03	18.44	0.1844	-1.691	0.3118
11	Street network	284731.82	28.47	13.45	0.1345	-2.006	0.2698
12	Transport	28533.31	2.85	1.35	0.0135	-4.305	0.0581
13	Sport Field	0	0	0			
		2116258.62	211.63	100.00		sum	1.8510
Number of land use types(N)=13						ENT	**0.7216**
					$\mathbf{ENT} = -\frac{\sum_{j=1}^{n} pj\ln(pj)}{\ln(N)}$		

Source: Own Computation Using GIS Analysis and Entropy Index Formula, 2022

Where P_j, represents the percentage of each land type use j in the area/ N is the total number of services/land type use present in the area. From the above land use function mix ratio analysis, the land use mix ratio is 0.514 and 0.722 in the sub city and study area respectively which is categorized by good performance range, but still below the standard land use mix ratio (0.991).

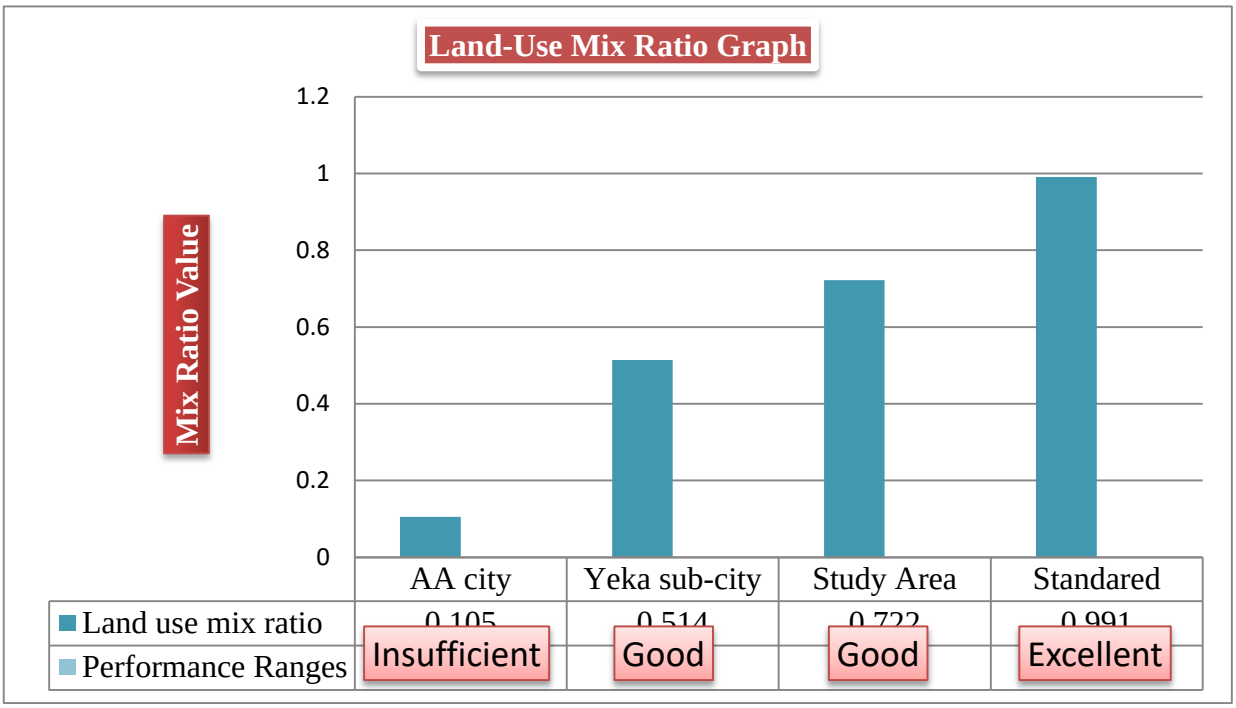

Figure 4.6 Land Use Mix Ratio Graph

From the above land use function mix ratio analysis, the graph showed that the mix ratio difference compared with city, sub city and study area, the land use mix ratio was found that 0.105, 0.514 and 0.722 in the city, sub city and study area respectively which categorized by insufficient, and good performance range, but still below the standard land use mix ratio (0.991).

4.4.2. Neighborhood Design and Layout

4.4.2.1. Existing Street Network

Road network coverage is limited in Addis Ababa, which creates an imbalance between the demand and supply of transportation infrastructure. The absence of adequate transport infrastructure (well-connected roads, parking spaces, loading and unloading areas, sidewalks, bikeways, etc.) and weak traffic management are major factors behind congestion around major business areas. This affects the performance of the road network. Major challenges within the road network include the fact that roads are built without proper forecasting of the real volume of pedestrians and vehicles and designed without adequate consideration of land use. The total length of roads in the city before 1983 was 1,503km, while the share of asphalted roads was

below 20%. Following the establishment of the Addis Ababa City Road Authority (AACRA) in 1998 and large-scale road construction, the total length of roads in the city almost doubled (to 3,731km between 1992 and 2012), and road density reached 12.9%. With the total urban space of about 54,000ha, the gross road density is even less than 10%, and the area covered by roads is about 5199ha. As shown in Figure 4.7, 79% of the roads are local streets. 7% are collector streets, 4% are sub-arterial streets, 9% are principal arterial streets, and 1% is expressways.
According Addis Ababa City Transport Strategy road hierarchy and coverage is presented in the table given below and compared with AASHTO standards

Table 4.7 Road Hierarchy and Coverage of the City

OID	Road Hierarchy	Coverage in Percentage	AASHTO standard coverage	Result analysis
1	Express Way	1	5-10	below standard
2	Principal Arterial Streets and Sub-Arterial Streets	13	15-25	below standard
3	Collector Streets	7	5-10	within standard
4	Local Streets	79	65-80	within standard
		100		

Source: AATB, world resources institute, 2021 and AASHTO, 2004

From the road hierarchy and coverage analysis of the city, it was found that the express way, Principal arterial streets and Sub-Arterial streets network is not provided according to the recommended standard indicated that both transport and land use is not integrated.

4.4.2.2. Road Density of the Study Area

From the existing base map analysis result the area proportion allocated to the existing road accounts 28.47 hectare (13.45%) almost the same as the road coverage of the city**.**

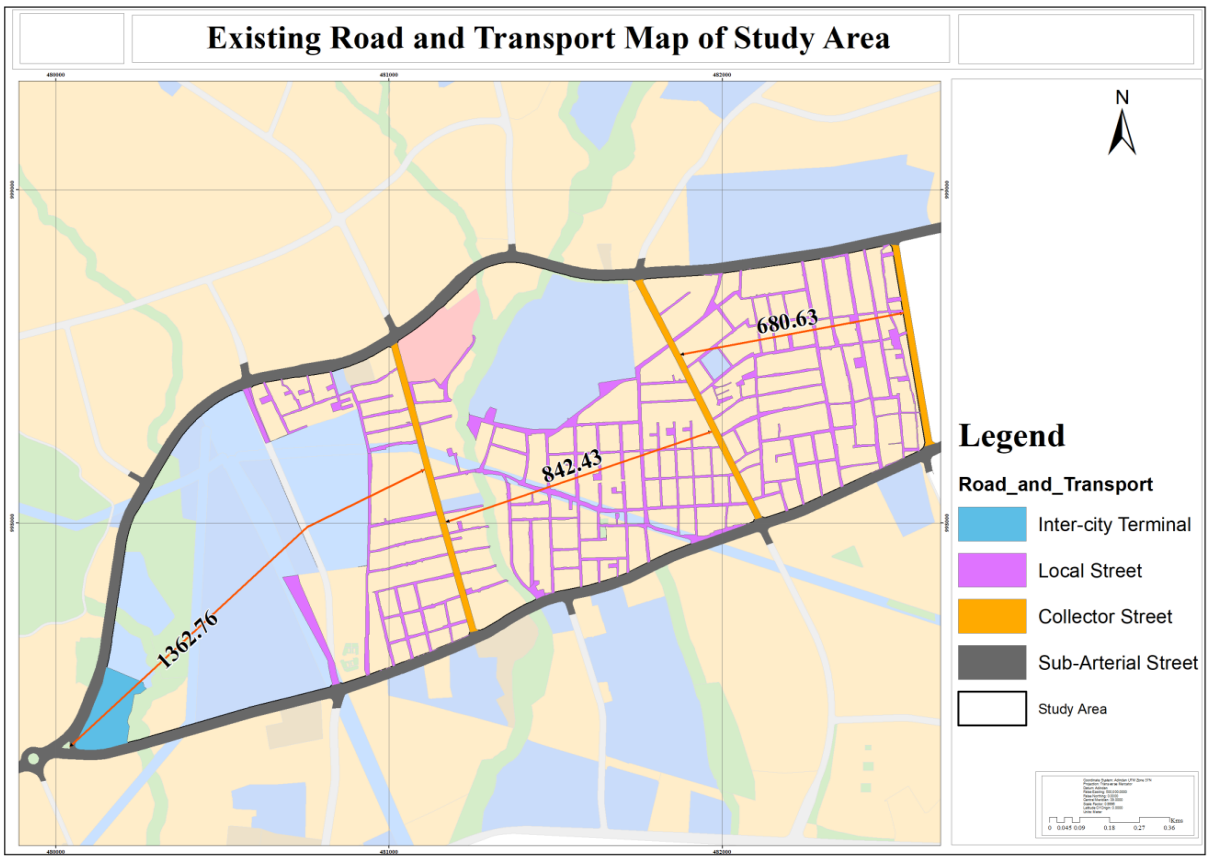

Figure 4.7 Existing Roads Hierarchy Network Map of the Study Area

Source: Own Computation Using GIS and Addis Ababa Structure Plan, 2017

Table 4.8 Road Hierarchy and Coverage of the Study Area

SN	Hierarchy	Area in Squ.meter	Coverage in percentage	AASHTO standard coverage	Result analysis
1	Collector Street	46864.39	9.10	5-10	within standard
2	Local Street	222674.71	43.24	65-80	below standard
3	Sub-Arterial Street and Inter-City Terminal	245436.65	47.66	15-25	above standard
	Total	514975.75	100.00		

Source: Own Development GIS Analysis, 2022 and AASHTO, 2004

From the road hierarchy and coverage analysis of the study area, it was found that the local street network is not provided according to the recommended standard, resulting in a less accessible area. Concerning hierarchical connectivity as shown in the map above, most of them are not

properly networked based on the standards in hierarchical manner. There are several local streets that directly linked and radiate with arterial may be due to poor road design or implementation. In addition to that, due to the undulating topography nature of the area most of the settlements have not access with local streets and their alignments were across the rugged topography. Therefore, it is difficult to vehicular movement's for instance emergency access for Ambulance and service delivery vehicles to enter easily to individual plots & houses

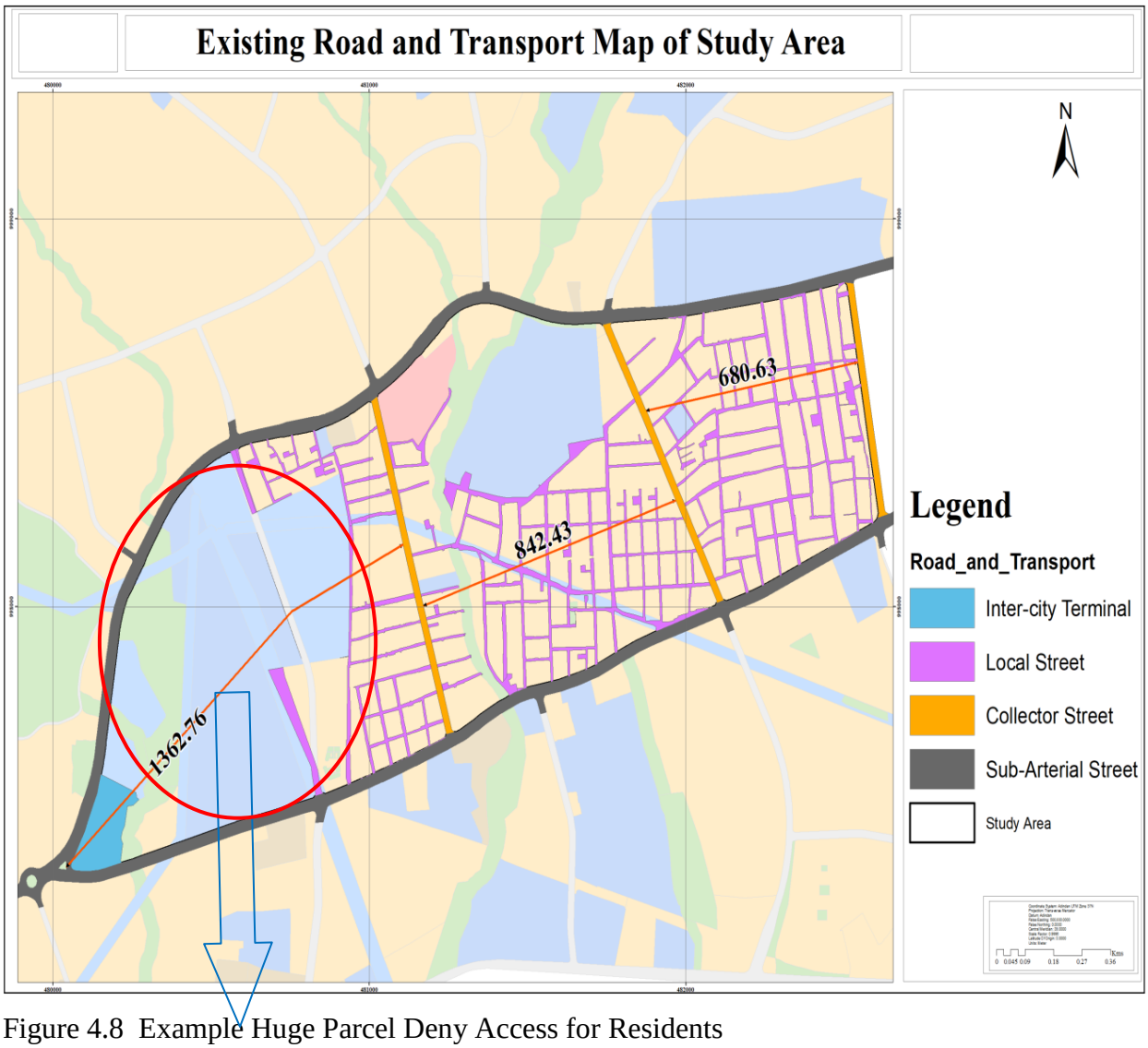

Figure 4.8 Example Huge Parcel Deny Access for Residents

Source: Own Computation Using GIS and Addis Ababa Structure Plan, 2017

Figure 4.9 Example of Cul-de-sac, Poor Junction and Local Streets, Foot Path that directly Linked and Radiate with Arterial

Source: Own Computation Using GIS and Addis Ababa Structure Plan, 2017

4.4.2.3. Standard versus Existing Span of Road Hierarchy

According to Addis Ababa city structure plan manual, the road hierarchy Span Planning standard is given by. PAS – Every 2 km SAS – Every 1 km CS – Every 0.5 km Right of way width: PAS – 60, 50, 40 and 30 m, SAS – 30m and 25m, and CS – 20m and 15m PAS can either take the form of expressway (AACPPO, 2017).

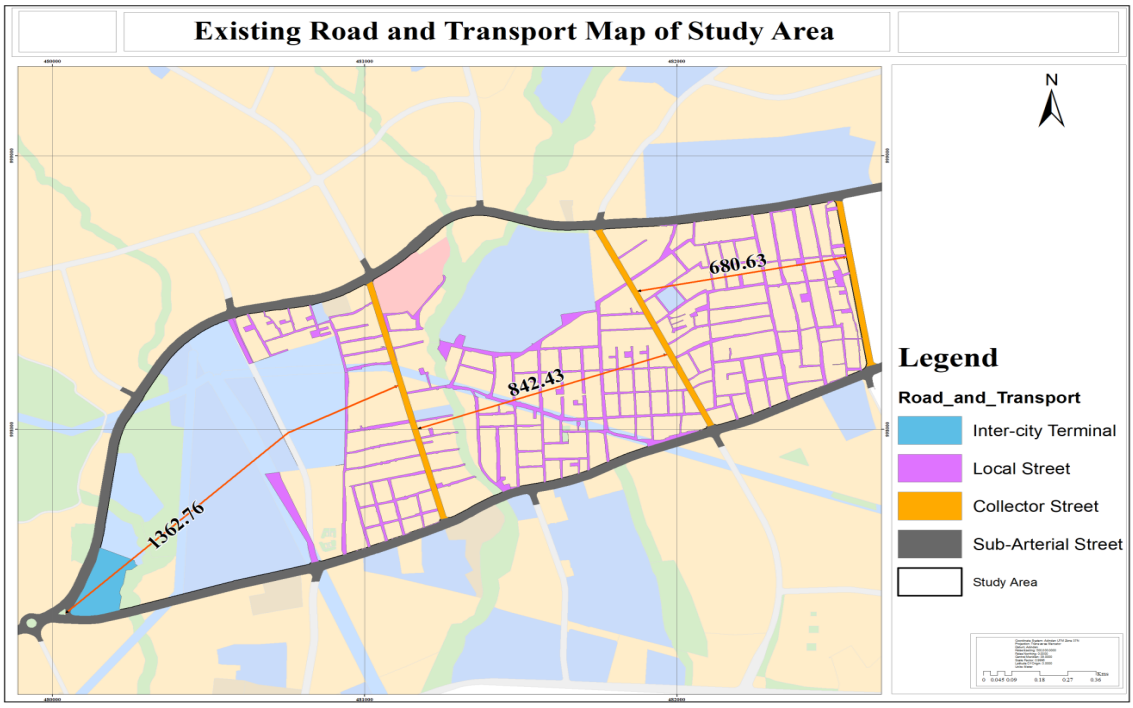

Figure 4.10 Road Hierarchy to Show Span Length

Source: Own Computation Using GIS and Addis Ababa Structure Plan, 2017

According to the existing road hierarchy map of the study area, the three collector roads of the site are found in the range of 1360 meters to 680 meters, which is beyond the span standard mentioned above. This leads to an increase in travel length and travel cost and has impacts on mode choice.

4.4.2.4. Pedestrian Friendliness and Cycling

According to Addis Ababa city transport strategy the mode share of the city is given below

Table 4.9 Transport Modal Share of the City

SN	Mode of Transport	Percentage Share
1	Public Transport	31
2	Walking	54
3	Car	15

From the above data 54 % of Addis Ababa population use walking as their primary mode of transport, which constituted the largest modal share, 31 percent use public transport, and only 15

percent travel by personal motor vehicle. Though cycling is not captured in official statistics, cycling is a mode for short-distance trips, primarily among low-income and risk-taking males. At the same time, the city does not have adequate and safe pedestrian facilities.

By the end of the first phase NMT Implementation Plan, the city planned to develop high-quality footpaths and pedestrian crossings. During the initial implementation period, a total of 210 km of footpaths were identified for upgrading, out of which 75.5 km, or 36 percent, has been implemented. In addition, 124.2 km, or 36 percent, out of a planned length of 350 km of high-quality pedestrian facilities on new streets have been implemented. Out of 9,000 bollards slated for installation, 3,816 have been implemented, or 42.4 percent of the planned quantity. Over 3,843 lights and poles have been fixed. AACRA's rehabilitation of walkways has improved walking environments in various cities. Future projects should avoid constant footpaths at property entrances, provide continuous tactile paths, avoid openings, and incorporate smooth ramps at intersections with level differences.

Table 4.10 Status of Pedestrian Network Implementation Activities

Activity	Implementing Agency	Implementation Plan 2019-2021 target	Status as of 2021	Performance in %
Upgrade existing footpaths to create a continuous pedestrian realm	AACRA	210 km	75.5 km	35.95
Incorporate high quality pedestrian facilities in new streets	AACRA	350 km	124.2 km	35.49
Install bollards to protect footpaths from parking encroachments	TMA	9,000 Bollards	3,816 bollards	42.4

Source: AATB, 2022

Figure 4.11 Example of Open Manhole in the Middle of Walkway and Street Vending
Source: AATB, 2022

From the above plan versus implementation pedestrian's network of the city the performance is under the average. So, it can conclude that the pedestrian network is not adequate to the number of pedestrian users as the plan stands from this number. Not only coverage problem but also the pedestrians are occupied by street vendors and other unplanned utilities lines results in making crowded the existing walk ways.

4.4.3. Transport Impact on Land-Use

4.4.3.1. Parking

Addis Ababa is organized into hierarchically arranged multi-nodal city centers. It is clear that the multiple activities in these centers will attract heavy traffic flow. Due to the value of the land, the provision of on- and off-street parking is problematic. To alleviate existing and impending challenges associated with growing economic activities in these centers, a number of strategic sites for car parking are identified and indicated on the structure plan. Allotting space for car parking does not mean individual buildings do not require parking space.

Figure 4.12 Types of Parking

Source: AACPPO, 2017

Table 4.11 Parking Facilities Given by Different MSE in the City

Sub City	**Types of Parking**		**Total**
	On Street Parking	Off street Parking (compound)	
Akaki Kaliti	-	-	
Nefas Silk-Lafto	47	2	49
Kolfe Keraniyo	9		9
Gullele	12		12
Lideta	45	3	48
Kirkos	47		47
Arada	26		26
Addis Ketema	33	1	34
Yeka	5	2	7
Bole	42	6	48
Lemi-kura	12		12
Total	**278**	**14**	**292**
Percentage	**95.2%**	**4.8%**	

Source: Addis Ababa traffic management agency, 2022

The above table of parking facilities given by the city indicates that both on-street parking and off-street parking are practiced in the city, and its proportional coverage is 95.2% for on-street parking and 4.8% for off-street parking (compound).The coverage of parking facilities provision in Yeka sub-city is 2.4%, it is less provision compared to other sub-cities.

4.4.3.2. Accessibility

The thesis report evaluates on the accessibility or proximity of open market and urban parks on sub city and the study area. Then, the study estimated the population with potential market service and urban parks access at the sub-city and the study area and ArcGIS was used to create analysis based on standard coverage that was specified on city structure map. A high service population ratio means that inhabitants of residential areas could benefit more, and a high service area ratio means greater accessibility of this specific land use category for inhabitants in residential areas. The accessibility was calculated based on the following equations: first the ratio of the service area of open market service within 500-750 m and 300m for urban parks standard distance was determined. As this ratio applied the population of neighborhood market and urban parks services, the 'total impact area population' were calculated which measures the proportion of the urban population that lives within the service area of open market service or urban parks. NA is the number of urban inhabitants who live within the standard distance to the specific land use category. NT is the total number of urban inhabitants within the sub city or study area(Azagew and Worku, 2020).

Table 4.12 Existing Open Market Service Coverage

Market Service	Area of Sub City/Study Area in hec.	Open Market Area in m^2	Open Market Area in hec.	Coverage in %
Yeka Sub-City	9770.60	75618.55	7.56	0.077
Study Area	211.63	39626.44	3.96	1.87

Source: Own Computation Using GIS Analysis, 2022

Table 4.13 Existing Open Market Service Coverage and Per-Capita in the Sub-City and Study Area

Sub city	Area of sub city/Study Area in hec.	Total population	Population Density/ hec	Area of Open Market m^2	Area of Open Market (hec)	Coverage in %	Market Per Capital (m2)
Yeka	9770.60	490003	50	75618.55	7.56	0.077	0.15
Study area	211.63	15977	76	39626.44	3.96	1.87	2.4

Source: Own Computation Using GIS Analysis, 2022

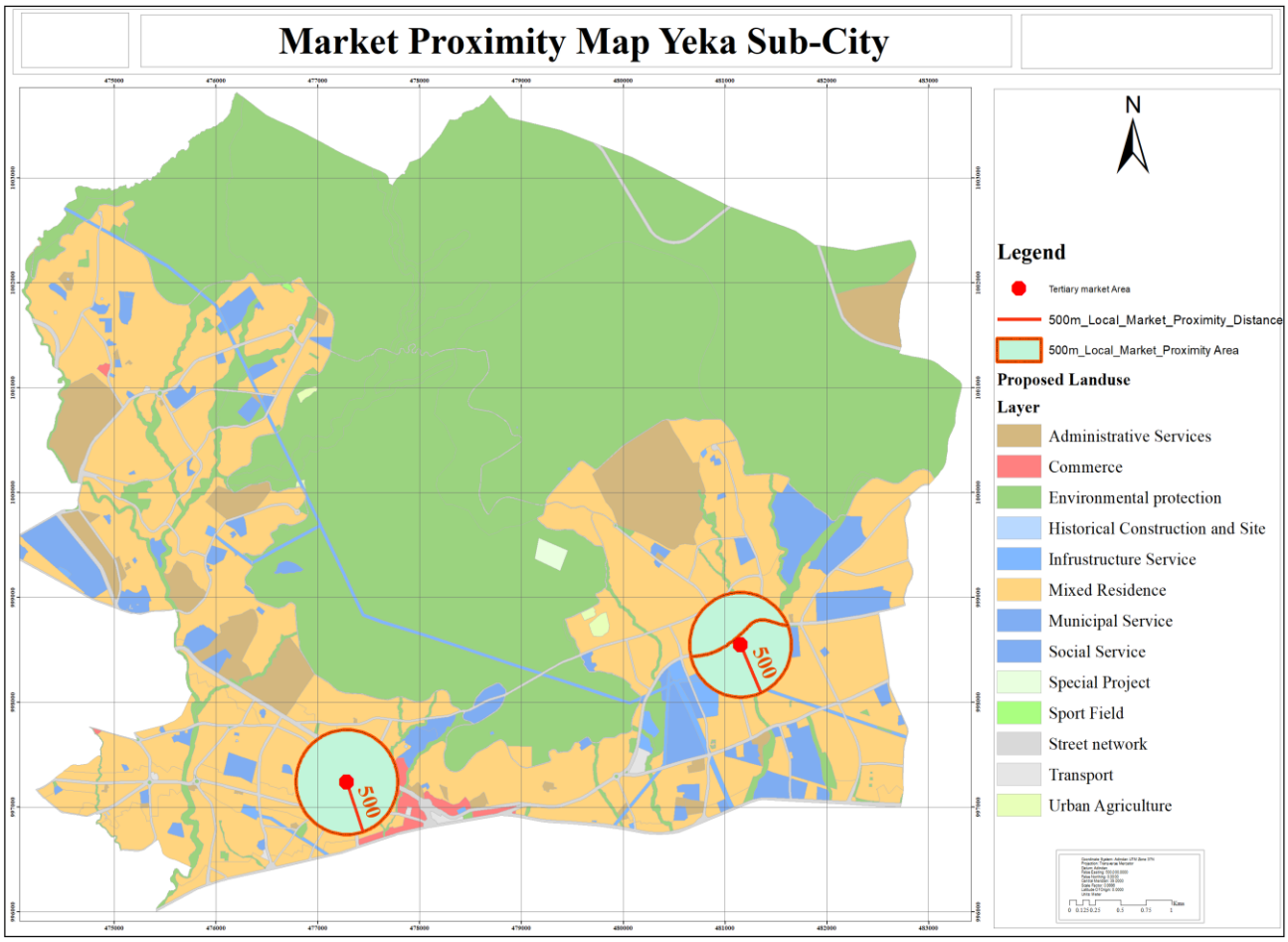

Figure 4.13 Market Proximity Map of Yeka Sub-City (500m)

Source: Own Computation Using GIS and Addis Ababa Structure Plan, 2017

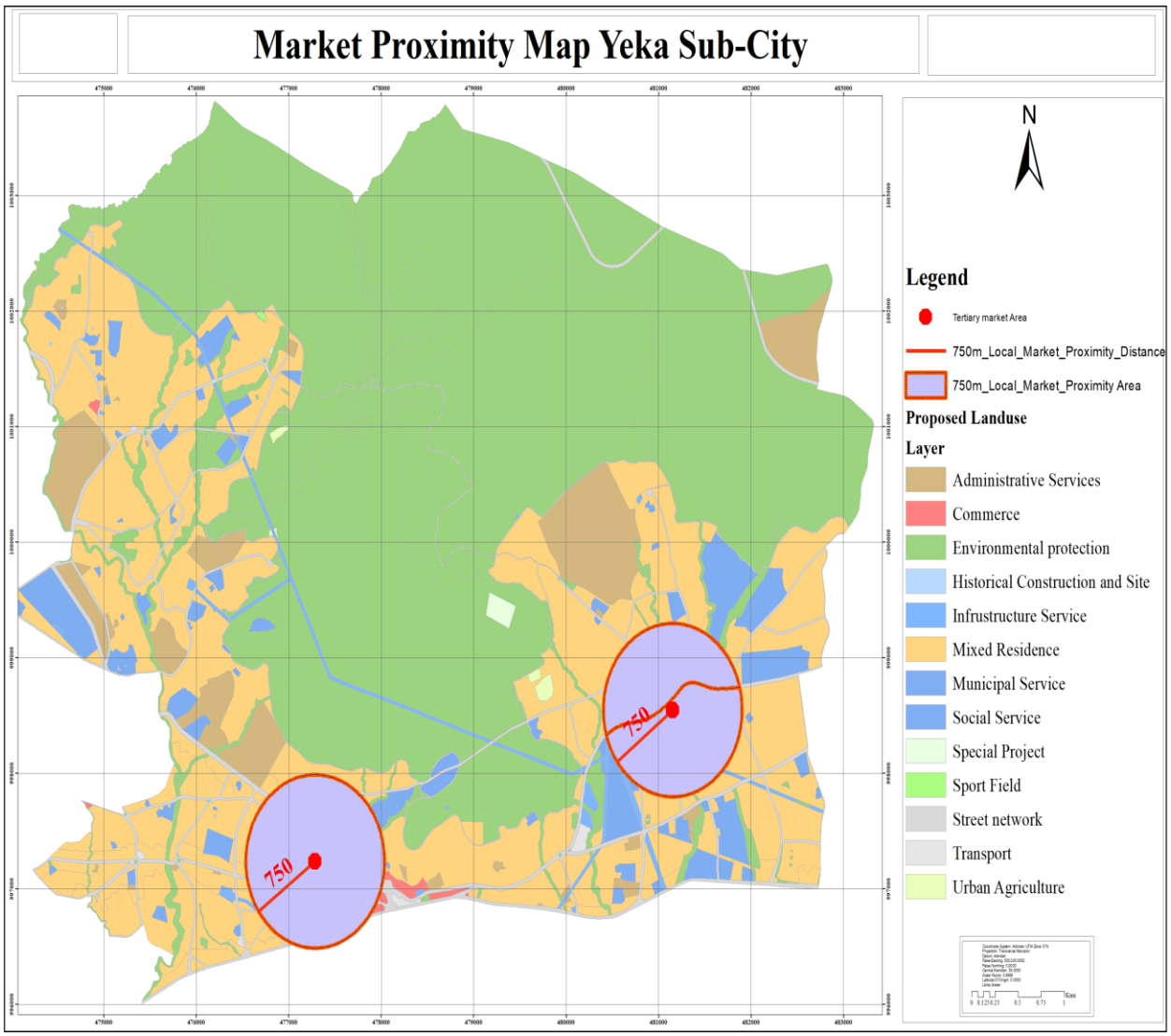

Figure 4.14 Market Proximity Map of Yeka Sub-City (750m)

Source: Own Computation Using GIS and Addis Ababa Structure Plan, 2017

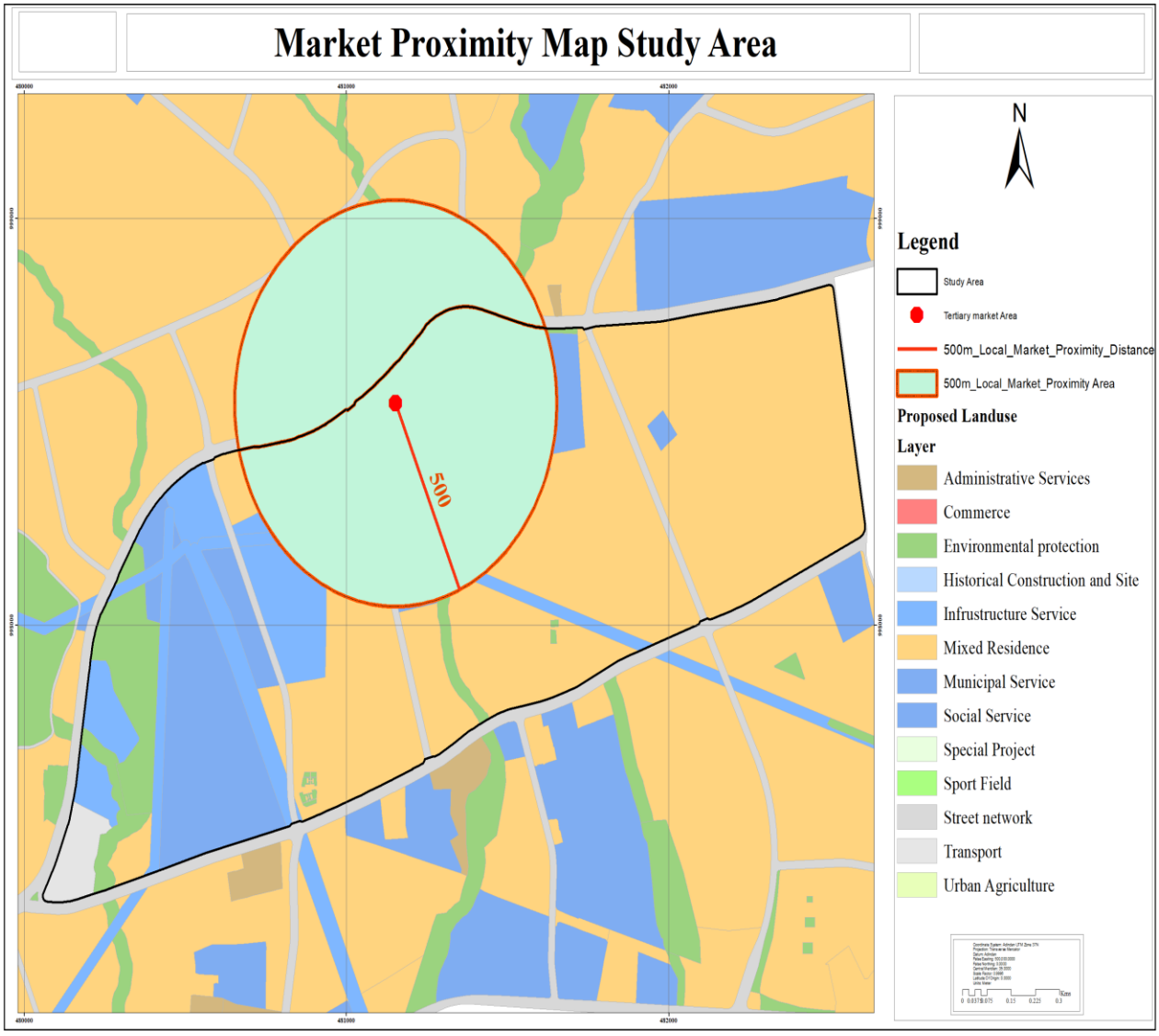

Figure 4.15 Market Proximity Map of the Study Area (500m)

Source: Own Computation Using GIS and Addis Ababa Structure Plan, 2017

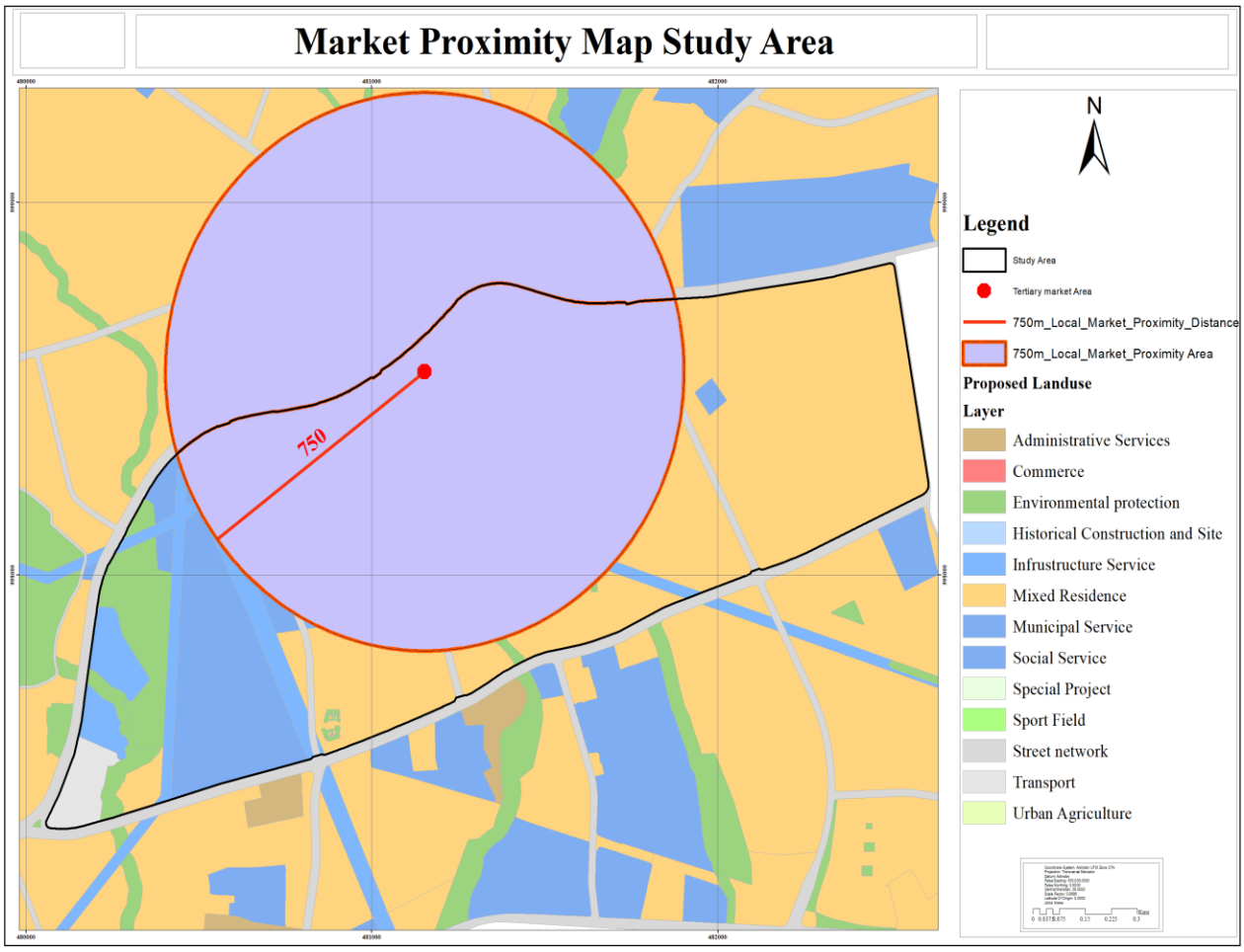

Figure 4.16 Market Proximity Map of Study Area (750m)

Source: Own Computation Using GIS and Addis Ababa Structure Plan, 2017

Table 4.14 Proximity of Open Market Service in the Sub-City and Study Area

	500m			750m		
Sub city	Service area (m2)	Served population	Service area per population (m2)	Service area (m2)	Served population	Service area per population(m2)
Yeka	1570382.35	7852	199.99	3533667.46	17668	200
Study area	468384	3560	131.57	967427.31	7352	131.59

Source: Own Computation Using GIS Analysis, 2022

Table 4.15 Existing Urban Parks Coverage

Urban Parks	Area of Sub- City/Study Area in hec.	Area in m^2	Area in hec.	Coverage in Percent
Yeka Sub-City	9770.60	314182.16	31.42	0.322
Study Area	211.63	75224.66	7.52	3.55

Source: Own Computation Using GIS Analysis, 2022

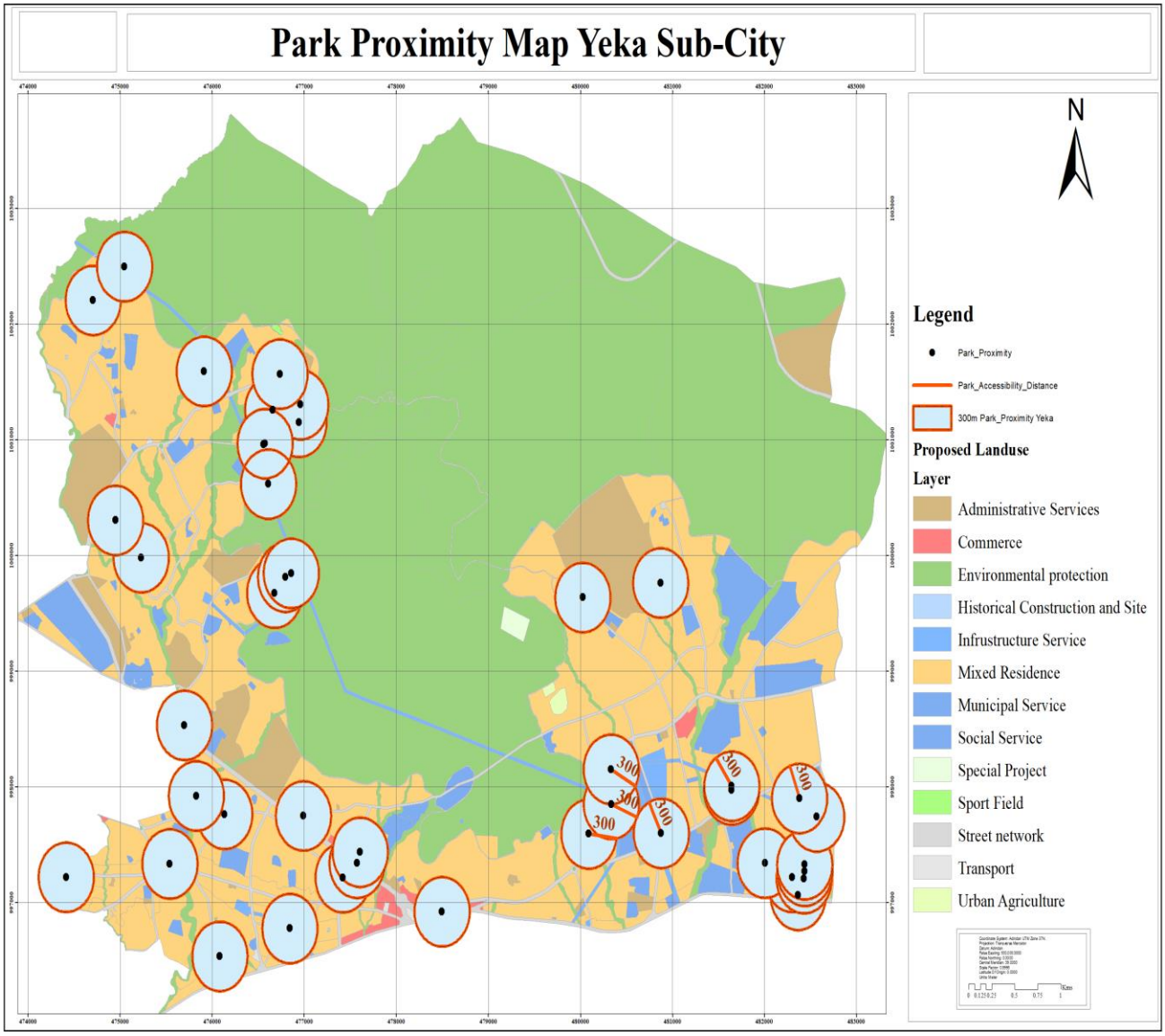

Figure 4.17 Urban Park Proximity Map of Yeka Sub-City

Source: Own Computation Using GIS and Addis Ababa Structure Plan, 2017

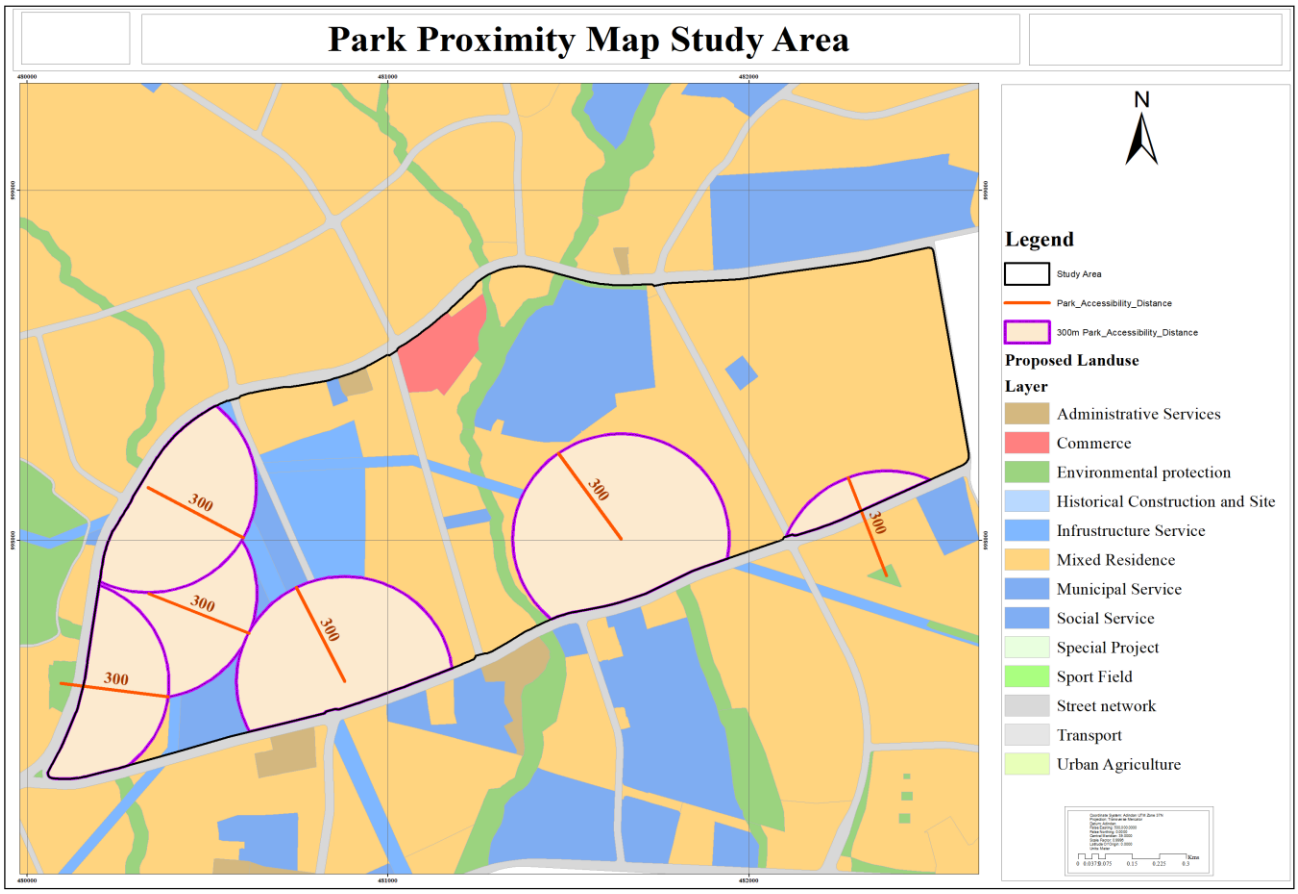

Figure 4.18 Urban Park Proximity Map of Study Area (300m)

Source: Own Computation Using GIS and Addis Ababa Structure Plan, 2017

Table 4.16 Existing Urban Parks Coverage and Per-Capita in the Sub-City and Study Area

Sub- City	Area of Sub-city/study area	Total Population (2022)	Population Density/hec	Area in m^2	Area of Urban Parks (hec)	Coverage in %	Urban Parks per Capita (m2)
Yeka	9770.60	490003	50	314182.16	31.42	0.322	0.641
Study Area	211.63	15977	76	75224.66	7.52	3.55	4.708

Source: Own computation using GIS Analysis, 2022

Table 4.17 Proximity of Urban Parks in the Sub-City and Study Area

Sub-City	300meter(neighborhood level)		
	Service Area (m2)	Served Population	Service Area per Population.(m2)
Yeka	8548827.54	42744	200
Study Area	779561.46	5925	131.57

Source: Own computation using GIS Analysis, 2022

4.4.3.3. Accessibility and Proximity of Market Service and Urban Parks Service per Capita

From the above analysis, the sub-city's and study area's urban park per capita is 0.641 m^2 and 4.708 m2, respectively, which is very small compared with the minimum standard set by WHO (9 m2), and a large portion of the sub-city population (above 90%) has no access to urban parks within the minimum walking distance thresholds (300m) set by the city structure plan. The majority of the sub-city residents and study areas are disadvantaged and forced to walk more than 300 m (91.28%) and 62.92% to use urban parks, respectively. It is known that this forced distance impacts the location of different land use functions and impacts trip length, trip frequency, and mode choice. Thus, individuals located within a service area were assumed to have better access to and easily use that particular park daily than people who were farther away from a park(Sister C. et al., 2007). The accessibility was calculated based on the following equations:

For Sub-City

SAR = SAUP/ (TA – UPA)*100%

SAR=854.88/ (9770.60-31.42) *100%

SAR =8.77%

AI = (NA/ NT) * 100%

AI = (42744/490003)*100%

AI = 8.72%

For Study Area

SAR = SAUP/ (TA –UPA)*100%

SAR = 77.96/ (211.63-7.52) *100%

SAR = 38.19%

AI = (NA/ NT) * 100%

AI = (5925/15977)*100%

AI = 37.08%

Where; SAR is a service area ratio, SAUP is a service area of urban park, TA is the total area of the sub city or study area and UPA is urban park area. Where; AI is an accessibility indicator, which measures the proportion of the urban population that lives within the service area of urban

parks, NA is the number of urban inhabitants who live within the standard distance of the specific land use category. NT is the total number of urban inhabitants within the subcity or study area(Huang *et al.*, 2017). Therefore, 8.72% and 37.08% have accessibility indicators of urban parks for Yeka Sub-City and Study Area, respectively.

Open Market Proximity for Sub-City (750m)

SAR = SAM/ (TA – MA)*100%	AI = (NA/ NT) * 100%
SAR = 353.37/ (9770.60-7.56)*100%	AI = (17668/490003)*100%
SAR = 3.62%	AI =3.61%

Open Market Proximity for Sub-City (500m)

SAR = SAM/ (TA – MA)*100%	AI = (NA/ NT) * 100%
SAR=157.04/ (9770.6-7.56)*100%	AI = (7852/490003)*100%
SAR=1.61%	AI =1.6%

Open Market Proximity for Study Area (750m)

SAR = SAM/ (TA – MA)*100%	AI = (NA/ NT) * 100%
SAR= 96.74/ (211.63-3.96)*100%	AI = (7352/15977)*100%
SAR= 46.58%	AI =46.2%

Open Market Proximity for Study Area (500m)

SAR = SAM/ (TA – MA)*100%	AI = (NA/ NT) * 100%
SAR= 46.84/(211.63-3.96)*100%	AI = (3560/15977)*100%
SAR= 22.56%	AI =22.28%

Where; SAR is a service area ratio, SAM is a service area of open market, TA is the total area of the sub city or study area and MA is market area. Where; AI is accessibility indicator, which measures the proportion of the urban population that lives within the service area of urban parks. NA is the number of urban inhabitants who live within the standard distance to the specific land use category. NT is the total number of urban inhabitants within the sub city or study area.

From the above Proximity analysis of existing open markets services both in the sub city and study area shows that the service area within 500 m covered 157.04hec.(1.61%) and 46.84hec.(22.56%). while the service area within 750m covers 353.37hec (3.62%) and 96.74hec(46.58%) of the residential area of sub-city and study area respectively. In addition, based on the accessibility indicator 1.6 % of the sub-city dwellers and 22.28% of the study area dwellers have access to existing open market within 500 m walking distance, and 3.61% of the

sub-city dwellers and 46.2% of the study area dwellers can access existing open market within 750 m walking distance.

4.4.3.4. Pollution

APA news reported that 60% of the air pollution in Addis Ababa comes from traffic. The accepted particulate matter as set by the World Health Organization (WHO) is 20 ppm, however, in some places in Addis Ababa, it goes up to 300 ppm, the same source stated. Air pollution levels in Ethiopia in general, and in Addis Ababa in particular, exceeds standards set by the World Health Organization(Bikis, 2019). Most air pollution monitoring efforts in the city have focused on PM2.5, using both reference and low-cost monitors. It is widely recognized that PM2.5 is the most important air pollutant: it drives more than 70% of the health impacts associated with air pollution(Alvarez and Mwaniki, no date).

4.4.3.5. Traffic Noise

Noise pollution from traffic is also an issue for the city of Addis Ababa. Even with the generous standards the country sets, many places exceeded the noise level. For example, a study by Mekonnen and Leta (2014), showed that in 20 selected places in Merkato open market, the maximum observed value is 102.6 decibel (with the average range from 61.7 to 83.9 decibel).

According to their analysis, the noise level at 19 of the 20 locations exceeded the recommended limit of 65 decibel for commercial areas. This may cause unobservable health problem, especially for those who are exposed to such noises for long period.

4.4.3.6. Greenhouse Gas from Transport

Greenhouse gas emission rate and average travel speed have a strong relationship when the average speed decreases below 65-80km/hr. the fuel consumption and emission rate of co_2 are increases at very low average speeds due to frequent start and stop driving cycles, vehicles do not travel far with engines running which consumes more fuel and emits more co_2 .therefore, the emission rate per kilometer is very high. Whereas when vehicles travel at much higher speed like above 80km/hr, they demand very high engine and requires more fuel which leads to a high co_2 emission rate. Then, after converting the wasted fuel due to congestion into co_2 emission the next step is converting co_2 emission into monetary value. Table below shows that in the eleven

corridors the total co_2 emission amount reaches 143,816.64kg per annum. When converted into monetary value in terms of atmospheric damage it is equivalent to the annual atmospheric damage cost of more than 388,304.92 birr.

Table 4.18 Greenhouse Gas Emission

Road Segment		Annual Fuel Wasted(L)	Annual co_2 Emission(kg)	Annual Atmospheric Damage Cost
Origin	Destination			
German square	Mexico	1417	3400.8	9182.16
Lideta	Jemo Michael	3644	8745.6	23613.12
Asco	Piazza	3235.2	7764.48	20964.096
Coca	Teklehaymanot	2126.3	5103.12	13778.424
Delber	Piazza	3648.2	8755.68	23640.336
Kara korey	Mexico	9464	22713.6	61326.72
Goro	Totot	4047	9712.8	26224.56
Megenagna	Mexico	13751	33002.4	89106.48
Saris Abo	Stadium	4093	9823.48	26522.64
CMC	Megenagna	10145	24348	65739.6
Wesson Grocery	Megenagna	4454	10689.6	28861.92
		59,923.6	**143,816.64**	**388,304.92**

Source: AATB Team Study, 2022

From the above previous study data, the study area is in the study corridor Wesson Grocery to megenagna and can take the value of annual co_2 emission which is about 10,689.6 kg and annual atmospheric damage cost 28,861.92 birr which is beyond the WHO minimum recommended value from the perspective of greenhouse emission rate,

4.4.3.7. Traffic Congestion

The traffic management challenges include poorly designed streets, intersections inadequate for existing traffic volume, and the absence of modern traffic management centers. Uncontrolled street vendors encroaching on pedestrian space and corridors dedicated for vehicle movement,

and a lack of signalized at-grade pedestrian crossing facilities become causes for traffic congestion.

4.4.3.8. Traffic Accidents

As of December 2022, the Addis Ababa traffic management agency's compiled report shows that road traffic deaths by road user types are presented below. And according to the report, pedestrians were again the largest group (82.5%), while vehicle occupants made up 17.5% (13.1% passengers and 4.4% drivers), which is the share of road traffic deaths by road user types.

Table 4.19 Road Traffic Death by Road User Types

No.	Year (E.C)	Driver	Pedestrian	Passengers	Total
1	2010	19	419	147	585
2	2011	15	421	44	480
3	2012	31	390	34	455
4	2013	25	344	22	391
5	2014	14	363.	61	438
	Total	104	1937	308	2349
	Percentage	4.4	82.46	13.10	100

Source: Agency, 2022

From the above table analysis report the number of pedestrian death covers about 82.5% of the total road traffic accident.

4.4.4. Discussion

There are many elements that constitute the physical form of the city; among these elements, the thesis work focused on density and land use mix ratio, critical to land use transport integration. These elements have a direct impact on travel patterns and are in turn impacted by the characteristics of the city's transportation system. In order to achieve a compact city, a high-density scenario is desirable(Swamy et al., 2013). However, from the result on the analysis of the

distribution of population density the city is categorized in low density categorization(AACPPO, 2017). Having this density dissatisfies the concept of one element of compact development.

Based on the analysis of density distribution, the Yeka sub-city and the study area appears to be sprawling, characterized by low density, increased car dependency, longer travel distances, and dispersed development patterns. These factors have resulted in road congestion, greenhouse gas emissions, environmental deterioration, increased accidents, high costs for extending infrastructure services, and a decline in urban life standards.

The study reveals that city density and transit accessibility impact household vehicle ownership and usage. A decrease in density from 76 to 50 people per hectare resulted in a 10.7% increase in average vehicle ownership, while a decrease in density increases annual vehicle travel. Reducing residential density also increases vehicle travel, resulting in increased air pollution emissions.

Compact city development efficiently utilizes land, minimizes infrastructure costs, and reduces environmental impact. It promotes densified occupation, overlapping uses, pedestrian, cyclist, and public transport movement. Cities can adopt compact development strategies like mixed-use zoning, transit-oriented development, and infill development but struggle with land use and transport integration due to population distribution issues.

Less land-use mix means that there is less diversity in land use types within an area. This can have several implications: such as; increased traffic congestion, reduced walkability, increased energy consumption, and reduced social interaction, increases infrastructure construction costs and maintenance costs. The entropy index is a measure of the diversity of land use types within an area. The score ranges from 0 to 1, with a score of zero indicating minimal heterogeneity and diversity of services, and a score of 1 indicating maximum variety of functions, where all land use types are equally present. The land use mix ratio in the sub-city and study area is 0.514 and 0.722, respectively, according to the above land use function mix ratio analysis. These values are considered good, but they are still below the standard land use proportion of 0.991.

The street network analysis reveals that most roads are insufficient, violating standard dimensions, not adhering to hierarchical connectivity principles, and having poor surface conditions, indicating insufficient road infrastructure. In comparison to accepted standards in most parts of the world, which stand at 25% or 30% according to the city structure map, the existing road coverage is almost half of the accepted standard(Construction, 2019). The planning area's interior parts and housing districts suffer from inadequate coverage due to unplanned, cul-

de-sacs roads with weak inter-linkage, irregular widths, and single narrow roads. Road infrastructure is insufficient to support smooth vehicle movement. These issues impact the mobility of both motorized vehicles and pedestrians. The existing span length of collector roads are beyond the standard that implication of the study was:

- Increase in travel length
- Travel cost,
- Mode choice.

Parking practice has contributed to inefficient utilization of the road network, safety problems and congestion, our roads are not safe for pedestrian users. Parking is crucial for transportation, affecting accessibility and convenience. However, it's a significant cost to society, and conflicts arise due to supply or management issues, affecting designers, operators, planners, and other officials (Litman, 2023). The analysis revealed that parking practices have contributed to inefficient utilization of the road network, safety problems, and congestion, especially close to junctions. It indicated that parking remains one of the critical issues that need to be addressed.

The result of the urban park per capita and open market service per capita analyses indicated that the sub-city and the study area have no sufficient amount of accessible urban parks and open market service areas that serve the city residents. The majority of Yeka sub-city residences have no access to green spaces or urban parks. But it was clear that providing universal access to green spaces and urban parks was a target of the Sustainable Development Goals (SDGs) adopted by international society in 2015(Huang *et al*., 2017). The analysis shows that the city administration fails to address environmental sustainability issues, but the study area has better access to market services due to the existing open market services available in 02 gebeya.

The land use accessibility analysis implication showed that it is difficult to reach within the recommended distances in the city structure plan, which affected overall accessibility. Urban park analysis indicated that the environmental sustainability issue is not recognized and considered by the city administration. It is known that this forced distance impacts the location of different land use:

- Trip length,
- Trip frequency,
- And mode choice

The study area, Wesson Grocery to Megenagna, has annual CO2 emissions of 10,689.6 kg and atmospheric damage of 28,861.92 birr, exceeding the WHO's minimum recommended value for greenhouse emission rates. The analysis indicates that two sectors are not integrated; indicating that cities with high green gas emissions, beyond WHO recommended values, have not achieved the objectives of sustainable development goals, particularly in cities of short distances.

The road traffic accident analysis result indicates that it is much higher than in those countries that do not meet the demand for pedestrian facilities, which accounts for a higher share of total fatalities in cities like India. For example, although the national pedestrian fatality share in India is 13% of road accidents, metropolitan cities like New Delhi, Bangalore, and Kolkata have pedestrian fatality shares greater than 40% (Leather et al., 2011). It implies that our roads are not safe for pedestrian users, either because the roads are not pedestrian-friendly or because the rules and regulations of the road traffic management agency should be highly monitored to create a sustainable transport system.

4.5. The Need to Integrate Transport and Land-Use Planning for Sustainable Development

4.5.1. Transport and Land-Use Planning Organization in Addis Ababa

4.5.1.1. Institutional Framework for Land-Use Planning and Transport in Addis Ababa

Addis Ababa City is divided into 11 sub-cities and into different wards. Addis Ababa City Road Authority manages transport policy, while Addis Ababa Transport Bureau improves traffic flow and safety, while Anbessa and Addis Ababa Transport Branch manage the bus network. The Federal Government created the ERC (Ethiopian Railway Corporation) in 2008. This company is in charge of developing the Addis Ababa LRT network and the national railway system.

Table 4.20 Institutional Framework for LUTP in Addis Ababa City

SN.	Land-Use Planning	Transport Planning
1	Development authorities like, , AA city plan and development commission, Land development and administration office, private consultants	Many sectors involvement, AA transport bureau, AA city road authority, AA traffic management agency, Federal transport minister

4.5.1.2. Strategic Institutions and Capacity Building

Create strategic institutions to ensure the integrated implementation of the Addis Ababa Structure Plan (Plan Commission; Development Coordination and Construction Permit Authority; City Centers and Corridors Development Corporation; and Green Development Agency). Institutionalize continuous capacity building.

4.5.1.3. Stakeholder Involvement

Create systems and forums for public participation in the decision-making process of 'key' issues and for stakeholder involvement in the planning and monitoring of development projects. In terms of finances, the situation regarding the city's revenue and expenditures is described in the part that follows. It also includes a revenue prediction and an expenditure strategy that take into account the duties and responsibilities of the city government(AACPPO, 2017).

4.5.1.4. Policy and Legal Documents in Addis Ababa

In this part, like structure plan, development plans, Transport policy of Addis Ababa, strategy and action plan documents were examined in detail for understanding the coordination between these plans and transport infrastructure investments in the city.

4.5.1.5. The Addis Ababa City Development Plan (2002-2012) in Retrospect

The City Development Plan (2002-2012) consists of a statutory structure plan, an action-oriented strategic development framework, and a management reform component. It prioritizes six key urban issues, including inner city renewal, financial investment requirements, housing, manufacturing, urban road network, transportation, and environment. This combination ensures legal basis, flexibility, and resource allocation for strategic issues. Administrative restructuring, defining the different roles of government, service decentralization and improvement, and capacity building had been the central themes of the management reform aspect of the plan(AACPPO, 2017).The Plan faces challenges due to its lack of vision and execution limitations, including inadequate detail in implementation procedures, such as establishing institutions and funding sources.

4.5.1.6. The Legal Framework

The City Structure Plan is prepared to guide the development of the city for ten years (2013-2023) cognizant of the fact that the city needs to achieve economic, social, cultural and environmental objectives stipulated by Articles 89-92 of the FDRE Constitution, and the right of the residents to “improved living standards and to sustainable development “by indicating major “development activities to enhance the capacity of citizens for development and to meet their basic needs”. From the legal framework document of the city, it was observed that, the plan acknowledges and appreciates the Addis Ababa City Government's role in upholding and advancing national policy principles and objectives as an organ of state as stipulated under art 85(1) of the FDRE constitution, and is in compliance with national policy principles and objectives, including the Revised Addis Ababa City Government Charter Proclamation No. 361/2003 and subsidiary legislations(AACPPO, 2017).

In compliance with Regulation No. 43/2011, the Addis Ababa City Government Plan Revision Project Office was founded with the goal of creating and presenting for approval an urban plan

that directs and implements the city's overall development and guarantees citizen participation and shared benefits. In order to achieve this, the Project Office is additionally required to update the city's current plans in accordance with Federal Urban Planning Proclamation No. 574/2008, contextualizing and adapting them to the views and principles of contemporary urban planning that are currently held at the national, local, and international levels.

The Structure Plan is the most important governing a citywide plan over all other urban plans. Nonetheless, it is a subordinate to a regional plan, which has to be developed and implemented based on the national urban scheme (Article 7 of Proclamation No. 574/20.08 on Urban Planning) According to this declaration, a structural plan is "a legally binding plan formulated and drawn at the level of an entire urban boundary along with its explanatory texts." The operational meaning, constituent elements, and overarching objective of a structural plan are issued by this legal definition of the Federal Proclamation, which takes precedence over the definition provided by Article 2(6) of the Proclamation to facilitate the preparation, issuance, and implementation of the Addis Ababa City Master Plan Proclamation No. 17/2004(AACPPO, 2017).A structural plan, as per Art. 9(2) of Federal Proclamation No. 574/2008, addresses urban growth, land use classes, housing development, infrastructure layout, urban redevelopment intervention areas, environmental aspects, and industry zones.

Article 5 of proclamation no. 574/2008 outlines Urban planning principles involve hierarchy alignment, national vision sharing, inter-urban and rural linkages, spatial frames, societal needs, balanced population distribution, environmental protection, cultural heritage preservation, and public-private interests balance(AACPPO, 2017).

The Addis Ababa City Government Plan Commission Establishment Proclamation that was promulgated by the City Council on December 10, 2016; The City Centers and Corridors Development Corporation Establishment Proclamation that was promulgated by the City Council on July 12, 2017; and The Plan Commission manages the Addis Ababa Plan Institute and Project Office, including human resources, and regulates urban spatial plans for medium and long-term development. This is clearly indicated by Proclamation No. 48/2016 as well as the responsibilities pertaining to social and economic development plans that are to be transferred from the Finance and Economic Development Bureau of the Addis Ababa City Government to the Plan Commission.

4.5.1.6a. Separation of Mandates and Responsibilities

Separate the political body mandates (such as policymaking, legislation, and setting developmental objectives and strategies) from the corporate mandates (such as service delivery, asset management, corporate finance management, etc.) for urban services operating on the basis of cost recovery. Defining precisely the roles and responsibilities of federal government agencies and the comparable municipal government offices in charge of directing and overseeing the same areas(AACPPO, 2017).

4.5.1.7. The Transport Policy of Addis Ababa

According to Transport (2011), Addis Ababa's transportation policy is Accelerating Addis Ababa's growth and making it a capable metropolis on a regional, continental, and global scale requires the provision of a comfortable, safe, dependable, efficient, and equitable transport service. A crucial component of meeting the stated needs is the provision of workable policies and strategies. The Addis Ababa Transport Policy addresses eleven key policy concerns, including land-use and transport planning integration, infrastructure expansion, service enhancement, traffic safety, modern traffic management, environmental protection, social issues, financial capacity, capacity building, legal framework equipping, and regional and international partnerships.

4.5.1.8. Legal Framework

Addis Ababa's transportation systems lack proper legislative structure, fragmentation, and proper implementation of policies and programs, hindering efficient development, management, and services due to insufficient proclamations, rules, and directives(Transport, 2011).The Federal Government created the ERC (Ethiopian Railway Corporation) in 2008. This company is in charge of developing the Addis Ababa LRT network and the national railway system(AACPPO, 2012). The Transport Bureau proposes a structure for better planning and integration of key sectors, with the city adapting policy development to local context. The lower administrative structures, Sub-city and Woreda, should be integrated for data development, community engagement, and infrastructure maintenance.

4.5.1.9. Critical Issues in the Transport Sector

According to Transport (2011), addresses six main problems with transportation infrastructure and services, including land-use issues, poor coordination between urban development and road transport plans, infrastructure issues like road network shortages, inadequate access roads, off-street parking, poorly designed junctions, pedestrian walkways, sub-standard terminals, and lack of segregated bike-ways.

4.5.1.10. Integrate Land Use and Transportation Planning and Development

The lack of integration between land use and urban transport in Addis Ababa as wel as in the study area has led to unnecessary trips, congestion, costly fuel consumption, pollution, and low productivity. Despite improvements in roads and public transport services, the transport problem remains unsolved due to limited expansion of mass transit and walking and biking facilities in inner-city redevelopment areas. Promoting integration between transportation and land use can reduce travel needs and support sustainable modes.

4.5.2. Strategic Alignment

About 12.9% of the land in the city(AATB and world resources institute, 2021) and 13.45% of the land has been used by road infrastructure in the study area, and there is limited scope to use more land for road networks due to competing demands for land development. The city structure plan stresses linking jobs and workplaces through mixed residences. Most housing developments have come within 500 meters of the public transit networks. The bus stops are placed every 500 m in order to cover the maximum number of destinations within accessible distance. But the existing bus stops are more than the recommended value. The strategic direction focuses on maintaining road infrastructure, improving neighborhood streets and intersections, and enhancing bike and pedestrian connections to reduce traffic congestion and improve public transport. Some concepts are adapted regarding the street system expansion focus on opening alternate streets for mobility and developing mass transport. Poor connectivity due to natural and artificial barriers, narrow, and unpaved networks, necessitates connected roads and mass transport services. Establishing pedestrian-friendly Pedestrian Enhanced Destinations and a transit network is crucial for improved bus services and multimodal potential.

Table 4.21 Summarized Land-Use and Transport Policy Documents in Addis Ababa

	Document	Description
1	Revised AACG Charter Proclamation No. 361/2003 and subsidiary legislations.	The plan recognizes and appreciates the responsibility of the AACG as an organ of state to abide by and promote the national policy principles and objectives
2	Article 15 of the Addis Ababa Master Plan Proclamation No.17/2004 and article 14(1(c)) of the revised Addis Ababa City Government charter proclamation No. 361/2003	give power to the City Council to enact the Structure Plan proclamation
3	AACG Plan Revision Project Office was established in accordance with Regulation No. 43/2011	The goal is to create and submit an urban plan that guides the city's development, ensuring the participation and common benefit of the people.
	Article 5 of the Revised Addis Ababa City Government Charter Proclamation No. 361/2003.	The Structure Plan will be implemented by means of the appropriate institutional setup.
4	Art. 7 of the Urban Planning Proclamation no.574/2008	Defines a structural plan as “a legally binding plan along with its explanatory texts formulated
5	Proclamation No. 17/2004	Issues the operational meaning, component parts and overall goal of a structural plan. provide for the preparation, issuance and implementation
6	The basic principles of urban planning as adopted by Article 5 of proclamation no. 574/2008.	Conformity with the hierarchy of plans; Consideration of inter-urban and urban-rural linkages; Balancing public and private interests in order to ensure sustainable development
7	Regulations No. 16/2004 on May 12, 2004 (Ginbot 4, 1996 E.C)	To review and replace the plan
8	Key activities and services that a structural plan addresses are given under Art. 9(2) of the Federal Proclamation No. 574/2008.	It describes urban growth, land use classes, housing development, infrastructure layout, urban redevelopment intervention areas, environmental aspects, and industry zones.
9	(Proclamation No. 574/2008).	The structure plan requires the establishment of necessary institutions, including an implementation scheme that includes institutional setup, resources, and legal framework, to become operational.
10	Proclamation No. 48/2016	The Plan Commission assumes the powers and functions of the Addis Ababa Plan Institute and the Project Office

According to the analysis of the review documents discussed above, the Addis Ababa Structure Plan, implemented by strategic institutions, aims to ensure legal basis, promote public participation in decision-making, and focus on administrative restructuring and capacity building while respecting the city government's role in upholding national policy principles. The Structure

Plan is a crucial urban plan, subordinate to regional plans based on the national urban scheme. It is legally binding and formulated at the entire urban boundary level. The Federal Proclamation defines the operational meaning, constituent elements, and overarching objective of a structural plan. The Addis Ababa Transport Policy addresses eleven policy concerns, including land-use planning, infrastructure expansion, traffic safety, and environmental protection. However, inadequate legislative structure and implementation hinder efficient development. Strategic direction focuses on maintaining road infrastructure, improving neighborhood streets, and enhancing public transport.

4.5.3. Discussion

The literature review highlights the significant impact of policies, legislation, and guidelines on the integration of transport and land use planning. Addis Ababa requires a structured knowledge and technology transfer scheme, a streamlined governing structure, and a robust financial strategy to fund both new and existing transportation projects. Coordination among stakeholders and service providers enhances the successful implementation of planned projects. It is well understood that plans, policies and strategies will continue to face challenges unless implementation capacities are adequately built within the urban transport sector(AATB and world resources institute, 2021). The Addis Ababa Plan and Development Commission aims to develop a comprehensive city structure, strategic, and development plan, focusing on urban design and transportation integration. However, these strategies have not been successfully implemented due to a lack of comprehensive legal regulations and enforcement. The City Development Plan of Addis Ababa classifies road hierarchies into five, but these classifications often fail to reflect capacity or land use, leading to fast-moving traffic in residential neighborhoods and inadequate intersection design. The structural plan proposes multi-centric development. A large proportion of the amenities, including the main central market, main business centers, commercial areas and centers, public transportation lines, general hospitals, and fire brigade stations, are concentrated in the inner city.

The City Structure Plan aims to guide the city's development from 2013-2023, focusing on economic, social, cultural, and environmental objectives. It acknowledges the Addis Ababa City Government's role in upholding national policy principles and objectives, and is in compliance with Revised Addis Ababa City Government Charter Proclamation No. 361/2003 and subsidiary

legislations. Separate political body mandates from corporate mandates for urban services based on cost recovery, defining roles and responsibilities between federal and municipal government agencies.

The lack of integration between land use and urban transport in Addis Ababa as wel as in the study area has led to unnecessary trips, congestion, costly fuel consumption, pollution, and low productivity.

The city's road infrastructure is currently used up to 12.9% and parallel to the analysis of the study area also found that about 13.45% of its land, with limited potential for expansion due to land development demands. The city structure plan emphasizes linking jobs and workplaces through mixed residences, with bus stops placed every 500 meters. Strategic directions include maintaining road infrastructure, improving neighborhood streets, and enhancing bike and pedestrian connections to reduce traffic congestion and improve public transport.

4.7. Major Barriers to Transport and Land-Use Integration

4.7.1. Major Types of Barriers Responded from Stakeholders That Involved in Transport and Land Use Planning

The questionnaire of this study considered 8 major types of barriers seen during transport and land use planning integration and respondents were required to determine how frequently the listed barriers encountered during integration of these sectors in Addis Ababa.

4.7.1.1. Respondents Respond Regarding Major Barriers to Integration

Major types of barriers to transport and land use planning integration are identified from the returned questionnaires based on the mean scores (MS) of the four sectors of respondents: transport bureau, plan and development commission, traffic management agency, and AACRA. In this research, barriers that have a mean score of greater than 3 (MS >3) are considered the most common types of barriers, since a mean score of less than 3 means the respondents do not agree with the barriers stated.

The most frequently occurring barriers have been financial constraints (mean value, 3.98); respondents acknowledged that this barrier has been frequently a problem during the integration of transport and land use planning strategies. The second most common barrier reported by respondents was a lack of regional coordination at the metropolitan level (mean value, 3.873), slightly lower than financial constraints;

Inconsistencies in the planning instruments and deficiencies in their implementation had the third highest mean value (3.838); respondents reported that these barriers to integration occurred frequently. The city administration continually tried to make all necessary corrections from year to year. The results are supported in the table given below.

Table 4.22 Major Types of Barriers during Integration

No	Major types of integration	Transport bureau		Plan and Development Commission		Traffic Management Agency		AACRA		Weighted Average	
		MS	Rank	MS	Rank	MS	Rank	MS	Rank	MS	Rank
1	Lack of regional coordination at the metropolitan level	3.90	3	4.00	3	3.59	4	4.00	1	3.87	2
2	Sector silo behavior and practices at the city level:	3.70	4.5	3.80	4	3.41	5.5	3.89	2.5	3.7	5
3	Inadequate policies and regulations for strategically creating articulated densities	3.10	7	3.27	6	2.88	8	2.67	8	2.98	7
4	Restrictive national regulations and administrative constraints	3.40	6	2.67	8	2.94	7	2.78	7	2.94	8
5	Inconsistencies in the planning instruments and deficiencies in their implementation:	4.20	1.5	3.60	5	3.88	1	3.67	4	3.83	3
6	Inadequate policies, regulations, and supporting mechanisms for redeveloping built-up areas:	2.90	8	3.00	7	3.41	5.5	3.00	6	3.07	6
7	Neglected urban design at the neighborhood and street level	3.70	4.5	4.13	1	3.65	3	3.56	5	3.76	4
8	Financial constraints	4.20	1.5	4.07	2	3.76	2	3.89	2.5	3.98	1

Table 4.23 Summary of the Correlation Test on Ranking Major Types of Integration Barriers

SN	Respondents	$\text{Rho } (\rho) = 1 - \frac{(6\ (\Sigma di^2))}{(N\ (N^2-1))}$
1	Transport Bureau versus Plan and Development Commission	0.6309
2	Plan and Development Commission versus Traffic Management Agency	0.6845
3	Transport Bureau versus Traffic Management Agency;	0.8215
4	Transport Bureau versus AACRA	0.744048
5	Plan and Development Commission versus AACRA	0.64881
6	Traffic Management Agency versus AACRA	0.6012

In this case, with a significance level of 95% (P = 0.05), the calculated value of **ρ** (rho) for all the six group cases is greater than the critical values of **r,** so it can be concluded that there was a strong correlation between the attitudes of respondents. This means that most of the respondents had the same perception about common barriers of transport and land use planning integration.

4.7.2. Discussion

The most frequently occurring barrier was financial constraints (mean value, 3.98); respondents acknowledged that this barrier was frequently a problem during the integration of transport and land use planning strategies. The second most common barrier reported by respondents was a lack of regional coordination at the metropolitan level (mean value, 3.873), slightly lower than financial constraints. The 95% significance level indicates a strong correlation between respondents' attitudes towards common barriers of transport and land use planning integration, indicating a common perception among all six group cases. The implications of this strong positive correlation between planners suggest that the barriers were rely the challenges of the integration and potential opportunity to solve these barriers and provide solutions for effective integration between transport and land use planning.

4.8. Enabling Planning Mechanisms for Integrated Transport and Land-Use Planning Strategies

4.8.1. Major Types of Enabling Planning Mechanisms Responded to by Stakeholders Involved in Transport and Land-Use Planning

This study surveyed respondents on the frequency of five major enabling planning mechanisms encountered during transport and land use planning integration.

4.8.1.1. Respondents Respond Regarding the Major Enabling Mechanisms of Integration

The most enabling mechanism or solution during integrating transport and land use planning is identified from the returned questionnaires based on the mean scores (MS) of the four sectors of respondents: transport bureau, plan and development commission, traffic management agency, and AACRA. In this thesis work, enabling mechanisms that have a mean score of greater than 3 (MS >3) are considered the most common types of enabling mechanisms, since a mean score of less than 3 means the respondents do not agree with the listed mechanism.

The most frequently occurring mechanism has been integrating land use and transport in the planning process (mean value, 4.398); respondents acknowledged that this enabling mechanism has been the most enabling solution during the integration of transport and land use planning strategies. The second most common mechanism reported by respondents was institutional integration and legal mechanism (mean value, 4.373), which is very slightly lower than integrating land use and transport in the planning process.

Capacity building had the third highest mean value (4.243); respondents reported that this mechanism of integration occurred frequently. The city administration continually tried to improve, making all necessary corrections from year to year.

Table 4.24 Major Types of Enabling Mechanism during Integration

No	Enabling Mechanism for Integration	Transport Bureau		Plan and Development Commission		Traffic Management Agency		AACRA		Weighted Average	
		MS	Rank	MS	Rank	MS	Rank	MS	Rank	MS	Rank
1	Integrating Land Use and Transport in the Planning Process	4.30	1	4.60	2	4.47	2	4.22	2	4.398	1
2	Institutional Integration and Legal Mechanism	3.90	3	4.67	1	4.59	1	4.33	1	4.373	2
3	Financial Requirements	3.40	5	4.27	4	4.12	4	3.56	4	3.838	4
4	Capacity Building	4.10	2	4.47	3	4.29	3	4.11	3	4.243	3
5	Stakeholder Identification	3.80	4	3.80	5	3.65	5	3.44	5	3.673	5

Table 4.25 Summary of Correlation Test to towards Enabling Mechanism or Solutions for the Achievement of Sound Transport System

SN	Respondents	$\text{Rho } (\rho) = 1 - \frac{(6\ (\Sigma di^2))}{(N\ (N^2-1))}$
1	Transport Bureau Versus Plan and Development Commission	0.6
2	Plan and Development Commission Versus Traffic Management Agency	1
3	Transport Bureau Versus Traffic Management Agency	0.6
4	Transport Bureau Versus AACRA	0.6
5	Plan and Development Commission Versus AACRA	1
6	Traffic Management Agency Versus AACRA	1

From the above summary of the correlation test, the calculated value of **ρ** (rho) for all six group cases are greater than five, which is termed a strong positive correlation**,** so it can be concluded that there is a strong correlation between the attitudes of respondents. This means that most of the respondents have the same perception about common enabling mechanisms or solutions for

the achievement of a sound transport system through efficient integration of transport and land use planning.

4.8.2. Discussion

The most common planning mechanism for integrating land use and transport in planning is institutional integration and legal mechanisms, followed by capacity building. City administration continuously improves and makes necessary corrections to ensure effective integration of transport and land use planning strategies. The correlation test results show a strong positive correlation between respondents' attitudes towards a sound transport system through efficient integration of transport and land use planning, indicating a common perception among respondents. The implications of this strong positive correlation between planners suggest a potential opportunity to implement planning mechanisms to achieve sustainable development or planning mechanisms for integrated transport and land use planning strategies.

Chapter Five: Conclusion and Recommendations

5.1. Conclusions

This section presents the main conclusions of the research based on the objectives established in Section 1. The purpose is to improve understanding of how transport and land use plans are integrated and related land management approaches are being used by the city and the degree to which the existing land use impacts the transport system of the city. Recommendations are also provided based on the findings and limitations, with the aim of addressing the research problem.

The literature review identifies principles for integrating transport and land use planning for sustainable development. Key elements and barriers are identified, and land use plans are evaluated based on city structure plan guiding principles. The thesis evaluates existing land use plans.

An integrated land use and transportation approach results in considerable opportunities and benefits for city residences and the general development of the area. Land development information aids transportation planning by predicting future demands and preparing for land use allocation. Integrating these sectors is crucial for sustainable urban structures. The transport system's success indicates city organization, providing safe, affordable, and efficient services, increasing energy efficiency, supporting a vibrant economy, reducing pollution, congestion, and adverse health effects. It has been seen that the key elements of land use and transport integration. Among these key elements, the enabling urban structures are the physical form of the city, which is critical for land use and transport integration because it has a direct impact on travel patterns. Settlement size, density distribution, mixed land use, activities, and networks are the variables used to evaluate the extent of land transport integration.

Based on the data and analysis results of this study, the following conclusions can be drawn:

Key Elements of Transport and Land-Use Planning Integrations

Looking at the way of population distribution, the sub-city and the study area are characterized by low density categorization, which leads to dissatisfaction with the concept of compact development. Density distribution is inversely related to annual household kilometers traveled

and ownership. It was found that reductions in residential density resulted for increase vehicle travel distances and, as a result, increased air pollution emissions. Less in mixity resulted for to increase travel distances, allows more trips by car, and leads to much dispersed trips, congestion, and an unreliable transport system

Road network coverage in the study area found that the area proportion allocated to the existing road accounts for 13.45%, almost the same as the road coverage of the city. If you compare it to the accepted standards, in most parts of the world, which is 25% or 30% according to the city structure map, the existing road coverage is almost half that of the accepted standard. The absence of adequate transport infrastructure and weak traffic management are major factors behind congestion around major business areas.

Regarding hierarchical connectivity, most of them are not properly networked based on the standards, and there are several local streets that are directly linked and radiate with arterials. Local street networks are narrow, not well paved, and lead to dead ends that are inaccessible by vehicles. The pedestrian network is not adequate, Not only the coverage problem, but also the pedestrians are occupied by street vendors and other unplanned utility lines, made the existing walkway crowded. The establishment of various pedestrian-enhanced destinations needs to be prioritized for pedestrian improvement, as walking is the most dominant mode of transport in Addis Ababa City, so allocating space equitably for this dominant mode is important.

Both on-street parking and off-street parking are practiced in the city as well as in the study area. The proportion of on-street parking is much higher than that of off-street parking (compound). This practice contributed to inefficient utilization of the road network, safety problems, and congestion, especially close to junctions. From the proximity analysis of specific categories of land use, it was conclude that the majority of the sub-city residents and study areas were disadvantaged and forced to walk more distances than set by the structure map of the city. This forced distance impacted the location of different land use functions resulted for trip length, trip frequency, and mode choice.

Based on road accident reports, the number of pedestrian deaths was higher than other categorizations of road users. The result indicated that our roads are not safe for pedestrian users and that road traffic management agency rules and regulations should be highly monitored.

The Need for Integrating Transport and Land-Use Planning for Sustainable Development

The structure plan is the most important thing governing a citywide plan over all other urban plans. It recognizes and appreciates the responsibility of the Addis Ababa City Government as an organ of the state to abide by and promote national policy principles and objectives. There are proclamations that guide how to use land in the city. But it had failed to sufficiently elaborate implementation mechanisms, including institutional set-up and financial sources, to encourage and guide proposed investments.

The transportation systems lack proper legislative structure, fragmentation, and proper implementation of policies and programs, hindering efficient development, management, and services due to insufficient proclamations, rules, and directives. Both transport and land use planning are managed at the city level. The Addis Ababa Plan and Development Planning Commission was created to prepare a new city structure plan, strategic plan, development plan, basic plan, neighborhood development plan, and urban design, including proper coordination with urban transportation projects. The city administration lacks coordination among these sectors and lags in the development process.

Barriers to Transport and Land Use Planning Integration

Integration barriers observation and analysis, the most frequently occurring barrier was financial constraints; respondents acknowledged that this barrier was frequently a problem during the integration of transport and land use planning strategies. The second most common barrier reported by respondents was a lack of regional coordination at the metropolitan level, slightly lower than financial constraints. The 95% significance level indicates a strong correlation between respondents' attitudes towards common barriers of transport and land use planning integration, indicating a common perception among all six group cases. The implications of this strong positive correlation between planners suggest that the barriers were rely the challenges of the integration and potential opportunity to solve these barriers and provide solutions for effective integration between transport and land use planning.

Enabling Planning Mechanisms for Integrated Transport and Land-Use Planning Strategies

The most common planning mechanism for integrating land use and transport in planning is institutional integration and legal mechanisms, followed by capacity building. City administration continuously improves and makes necessary corrections to ensure effective integration of transport and land use planning strategies. The correlation test results show a strong positive correlation between respondents' attitudes towards a sound transport system through efficient integration of transport and land use planning, indicating a common perception among respondents. The implications of this strong positive correlation between planners suggest a potential opportunity to implement planning mechanisms to achieve sustainable development or planning mechanisms for integrated transport and land use planning strategies.

5.2. Recommendations

Taken together, the above findings show that transportation and land planning are not yet as integrated as they could or should be, thereby depriving communities of many of their benefits. In line with the above-mentioned findings, limitations, and conclusions, the following recommendations were made:

- Diversity of land use categories should be practiced during new settlement, infill development and other development mechanisms by keeping mix ratio standard
- Opening new roads with adequate walkway spaces is necessarily important. The separation of the pedestrian from the vehicle by providing adequate sidewalks is critical to enhancing the safety, security, and convenience of pedestrian users.
- Providing spaces/access for street vendors is important to increase the existing walkway capacities
- Integrating transport and land use planning should start with the early planning process.
- The city master plan should have strong integration with sheger-city master plan/land use plan
- Creating new institutional arrangements and assignments of responsibility along with new integrated plan is important
- Transport Authority should engages in planning to ensure:

- optimizing network efficiency
- maximizing achievement of transport benefits
- ensuring a safer transport system

Strengthening plan implementation is useful. Plans that do a better job in their implementation also tend to account for transportation-land use integration.

Generally, a coordinated approach to transportation and land use planning has resulted in many benefits for city residents. Land use planners can better anticipate which areas, previously inaccessible or less accessible, are likely to become attractive for development due to a transportation project. So that the government and other stakeholders should support these two sectors.

5.3. Recommendations for Future Studies

Further study should be conducted to explore the impact of land use on transport with the variables of employment density, location of some land use functions, and their impacts on trip length, trip frequency, and mode choice. So, future studies can develop their own conclusions regarding how to develop integrated transport and land use planning strategies for sustainable development.

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Annexes
Annex: A, Article

Evaluating the Key Elements of Transport and Land- Use Integration: Case study Yeka Sub-city

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Abstract

Assessing land-use and transport main elements of integration are very important to achieve sustainable urban development. Within this concept, land-use and transport integration is highlighted as one of the most important and attainable policy objectives. The study focused on assessing and evaluating the key elements in order to integrating land use planning strategies with transport developments has been considered key for moving towards sustainable development of cities, even though the city government had tried a lot of efforts. The main research instrument used was used document analysis and within these phenomena varieties of socio-spatial data were collected from different sources and analyzed by using various analytical techniques using ArcGIS and excel. Then, the study analyzed and evaluated the key elements of integration based on distribution of population density, land use mix, neighborhood design and layout, parking facilities, resource consumption, accessibilities. The study employed existing situational analysis and secondary document analysis from stake holders that involved in land use planning and transport planning in city. In general, the study revealed that from the density of the sub-cities, population density significantly differs in many parts of the city, as we move away from the city center the density tends to decrease. There are several local streets that directly linked and radiate with arterial may be due to poor road design or implementation leads to access problem to vehicular movement's for instance emergency access for Ambulance and service delivery vehicles. From vehicle ownership analysis using land use formula, indicates that, density distribution is inversely related to household ownership or uses.

1. Introduction

Land use and transportation are two sides of the same coin. Transportation affects land use and land use affects transportation. Decisions that affect one also affect the other. As a result, it is important to coordinate transportation and land use planning decisions so they are complementary rather than contradictory. This insures that transport planning decisions support land use planning objectives and land use planning decisions support transport planning objectives. This requires an understanding of how specific land use patterns affect travel (Litman, 2005a).

One of the most crucial strategic objectives for creating more sustainable urban structure is the integration of land use and transport. A compelling, forward-looking strategic vision for the future city, a supportive institutional framework, and viable finance models are necessary for achieving successful integration. The creation of urban spaces and structures through well-integrated land use and transportation planning lessens the demand for private motorized vehicle travel. Good public transportation access and thoughtfully planned, bike able, and walk able urban areas make for incredibly desirable places to live, work, learn, play, and socialize. One of the most promising ways to stop the trend of automobile-dependent sprawl and put developing countries on a sustainable path is to integrate land use and transport. These surroundings improve a city's economic competitiveness, reduce local pollution and global greenhouse gas emissions, and promote inclusive development. The integration of land use with transportation systems has to happen at all levels of planning and through multiple intervention mechanisms. There are many elements of transport and land use planning integration, among those elements the following are basic elements of integration that would be discussed and tried to analysis on the existing satiation of the case study.

- Enabling Urban Structure
- Complete network and complete streets
- Public Transit and its Strategic Alignment
- Transit oriented development and value capture
- Accessibility improvements in terms of local area plans
- Re-development & Re-vitalization & Transit
- Integrated Multimodal Transit Interchanges

Enabling Urban Structure can be discussed in the form of, Density Distribution, Land-use Mix and Activities, Networks

Complete Network and Complete Streets

Completeness: Along with a clear pattern for the network to be efficient it needs to be complete so that there are no missing links. Completeness of the network is required for achieving the following: Availability of alternate routes for users, shorter trip lengths, higher accessibility of public transport, Safety and comfort of pedestrians and NMV users,

Hierarchy: The hierarchy of the network is also important to improve the efficiency.

Accessibility Improvements in Terms of Local Area Plans

Accessibility plays an important role at a local level in getting people to use sustainable modes. Walking, cycling and public transport services are the most sustainable modes for travel(Swamy et al., 2013).

To conclude, the transport system in a city is crucial for its overall organization. As Addis Ababa expands horizontally due to population growth, mobility becomes a significant issue. Inadequate public transport leads to automobile dependency, economic and environmental problems in the city. These points help us to know the need to integrate transport and land use planning strategies in urban areas. The article focused on how to develop well integrated land use and transport by assessing and evaluating the key elements of integration to have sustainable transport system for healthy environment and smart city.

2. Methods and Materials

2.1. Description of the Study Area

Addis Ababa, a 540 km2 city, is the political and economic center of Ethiopia, home to the African Union and United Nations Economic Commission for Africa, and hosts numerous international aid and development organizations(Transport, 2011). This article is conducted in Addis Ababa in Yeka sub city and described by 38051” 17’ E and 9002” 14’N, Yeka sub city is the second largest populated sub-city of Addis Ababa, located in the northern part of the city. It has an area of 97.7sq. km. According to the Central Statistical Agency of Ethiopia 2017, the population of the Yeka Sub-city was 201,156males and 233,443 females which aggregated to 434,599 peoples living in the sub-city. The population density of the Sub-city then was 5015 per sq.km. The sub-city is divided into 11 administrative woredas. The reason/Rationale behind

choosing this part of the city is that has potential to represent the identified problem at hand, because of large number of residential building developments and also squatter settlements with in the sub-city. That has dramatically increased the number of households living in that area. Being the sub-city is the second largest populated area, it was believed that it would represent the city; on the other hand, the area is more familiar to the researcher.

2.2. Method of Data Collection

Field observation to understand the elements of integration and their implementation on the existing settlement patterns, observations on the road networks to understand the road hierarchy of connectivity and service performance are the primary data collection mechanisms in this research whereas secondary data were collected in both Addis Ababa transport Bureau and Addis Ababa plan and development commission were provided majority of the data which include the land use and socio-economic data, the transport network data, the transport study report. Data on existing traffic conditions were acquired from Addis Ababa traffic management agency. Data also collected from secondary sources such as: structural plan of the city, executive summary of the master plan, text books, the internet, academic journals, magazines and newspaper.

Table 2-1.Secondary Data collected from Authorities Involved in Transport and Land Use Planning

No.	Data Type	Source	Format
1	Existing and proposed road network map	Addis Ababa road Authority	Auto CAD and ArcGIS file
2	Socio- economic and demographic data.	CSA	Excel
3	Land Use Map (existing and proposed)	Addis Ababa Land Management Office	Auto CAD and ArcGIS file
4	Addis Ababa City Master Plan Preparation, Issuance and Implementation Proclamation No. 17/2004	A.A.C.A Master Plan Office	Pdf
5	A.A.C.A. Structural Plan Approval and implementation Regulation No. 16/2004	A.A.C.A Master Plan Office	Pdf
6	Summary Report on Addis Ababa Master plan	Addis Ababa plan development commission	Pdf
7	Traffic Condition Data	Addis Ababa Traffic Management Agency	Excel

2.3. Method of Data Analysis

Finally, the case studies were analyzed using statistical techniques and the results used to form a basis for conclusions and recommendations. The analysis will do using Microsoft **Excel** and **GIS** software.

Table 2.2 Research Question versus Data Analysis Method

No.	Main Question	Secondary Questions	Variables	Measurement	Data Analysis Method
1.	What are the key elements of integration?	1.1. What is the impact of land use on transport?	Urban form/enabling urban structure ▪ Distribution of population density ▪ Land-use mix	▪ The number of residents per hectare ▪ land-use mixing(intropy Index)	Excel and GIS
		1.2. What is the impact of Neighborhood design and layout?	Existing Street Network ▪ Road density of the study area ▪ Pedestrian friendliness and cycling ▪ Strategic Alignment	▪ Internal connectivity ▪ road hierarchy and coverage of the city ▪ Ratio of road segments with pathways to overall network	Excel and GIS
		1.3. What is the impact of transport on land use?	▪ Parking ▪ Greenhouse gases from transport ▪ Accessibility ▪ Traffic noise ▪ Pollution ▪ Traffic congestion ▪ Traffic accidents	▪ Probability of finding a parking space in the city ▪ Air quality ▪ Average walking distance to specific land use in the city ▪ Average level of service (LOS) ▪ Number of traffic accidents	Excel and GIS

3. Result and Discussion

3.1. Evaluating the Key Elements of Integration

The data analysis looked at the practical land use development of specific area and its impact on transport and vice versa which is not be limited to the formal development process of the study area and compare with its standards.

3.1.1 Urban Form/Enabling Urban Structure

There are many elements that constitute the physical form of the city, the given below are critical to land use transport integration. In this thesis report, it was tried to make analysis of their impacts on transport system of the city.

3.1.1.1. Distribution of Population Density

Cities must adopt density to maintain small settlement sizes, aiming for a compact city form. However, increasing density too much is limited due to built-up areas, and the scope for growth is limited to regeneration and vacant land development.

Table 3.1 Density of the Sub-Cities

sub city	population estimate, 2022	Area (sq. Km)	population density (peoples/sq. Km)	density in hec.
Addis Ketema	360854	7.41	48698	487
Arada	298942	9.91	30166	302
Lideta	285075	9.18	31054	311
Kirkos	312703	14.62	21389	214
Gullele	378196	30.18	12531	125
Kolfe Keraniyo	606091	61.25	9895	99
Nefas Silk-Lafto	447031	68.3	6545	65
Yeka	490003	97.7	5015	50
Bole	436736	122.08	3577	36
Akaki Kaliti	256144	118.08	2169	22

Source: Own Computation Using GIS Analysis, 2022 and Addis Ababa Structure Plan, 2017

From the above statistical data analysis, density of Yeka Sub- City is 5015 person/$km^{2.}$ So, based on the Structure Plan of the city it is in low density categorization .having this density it dis satisfies the concept of compact development. Creating compact city development that utilizes land efficiently helps to minimize the need for costly infrastructure expansion and service extensions. In addition to, makes better use of existing facilities and services and poses less impact on the environment. Travel by modes other than the automobile is also easier when land uses are contiguous. Therefore, having this compact development concept in mind the city is still faced in problem to have well integration on land use and transport because the population distribution analysis shows that the city lacks compactness.

It was also observed that the Addis Ababa City Development Plan (2002-2012) proposed a poly-nuclear main center with a core CBD around La Gare and three important nodes (Arada, Merkato, and Arat Killo) linked through strong business corridors.)(AACPPO, 2017) to the periphery (like, akaki kality, nefas silk-lafto, yeka,bole) the density tends to decrease as shown in the figure given above. From the above density distribution the city seems to sprawling cities characterized by low density, more car dependency, longer travel distances due to increasing city sizes and dispersed development patterns, and resulted in road congestion and greenhouse gas emissions, deterioration of environment, increased accidents, high costs for extending infrastructure services and diminution of urban life standards.

According to Litman (2005a), the formula for calculating household vehicle ownership and annual vehicle traveled in the United States was developed, but its accuracy may vary based on factors like income, age, and access to public transportation, affecting vehicle ownership rates. According to litman (2005), described that International studies show that increased urban density significantly decreases per capita vehicle travel, affecting both higher-income and lower-income regions. The formula was used to calculate city density, illustrating the inverse relationship between density and vehicle ownership and household annual vehicle traveled, while maintaining other demographic factors like household size and income.

Table 3.2 Household Vehicle Ownership and Annual Vehicle Miles Traveled

Household vehicle ownership and Annual vehicles kilometers traveled			
Sub-city	**Density**	**household vehicle ownership** $(2.702 * (Density)^{-0.25}$	**Household Annual Vehicle kilometers Traveled** $(54{,}832 * (Density)^{-0.25} * (TAI)^{-0.076})$
Addis Ketema	487	0.575	8670.30
Arada	302	0.648	9773.14
Lideta	311	0.644	9702.49
Kirkos	214	0.707	10650.41
Gullele	125	0.808	12173.43
Kolfe Keraniyo	99	0.857	12913.81
Nefas Silk-Lafto	65	0.950	14319.67
Yeka	50	1.015	15305.11
Bole	36	1.105	16654.01
Akaki Kaliti	22	1.252	18872.76

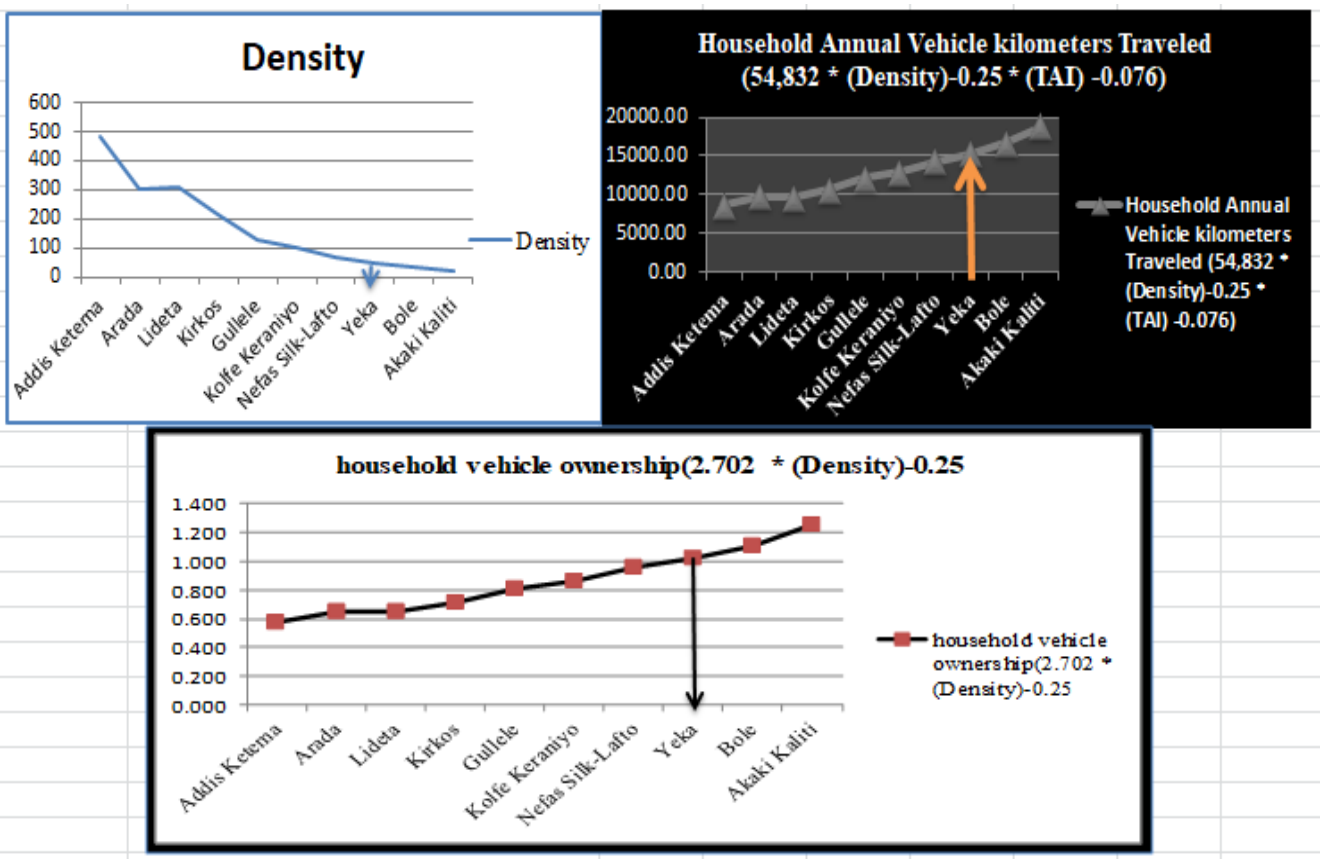

Figure 3.1 Comparative Figure on Density, Household vehicle ownership and Household Annual Vehicle Kilometers Traveled

From the above household vehicle ownership analysis using land use formula, indicates that how density and transit accessibility affect per-household vehicle ownership or uses. For example, as density decreases from 487 to 22 units per hectare the average house hold vehicle ownership or uses increases by about 117.7%. That is density distribution is inversely related to household ownership or uses. House hold vehicle ownership in Yeka Sub-City is the third compared to other Sub –Cities.

It is important to note that this formula was developed specifically for the United States, and the accuracy of the formula may also vary depending on the specific area being studied and other factors that may affect vehicle ownership rates, such as income, age, and access to public transportation. It was commonly used in transportation analysis for many countries, despite variations in development. Here, the formula is used to demonstrate the inverse relationship between density and household vehicle ownership and annual vehicles traveled. While the constant value may be adjusted based on vehicle ownership rates, the implication of the formula

remains consistent regardless of location. From the above household annual vehicle kilometers traveled table analysis using land use formula; it can conclude that, when you make it denser, household annual vehicle kilometers traveled is getting less, which is density distribution is inversely related to household annual vehicle kilometers traveled.

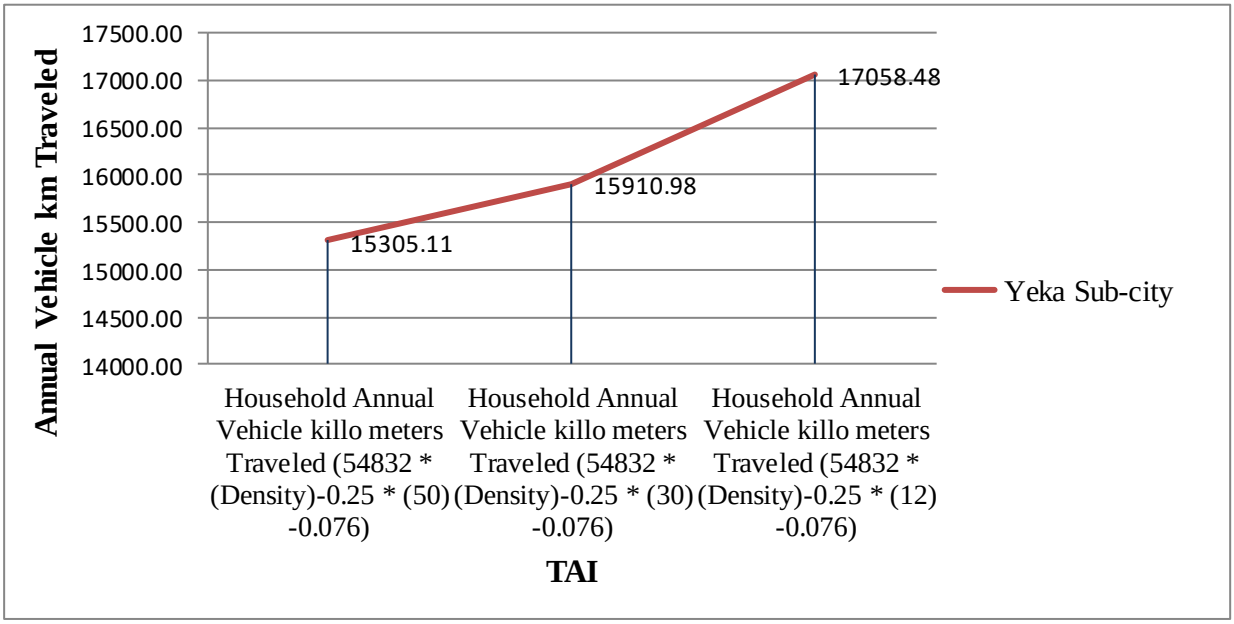

Figure 3.2 Household Annual Vehicle Traveled in Kilo Meters at Different TAI

From the above household annual vehicles kilometers traveled analysis using land use formula, indicates that how density and transit accessibility affect per-household vehicle ownership or uses. For example, as Transit Accessibility Index decreases from 50 to 12, the household annual vehicles miles traveled increases by about 11.46%. That is Transit Accessibility Index is inversely related to household annual vehicles kilometers traveled with in constant density distribution. It could be found that reduces in residential density tend to increase vehicle traveled distances, and as a result tend to increase air pollution emissions

3.1.1.2. Land-Use Mix

In order to make the transport system efficient it is important to start creating more activity centers and mix use development. In this analysis the Entropy index is used to find the land use mix ratio the sub-city and the study area. The entropy index is a measure of the diversity of land use types within an area. It ranges from 0 to 1, with higher values indicating greater diversity in

land use types and Less land-use mix means that there is less diversity in land use types within an area.

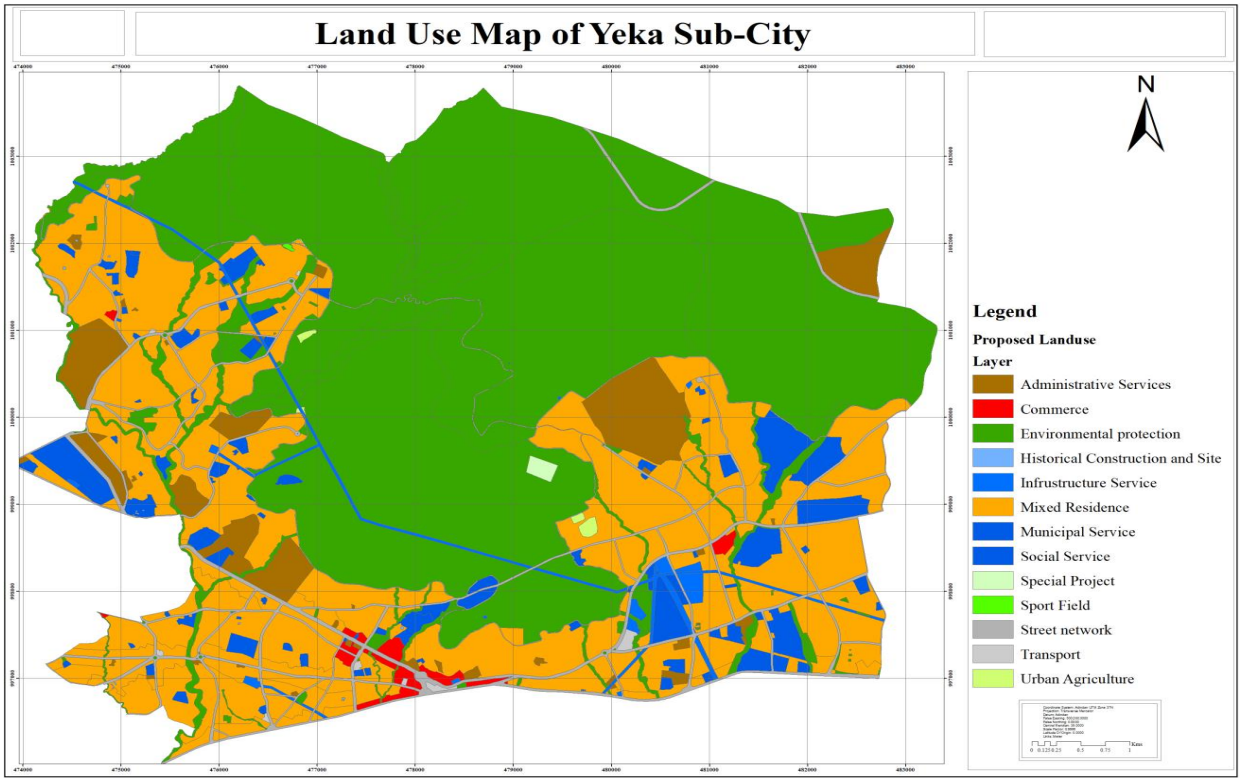

Figure 3.3 Land Use Map of Yeka Sub City
Source: Own Computation Using GIS and Addis Ababa Structure Plan, 2017

Table 3.3 Land-Use Function Yeka Sub-City

SN	Land use Function	Area in Meter square	Area in hec.	percentage	Land use mix ratio of coverage (P j)	ln(P j)	P j ln(P j)
1	Administrative Services	2593286.76	259.33	2.654	0.0265	-3.629	0.096
2	Commerce	316700.89	31.67	0.324	0.0032	-5.732	0.019
3	Environmental protection	37315423.65	3731.54	38.192	0.3819	-0.963	0.368
4	Historical Construction and Site	6223.67	0.62	0.006	0.0001	-9.665	0.001
5	Infrastructure Service	666470.37	66.65	0.682	0.0068	-4.988	0.034
6	Mixed Residence	16752449.68	1675.24	17.146	0.1715	-1.763	0.302

7	Municipal Service	881109.73	88.11	0.902	0.0090	-4.709	0.042
8	Social Service	1794137.72	179.41	1.836	0.0184	-3.997	0.073
9	Special Project	59080.55	5.91	0.060	0.0006	-7.410	0.004
10	Sport Field	5419.4	0.54	0.006	0.0001	-9.803	0.001
11	Street network	37187318.68	3718.73	38.060	0.3806	-0.966	0.368
12	Transport	67850.37	6.79	0.069	0.0007	-7.272	0.005
13	Urban Agriculture	60493.02	6.05	0.062	0.0006	-7.387	0.005
Number of land use types(N)=13			**9770.6**	100.000	1.0000	**SUM**	**1.318**
						ENT	**0.514**
				ENT $= -\sum_{j=1}^{n} pj ln(pj)$ / **ln(N)**			

Source: Own Development using GIS Analysis and Entropy index formula, 2022

Table 3.4 Land-Use Function of the City Administration

Major Category	area	Area in hec.	percentage	Land use mix ratio of coverage(P j)	ln(P j)	P j ln(P j)
Administration	5560102.69	556.010	1.069	0.011	-4.539	0.049
Commerce and Business	7658738.77	765.874	1.472	0.015	-4.219	0.062
Environment	158557678.2	15855.768	30.474	0.305	-1.188	0.362
Historical Buildings and Sites	188865.85	18.887	0.036	0.000	-7.921	0.003
Manufacturing and Storage	30564058.19	3056.406	5.874	0.059	-2.835	0.167
Mixed Residence	219072034.7	21907.203	42.105	0.421	-0.865	0.364
Municipal Services	6156429.6	615.643	1.183	0.012	-4.437	0.052
Religious Institutions	3699328.77	369.933	0.711	0.007	-4.946	0.035
Social Services	14555278.28	1455.528	2.797	0.028	-3.576	0.100
Special Projects	7510338.19	751.034	1.443	0.014	-4.238	0.061
Special Use	3313898.72	331.390	0.637	0.006	-5.056	0.032
Sport Field	191757.07	19.176	0.037	0.000	-7.906	0.003
Street Network	36307891.3	3630.789	6.978	0.070	-2.662	0.186
Transport	11527835.78	1152.784	2.216	0.022	-3.810	0.084
Urban Agriculture	9239017.57	923.902	1.776	0.018	-4.031	0.072

Utility and Infrastructure	6193381.33	619.338	1.190	0.012	-4.431	0.053
		52029.6635	100.000	1.000	0.000	0.000
					sum	1.685
					ENT	**0.105**

Source: Own Development using GIS Analysis and Entropy index formula, 2022

$$ENT = \frac{-\sum_{j=1}^{n} pj ln(pj)}{ln(N)}$$

Where $\mathbf{P_j}$, represents the percentage of each land type use j in the area/ N is the total number of services/land type use present in the area. From the above land use function mix ratio analysis, the land use mix ratio is 0.514 and 0.105 in the sub city and the city administration respectively which is categorized by good and insufficient, but still below the standard land use proportion (0.991).

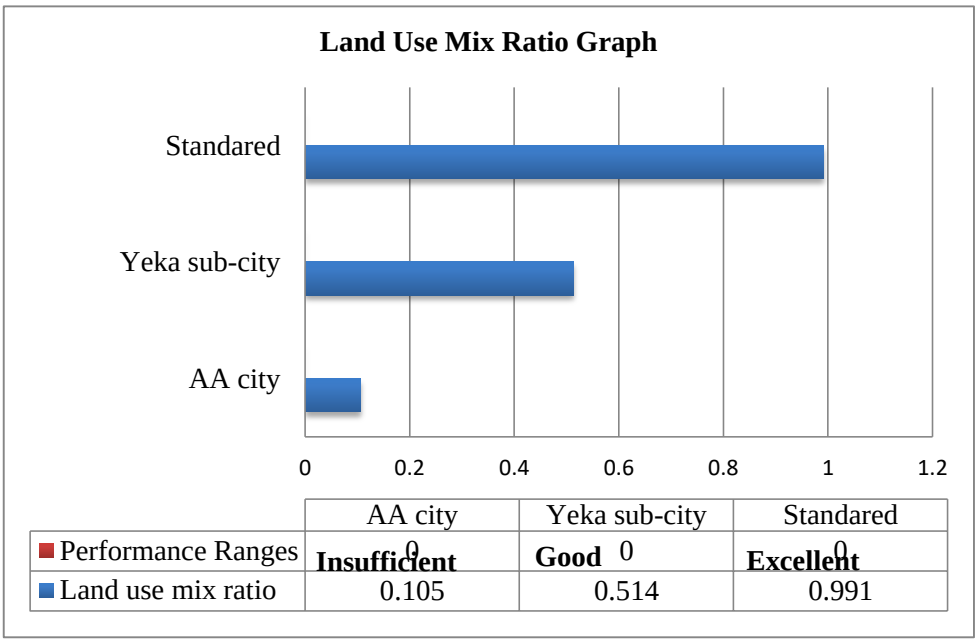

Figure 3.4 Land Use Mix Ratio Graph

The entropy index is a measure of the diversity of land use types within an area. It can have a value between 0 and 1. A score of 0 corresponds to a condition of minimum heterogeneity and diversity of services, for which there would be a single land use for the entire spatial unit. A score of 1 corresponds to a condition of maximum variety of functions in which all types of land use are equally present(Iannillo and Fasolino, 2021). From the above land use function mix ratio

analysis, the land use mix ratio is **0.514 and 0.105** in the sub city and City administration respectively, which is categorized good and insufficient respectively, but still below the standard land use proportion **0.991**(Construction, 2019). The mix ratio, less in number implying that less in mixity tends to increase travel distances, allows more trips by car and leading to very dispersed trips, congestion and un reliable transport system because increased mix tends to reduce travel distances, and allows more trips to be made by walking and cycling(Litman, 2005a)

3.1.2. Neighborhood Design and Layout

3.1.2.1. Existing Street Network

Addis Ababa's road network is inadequate, leading to congestion in major business areas. The lack of adequate infrastructure and weak traffic management contribute to this imbalance. Challenges include inadequate road design, lack of accurate forecasts of pedestrian and vehicle volumes, and violations of standard dimensions like right-of-way. Connections within the network do not adhere to the principle of hierarchical road connectivity. Poor surface conditions of most of the roads and lack of proper maintenance are also among the major challenges

Following the establishment of the Addis Ababa City Road Authority (AACRA) in 1998, and large-scale road construction, the total length of roads in the city almost doubled (to 3,731km between 1992 and 2012), and road density reached 12.9%. As shown in Figure 3.7, 79% of the roads are local streets. 7% Collector streets, 4% Sub-Arterial streets, 9% Principal arterial streets and 1% express way.

Table 3.5 Road Hierarchy and Coverage of the City versus AASHTO standard

No.	Road hierarchy	Percentage coverage	AASHTO standard coverage	Result analysis
1	Express way	1	5-10	Below standard
2	Principal arterial streets and Sub-Arterial streets	13	15-25	Below standard
3	Collector streets	7	5-10	Within standard
4	Local streets	79	65-80	Within standard

AATB, world resources institute, 2021and AASHTO, 2004

From the road hierarchy and coverage analysis of the city, it was found that the express way, Principal arterial streets and Sub-Arterial streets network is not provided according to the recommended standard implying that both transport and land use is not yet integrated. This

shows that the road infrastructure is not enough to support smooth vehicle movement because it is below the recommended value in the structure plan of the city.

3.1.2.2. Existing Road Hierarchy Characteristics of the Yeka Sub-City

Generally it is not adequate enough of its coverage and the interior parts and housing districts of the planning area, and also the roads are characterized as:

- unplanned,
- cul-de-sac,
- weak inter linkage,
- Irregular width and single narrow roads which affect the mobility of both the motorized as well as walking.

From the existing map Analysis shows that most settlements are not properly networked according to hierarchical standards, with some local streets directly linking with arterials due to poor road design. The undulating topography and lack of access to local streets make it difficult for vehicular movement, especially emergency access for ambulances and service delivery vehicles, to enter individual plots and houses.

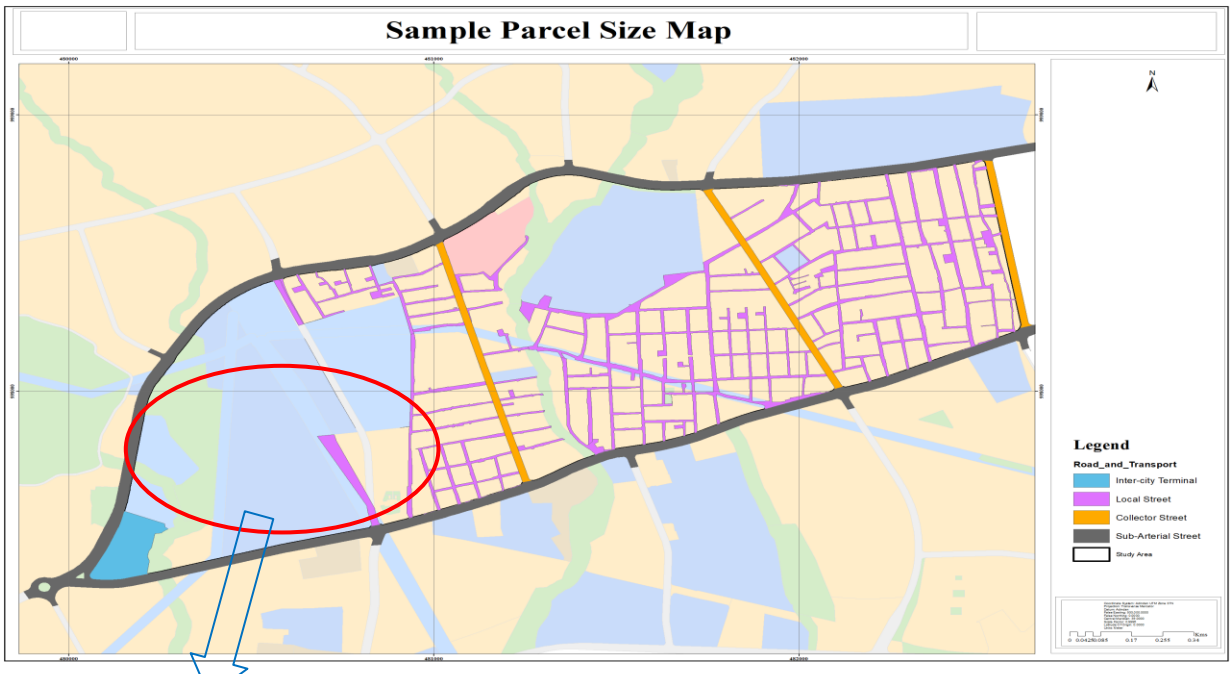

Figure 3.5 Example Huge Parcel Deny Access for Residents

Source: Own Computation Using GIS and Addis Ababa Structure Plan, 2017

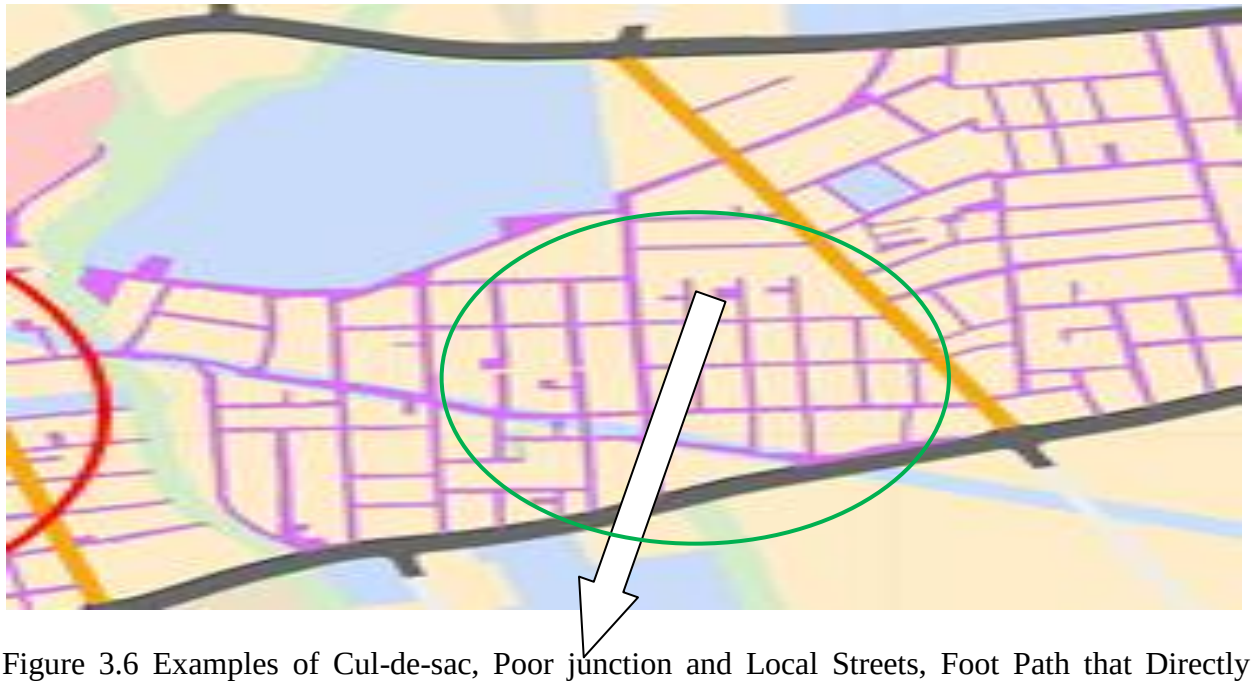

Figure 3.6 Examples of Cul-de-sac, Poor junction and Local Streets, Foot Path that Directly Linked and Radiate with Arterial

Source: Own Computation Using GIS and Addis Ababa Structure Plan, 2017

3.1.2.3. Standard vs Existing Span of Road Hierarchy

According to Addis Ababa city structure plan manual, the road hierarchy Span Planning standard is given below. PAS – Every 2 km SAS – Every 1 km CS – Every 0.5 km Right of way width: PAS – 60, 50, 40 and 30 m, SAS – 30m and 25m, and CS – 20m and 15m PAS can either take the form of expressway(AACPPO, 2017).

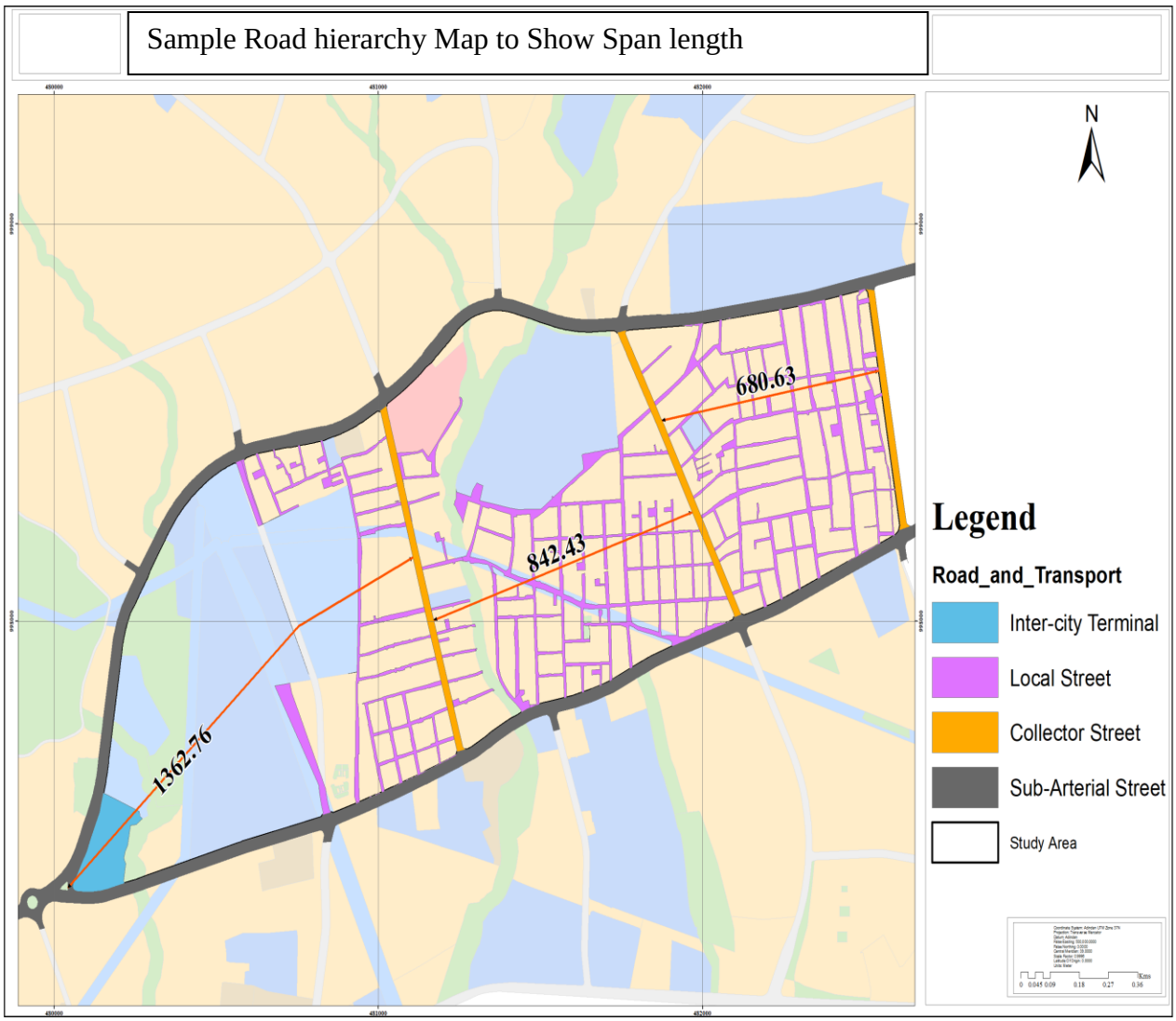

Figure 3.7 Road Hierarchies to Show Span Length

Source: Own Computation Using GIS and Addis Ababa Structure Plan, 2017

Form the existing road hierarchy map of the study area, the three collector road of the site found in the range between 1360meters to 680 meters which is beyond span standard mentioned above. This leads to increasing in travel length; travel cost and has impacts on mode choice. Requiring closely maximum standard spaced pattern of arterial and collector roads leads to ensure developing areas are accessible for pedestrians and cyclists, and can be more easily serviced by transit but the opposite is true in the study area.

3.1.2.4. Pedestrian Friendliness and Cycling

According to Addis Ababa city transport strategy the mode share of the city is given below

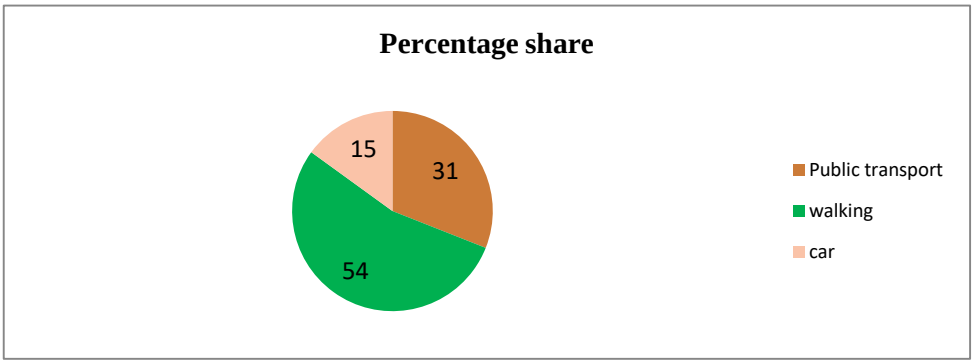

Figure 3.8 Transport Modal Share of the City

From the above data 54 % of Addis Ababa population use walking as their primary mode of transport, which constituted the largest modal share, 31 percent use public transport, and only 15 percent travel by personal motor vehicle. Though cycling is not captured in official statistics, cycling is a mode for short-distance trips, primarily among low-income and risk-taking males. At the same time, the city does not have adequate and safe pedestrian facilities. According to AACPPO (2017), The city has constructed 440km of pedestrian pathways in the last decade, but 53% of streets lack adequate facilities. Bicycle transport is minimal. During the initial implementation period, a total of 210 km of footpaths were identified for upgrading, out of which 75.5 km, or 36 percent, has been implemented. AACRA has implemented 36% of a planned 350 km of pedestrian facilities on new streets, out of 9,000 bollards, and fixed over 3,843 lights and poles. The rehabilitation of existing walkways by AACRA has brought notable improvements in the walking environment in several parts of the city.

Table 3.6 Status of Pedestrian Network Implementation Activities

Activity	Implementing Agency	Implementation Plan 2019-2021 target	Status as of 2021	Performance in %
Upgrade existing footpaths to create a continuous pedestrian realm	AACRA	210 km	75.5 km	**35.95**
Incorporate high quality pedestrian facilities in new streets	AACRA	350 km	124.2 km	**35.49**

Install bollards to protect footpaths from parking encroachments	TMA	9,000 Bollards	3,816 bollards	**42.4**

Source: AATB,2022

Figure 3.9 Example of Open Manhole in the Middle of Walkway and Street Vending

Source: AATB, 2022

From the above plan versus the implementation of the pedestrian network in the city, the performance is below average. So it can conclude that the pedestrian network is not adequate for the number of pedestrian users, as the plan stands at this number. The current walkways are obstructed not only by the coverage issue but also by street vendors and other unforeseen utility lines using pedestrian space. This low implementation performance also affected the study area.

3.1.3. Parking

Addis Ababa is organized into hierarchically arranged multi-nodal city centers. It is clear that the multiple activities in these centers will attract heavy traffic flow. Due to the value of the land, the provision of on- and off-street parking will be problematic. The structure plan identifies strategic car parking sites in centers to address challenges related to economic activities, ensuring individual buildings still require parking space.

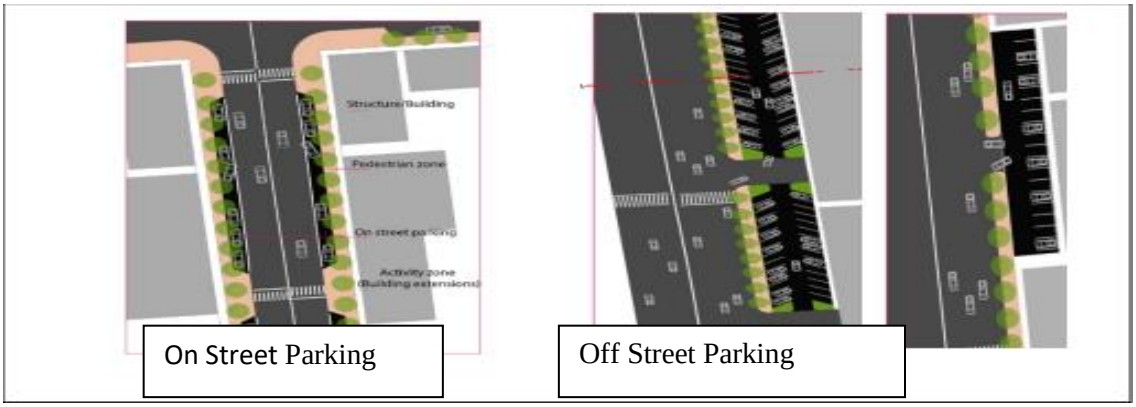

Figure 3.10 Types of Parking

Source: AACPPO, 2017

Table 3.7 Parking Facilities Given by Different MSE in the City

Sub city	**Types of Parking**		**Total**
	On street parking	Off street Parking (compound)	
Akaki Kaliti	-	-	
Nefas Silk-Lafto	47	2	49
Kolfe Keraniyo	9		9
Gullele	12		12
Lideta	45	3	48
Kirkos	47		47
Arada	26		26
Addis Ketema	33	1	34
Yeka	**5**	**2**	**7**
Bole	42	6	48
Lemi-kura	12		12
Total	278	14	292
Percentage	95.2%	4.8%	

Source: AA Traffic Management Agency, 2022

The above table of parking facilities given by the city indicates that both on-street parking and off-street parking are practiced in the city, and its proportional coverage is 95.2% for on-street parking and 4.8% for off-street parking (compound). This practice has contributed to inefficient

utilization of the road network, safety problems, and congestion, especially close to junctions. It indicates that parking remains one of the critical issues that need to be addressed.

3.1.4. Pollution

APA news reported that 60% of the air pollution in Addis Ababa comes from traffic. The accepted particulate matter as set by the World Health Organization (WHO) is 20 ppm, however, in some places in Addis Ababa, it goes up to 300 ppm, the same source stated. Air pollution levels in Ethiopia in general, and in Addis Ababa in particular, exceeds standards set by the World Health Organization(Bikis, 2019). The city's air pollution monitoring efforts primarily focus on PM2.5, the most significant air pollutant, which accounts for over 70% of health impacts(Alvarez and Mwaniki, 2021).

3.1.5. Traffic Congestion

Traffic management issues include poorly designed streets, inadequate intersections, and lack of modern centers. Uncontrolled vendors and lack of signalized pedestrian crossing facilities contribute to traffic congestion. Congestion is caused by on-street parking, loading/unloading, and informal trading activities.

3.1.6. Traffic Accidents

As of December 2022 Addis Ababa traffic management agency compiled report shows that the road traffic death by road user types is presented below. And according to the report Pedestrians were again the largest group (82.5%), while vehicle occupants made up 17.5% (13.1% passengers and 4.4% drivers) is the share of road traffic death by road user types.

Table 3.8 Road Traffic Death by Road User Types

No.	Year (E.C)	driver	pedestrian	passengers	Total
1	2010	19	419	147	585
2	2011	15	421	44	480
3	2012	31	390	34	455
4	2013	25	344	22	391
5	2014	14	363.	61	438

	Total	104	1937	308	2349
	Percentage	4.4	82.46	13.10	100

Source: Agency, 2022

From the above table analysis report, the number of pedestrian deaths covers about 82.5% of the total road traffic accidents, which is much higher than for those countries that do not meet the demand for pedestrian facilities, which is the higher share of total fatalities in cities like India. For example, although the national pedestrian fatality share in India is 13% of road accidents, metropolitan cities like New Delhi, Bangalore, and Kolkata have pedestrian fatality shares greater than 40%(Leather *et al.*, 2011). It emphasized that our roads are unsafe for pedestrians, either due to their lack of friendliness or the need for stricter monitoring of road traffic management agency rules and regulations to ensure a sustainable transport system.

3.1.7. Accessibility

The study investigates the influence of transport on land use in a specific area, focusing on open markets and urban parks' accessibility. It estimates the population with potential market and park access, using ArcGIS for analysis. High service population ratios suggest greater benefits for residential residents. The accessibility was calculated based on the following equations: First, the ratio of the service area of open market service within 500–750 m and 300m for urban parks was determined. As this ratio applied to the population of neighborhood markets and urban park services, the 'total impact area population' was calculated by the given formula below.

SAR = MSA/ (TA – MA)*100% , Where; AR is a service area ratio, MSA is a service area of open market, TA is the total area of the sub city or study area and MA is open market area.

AI = (NA/ NT) * 100%, Where; AI is accessibility indicator, which measures the proportion of the urban population that lives within the service area of open market service or urban parks. NA is the number of urban inhabitants who live within the standard distance to the specific land use category. NT is the total number of urban inhabitants within the sub city or study area(Azagew and Worku, 2020).

Table 3.9 Existing Open Market Service Coverage

Market service	Area of sub city in hec.	Open market Area in m^2	Open market Area in hec.	Coverage in %
Yeka sub city	9770.60	75618.55	7.56	0.077

Source: Own Computation Using GIS Analysis, 2022

Table 3.10 Existing open market service coverage and per-capita in the sub city

Sub city	Area of sub city in hec.	Total population	Population density/ hec	Area of open market m^2	Area of open market (hec)	Coverage in %	Market per capital (m2)
Yeka	9770.60	490003	50	75618.55	7.56	0.077	0.15

Source: Own Computation Using GIS Analysis, 2022

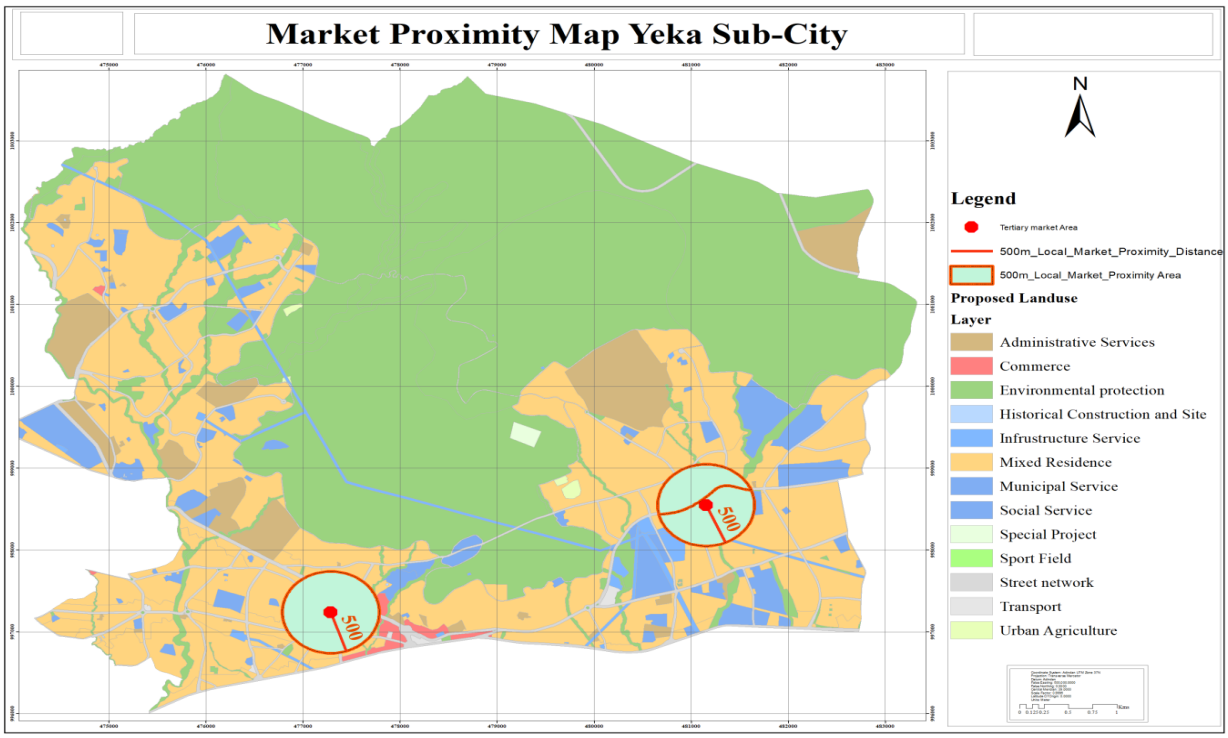

Figure 3.11 Market Proximity Map of Yeka Sub-City (500m)
Source: Own Computation Using GIS and Addis Ababa Structure Plan, 2017

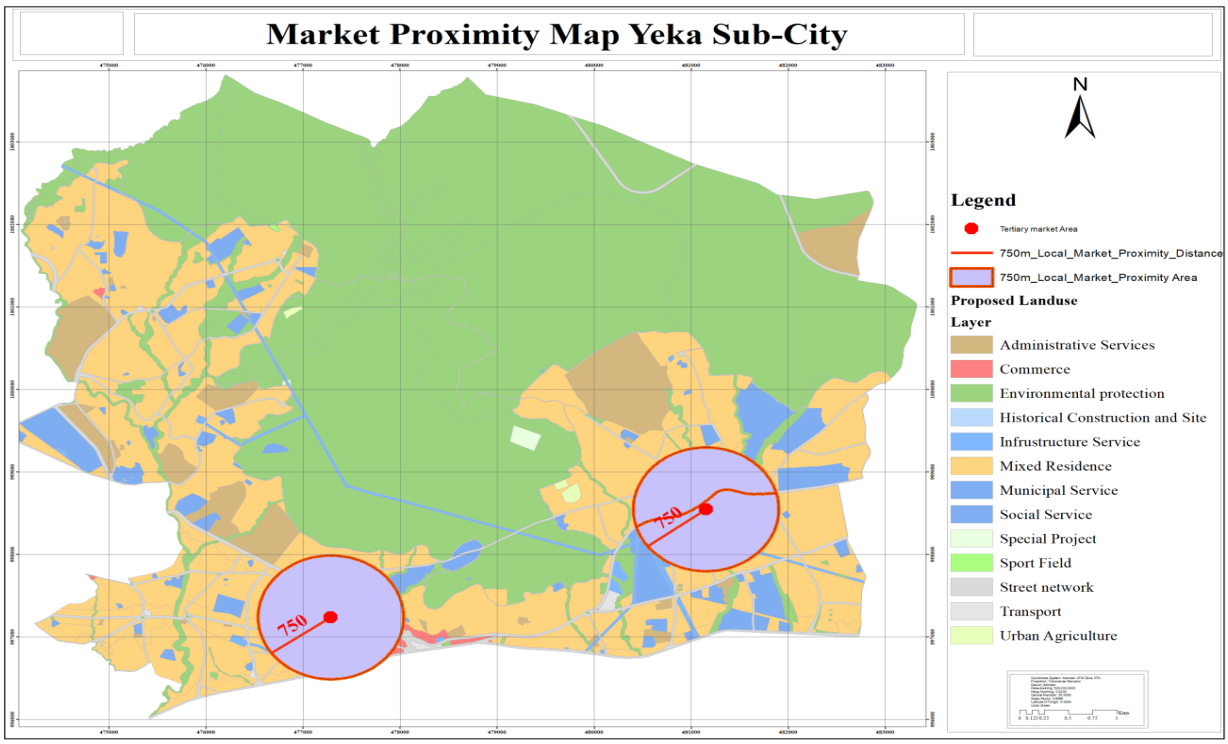

Figure 3.12 Market Proximity Map of Yeka Sub-City (750m)

Source: Own Computation Using GIS and Addis Ababa Structure Plan, 2017

Table 3.11 Proximity of Open Market Service in the Sub-City and Study Area

	500m			750m		
Sub city	Service area (m2)	Served population	SA per populatio n(m2)	Service area (m2)	Served population	SA per populatio n(m2)
Yeka	1570382.35	7852	199.99	3533667.46	17668	200

Source: Own Computation Using GIS Analysis, 2022

Table 3.12 Existing Urban Parks Coverage

urban parks	Area of sub city in hec.	Area in m^2	Area in hec.	Coverage in percent
Yeka sub city	9770.60	314182.16	31.42	0.322

Source: Own Computation Using GIS Analysis, 2022

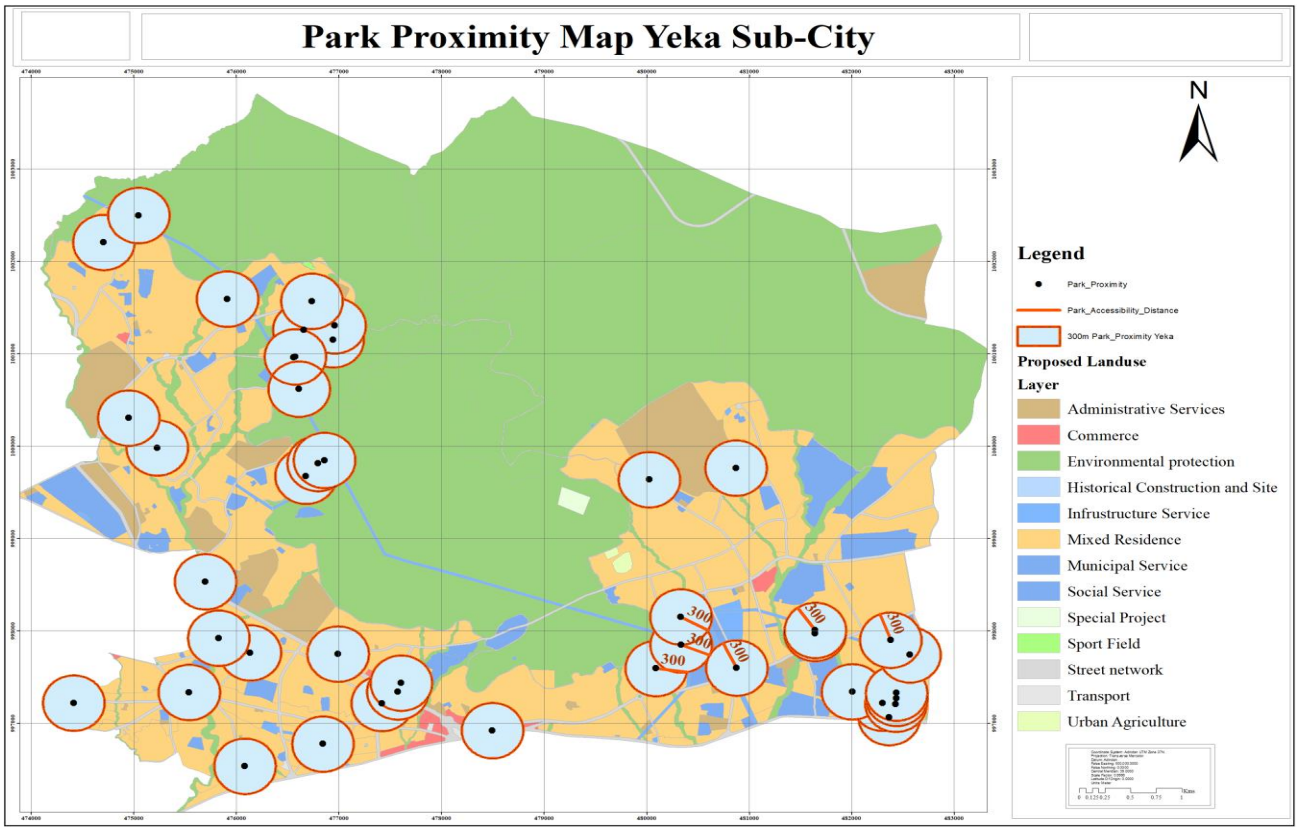

Figure 3.13 Urban Park Proximity Map of Yeka Sub-City

Source: Own Computation Using GIS and Addis Ababa Structure Plan, 2017

Table 3.13 Existing Urban Parks Coverage and Per-Capita in the Sub- City

Sub city	Area of sub city/study area	Total population	Population density/hec	Area in m^2	Area of urban parks (hec)	Coverage in %	Urban parks per capita (m2)
Yeka	9770.60	490003	50	314182.16	31.42	0.322	0.641

Source: Own Computation Using GIS Analysis, 2022.

Table 3.14 Proximity of Urban Parks in the Sub-City

Sub city	300meter(neighborhood level)		
	Service area (m2)	Served population	SA per population.(m2)
Yeka	8548827.54	42744	200

Source: Own computation using GIS Analysis, 2022

3.1.8.1. Accessibility and Proximity of Market Service and Urban Parks Service Per Capita

From the above analysis the Yeka Sub-City of urban park per capita is 0.641 m^2 which is very small compared with the minimum standard set by WHO ($9m^2$) and the large portion of the sub-city population (above 90%) has no access to urban parks within the minimum walking distance thresholds (300m) set by city structure plan. The majority of the sub -city residents are disadvantaged and forced to walk more than 300 m (91.28%) distance to use urban parks respectively.it is known that this forced distance impacts on location of different land use functions and impacts on trip length, trip frequency, and mode choice. Thus, individuals located within a service area were assumed to have better access and easily use that particular park daily than people distance away from a park (Sister et al. 2007). The accessibility was calculated based on the following equations:

For Sub-City

SAR = SAUP/ (TA – UPA)*100%

SAR=854.88/ (9770.60-31.42)

SAR =8.77%

AI = (NA/ NT) * 100%

AI = (42744/490003)*100%

AI = 8.72%

Where; SAR is a service area ratio, SAUP is a service area of urban park, TA is the total area of the sub city and UPA is urban park area. Where; AI is accessibility indicator, which measures the proportion of the urban population that lives within the service area of urban parks. NA is the number of urban inhabitants who live within the standard distance to the specific land use category. NT is the total number of urban inhabitants within the sub city or study area. Therefore, 8.72% has accessibility indicator of urban parks for yeka sub-city. The majority of Yeka sub-city residences have no access to green spaces and urban parks. But it is clear that providing universal access to green spaces and urban parks is a target of the sustainable development goals (SDGs) adopted by the international society in 2015(Huang *et al.*, 2017). However, the analysis can indicated that the environmental sustainability issue is not recognized and considered by the city administration.

Open Market Proximity for Sub-City (750m)

SAR = SAM/ (TA – MA)*100%

SAR = 353.37/ (9770.60-7.56)*100%

SAR = 3.62%

AI = (NA/ NT) * 100%

AI = (17668/490003)*100%

AI =3.61%

Open Market Proximity for Sub-City (500m)

SAR = SAM/ (TA – MA)*100%

SAR=157.04/ (9770.6-7.56)*100%

SAR=1.61%

AI = (NA/ NT) * 100%

AI = (7852/490003)*100%

AI =1.6%

Where; SAR is a service area ratio, SAM is a service area of open market, TA is the total area of the sub city or study area and MA is market area. Where; AI is accessibility indicator, which measures the proportion of the urban population that lives within the service area of urban parks. NA is the number of urban inhabitants who live within the standard distance to the specific land use category. NT is the total number of urban inhabitants within the sub city or study area.

From the above Proximity analysis of existing open markets services in the sub city shows that the service area within 500 m covered 157.04hec.(1.61%). while the service area within 750m covers 353.37hec (3.62%) of the residential area of sub-city. In addition, based on the accessibility indicator 1.6 % of the sub-city dwellers have access to existing open market within 500 m walking distance, and 3.61% of the sub-city dwellers have an access existing open market within 750 m walking distance.

4. Conclusions

Road network coverage is limited in the sub-city especially those Express, Principal arterial streets and Sub-Arterial streets are below standard, which created imbalance between the demand and supply of the transportation infrastructure. The absence of adequate transport infrastructures and weak traffic management are major factors behind transportation problems in the city.

Local street networks are narrow, not well paved and lead to dead ends, which is inaccessible by vehicles. Therefore, connecting the main center with sub-centers by connected roads and mass transport services is important.

From the proximity analysis of specific category of land use, it was concluded that the majority of the sub -city residents are disadvantaged and forced to walk more distance than set by the structure map of the city.it is known that this forced distance impacts on location of different land use functions and impacts on trip length, trip frequency, and mode choice.

Generally the main elements of integration that had seen earlier are not based on the standards that defined in the structure map of the city as well below the minimum international standards.so, solving the transportation system problems in the City as well as in Yeka Sub-City, coordinate transportation and other infrastructure planning, Design and implement according the international and local concepts is very essential for integrating transport and land use planning for sustainable development.

5. Abbreviations

AACRA	Addis Ababa City Road Authority
AATB	Addis Ababa Transport Bureau
AI	Accessibility Indicator
CS	Collector Street
NA	Number of urban inhabitants who live within the standard distance
NMT	Non Motor Transport
NT	Total number of urban inhabitants within the sub city or study area
MSA	Service Area of Open Market
PAS	Principal Arterial Street
SAS	Sub-Arterial Street
SAR	Service Area Ratio
TA	Total area of the Sub City or Study Area
TMA	Traffic Management Agency

6. Acknowledgements

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Annex: B, Questionnaire

For authorities involved in Land-Use planning and transport planning:

Integrating Transport and Land Use Planning Strategies for Sustainable Development in Addis Ababa

Dear respondent, this questionnaire prepared to obtain necessary data for the partial fulfillment of MSc thesis in urban planning at Addis Ababa University. The objective of this thesis is: Integrating transport and land use planning strategies for sustainable development in Addis Ababa

Therefore, the information you are going to give will help me to Integrating transport and land use planning strategies for sustainable development in Addis Ababa and suggest possible solutions. In this respect, you are the one who can give the correct information; hence I kindly request you to respond to these questions. I would like to confirm that the information you provide me will be kept strictly confidential and will not be shown to other persons. As such the quality of this study highly depends on the information provided by you. If you have any inquiry, please contact through the following addresses.

Yigzaw Shewaye

Post Graduate Student at A.A University, Ethiopian Institute of Architecture, Building Construction and City Development, in Urban Planning stream.

Thank you in advance for your valuable cooperation

Part One: General Information

1. Please specify your position in the organization _____

2. Educational Background

☐ Graduate (MSC) ☐ Undergraduate (BSC) ☐ Diploma, if other, please specify_____

3. Years of experience in the sector

☐ < 1 year ☐ 1 - 3 years ☐ 3 - 5 years ☐ 5 - 10 years

☐ 10 – 15 years ☐ 15 - 20 years ☐ > 20 years

PART TWO: The major barriers for integration of land use and transport

Below are the major possible barriers to integration of land use and transport. Rank on a scale of 1-5 to what level these barriers affects to its integration by ticking (X or √) in the box representing your selection.

No	Attribute	1	2	3	4	5
		Not barrier	Insignificant barrier	Quite barrier	Significant barrier	Major barrier
1	Lack of regional coordination at the metropolitan level					
2	Sector silo behavior and practices at the city level:					
3	Inadequate policies and regulations for strategically creating articulated densities					
4	Restrictive national regulations and administrative constraints					
5	Inconsistencies in the planning instruments and deficiencies in their implementation:					
6	Inadequate policies, regulations, and supporting mechanisms for redeveloping built-up areas:					
7	Neglected urban design at the neighborhood and street level					
8	Financial Constraints					

Please specify if there are any other major barriers to integration of land use and transport?

_____
_____
_____
_____

PART THREE: - The possible enabling mechanisms for land use transport integration

Below are possible enabling mechanisms that contribute to enhance land use transport integration? Please rank on a scale of 1-5the level of contribution of these mechanisms for land use transport integration by ticking (X or √) in the box representing your selection.

No	Attribute	**1** Not mechanism	**2** Insignificant mechanism	**3** Quite mechanism	**4** Significant mechanism	**5** Major mechanism
1	Integrating Land-Use and Transport in the Planning Process					
2	Institutional Integration and Legal Mechanism					
3	Financial Requirements					
4	Capacity Building					
5	Stakeholder Identification					

Please specify if there are any other the possible enabling mechanisms for land use transport integration_____

_____

_____

_____

Thank you for your cooperation

Check list for interview higher officials

For authorities involved in land use planning:

Which organizations are involved in land use planning in the city and how much control do they have?

Planning and Policy area	Federal Government	City Government	Private Org.
Land-Use Planning Policy			
Master Plan of the City			
Building Regulations			
Policy Environment Study			

Does the land use plan account for the transportation impacts of land development?	Does not account	Only for certain development projects	For most projects	For all projects

- How do you characterize the working relationship of your organization with the Addis Ababa transport Bureau?
- How do you evaluate the level of involvement of the Addis Ababa transport Bureau in the land use planning decision process of your organization?
- What do you think is the best approach to solve this problem? How important is integrated planning making to solve the problems?

For authorities involved in transport planning:

- How do you characterize the working relationship of your organization with the Addis Ababa plan development commission or Land development and Administration Bureau?
- Does your organization give trainings on participation or collaborative approaches to policy making or implementers?
- How much impact does the land use development plans have on the transport policy?
- Does your organization's have transport zoning? If yes, how do you integrate this with land use zoning of the city?

Annex: C Population Forecast of Addis Ababa Sub-Cities

	population forcast of addis ababa sub-cities											
Year	Addis Ketema	Arada	Lideta	Kirkos	Gullele	Kolfe Keraniyo	Nefas Silk-Lafto	Yeka	Bole	Akaki Kaliti	Total	$p_t = p_o e^{r*t}$
2014	297793	246680	235246	258035	312096	500163	368883	404336	360387	211380		pt-total population
2015	305,058	252,705	240,989	264,637	319,712	512,369	377,892	414,212	369,189	216,538		po-base opulation
2016	312,414	258,808	246,805	270,721	327,426	524,729	387,017	424,21	378,104	221,759		r-growth rate
2017	320,053	265,141	252,842	277,346	335,434	537,561	396,486	434,599	387,355	227,182		t- year
2022	360854.26	298941.92	285075.01	312702.85	378196.07	606090.79	447031.15	490002.91	436736.11	256143.80	3871774.887	

Annex: D Analysis Sheet

	Addis Ababa Transport Bureau											
No		Not barriers		insignificant barriers		Quite barriers		Significant barriers		Major barriers		
		1		2		3		4		5		
	Attribute	number	product	numbe	product	number	product	number	product	numbe	product	MS
1	Lack of regional coordination at the metropolitan level	0	0	1	2	3	9	2	8	4	20	3.90
			0		0		0		0		0	0.00
2	Sector silo behavior and practices at the city level:	0	0	1	2	3	9	4	16	2	10	3.70
3	Inadequate policies and regulations for strategically creating articulated densities	2	2	2	4	2	6	1	4	3	15	3.10
4	Restrictive national regulations and administrative constraints	0	0	3	6	3	9	1	4	3	15	3.40
5	Inconsistencies in the planning instruments and deficiencies in their implementation:	0	0	0	0	2	6	4	16	4	20	4.20
6	Inadequate policies, regulations, and supporting mechanisms for redeveloping built-up areas:	2	2	2	4	3	9	1	4	2	10	2.90
7	Neglected urban design at the neighborhood and street level	0	0	1	2	3	9	4	16	2	10	3.70
8	Financial constraints	0	0	0	0	3	9	2	8	5	25	4.20

	plan and development commission											
No		Not barriers		insignificant barriers		Quite barriers		Significant barriers		Major barriers		
				2		3		4		5		
	Attribute	number	product	numbe	product	number	product	number	product	numbe	product	MS
1	Lack of regional coordination at the metropolita	0	0	0	0	4	12	7	28	4	20	4.00
2	Sector silo behavior and practices at the city lev	0	0	2	4	3	9	6	24	4	20	3.80
3	Inadequate policies and regulations for strategically creating articulated densities	1	1	3	6	4	12	5	20	2	10	3.27
4	Restrictive national regulations and administrative constraints	1	1	0	0	3	9	5	20	2	10	2.67
5	Inconsistencies in the planning instruments and deficiencies in their implementation:	2	2	1	2	3	9	4	16	5	25	3.60
6	Inadequate policies, regulations, and supporting mechanisms for redeveloping built-up areas:	2	2	3	6	4	12	5	20	1	5	3.00
7	Neglected urban design at the neighborhood and street level	0	0	0	0	3	9	7	28	5	25	4.13
8	Financial constraints	0	0	0	0	3	9	8	32	4	20	4.07

	Traffic management agency											
No		Not barriers		insignificant barriers		Quite barriers		Significant barriers		Major barriers		
		1		2		3		4		5		
	Attribute	number	product	numbe	product	number	product	number	product	numbe	product	MS
1	Lack of regional coordination at the metropolitan level	0	0	4	8	4	12	4	16	5	25	3.59
2	Sector silo behavior and practices at the city level:	3	3	1	2	3	9	6	24	4	20	3.41
3	Inadequate policies and regulations for strategically creating articulated densities	3	3	4	8	5	15	2	8	3	15	2.88
4	Restrictive national regulations and administrative constraints	2	2	4	8	6	18	3	12	2	10	2.94
5	Inconsistencies in the planning instruments and deficiencies in their implementation:	0	0	2	4	4	12	5	20	6	30	3.88
6	Inadequate policies, regulations, and supporting mechanisms for redeveloping built-up areas:	2	2	2	4	5	15	3	12	5	25	3.41
7	Neglected urban design at the neighborhood ar	0	0	3	6	4	12	6	24	4	20	3.65
8	Financial constraints	0	0	3	6	3	9	6	24	5	25	3.76

	Addis Ababa city Road Authority											
No		Not barriers		insignificant barriers		Quite barriers		Significant barriers		Major barriers		
		1		2		3		4		5		
	Attribute	number	product	numbe	product	number	product	number	product	numbe	product	MS
1	Lack of regional coordination at the metropolitan level	0	0	1	2	2	6	2	8	4	20	4.00
2	Sector silo behavior and practices at the city level:	0	0	1	2	2	6	3	12	3	15	3.89
3	Inadequate policies and regulations for strategically creating articulated densities	0	0	3	6	3	5	2	8	1	5	2.67
4	Restrictive national regulations and administrative constraints	2	2	2	4	2	6	2	8	1	5	2.78
5	Inconsistencies in the planning instruments and deficiencies in their implementation:	0	0	2	4	2	6	2	8	3	15	3.67
6	Inadequate policies, regulations, and supporting mechanisms for redeveloping built-up areas:	2	2	1	2	3	9	1	4	2	10	3.00
7	Neglected urban design at the neighborhood ar	0	0	2	4	2	6	3	12	2	10	3.56
8	Financial constraints	0	0	1	2	2	6	3	12	3	15	3.89

Enabling mechanisms/solutions / for the achievement of sound transport system through efficient integration of transport and land use planning strategies

	Addia Ababa Transport Bureau											
No		Not mechanism		insignificant mechanism		Quite mechanism		Significant mechanism		Major mechanism		
		1		2		3		4		5		
	Attribute	number	product	numbe	product	number	product	number	product	numbe	product	MS
1	Integrating land use and transport in the planning process	0	0		0	2	6	3	12	5	25	4.30
2	Institutional integration and legal mechanism	0	0		0	3	9	5	20	2	10	3.90
3	Financial requirements	0	0	3	6	2	6	3	12	2	10	3.40
4	Capacity building	0	0	1	2	1	3	4	16	4	20	4.10
5	Stakeholder identification	0	0	1	2	3	9	3	12	3	15	3.80

	plan and development commission											
No		Not mechanism		insignificant mechanism		Quite mechanism		Significant mechanism		Major mechanism		
				2		3		4		5		
	Attribute	number	product	numbe	product	number	product	number	product	numbe	product	MS
1	Integrating land use and transport in the planni	0	0		0		0	6	24	9	45	4.60
2	Institutional integration and legal mechanism	0	0		0		0	5	20	10	50	4.67
3	Financial requirements	0	0		0	2	6	7	28	6	30	4.27
4	Capacity building	0	0		0		0	8	32	7	35	4.47
5	Stakeholder identification	0	0	2	4	3	9	6	24	4	20	3.80

	Traffic management agency											
No		Not mechanism		insignificant mechanism		Quite mechanism		Significant mechanism		Major mechanism		
						3		4		5		
	Attribute	number	product	numbe	product	number	product	number	product	numbe	product	MS
1	Integrating land use and transport in the planni	0	0		0	1	3	7	28	9	45	4.47
2	Institutional integration and legal mechanism	0	0		0	1	3	5	20	11	55	4.59
3	Financial requirements	0	0		0	3	9	9	36	5	25	4.12
4	Capacity building	0	0		0	2	6	8	32	7	35	4.29
5	Stakeholder identification	0	0	3	6	4	12	6	24	4	20	3.65

	Addis Ababa City Road Authority											
No		Not mechnism		insignificant mechanism		Quite mechanism		Significant mechanism		Major mechanism		
		1		2		3		4		5		
	Attribute	number	product	numbe	product	number	product	number	product	numbe	product	MS
1	Integrating land use and transport in the planni	0	0	0	0	2	6	3	12	4	20	4.22
2	Institutional integration and legal mechanism	0	0		0	2	6	2	8	5	25	4.33
3	Financial requirements	0	0	1	2	3	9	4	16	1	5	3.56
4	Capacity building	0	0		0	2	6	4	16	3	15	4.11
5	Stakeholder identification	0	0	3	6	1	3	3	12	2	10	3.44

Annex: E, Correlation Test Sheet

		AATB		AAPADC					
		MS	rank	MS	rank	d	d^2		
1	Lack of regional coordination at the metropolitan level	3.9	3	4	3	0	0		
2	Sector silo behavior and practices at the city level:	3.7	4.5	3.93	4	0.5	0.25		
3	Inadequate policies and regulations for strategically creating articulated densities	3.1	7	3.27	6	1	1		
4	Restrictive national regulations and administrative constraints	3.4	6	2.67	8	-2	4		
5	Inconsistencies in the planning instruments and deficiencies in their implementation:	4.2	1.5	3.6	5	-3.5	12.25		
6	Inadequate policies, regulations, and supporting mechanisms for redeveloping built-up areas:	2.9	8	3	7	1	1		
7	Neglected urban design at the neighborhood and street level	3.7	4.5	4.13	1	3.5	12.25		
8	Financial constraints	4.2	1.5	4.07	2	-0.5	0.25		
						sum	**31**		
							$6*d^2$	186	
						n=8	n^3-n	504	
									0.369048
								1	
								R	**0.630952**

		AATMA		AACRA					
		MS	rank	MS	rank	d	d^2		
1	Lack of regional coordination at the metropolitan level	3.59	4	4	1	3	9		
2	Sector silo behavior and practices at the city level:	3.41	5.5	3.89	2.5	3	9		
3	Inadequate policies and regulations for strategically creating articulated densities	2.88	7	2.67	8	-1	1		
4	Restrictive national regulations and administrative constraints	2.94	8	2.78	7	1	1		
5	Inconsistencies in the planning instruments and deficiencies in their implementation:	3.88	1	3.67	4	-3	9		
6	Inadequate policies, regulations, and supporting mechanisms for redeveloping built-up areas:	3.41	5.5	3	6	-0.5	0.25		
7	Neglected urban design at the neighborhood and street level	3.65	3	3.56	5	-2	4		
8	Financial constraints	3.76	2	3.89	2.5	-0.5	0.25		
						sum	**33.5**		
							$6*d^2$	201	
						n=8	n^3-n	504	
									0.39881
								1	
								R	**0.60119**

		AAPADC		AATMA					
		MS	rank	MS	rank	d	d^2		
1	Lack of regional coordination at the metropolitan level	4	3	3.59	4	-1	1		
2	Sector silo behavior and practices at the city level:	3.93	4	3.41	5.5	-1.5	2.25		
3	Inadequate policies and regulations for strategically creating articulated densities	3.27	6	2.88	7	-1	1		
4	Restrictive national regulations and administrative constraints	2.67	8	2.94	8	0	0		
5	Inconsistencies in the planning instruments and deficiencies in their implementation:	3.6	5	3.88	1	4	16		
6	Inadequate policies, regulations, and supporting mechanisms for redeveloping built-up areas:	3	7	3.41	5.5	1.5	2.25		
7	Neglected urban design at the neighborhood and street level	4.13	1	3.65	3	-2	4		
8	Financial constraints	4.07	2	3.76	2	0	0		
						sum	**26.5**		
							$6*d^2$	159	
						n=8	n^3-n	504	
									0.315476
								1	
								R	**0.684524**

		AATB		AACRA					
		MS	rank	MS	rank	d	d^2		
1	Lack of regional coordination at the metropolitan level	3.9	3	4	1	2	4		
2	Sector silo behavior and practices at the city level:	3.7	4.5	3.89	2.5	2	4		
3	Inadequate policies and regulations for strategically creating articulated densities	3.1	7	2.67	8	-1	1		
4	Restrictive national regulations and administrative constraints	3.4	6	2.78	7	-1	1		
5	Inconsistencies in the planning instruments and deficiencies in their implementation:	4.2	1.5	3.67	4	-2.5	6.25		
6	Inadequate policies, regulations, and supporting mechanisms for redeveloping built-up areas:	2.9	8	3	6	2	4		
7	Neglected urban design at the neighborhood and street level	3.7	4.5	3.56	5	-0.5	0.25		
8	Financial constraints	4.2	1.5	3.89	2.5	-1	1		
						sum	**21.5**		
							$6*d^2$	129	
						n=8	n^3-n	504	
									0.255952
								1	
								R	**0.744048**

		AATB		AATMA					
		MS	rank	MS	rank	d	d^2		
1	Lack of regional coordination at the metropolitan level	3.9	3	3.59	4	-1	1		
2	Sector silo behavior and practices at the city level:	3.7	4.5	3.41	5.5	-1	1		
3	Inadequate policies and regulations for strategically creating articulated densities	3.1	7	2.88	7	0	0		
4	Restrictive national regulations and administrative constraints	3.4	6	2.94	8	-2	4		
5	Inconsistencies in the planning instruments and deficiencies in their implementation:	4.2	1.5	3.88	1	0.5	0.25		
6	Inadequate policies, regulations, and supporting mechanisms for redeveloping built-up areas:	2.9	8	3.41	5.5	2.5	6.25		
7	Neglected urban design at the neighborhood and street level	3.7	4.5	3.65	3	1.5	2.25		
8	Financial constraints	4.2	1.5	3.76	2	-0.5	0.25		
						sum	**15**		
							$6*d^2$	90	
						n=8	n^3-n	504	
									0.178571
								1	
								R	**0.821429**

		Aapadc		AACRA					
		MS	rank	MS	rank	d	d^2		
1	Lack of regional coordination at the metropolitan level	4	3	4	1	2	4		
2	Sector silo behavior and practices at the city level:	3.93	4	3.89	2.5	1.5	2.25		
3	Inadequate policies and regulations for strategically creating articulated densities	3.27	6	2.67	8	-2	4		
4	Restrictive national regulations and administrative constraints	2.67	8	2.78	7	1	1		
5	Inconsistencies in the planning instruments and deficiencies in their implementation:	3.6	5	3.67	4	1	1		
6	Inadequate policies, regulations, and supporting mechanisms for redeveloping built-up areas:	3	7	3	6	1	1		
7	Neglected urban design at the neighborhood and street level	4.13	1	3.56	5	-4	16		
8	Financial constraints	4.07	2	3.89	2.5	-0.5	0.25		
						sum	**29.5**		
							$6*d^2$	177	
						n=8	n^3-n	504	
									0.35119
								1	
								R	**0.64881**

Enabling mechanisms/solutions / for the achievement of sound transport system through efficient integration of transport and land use planning strategies.

		AATB		AAPADC							
		MS	rank	MS	rank	d	d^2				
1	Integrating land use and transport in the planning process	4.3	1	4.6	2	-1	1				
2	Institutional integration and legal mechanism	3.9	3	4.67	1	2	4				
3	Financial requirements	3.4	5	4.27	4	1	1				
4	Capacity building	4.1	2	4.47	3	-1	1				
5	Stakeholder identification	3.8	4	3.8	5	-1	1				
						sum	**8**				

	$6*\Sigma d^2$	48	
n=8	n^3-n	120	
			0.4
		1	
		R	**0.6**

		AATMA		AACRA					
		MS	rank	MS	rank	d	d^2		
1	Integrating land use and transport in the planning process	4.47	2	4.22	2	0	0		
2	Institutional integration and legal mechanism	4.59	1	4.33	1	0	0		
3	Financial requirements	4.12	4	3.56	4	0	0		
4	Capacity building	4.29	3	4.11	3	0	0		
5	Stakeholder identification	3.65	5	3.44	5	0	0		
						sum	**0**		

	$6*\Sigma d^2$	0	
n=8	n^3-n	120	
			0
		1	
		R	**1**

		AAPADC		AACRA					
		MS	rank	MS	rank	d	d^2		
1	Integrating land use and transport in the planning process	4.6	2	4.22	2	0	0		
2	Institutional integration and legal mechanism	4.67	1	4.33	1	0	0		
3	Financial requirements	4.27	4	3.56	4	0	0		
4	Capacity building	4.47	3	4.11	3	0	0		
5	Stakeholder identification	3.8	5	3.44	5	0	0		
						sum	**0**		
							$6*\Sigma d^2$	0	
						n=8	n^3-n	120	
									0
								1	
								R	**1**

		AATB		AATM					
		MS	rank	MS	rank	d	d^2		
1	Integrating land use and transport in the planning process	4.3	1	4.47	2	-1	1		
2	Institutional integration and legal mechanism	3.9	3	4.59	1	2	4		
3	Financial requirements	3.4	5	4.12	4	1	1		
4	Capacity building	4.1	2	4.29	3	-1	1		
5	Stakeholder identification	3.8	4	3.65	5	-1	1		
						sum	**8**		
							$6*\Sigma d^2$	48	
						n=8	n^3-n	120	
									0.4
								1	
								R	**0.6**

		AAPADC		AATMA					
		MS	rank	MS	rank	d	d^2		
1	Integrating land use and transport in the planning process	4.6	2	4.47	2	0	0		
2	Institutional integration and legal mechanism	4.67	1	4.59	1	0	0		
3	Financial requirements	4.27	4	4.12	4	0	0		
4	Capacity building	4.47	3	4.29	3	0	0		
5	Stakeholder identification	3.8	5	3.65	5	0	0		
						sum	**0**		

	$6*\Sigma d^2$	0	
n=8	n^3-n	120	
			0
		1	
		R	**1**

		AATB		AACRA					
		MS	rank	MS	rank	d	d^2		
1	Integrating land use and transport in the planning process	4.3	1	4.22	2	-1	1		
2	Institutional integration and legal mechanism	3.9	3	4.33	1	2	4		
3	Financial requirements	3.4	5	3.56	4	1	1		
4	Capacity building	4.1	2	4.11	3	-1	1		
5	Stakeholder identification	3.8	4	3.44	5	-1	1		
						sum	**8**		

	$6*\Sigma d^2$	48	
n=8	n^3-n	120	
			0.4
		1	
		R	**0.6**

Annex: F, Location of Parking Facilities

በምዕራብቅ/ፅ/ቤት(በልደታ እና ኮ/ቀራንዮ ክ/ከተሞች)የሰርፌስ ፓርኪንግ እና በመንገድ ዳ

ተ/ቁ	የማህበሩ ስም			ክ/ከተ	ወረዳ	የስራ ቦታው ልዩ ስሙ	የአባላት ብዛት			የቆይታ ጊዜ/የውል ዘመን		
		የሰብሳቢው ስ	ስ.ቁጥር				ወንድ	ሴ	ድምር	መጀመሪያ ስራ የጀመሩበት ና ውል የተዋዋሉበት ቀን	የውል ጊዜው የሚጠናቀቅበት ቀን	ፓርኪንጉ አይነት
1	መህዲ ሄኖክ እና ጓደኞቻቸው የፓርኪንግ ስራ ህ/ሽ/ማ	መህዲ አወል	911186201	ልደታ	8	ጨለለቅ ህንጻ -ዛግዌ ህንፃ	6	4	10	27/11/2012	26/11/2014	የመንገድ ዳር
2	ልኡል አቤል እና ጓደኞቻቸው የፓርኪንግ ስራ ህ/ሽ/ማ	አቤል ከተማ	09 12643059	ልደታ	4	ልደታ ፍርድ ቤት- ህንጻኮሌጅ	7	4	11	15/02/2013	14/11/2015	የመንገድ ዳር
3	ናትናኤልሃብታሙ እና ጓደኞቻቸው የፓርኪንግ ስራ ህ/	ናትናኤል ሙሉ	947449392	ልደታ	2	ከዋልያ ፐብሊክ -ዜድ የውበት ሳ	8	2	10	19/3/2011	18/3/2013	የመንገድ ዳር
4	ያሬድ ጎሳ እና ጓደኞቻቸው የፓርኪንግ ስራ ህ/ሽ/ማኅበ	ያሬድ ጣሰው	920813493	ልደታ	4	ከከፍተኛ ፍርድ ቤት - ህንጻ ኮሌ	8	3	11	26/11/2013	25/11/2015	የመንገድ ዳር
5	ሄኖክ አስራት እና ጓደኞቻቸው የፓርኪንግ ስራ ህ/ሽ/ማ	ሄኖክ ያሲን	913932868	ልደታ	9	ከኮሜርስ-ብሄራዊ ፊት ለፊት	7		7	12/12/2012	11/12/2014	የመንገድ ዳር
6	አቤል ደሳለኝ እናጓደኞቻቸው የፓርኪንግ ስራ ህ/ሽ/ማ	አቤል ቢተው	947806832	ልደታ	9	ከዳሽንባንክ እስከ ንግድ ባንክ	12		12	16/9/2012	15/9/2014	የመንገድ ዳር
7	ሶሻል የፓርኪንግ አገልግሎት ህ/ሥ/ማህበር	ሙልተዘም መ	923713501	ኮልፌ	4	ከአለም ባንክ አካባቢ-ቤተል አደ	10	5	15	21/12/2012	20/12/2014	የመንገድ ዳር
8	አገልግሎት ሕ/የተሽከርካሪ ማቆሚያ አገልግሎት ሰጪ ማሕበር	ኢዮብ ሰለሞን	940834353	ልደታ	8	ከኑር ህንፃ-ቢጂአይ	7	0	7	18/12/2012	17/12/2014	የመንገድ ዳር
9	ቴዎድሮስ፤ዮሴፍ እና ጓደኞቻቸው የተሽከርካሪ ማቆሚያ አገልግሎት ህ/የተሽከርካሪ ማቆሚያ አገልግሎት ሰጪ	ሃብታሙ ገዛኸኝ	910363726	ልደታ	4	ከጥቁር አንበሳ-ሜትሮሎጂ	5	0	5	28/11/2012	27/11/2014	የመንገድ ዳር
10	ጉልላት፤እንዳለ እና ጓደኞቻቸው የፓርኪንግ ስራ ህ/ሽ/	ጉልላት ወልዴ	912483889	ልደታ	9	ከሞላ ማሩ ጨፍ -አብነት ጨፍ	6	1	7	12/4/2012	11/4/2014	የመንገድ ዳር
11	ትግስት፤ አገኘሁሽ እናጓደኞቻቸው የፓርኪንግ ስራ ህ/ሽ	ትግስት የሺጥላ	911182365	ልደታ	8	ከባልቻ ሆስፒታልእስከ በላይ ተ	4	8	12	1/11/2012	30/11/2014	የመንገድ ዳር
12	በሱፍቃድ፤ መሃሪ እናጓደኞቻቸው የፓርኪንግ ስራ ህ/ሽ	በርሱፍቃድ ማ	912196309	ልደታ	4	ከአብደላ ህንጻፊትለፊት-40ቀበ	10		10	4/11/2012	3/11/2014	የመንገድ ዳር
13	ሃይለኢየሱስ እናጓደኞቻቸው የፓርኪንግ ስራ ህ/ሽ/ማ	ሃይለኢየሱስ ሽር	912453242	ልደታ	2	ከአባጅፋር መስጊድ እስከ እየሱ	11	1	12	15/01/2013	14/1/2015	የመንገድ ዳር
14	አዶኒያስ፤ኤፍሬምእና ጓደኞቻቸው የፓርኪንግ ስራ ህ/ሽ	አዶኒያስ ጌታሁ	991177671	ልደታ	9	ከዲያፍሪክ ጨፍ -5ኛ ፖሊስ ጣቢያ መሰቀለኛ	3	0	3	18/2/2013	17/02/0215	የመንገድ ዳር
15	ዲሮ፤ ያሬድ እና ጓደኞቻቸው የፓርኪንግ ስራ ህ/ሽ/ማ	ዲሮ ሻሽ	920332154	ልደታ	8	ከአረቄ ፋብሪካ- 5ኛፖሊስ ጣቢያ መስቀለኛ ጨፍ	5	0	5	27/02/2013	26/02/2015	የመንገድ ዳር
16	አዲሱ ፤ቸርነት እና ጓደኞቻቸው የፓርኪንግ ስራ ህ/ሽ/	አዲሱ ፍቃዱ	921320768	ልደታ	9	ከሰንጋ ተራ ኮንደ ሚኒየም-40/60 እና አክሲዮን	9	10	19	13/04/2013	12/4/2015	የመንገድ ዳር
17	ኮካኮላ፤አካባቢው እናጓደኞቻቸው የፓርኪንግ ስራ ህ/ሽ	ኑር አዲስ	911114961	ልደታ	4	አሜን ሆቴል- ኮካኮላ	4	10	14	15/04/2013	14/04/2015	የመንገድ ዳር
18	ባወቀ፤ ደሳለኝ እና ጓደኞቻቸው የፓርኪንግ ስራ ህ/ሽ/	ባወቀ ፈረደ	919065971/0	ልደታ	7	ከጥቁር አንበሳ ነዳጅ ማደያ-ተክለሃይማኖት ንግድ ባንክ	9	1	10	30/04/2013	29/04/2015	የመንገድ ዳር
19	ትግስት፤ አይናለም እና ጓደኞቻቸው የፓርኪንግ ስራ ህ/	ትግስት አሰፋ	901101411	ልደታ	3	ተክለሃይማኖት	0	3	3	25/04/2013	24/04/2015	የመንገድ ዳር
20	ኤርምያስ፤ ሙሉወርቅ እናጓደኞቻቸው የፓርኪንግ ስራ	ኤርምያስ ዳንኤ	913924665	ልደታ	7	ዩቤክ ህንፃ	10	0	10	25/04/2013	24/04/2015	የተከለለ
21	ገበየሁ በላይነህ እናጓደኞቻቸው የፓርኪንግ ስራ ህ/ሽ/	ገበየሁ መንግስ	913932950	ልደታ	7	ዩቤክ ህንፃ	10	0	10	25/04/2013	24/04/2015	የተከለለ
22	አብድረዛቅ፤ መቅቡል እናጓደኞቻቸው የፓርኪንግ ስራ ሀ	አብድረዛቅ ቁል	920329907	ልደታ	7	ዩቤክ ህንፃ	9	0	9	24/04/2013	23/04/2015	የተከለለ
23	ማዕረግ ሽኩር እና ጓደኞቻቸው የፓ/አ/ህ/ሽ/ማ	ማዕረግ ዳሩ	922401626	ልደታ	9	ዳሽን ባንክ ዋ/መ/ቤት እስከ ከተማ ልማት አካባቢ	9	1	10	21/10/2013	21/10/2015	የመንገድ ዳር
24	ያሬድ ይሳቅ እና ጓደኞቻቸው የፓ/አ/ህ/ሽ/ማ	ያሬድ አፈወርቅ	923935317	ልደታ	3	ኮካ ፋብሪካ እስከ ጦርሀይሎች ማዞሪያ	5	0	5	8/10/2013	8/10/2015	የመንገድ ዳር
25	ቢኒያም ኤርሚያስ እና ጓደኞቻቸው የፓ/አ/ህ/ሽ/ማ	ኤሚያስ አንሳ	933685250	ልደታ	9	ሰንጋ ተራ ኮንዶሚኒየም 40/60	5	0	5	13/06/2013	13/06/2015	የመንገድ ዳር
26	ሰለሞን ዮሴፍ ደጀኔ እና ጓ/የፓ/አ/ህ/ሽ/ማህበር	ሰለሞን ደጉ		ን/ስ/	3	ከመና ሆቴል እስከ አቦ ቤተክርስ	6		6	15/11/2013	14/11/2015	መንገድ ዳር
27	ቢንያም ተስፋዬ አያኖ እና ጓ/የፓ/አ/ህ/ሽ/ማህበር	ቢንያም ታምራ	0920-72-80-5	ን/ስ/	3	ከግሩም ሽሮ ቤት እስከ ሴቭ ዘ	4		4	6/12/2013	5/12/2015	መንገድ ዳር
28	እስክንድር መንግስቱ አበበ እና ጓደኞቻቸው የመኪና ፓ	እስክንድር ሄነሪ	912618064	ን/ስ/	3	ሱፐር ማርኬት በስተግራ በኩል እና በስተቀኝ ከ	4	0	4	14/9/2013	14/9/2015	የመንገድ ዳር
29	እንዳልካቸው አለምዘርፍ በረከት እና ጓ/የፓ/አ/ህ/ሽ/ማ	እዳልካቸዉ አበ	910684078	ን/ስ/	3	ከቴሌ ጨፍ መነሻ በማድረግ በስተግራ በኩል እስከ መቻሬ ሜዳ	5	0	5	14/08/2013	13/08/2015	የመንገድ ዳር
30	ፍቃዱ፡አብዲ ፡ሚፍታ እና ጓደኞቻቸው	ፍቃዱ ወዳጆ	900818027	ን/ስ/	3	ከአፍሪካ ኢንሹራንስ-እስኩል ኦፍ ቱሞሮ	6		6	10/06/21013	9/6/2015	የመንገድ ዳር
31	አዲስዓለም፤ ከድር፤ሽመልስ እና ጓደኞቻቸው የፓርኪንግ	አዲስአለም ታመነ	912712204	ን/ስ/	3	መስማት ከተሳናቸው ት/ቤት-አቦ ማዞሪያ ግራእና ቀኝ	5	0	5	30/03/2013	29/03/2015	የመንገድ ዳር
32	ተስፋ፤ ያሬድ እና ጓ/የፓ/አገ/ህ/ሽ/ማ	ተስፋ ገ/መስቀል	912065102	ን/ስ/	3	ሙልሙል ዳቦ ቤት	4	0	4	02/02/2013	01/02/2015	የመንገድ ዳር
33	ሰየመ፤ ቸርነት እና ጓ/የፓ/አገ/ህ/ሽ/ማ	ሰየመ ሞገስ	945802629	ን/ስ/ላፍቶ		ከኤም ኤን ኤም በርገር-ቴኒስ ክ	3	1	4	26/01/2013	25/01/2015	የመንገድ ዳር
34	አብዱረሃቅ፤ አብድልሙ ፤ ኢዝ ተባረክ እና ጓ/የፓ/አገ/ህ/ሽ/ማ	አብደረዛቅ ነስሩ	922482309	ን/ስ/	3	ምስራቅ ጨፍ-ግራር ጨፍ ግራና ቀኝ	5	0	5	02/03/2013	01/03/2015	የመንገድ ዳር
35	ሲሳይ፤ አስናቀች እና ጓ/የፓ/አገ/ህ/ሽ/ማ	ሲሳይ ፀጋ	940146604	ን/ስ/	3	አደባባይ ቀኝ እና ግራ	4	2	6	12/02/2013	11/02/2015	የመንገድ ዳር
36	ሳሙኤል ፤ሰለሞን እና ጓደኞቻቸው የፓርኪንግ ስራ ህ/ሽ/ማ	ሰለሞን ሽብሩ	920351422	ን/ስ/	3	ሳር ቤት አካባቢ	10	0	10	02/3/2013	1/3/2015	የመንገድ ዳር
37	ኢሳያስ መለስ ተፈሪን ጓዶኞቹ ሕብረት ሽርክና ማህበር የፓርኪንግ አስተዳደር ስራ	ኢሳያስ አርአያ	919320378	ን/ ስል	3	ሳር ቤት -ብስራት ገብሬል	5	2	7	8/3/2012	7/3/2014	የመንገድ ዳር
38	ሃብታሙ ግርማ		912359536			ላፍቶ ሞል						
39	ሄኖክ እንዳለ እና ጓደኞቹ ህ/ሽ/ማ	ሄኖክ ዳንኤል	988179041	ን/ስ/ ላፍቶ	3	ሸዋ ሱፐር ማርኬት ጀርባ ከ ኤም ኤን ኤም በርገር እስከ ውሁ ልማት	3	0	3	21/4/2014	20/4/2014	መንገድ ዳር
40	ሙሉጌታ፤ ፈቀደ እና ጓደኞቻቸው የፓ/አ/ህ/ሽ/ማ	ሙሉጌታ አባቡ	0940240650 /	ልደታ	10	ህብረት ባንክ ጀርባ አካባቢ	7	_	7	20/11/2013	19/11/2015	መንገድ ዳር
41	ሚኪኤሌ እና ታምራት እና ጓደኞቻቸው የፓ/አ/ህ/ሽ/	ሚካኤል ክፍያለ	986111559	ልደታ	9	ቢፍቱ ህንፃ ገርባ	5	-	5	26/01/204	25/11/2016	መንገድ ዳር
42	ናትናኤል እና ክበበው እና ጓደኞቻቸው የፓ/አ/ህ/ሽ/ማ	ናትናኤል ደረጀ	944039227	ልደታ	9	ዳሽን ባንክ ጀርባ	5	-	5	16/02/14	15/2/2016	መንገድ ዳር
43	መሳይያአብ እና ጓደኞቻቸው የፓ/አ/ህ/ሽ/ማ	መሳይያአብ ምገ	912442998	ኮልፌ	9	ቴክሳስ ብረታብረት ማምረቻ	5	-	5	29/11/2013	28/11/2015	መንገድ ዳር
44	ታሪኩ እና ዘለቀ እና ጓደኞቻቸው የፓ/አ/ህ/ሽ/ማ	ታሪኩ ለማ	912970779	ኮልፌ	10	ቃሳቃሳ እስከ ባሻ እንዳይላሉ ህንፃ	5	-	5	30/02/14	29/2/2016	መንገድ ዳር
45	ፀጋዬ እና ወንድሰን እና ጓደኞቻቸው የፓ/አ/ህ/ሽ/ማ	ፀጋዬ ሄይ	910684434	ልደታ	9	ከ5ኛ ፖሊስ ጣቢያ እስ ኮጩ	5	-	5	9/3/2014	8/3/2016	መንገድ ዳር
46	ግርማ፤ ኡመል እና ጓደኞቻቸው የፓ/አ/ህ/ሽ/ማ	ግርማ ነጋሽ	0920349167 / 0910069002	ልደታ		ጥቁር አንበሳ ድላችን ሀውልት	5	0	5	26/01/2014	25/01/2016	መንገድ ዳር
47	በላይ፤ ትዕግስት እና ጓደኞቻቸው የፓ/አ/ህ/ሽ/ማ		0913160326 /0974343556	ኮልፌ	10	ከልካንዳ _ኮምፕሬሲቭ ት/ቤት	5	0	5	4/4/2014	3/4/2016	መንገድ ዳር
48	እመቤት ፤ መኩሪያ እና ጓደኞቻቸው የፓ/አ/ህ/ሽ/ማ	እመቤት ሃይሉ		ልደት	9	አምስተኛፖሊስ ጣቢያ_ቆጩ	5	3	8	18/4/14	17/4/16	መንገድ ዳር
49	አብነት ፓርኪንግ እና ጓደኞቻቸው የፓ/አ/ህ/ሽ/ማ	መስታወት ተፈ	979080287	ልደት	3	ኮካ አደባባይ አዲሱ አስፋልት	5	4	9	18/4/14	17/4/16	መንገድ ዳር
50	አብርሃም ፤ ወንድወሰን እና ጓደኞቻቸው የፓ/አ/ህ/ሽ/	ሁሴን መሃመድ	918368314	ኮ/ቀ	9	ከጌታ ክሊኒክ_ ዋቆ ጎቹ ት/ቤት	5	0	5	21/4/14	20/4/16	መንገድ ዳር
51	በረከት፤ ያዕቆብ እና ጓደኞቻቸው የፓ/አ/ህ/ሽ/ማ	በረከት ዋቄ	989116097	ልደታ	8	ሰርክ ባርና ሬስቶራንት _ፍሬሽ ኮርነር	8	0	8	19/4/14	18/4/16	መንገድ ዳር
52	ልጃለም፤ገለታ እና ጓደኞቻቸው የፓ/አ/ህ/ሽ/ማ	ገለታ አለዩ	911716661	ልደታ	3	ከአብነት አደባባይ ጨፍ እስከ ኮ	5	0	5	1/7/2014	1/7/2016	መንገድ ዳር
53	ሞሳ ክፍለማርያም እና ጓደኞቻቸው የፓ/አ/ህ/ሽ/ማ	ክፍለማርያም	913789431	ልደታ		አብርሀም ስጋ ቤት አካባቢ	8	1	9	19/07/2014	19/07/2016	መንገድ ዳር
54	መስፍን ኤርሚያስ እና ጓደኞቻቸው የፓ/አ/ህ/ሽ/ማ	መስፍን እሸቴ	942199369	ልደታ	9	ከስማርት ፕላዛ እስከ ሸንበቆ ጠ	6	0	6	20/07/2014	20/07/2016	መንገድ ዳር
55	ዘላለም ሲሳይ እና ጓደኞቻቸው የፓ/አ/ህ/ሽ/ማ	ዘላለም ጥበቡ	912791212	ኮ/ቀ	4	ከዮናታን ህንፃ መግቢያ እስከ ሊ	3	3	6	5/8/2014	5/8/2016	መንገድ ዳር
56	ጌቱ ሙሉ እና ጓደኞቻቸው የፓ/አ/ህ/ሽ/ማ	መንበረ ክብሩ	913613319	ልደታ		ታሪክ ስጋ ቤት አካባቢ	2	1	3	20/08/2014	20/08/2016	የመንገድ ዳር
57	ደመቀ እንዳለ እና ጓደኞቻቸው የፓ/አ/ህ/ሽ/ማ	ዳንኤል ሳይሉ	902644671	ልደታ	4	ከጂብሰን ት/ቤት እስከ ቫቲካን	5	0	5	28/08/2014	28/08/2016	የመንገድ ዳር
58	እዮብ ነፃነት እና ጓደኞቻቸው የፓ/አ/ህ/ሽ/ማ	እዮብ ተመስጌን	929418406	ልደታ	9	ከጉሊት እስከ ዙቦ ዳቦ ቤት	8	0	8	1/9/2014	1/9/2016	የመንገድ ዳር
59	ሀይሉ ሚኪያስ እና ጓደኞቻቸው የፓ/አ/ህ/ሽ/ማ	ሀይሉ አትራጋ	942215444	ልደታ	9	ከዊዝደም ህንፃ እስከ ኒያት ክሊ	8	0	8	15/09/2014	15/09/2016	የመንገድ ዳር
60	ንብረቴ መኳንንት እና ጓደኞቻቸው የፓ/አ/ህ/ሽ/ማ	ንብረቴ ሰማሀ	929099553	ኮ/ቀ	9	ከድሪም ታወር እስከ GS ሆቴል	5	0	5	17/09/2014	17/09/2016	የመንገድ ዳር
61	ራሄል ፍፁም እና ጓደኞቻቸው የፓ/አ/ህ/ሽ/ማ	ፍፁም ደሳለኝ	985329801	ልደታ	7	ከፋዱንጋ እሰከ ዮቤክ አምባ ህንፃ	4	2	6	10/10/2014	10/10/2016	የመንገድ ዳር
							362	72	434			

1	አንድነት ፓርኪንግ(አዳር) እና ጓደኞቻቸው የፓ/ሽ/ህ/ስ	ሁሴን አህመድ	920232158	ልደታ	3	ከኮካ ማዞሪያ ጫፍ በስተ ቀኝ -አ	9	0	9	5/12/2014	4/12/2016	መንገድ ዳር
2	ናትናኤል ሳሙኤል እና ጓደኞቻቸው የፓ/ሽ/ህ/ስ /ማ	ሳሙኤል ወዳጆ	941508951	ልደታ	8	ከዘመን ባንክ - ሙልሙል ዳቦ ቦ	4	0	4	9/12/2014	8/12/2016	መንገድ ዳር
3	ዮናስ ተገኝወርቅ እና ጓደኞቻቸው የፓ/ሽ/ህ/ስ /ማ	ዮናስ ታመነ	920599830	ልደታ	8	ከደቡብ አፍሪካ ኤምባሲ -ገነት ዶ	5	0	5	18/12/2014	17/12/16	መንገድ ዳር
4	ገነት ኃ/ሚካኤል እና ጓደኞቻቸው የፓ/ሽ/ህ/ስ /ማ	ገነት ዳዊት	973013473	ልደታ	8	ከአብደላ ሀንፃ-5ተኛ መብራት	7	2	9	19/12/2014	18/12/2016	መንገድ ዳር
5	አቡበከር ይሳቅ እና ጓደኞቻቸው የፓ/ሽ/ህ/ስ /ማ	አቡበከር መኮን	910497524	ኮ/ቀ	4	ከጀሞ ት/ቤት መግቢያ-ሊዲያ ሪ	5	0	5	28/11/2014	27/11/2016	መንገድ ዳር
6	ኤርሚያስ ደመላሽ እና ጓደኞቻቸው የፓ/ሽ/ህ/ስ	ኤርሚያስ ደጉ	973076210	ልደታ	1	ከሀቫና እስከ ሄለን ሀንፃ	5	0	5	19/03/2015	18/3/2017	መንገድ ዳር
7	አለሙ፣ባህሩ እና ጓደኞቻቸው የፓ/ሽ/ህ/ስ	አለሙ መኮንን	913026618	ልደታ	8	መድሀኒት ፋብሪካ አካባቢ ግራና	3	0	3	5/4/2015	4/4/2017	መንገድ ዳር
8	ይብራዓለም፣ነዋብ እና ጓደኞቻቸው የፓ/ሽ/ህ/ስ	ይብራዓለም ስዩ	9	ኮ/ቀ	6	ከቤተል ታክሲ ተርሚናል _ካሊድ	5	0	5			መንገድ ዳር
9	አዲስ፤ተስፋዬ	ተስፋዬ ወልዴ	911546123	ልደታ	9	ከፒዛት ሀንጻ_ተስፋኮከብ ት/ቤት	3	2	5	25/4/15	24/4/17	
10	አዲስ፤አብዱልፈታ	አብዱልፈታ	976779191	ልደታ	9	ከጉለላት_አብነት ክሊኒክ	5	0	5	5/7/2015	4/7/2017	
							51	**4**	**55**			