# ADDIS ABABA UNIVERSITY

## COLLEGE OF TECHNOLOGY AND BUILT ENVIRONMENT

### ANALYSIS OF LAND USE /LAND COVER DYNAMICS IN RELATION TO URBAN EXPANSION: THE CASE OF HAWASSA CITY, ETHIOPIA

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Analysis of Land Use /Land Cover Dynamics in Relation to Urban Expansion: The case of Hawassa City, Ethiopia

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April, 2025

# DECLARATION

I, the undersigned, declare that this is my original work, has never been presented at this or any other university, and that all the resources and materials used for the dissertation have been duly acknowledged.

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This dissertation has been submitted for examination with my approval as the student's supervisor.

**Name Birhanu Girma (Ph.D.) ( Supervisor).**

**Signature: ____________________**

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# DISSERTATION APPROVAL

**Addis Ababa University**

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This is to certify that the dissertation prepared by Mefekir Woldegebriel Tessema, entitled: “Analysis of Land Use /Land Cover Dynamics in relation to Urban Expansion: The case of Hawassa City, Ethiopia” is presented in fulfillment of the requirements for the Degree of Doctor of Philosophy in Urban and Regional Planning and meets the accepted standards concerning originality and quality.

**Signed by the Examining Committee:**

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**List of Publications**

This Dissertation is organized based on the following four peer-reviewed and published articles.

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4. Challenges of urban land management in the case of Hawassa City, Ethiopia. International Journal of Community Well-Being, Volume 7, (Springer). **Under review.**

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**List of Abbreviations and Acronyms**

| | |
|---|---|
| BU | Built-up |
| ES | Ecological system |
| EMA | Ethiopian Mapping Agency |
| ERDAS | Earth Resource Data Analysis System |
| ETM | Enhance Thematic Mapper |
| ENV | Enhance Vegetable Index |
| FAO | Food and Agricultural Organization |
| FGD | Focus Group Discussion. |
| GDP | Growth Domestic Production |
| GI | Green Infrastructure |
| GIS | Geographic Information System |
| GPS | Global Positioning System |
| GTP | Growth ant Transformation Plan |
| HCA | Hawassa City Administration |
| IDP | Integrated Development Plan |
| IPCC | Intergovernmental Panel on Climate Change |
| KM2 | Square Kilometer |
| KIs | Key Informants |
| LDPs | Local Development Plan |
| LU/LCC | Land Use/Land Cover Changes |
| LULC | Land Use/Land Cover |
| LULUC | Land Use/ Land Cover Change |
| MOFED | Minster of Finance and Economic Development |
| MSS | Multi-Spectral Scanner |
| NDBI | Normalized Difference Built-up index |
| NDVI | Normalized Difference Vegetation Index |

| | |
|---|---|
| NGOs | Nongovernmental Organization |
| NIR | Near-Infrared |
| OLI | Operational Land Imagery |
| RS | Remote Sensing |
| SE | Standard Error |
| SNNPR | Southern Nations Nationalities and People Region |
| SPSS | Statistical Package for Social Science. |
| SWIR | Short Wave Infrared |
| TLU | Tropical Livestock Unit |
| TM | Thematic Mapper |
| UCCRN | Urban Climate Change Research Network |
| UNDP | United Nation Development Program |
| US-EPA | United State Environmental Protection Agency |
| USGS-EROS | United State Geological Earth Resource Observation and Science |
| UTM | Universal Transverse Mercator |
| UTM | Universal Transverse Mercator |

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## General Abstract

Land Use and Land Cover Changes (LULC) are some of the worldwide factors that have the most impact on city growth. This study examines land use and land cover changes in relation to urban expansion in Hawassa City. The objectives of the study include quantifying land use and land cover changes over three decades, examining public perception on urban green infrastructure and land use management, physical and socio-economic driving forces of land use and land cover change, and identifying challenges of urban land management. The data were collected through questionnaires, interviews, and key interviews. Finally, the data were analyzed in different ways, using figures and tables, for example. Descriptive and econometric models were also used to analyze the data and probit regression models were used to investigate the impact of urban expansion on the livelihood of displaced farmers in the surrounding area. The study used multi-spectral satellite images from 1990 and 2020, and employed packages like QGIS version 3.2, ArcGIS 10.3, ENVI 4.2, and ERDAS Imagine 2013 for image classification. Descriptive and econometric analyses were used to analyze both quantitative and qualitative data using SPSS version 25. Multivariate analysis of variance indicated that the effect of urban expansion on the combined dependent variables, namely, on land use, socioeconomic activities, culture, and environmental change, is statistically significant $F(8, 616) = 12.704$, $p = 0.000$, Wilk's Lambda ($\lambda$) = .737, partial eta squared(partial $\eta 2$) = 0.142, observed power = 1.000. Comparatively, the area covered by farmland, built-up areas, and bushland increased from 19.46% to 26.51%, 11.97% to 18.71%, and 3.07% to 4.51%, respectively. Hawassa City has developed very rapidly, growing from a surface coverage of 4.98 km2 in the 1983s to built-up area coverage of around 48.29 km2 in 2018. The mean score for the level of social relationship and values after land expropriation was 1.7 moderate, with a standard deviation of 0.852 in comparison with the mean score for the level of social relationship and values before land expropriation, which was 3.21 high, with a standard deviation of 0.79. There isn't much of a difference between them in the second category, where the lease price was increased from the starting price by (457%) from 2015 to 2016. The f-statics or f-ratio were 91.656 and the sign value of highly significant as ($p=.000<0.01$).



Keywords: Change detection, Green Infrastructure, Land Use/ Land Cover, Informal Settlement, Probit model, Urban Expansion.

# CHAPTER ONE

## 1. GENERAL INTRODUCATION

### 1.1. Background and justification

Urbanization is rapidly increasing worldwide, with a significant shift toward City living. According to the United Nations Department of Economic and Social Affairs, it is projected that by 2030, more than 60% of the global population will reside in urban areas. Despite occupying only 2.7% of the Earth's surface, cities currently account for 75% of global energy consumption, 80% of greenhouse gas emissions, and have a significant negative impact on natural resources (Ayeni, 2017; Gret-Regamey et al., 2013). To mitigate the environmental challenges posed by urbanization, urban green infrastructure has emerged as a promising solution. This concept encompasses the network of green spaces and recreational parks that offer numerous benefits to the urban environment, improving the quality of life and providing ecological services (Jennings et al., 2016; Wolch et al., 2014).

Cities play a central role in various forms of capital, including physical, economic, social, political, and cultural resources (Aerni, 2016). As such, it is crucial to consider how cities are structured and managed, particularly in terms of sustainability. However, cities are increasingly vulnerable to the pressures of unchecked urban growth and climate change. These challenges manifest in issues such as biodiversity loss, air pollution exceeding safe levels, and urban flooding (UCCRN, 2014).

One of the primary drivers of urban growth and environmental change is Land Use and Land Cover Change (LULCC), which refers to the transformation of the land surface due to human activities. This study aims to analyze the dynamics of LULCC over three decades in Hawassa, Ethiopia, by using satellite imagery from 1990 to 2020. The study focuses on six land classification categories: agriculture, bare land, built-up areas, shrubs, forests, and water bodies. The data for this analysis was obtained from Landsat satellite images, including Landsat 5TM (1990, 2000, and 2010) and Landsat 8 OLI and SWIR (2020). Various software tools, including QGIS, ArcGIS, ENVI, and ERDAS Imagine, were utilized for image classification.

The rapid urbanization process demands a transformation of land use in peri-urban pressure on conversion process areas to cater to the needs of urban areas. Land is a primary asset, which can be affected by intense peri-urban areas. Change in land use from rural to urban activities affects the economic features of peri-urban interfaced. Peri-urban areas are largely occupied by agricultural communities in rural settlement patterns to which urban settlement expands peri-urban areas are those adjacent to build-up areas of high population concentration, areas where traditional farming activities come into conflict with alternative economic, residential, and recreation activities peri-urban is an area neither urban nor rural but interface where there is increasing less provision of various urban services when compared to urban system and increasing less provision of ecological services when compared to rural system (Mohammed et al.,2017).

Land is a vital natural resource that serves a wide range of social, economic, and ecological functions. It is essential for creating wealth, providing food and water, and supporting biodiversity, climate regulation, and water purification. Land Use and Land Cover (LULC) changes are critical factors influencing global environmental processes and ecosystems. The demand for agricultural, industrial, and urban land often leads to the degradation of natural ecosystems, such as forests and water bodies, which provide essential services to humanity (Goldman-Benner et al., 2013). These changes are driven by various socioeconomic factors, including population growth, agricultural expansion, and increased accessibility to infrastructure and markets (Shiferaw et al., 2019).

LULC change is a complex process that results from interactions between human activities and environmental factors. It has significant impacts on the physical and social dimensions of landscapes (Lambin et al., 2005). Historically, human activities, such as agriculture, have led to the conversion of forests, savannas, and other ecosystems to meet the demands of growing populations and economies (FAO, 2000). The rapid urbanization of cities, while often associated with economic growth, also leads to the loss of natural resources, environmental degradation, and increased costs of urban land (Redman, 1999; Xiao et al., 2006).

As urbanization accelerates globally, its effects on urban landscapes and hydrology are becoming increasingly evident. By 2050, it is expected that 2.5 billion people will be added to the urban population, with 90% of this growth occurring in Asia and Africa, where many cities are already facing challenges related to slum growth and flood risks (Miller et al., 2014; Li, Xie, and Hao, 2014). Understanding the historical patterns of land use change and the future trajectories of urbanization is critical for developing effective flood risk management strategies and other urban planning initiatives in these regions.

Hawassa, like many Ethiopian cities, is experiencing rapid urban growth, and this study examines the unique patterns and challenges of its urban expansion. By identifying trends in land use and analyzing the spatial and temporal changes in the  City, this research aims to provide valuable insights for urban planning and infrastructure development. The findings of this study will assist Hawassa's City planners, developers, and decision-makers in making informed choices to enhance the City's livability and resilience in the face of growing urban pressures.

The primary goal of this study is to quantify the dynamics of LULCC in Hawassa over a 30-year period using Geographic Information System (GIS) and remote sensing techniques. The results of this analysis will help create a comprehensive understanding of the land use changes in the area and provide valuable data for future urban planning and development. This study contributes to the broader knowledge of urban land dynamics and can serve as a reliable tool for City planners and policymakers working to improve the quality of life in Hawassa.

The phenomenon of rapid urbanization in Ethiopia has led to significant transformations in land use, particularly in peri-urban areas. These regions, which serve as a transitional zone between urban and rural environments, are increasingly under pressure due to the expansion of urban centers. As cities like Addis Ababa and other regional capitals grow, they encroach upon surrounding agricultural lands, leading to a complex interplay of economic, social, and environmental changes (Mohamed etal, 2027).

Economic Implications in Ethiopia, peri-urban areas are predominantly characterized by agricultural communities that have historically relied on farming as their primary source of livelihood. However, as urban areas expand, these communities face increasing pressure to convert their land for urban uses, such as housing, commercial developments, and infrastructure projects. This conversion often leads to a decline in agricultural productivity, as fertile lands are lost to urban sprawl. The economic features of these peri-urban interfaces are thus transformed, with traditional agricultural practices being replaced by urban-centric economic activities (Aggrey Daniel, 2013).

The shift from rural to urban land use can create new economic opportunities, such as employment in construction, services, and trade. However, it can also lead to economic displacement for farmers who may not have the skills or resources to transition into the urban economy. This duality presents a challenge for policymakers, who must balance the need for urban development with the preservation of agricultural livelihoods. The social fabric of peri-urban areas in Ethiopia is also changing. As urban populations grow, there is an influx of people from rural areas seeking better opportunities, leading to increased competition for resources and services. This migration can strain existing infrastructure and social services, which are often inadequate in peri-urban settings. The lack of access to essential services such as healthcare, education, and sanitation can exacerbate social inequalities and create tensions between long-standing residents and newcomers (Francis etal, 2013).

Moreover, the cultural identity of peri-urban communities may be threatened as traditional practices and lifestyles are overshadowed by urban influences. The integration of diverse populations can lead to a rich cultural exchange, but it can also result in conflicts over land use, resource allocation, and social norms. The environmental implications of urbanization in peri-urban areas are significant. The conversion of agricultural land to urban uses can lead to habitat loss, reduced biodiversity, and increased pollution. Peri-urban areas often serve as critical ecological buffers, providing essential services such as water filtration, carbon sequestration, and recreational spaces. However, as urban development encroaches, these ecological functions are compromised (Teketel Fekadu, 2015).

In Ethiopia, where agriculture is a vital component of the economy and food security, the loss of arable land poses a serious threat. The challenge lies in finding sustainable land use practices that can accommodate urban growth while preserving the ecological integrity of peri-urban areas. This may involve implementing policies that promote smart growth, land-use planning, and the integration of green spaces within urban developments. To address the challenges posed by rapid urbanization in peri-urban areas, Ethiopian policymakers must adopt a holistic approach that considers the interconnectedness of economic, social, and environmental factors. In conclusion, the rapid urbanization process in Ethiopia presents both challenges and opportunities for peri-urban areas. By adopting a comprehensive and inclusive approach to land use planning, policymakers can help ensure that these regions thrive amidst the pressures of urban growth while preserving their unique economic, social, and environmental characteristics.

## 1.2. Literature Review

### 1.2.1. Land Use/ Land Cover changes

The way land is used and managed has become an increasingly important issue in modern times. To better understand the concept of land use and land cover change, it's essential to first define these terms. Land Cover refers to the physical characteristics of the Earth's surface, including natural and man-made features. In its most literal sense, land cover describes what is physically present, such as forests, water bodies, or urban areas. However, areas consisting of bare rock or soil are not considered land cover, as they lack the physical features typically classified as such. On the other hand, Land Use pertains to the ways in which humans utilize and modify the land's biophysical features. This includes the activities and decisions that alter or preserve a specific land cover type, establishing a direct connection between human actions and the environment (FAO, 2000).

In land use studies, two main approaches are commonly used: exploratory studies and predictive studies. Exploratory studies focus on determining the range of possibilities for development, asking the question: "What might be possible?" These studies emphasize the biophysical potential of land, operating on the premise that while human attitudes and behaviors can be influenced over time, the physical characteristics of land are more difficult to change. Therefore, these studies aim to quantify potential alternatives based on the current biophysical conditions. In contrast, predictive studies are concerned with understanding "What can be changed?" and "How can desired changes be achieved?" These studies focus on current and future socio-economic conditions and land use patterns, considering them as the main constraints or influences on potential land use modifications

### 1.2.2. The impacts of LULC change on urban growth

According to Banja and Chimdesa (2023), the impacts of horizontal urban expansion extend beyond the mere loss of agricultural land, also causing the displacement of rural communities and altering their livelihoods. On a global scale, it is estimated that around 10 million people are displaced annually due to development projects, with 6 million of these displacements directly resulting from urban expansion. Zewdu (2021) also highlighted that urban growth leads to the loss of valuable agricultural land, natural landscapes, parks, and scenic areas. Specifically, Abebe (2020) identified key drivers of rapid urban expansion in Ethiopia, including high natural population growth, rural-to-urban migration, and spatial development of cities. This growth has significant consequences for the livelihoods of farmers. Similarly, Asghar Pilehvar (2021) observed that while urbanization is often seen as a symbol of economic progress and development, it also brings with it various socio-economic challenges in Ethiopia.

There is a clear link between population growth, natural resources, urbanization, and the transformation of the natural landscape. Cities and urban areas across the world have experienced significant changes due to economic development, industrial expansion, rural-urban migration, and other socio-economic factors, often extending beyond their traditional boundaries (Shirazi and Kazmi, 2014). Population growth plays a crucial role in this process (Bongaarts, 2006). The factors driving urban growth, such as the replacement of natural land with impermeable urban materials, lead to biophysical environmental changes that affect land surface properties and energy dynamics. As natural landscapes are replaced by urban infrastructure, the environment deteriorates, which in turn can impact food production (Ahmad et al., 2022). These changes in land use and land cover (LULC) are driven by human activity and have a significant impact on local ecosystems. Land cover is a dynamic and evolving entity that changes over time and across geographical regions (Clark and Kilham, 2016).

### 1.2.3. Challenges that hinder the development of urban green infrastructure

The challenges to the development of green spaces in Africa are multifaceted and include rapid urbanization, the limited resources of institutions responsible for green space management, the lack of prioritization of green spaces, corruption, uncooperative local attitudes, and political instability. Jim (2013) emphasizes that addressing these issues requires coordinated and sustained efforts from national governments, local authorities, and the community to protect and enhance these spaces.

Green infrastructure refers to a set of techniques, technologies, management practices, and strategies designed to mitigate storm water runoff and reduce non-point source pollution, including water and pollutants entering combined sewer systems. It is a strategically planned network of natural and semi-natural areas, along with other environmental features, that are managed to deliver ecosystem services and protect biodiversity in both rural and urban settings. More specifically, green infrastructure seeks to enhance nature’s ability to provide valuable goods and services—such as clean air and water—to people (Buettner et al., 2013). In the urban context, green spaces encompass areas like urban forests, river buffer zones, recreational parks, tree-lined streets, and other garden spaces (Fratini and Marone, 2011).

Urban spaces are composed of built-up areas that serve various functions, such as commercial, residential, and institutional, alongside non-built environments predominantly made up of vegetation and open areas (Moroney and Jones, 2006; Tzoulas et al., 2007). Earlier studies (Kong and Nakagoshi, 2006; Uy and Nakagoshi, 2007; Byomkesh et al., 2012) have defined urban green spaces as areas with natural or man-made vegetation located within built-up urban environments. However, the precise definition remains open to interpretation. Many developed nations have their own definitions (Byomkesh et al., 2012). For the purposes of this research, the working definition follows that provided by the Ethiopian Ministry of Urban Development and Housing (MoUDH, 2015), which includes various green infrastructure typologies, such as parks, sports fields, roadways with green areas, public squares and plazas, riverside zones, lakes and their shorelines, watersheds, urban agriculture zones, woodlots, green belts (including surrounding forests), private and institutional compounds (both government and non-governmental), as well as communal housing compounds and their surrounding areas.

**Formal green areas** are proportion of open space that is retained in a mostly undisturbed vegetative state. It can be partly or completely covered with grass, trees, shrubs, or other vegetation (Ethiopia National Urban Green Infrastructure Standard, 2015).

**Informal green areas** are vacant lots street or railway verges, fields and power line corridors that are not intentionally designed for parks and recreational spaces (Christoph & Jason, 2017). Communal green areas are shared spaces and communally used and managed by residents that live around the green areas. They are not a public park, a private backyard or a community garden however they can function as all (Fratini and Marone, 2011).

### 1.2.4. Urban planning and land management

Urban planning and land management are crucial in shaping discussions about improving land development in response to climate challenges. Urban planning focuses on optimizing land use potential within cities, aiming to make efficient use of available land resources. Land management plays a significant role in the development and sustainability of urban environments. However, managing land effectively remains a significant challenge. Inadequate land management can hinder land users from fully realizing the economic and social benefits that the land can provide. Despite this, land management practices are often under-examined, especially in the context of long-term maintenance planning (Mohammed, 2015; Owoeye, 2018).

Sustainable land management involves adopting land use systems that, through effective management practices, allow land users to maximize economic and social benefits while maintaining or enhancing the ecological functions of land resources (Mohammed, 2015). In Ethiopia, the federal government is responsible for enacting laws concerning the use and management of land and natural resources, while regional states are tasked with the administration of these resources within their jurisdictions. The division of responsibilities between rural and urban land management often leads to conflicts and confusion, particularly in peri-urban areas where the boundaries between urban and rural land are less clear. This overlap, combined with varying capacities and structures across regions, complicates the management of land at both the federal and regional levels (Deininger and Byerlee, 2011; Araya, 2013).

Land conversion in rural-urban fringes is leading to significant social, cultural, economic, and environmental transformations in these areas. While these changes can bring about positive developments for some community members, the benefits are not universally experienced. For instance, certain members of indigenous groups have successfully leveraged new opportunities by networking with newcomers, allowing them to access resources that were previously unavailable in their surroundings (Mastrorillo et al., 2016). This networking can facilitate the exchange of knowledge and resources, enabling indigenous individuals to adapt to the changing economic landscape.

Additionally, some indigenous entrepreneurs have capitalized on the presence of economically better-off newcomers by establishing businesses that cater to their service needs. This entrepreneurial spirit can lead to economic diversification and increased local employment opportunities (Rogerson, 2014). However, the sale of land by some community members is creating a new class of landless individuals who may find themselves working as laborers on construction sites or remaining as farmers on increasingly fragmented plots of land. This shift can exacerbate social inequalities, as those who are landless may struggle to secure stable livelihoods (Deininger, 2003).

The rise in the number of landless individuals is likely to contribute to the proliferation of informal settlements or squatter housing on public lands, as displaced individuals seek affordable housing options (UN-Habitat, 2015). This unplanned residential development is resulting in significant housing sprawl, which can overwhelm existing infrastructure and services. As residential areas expand, they often encroach upon agricultural land, disrupting the rural economy and leading to conflicts over land use (Seto et al., 2012).

Moreover, the sprawl can negatively impact previously established commercial centers, which may struggle to compete with the new residential developments. As these centers fall into disuse, the economic vitality of the area can decline, further complicating the transition from a rural to an urban economy (Bhatta, 2010). The consequences of sprawling land development have been particularly pronounced in agricultural-oriented rural economies that are not well-prepared to handle the challenges of urbanization, leading to a range of socio-economic and environmental issues (Aggrey Daniel, 2013).

In summary, while land conversion in rural-urban fringes can create new opportunities for some, it also poses significant challenges, including social inequality, the rise of informal settlements, and the disruption of established economic systems. Addressing these issues requires careful planning and consideration of the needs of all community members to ensure that the benefits of urbanization are equitably distributed.

### 1.2.5. Urban land policy and land management

Land plays a unique and important role in social, political, environmental, and economic philosophy. It is of critical importance for the country's urbanization, economic progress, and social stability. Land is not only at the foundation of human culture and institutions, but it is also used directly or indirectly in the creation of all products and services. Land's distinctiveness comes from its fixed supply and immobility. Therefore, the nature of property rights towards land is very crucial in the process of economic growth and poverty reduction (Mushir and Hailemariam, (2015).

Land policy commonly aims to achieve a green eco-environment, and equity, enhances investment, attains assurance of developers or investors, and may consider cultural as well as environmental sustainability. Land Policy describes an official statement by a government of its intentions and plans regarding the upkeep, use, and sharing of land but does not have the force of law. The dispute over urban land policy is basically about whether it should be private or public ownership. Even if the idea of private ownership is broadly accepted, history has demonstrated the detrimental implications of unrestrained private ownership of land. Experience has repeatedly demonstrated that in many nations, governmental ownership of property leads to mismanagement, underutilization of resources, and corruption (Mohammed, 2015).

### 1.2.6 Theories of Informal Settlement

Informal settlements have been the subject of various theoretical frameworks. These theories aim to explain the origins and proliferation of such settlements in urban areas. The views on informal settlements can be classified into three main categories:

#### A. Liberal Views

Liberal theories, which underlie this perspective, attribute the formation of informal settlements primarily to population growth and migration. According to this view, urbanization occurs rapidly due to increased migration from rural to urban areas. This surge in population leads to the formation of informal settlements, as available housing cannot accommodate the growing numbers. The solution proposed by liberal theorists involves controlling population growth and regulating immigration to manage urban development (Dadash and Alizade, 2011).

#### B. Fundamentalist Views

Emerging in the 1970s, fundamentalist views focus on the political economy of space, highlighting the marginalization that occurs as cities expand. This perspective rejects the liberal view's focus on population growth, instead examining the role of external factors in shaping urban spaces. According to this theory, the development of informal settlements can be linked to the capitalist system and the unequal distribution of resources, labor, and production. The theory emphasizes the need to address the underlying issues of urban inequality by rethinking economic structures such as work, production, and consumption (Meshkin etal, 2013).

#### C. Socialist or Goal-Oriented Views

The socialist or goal oriented view, popularized during the 1980s and 1990s, sees informal settlements and marginalization as part of the broader conflict between labor and capital. This perspective recognizes that informal settlements often emerge as a consequence of economic inequality in developing nations. Rather than focusing on destruction or eradication, this theory advocates for the empowerment, improvement, and renovation of these settlements.

The approach stresses the importance of community engagement and sustainable urban development to address the needs of marginalized groups (Dadash and Alizade, 2011).

### 1.2.7. Causes of Squatter Settlements and Squatting

#### 1.2.7.1. Population Growth

A significant factor contributing to the rise of informal settlements is rapid population growth. Urban areas were home to only 4% of the world's population a century ago, but today, half of the global population lives in cities. The explosive growth of urban populations in developing countries has been driven by both natural population increase and migration from rural areas. This surge in population has outstripped the capacity of cities to provide affordable housing for low- and middle-income residents, leading to the growth of squatter colonies. As the urban population continues to expand, the demand for housing remains high, exacerbating the issue of informal settlements (Manaster, 1968).

#### 1.2.7.2. Insecurity of Land Tenure

Insecure land tenure is another key factor driving the growth of informal settlements. In contrast to the formal housing sector, where land and property rights are clear, residents of informal settlements often lack legal claims to the land they occupy. This situation is worsened by political and economic inequality, which leads to poor access to housing and services. In many developing countries, land tenure issues are exacerbated by privatization policies, market failures, and lack of state intervention in the housing sector. This leaves the urban poor with no choice but to occupy vacant or unregulated land. Despite poverty reduction initiatives, the number of people living in informal settlements continues to rise due to the lack of formal land tenure and housing solutions (Hardoy et al., 1990; CSA, 2007; Aramde, 2012).

#### 1.2.7.3. The Failure of Governance

The formation and growth of informal settlements can also be attributed to the failure of governance at multiple levels global, national, and local. At the global level, policies that undermine national governments and promote inequality contribute to the rise of slums. Nationally, liberalization and sectoral fragmentation of policies have failed to address urban-rural dynamics and ensure equitable distribution of resources. Locally, insufficient governance capacity has left slum dwellers in a state of illegality and marginalization. This failure of governance creates an environment where informal settlements proliferate and urban poverty deepens (UN-Habitat, 2004).

#### 1.2.7.4. Lack of Good Governance

Good governance is essential for managing urban development and addressing the needs of marginalized populations. Defined by principles such as transparency, accountability, and inclusivity, good governance ensures that decision-making processes reflect the needs of the community. In many developing countries, however, poor governance practices characterized by corruption, inefficiency, and exclusion prevent the urban poor from having their voices heard in policy decisions. This leads to ineffective housing solutions and further marginalization of informal settlers (UNESCAP, 2009; Stien et al., 2001).

#### 1.2.7.5. Institutional and Legal Failures

Many slum dwellers live in conditions where they are excluded from formal legal and institutional frameworks. Without property rights or security of tenure, residents in informal settlements often resort to informal, unregulated land markets and housing arrangements. The absence of effective legal systems and governance structures exacerbates the plight of the urban poor, as they are denied access to services such as waste management, water, and electricity. Moreover, slum dwellers often face exclusion from formal employment and financial systems, limiting their ability to improve their living conditions (Azlinor, 2009; Getachew, 2015).

#### 1.2.7.6. Informal Actors and Corruption

Corruption is pervasive in the land sector, with public officials, private investors, and even local authorities often engaging in illegal practices related to land transactions. Informal actors, such as slum landlords or mafia leaders, may control land in informal settlements, further hindering efforts to formalize land tenure. Corruption in the land sector often arises from weak governance, where public officials may collude with private actors to exploit land for personal gain. This undermines land governance systems and perpetuates the growth of informal settlements (Getachew, 2015).

#### 1.2.7.7. Informal Land Markets

Access to land in formal markets is limited in many developing countries, especially for the urban poor. As a result, informal land markets have become a dominant means for the poor to secure land and housing. In these informal markets, residents often face exploitation and pay higher prices for land and housing due to the lack of legal protection and regulation. The informal market is often larger than the formal market, and its existence is a direct result of the failure of formal institutions to meet the demand for affordable land and housing (Transparency International, 2010/2011).

#### 1.2.7.8. Inadequate Formal Land Distribution

One of the most significant factors contributing to informal settlements is the inability of governments and institutions to provide adequate land for housing. In many cities, the supply of residential plots has not kept pace with the growing demand, resulting in shortages of affordable land. This is especially evident in cities like Zanzibar, where the supply of land for housing is insufficient, leaving many people with no option but to occupy informal settlements (Ali and Sulaiman, 2006).

These combined factors population growth, land tenure insecurity; poor governance, corruption, and institutional failure have contributed to the rise and expansion of informal settlements, highlighting the need for comprehensive policies and interventions to address these complex challenges.

## 1.3. Statement of the problem

Land use changes are complex processes that result from the transformation of land cover into different types of land use (Aboud, 2002). Despite the complexity of these processes, the interaction between human and environmental factors and their influence on land use patterns remains poorly understood (US-EPA, 2009). According to Lambin et al. (2005), land use changes are driven by the interaction between biophysical factors and human activities over time and space. These changes can have significant physical and social impacts. Gereta et al. (2001) note that throughout human history, intensive human use of natural resources has led to substantial shifts in land use and land cover (LULC). The rise of industrialization and rapid urban expansion has exacerbated these land use changes in various regions. In fact, land use changes are considered one of the most significant human-driven factors affecting hydrological systems (Akotsi et al., 2006). For example, agriculture has expanded into forests, savannas, and steppes globally to meet the increasing demand for food, with agricultural land use shifting between regions over time as civilizations and populations developed (FAO, 2000).

While urbanization is often linked to economic growth, it also brings about increased land costs and a conversion of land from its natural state, affecting both the environment and cultural resources of cities. The influx of people into urban areas leads to difficult urban conditions due to the structural growth of cities (Redman, 1999; Xiao et al., 2006). Population growth naturally drives adjustments in land use activities within urban areas, resulting in lateral and structural changes (Luck and Wu, 2003). Lateral changes refer to the expansion of urban boundaries, leading to sprawl and peripheral developments, while structural growth involves increased land use density within existing urban centers. As the demand for land rises due to population growth, lateral expansion or urban sprawl becomes inevitable. Additionally, as land becomes scarcer and more expensive, previously low-density or rural areas become intensively used, leading to higher-density or medium-density developments (Redman, 1999; Xiao et al., 2006).

Globally, cities are experiencing rapid urbanization, resulting in profound and unintended changes to landscapes and urban hydrology (Seto et al., 2011). By 2014, more than half of the world's population (54%) lived in cities, and this figure is expected to rise by an additional 2.5 billion people by 2050. The majority of this urban growth is projected to occur in Asia and Africa, where up to 60% of the new urban population is expected to live in slums (Miller et al., 2014). Cities in these regions are particularly vulnerable to flooding, exacerbated by urbanization, climate change, poor planning, weak regulations, and limited adaptive capa City (Li, Xie, and Hao, 2014). Therefore, it is essential to understand historical patterns of land use change, future urbanization trends, and their impacts on urban landscapes in order to develop effective flood risk management strategies.

Hawassa, like many other cities in Ethiopia, is undergoing rapid urban growth, but it also presents unique challenges due to its geographical location. The City exhibits many of the characteristics, causes, and effects of urban expansion discussed above. Identifying patterns of urban sprawl and analyzing the temporal and spatial changes in land use will be crucial in guiding the development of infrastructure in the future. The current growth rate and projected trends indicate that urban planning must prioritize sustainable, affordable, and inclusive development that is socially, economically, culturally, and environmentally responsible (Marshall et al., 2009).

This study

The primary objective of this study was to quantify the dynamics of land use and land cover (LULC) changes over three decades in the Hawassa area using Geographic Information System (GIS) and remote sensing techniques. Our analysis contributes to a better understanding of the LULC changes in the study area over three decades, assessing classification accuracy, examining land use changes, landscape metrics, and the rapid pace of urbanization. The results of this study can serve as a valuable resource for the Hawassa City planning department, real estate developers, and decision-makers, helping to guide future urban planning and improve the quality of life in Hawassa City.

### 1.4 Research Questions

**The current study answer the following four research questions**

- How does land use/land cover changes of the last three decades in the study area?
- What are the public perception on the role of urban green infrastructure development and land use management study area
- What are the physical and socio-economic driving forces of land use and land cover change in study area
- What are the challenges of urban land management in the case of Hawassa City, Ethiopia

### 1.5. Objectives of the Study

#### 1.5.1. General objectives

The study's general objective was to contribute to the knowledge of analysis of land use /land cover dynamics in relation to urban expansion: The case of Hawassa City, Ethiopia.

#### 1.5.2. Specific objectives

The specific objectives of the study were:

- Quantification of land use/land cover dynamics and urban growth in rapidly urbanized countries: The case of Hawassa City, Ethiopia
- Public Perception on the Role of Urban Green Infrastructure Development and Land Use Management in Rapidly Urbanized Countries: The Case of Hawassa City, Ethiopia
- Physical and socioeconomic driving forces of land use and land cover changes: The case of Hawassa City, Ethiopia

- Challenges of urban land management :The case of Hawassa  City, Ethiopia

### 1.6. Significance of the Study

This research is crucial for gaining a comprehensive understanding of the causes behind land cover dynamics in the study area. It highlights the existing knowledge gap regarding spatiotemporal changes in land cover by integrating GIS and remote sensing data. This approach provides insights into the historical and current state of the land cover, the driving forces behind these changes, and their implications for the local ecosystem. To address this gap, digital change detection techniques were utilized, and socioeconomic factors were examined to explore the causes and effects of land cover changes on local livelihoods. The findings of this study are valuable for governmental and non-governmental organizations, policy planners, environmental researchers, natural resource managers, agricultural departments, and environmentalists. They can use this information to develop effective environmental protection strategies and sustainable development plans, while helping the local community mitigate the challenges of environmental degradation.

The study aims to address the significant knowledge gap left by previous research by providing a comprehensive and detailed analysis of land use changes in Hawassa City, with a particular focus on the effects of urban growth on the surrounding agricultural land and its broader environmental implications. As urban areas expand, they often encroach upon agricultural zones, leading to a transformation of land use that can have profound effects on local ecosystems, food security, and the livelihoods of rural communities. By examining these dynamics in Hawassa City, the study seeks to illuminate the complex interactions between urbanization and agricultural practices, offering a nuanced understanding of how urban growth can impact both the environment and local economies.

The findings of this study will contribute valuable insights to the academic community by filling existing gaps in the literature regarding urbanization in Ethiopia, particularly in the context of rapidly growing cities like Hawassa. This research will employ a multidisciplinary approach, integrating geographic information systems (GIS), remote sensing data, and socio-economic analyses to provide a holistic view of land use changes over time. By doing so, it will not only enhance the academic discourse surrounding urbanization and land use but also serve as a critical resource for future studies in similar contexts.

Moreover, the study aims to offer practical recommendations for policymakers and urban planners who are tasked with managing the challenges of urban growth while ensuring sustainable development. As cities like Hawassa continue to expand, it is essential for decision-makers to understand the implications of land use changes on agricultural productivity, water resources, and biodiversity. The research will advocate for the implementation of land use planning strategies that prioritize the protection of agricultural land and natural resources, thereby promoting a more sustainable urban development model.

In addition to its academic and policy contributions, the study highlights the importance of balancing urban development with the protection of surrounding natural resources and ecosystems. It will emphasize the need for integrated land use policies that consider the ecological, social, and economic dimensions of urban growth. By fostering collaboration between urban planners, agricultural stakeholders, and environmental conservationists, the study aims to promote a more sustainable approach to urbanization that safeguards the integrity of both urban and rural environments.

Ultimately, this research aspires to serve as a catalyst for informed discussions and actions regarding urban growth in Hawassa City and similar contexts, ensuring that the benefits of urbanization do not come at the expense of agricultural viability and environmental health. By addressing the intricate relationships between urban expansion and agricultural land use, the study seeks to contribute to a more sustainable future for both urban and rural communities in Ethiopia.

For urban planners and decision-makers, this research provides critical data for informed planning and management ensuring they are safely reclaimed and restored to benefit the community and the environment. Moreover, the study will assess the strengths, weaknesses, opportunities, and threats related to current urban planning and management practices, helping to promote sustainable resource utilization while protecting the socio-economic and physical environment.

Ultimately, the findings of this research will serve as a resource for the City’s administration, including the Mayor's office and urban land administration departments, by providing data that can guide land use management decisions. The insights generated will be essential for creating a sustainable urban development framework that accommodates both the needs of the growing urban population and the protection of surrounding agricultural lands. With an understanding of the patterns and drivers of land use change over the past three decades, planners will be better equipped to forecast future developments and implement strategies to ensure sustainable land management. This will contribute to preserving the ecological balance, supporting green economic growth, and promoting social equity in the City.

### 1.7. Scope of the Study

This study was constrained in several ways, including its geographical, thematic, and methodological scope. Geographically, the research focused specifically on six urban kebeles located on the periphery of Hawassa City. These kebeles, which are particularly impacted by urban expansion, include Alammura, Dato, Tulla-Rural, Millennium-Adebele, Guwe-Stadium, and Pissa. The first five kebeles were selected due to their direct exposure to the effects of urban growth, while Pissa was included to meet the second research objective, which involved exploring public perceptions of urban green infrastructure development and land use management.

From the perspectives of urban-urban and urban-rural linkages, the study of Hawassa City presents certain limitations, particularly in its treatment of the immediate hinterlands. While the research acknowledges the importance of these surrounding areas, it does not adequately identify or analyze the degree of influence that these hinterlands exert on Hawassa, nor does it explore how the dynamics of Hawassa impact the neighboring regions. This oversight is significant, as understanding these reciprocal relationships is crucial for a comprehensive analysis of urban growth and its implications.

The study could benefit from a more nuanced examination of potential influential urban centers within the Sidama Zone, as well as those in the Oromiya Regional State and the Southern Nations, Nationalities, and Peoples' Regional State. These areas are not only geographically adjacent to Hawassa but also play a vital role in shaping the economic, social, and cultural landscape of the region. By excluding these influential centers from the analysis, the study risks overlooking critical interactions that could provide deeper insights into the urban dynamics at play.

Moreover, the delineation of influence areas in the study primarily focuses on distance and the catchment of neighborhoods, which may not fully capture the complexity of the interactions between Hawassa and its hinterlands. Economic ties, such as trade relationships and labor migration, as well as social connections, including cultural exchanges and community networks, are essential components of urban-rural linkages that warrant further investigation. Additionally, environmental factors, such as shared natural resources and ecological impacts, should be considered to understand how urban expansion in Hawassa affects surrounding agricultural practices and ecosystems.

Political interactions also play a crucial role in shaping the relationships between urban centers and their hinterlands. Governance structures, policy decisions, and regional planning initiatives can significantly influence how urban growth is managed and how resources are allocated. By not addressing these political dimensions, the study may miss important factors that contribute to the overall dynamics of urbanization in the region.

In summary, a more comprehensive approach to studying the urban-urban and urban-rural linkages surrounding Hawassa City is necessary. This would involve a detailed analysis of the reciprocal influences between Hawassa and its hinterlands, taking into account economic, social, environmental, and political interactions. By incorporating these dimensions, the study could provide a richer understanding of the complexities of urban growth and its implications for both the city and its surrounding areas, ultimately contributing to more effective urban planning and policy development in the region.

Methodologically, the study relied on satellite imagery to assess spatial and temporal land use changes. The analysis utilized Enhanced Thematic Mapper (ETM) data from three distinct time periods, covering the years 1990 to 2020. These time points provided a sufficient temporal range to identify trends in urban growth, land cover transformation, and associated socio-economic impacts. The use of remote sensing technology allowed for the precise monitoring of land use and land cover over the specified period, offering a detailed understanding of the dynamics of urban expansion.

The thematic focus of the study addresses both environmental and socio-economic issues, particularly the factors driving land use changes, the extent and patterns of urbanization, and the broader consequences for the physical environment and local livelihoods. It also investigates the impacts of these changes on income, economic benefits, and the social fabric of both the City and its surrounding rural areas. The study emphasizes how urbanization has altered the physical landscape, reduced agricultural land, and disrupted local economic systems, which are critical for the local population's livelihood strategies.

The study's primary aim was to assess the effects of horizontal urban growth on the peri-urban lands, specifically the land held by surrounding farmers. This research focused on urban expansion trends in the study area and aimed to capture the full range of impacts as identified by local respondents. The analysis categorized the impacts into distinct dependent variables socio-economic impacts, cultural impacts, environmental impacts, and land use changes while urban expansion itself served as the independent variable.

The findings of this research are intended to shed light on the challenges posed by rapid urbanization and to propose possible solutions. By identifying the key socio-economic and environmental consequences of land use change, the study provides valuable insights for policymakers, urban planners, and stakeholders. These insights can guide the development of strategies and policies that promote sustainable urban growth while mitigating the adverse effects on surrounding rural communities. In particular, the research aims to inform the municipal authorities in Hawassa City, helping them design more effective urban planning systems that balance the needs of urban development with the protection of agricultural land and the livelihoods of farmers.

Ultimately, this study contributes to the broader discourse on sustainable urban development, offering critical data and recommendations that could enhance decision-making processes at the local level. It highlights the importance of managing urban expansion in a way that considers both the socio economic well-being of displaced communities and the ecological sustainability of the region.

### 1.8. Structure of the Study

This dissertation is organized into six chapters. Chapter One discusses the background, statement of the problem and fundamental research questions, objectives of the study, rationale of the study, scope of the study, literature, concepts, and theories, description of the study area, and dissertation organization.

The second chapter addresses the study's first objective: Quantification of LULC dynamics and urban growth in rapidly urbanized countries: The case of Hawassa City, Ethiopia. This chapter discussed the LULC change, (1990-2020). Landsat images from four different years

(1) Thematic Mapper of 1990, (2), Enhanced Thematic Mapper Plus of 2000, and 2010 (3) Operational Land Imager or Thermal Infrared Sensor of 2020 were used for LULC classifications. These images were classified by using supervised classification with a maximum likelihood algorithm.

Chapter three Public Perception on the Role of Urban Green Infrastructure Development and Land Use Management in Rapidly Urbanized Countries: The Case of Hawassa City, Ethiopia. Public involvement in green infrastructure planning and development was determinant and core variable of the study.
The majority of the area that is officially part of Hawassa is undeveloped. The entirety of the undeveloped region is made up of several ecosystems (or ecological units) that offer a variety of functions and advantages, including flood mitigation, air purification, carbon dioxide storage, food production, and wood supply. Ecosystem services are the services provided by ecosystems

The fourth chapter Physical and Socio-Economic Driving Forces of Land Use and Land Cover Change, A case Study of Hawassa City, Ethiopia. The Hawassa City urban expansion is not properly managed by the concerned people and the urban land is taken from the peripheral people, but the rule and the regulation of how to take the urban land must need respect ion and proper implementations of the urban land, and there is a need for a proper compensation system for those losing their land. Urban land is not properly utilized.
Chapter five Challenges of urban land management in the case of Hawassa City, Ethiopia. The finding indicates that the lack of capacity in several municipalities for comprehensive infrastructure investment plans and systems for managing and maintaining their assets, enforcing laws, regulations, codes, procedures, and by-laws has opened doors to poor governance practices and that Hawassa City is no exception to this. Building municipal City towards bringing in good governance practices has been emphasized in the areas of regulatory, administrative, technical, and extractive capacity areas with the involvement of several stakeholders.

The sixth chapter discusses the paper's general summary, conclusions, and recommendations. This chapter also discusses the study's contributions to existing methodological, theoretical, empirical, and conceptual frameworks and the findings, recommendations, and policy implications.

# CHAPTER TWO

## 2. Quantifying Land use and Land Cover Dynamics in relation to urban growth a case of Hawassa City, Ethiopia

**Abstract**

*Land Use and Land Cover Changes (LULC) are significant factors influencing urban growth worldwide. In Ethiopia, the past few years have witnessed substantial shifts in LULC patterns, often occurring without adequate planning or management. This study aims to quantify the dynamics of land use and land cover over three decades in Hawassa City, Ethiopia. Utilizing multi-spectral satellite images from the years 1990 and 2020, the research categorizes land use into six classifications: Agriculture, Bare Land, Built-up Areas, Bushland, Forest, and Water Bodies. Data were obtained from Landsat 5 TM for the years 1990, 2000, and 2010, and Landsat 8 OLI and SWIR for 2020. Image classification was performed using software packages including QGIS version 3.2, ArcGIS 10.3, ENVI 4.2, and ERDAS Imagine 2013. The processed maps were analyzed to accurately delineate LULC categories within the study area. The findings indicate a significant conversion of land use, with bare land transitioning to built-up space and bushland being converted to agricultural use. Specifically, the results show that between 1990 and 2020, the proportion of built-up land increased from 12.76% to 16.85% of the study area, while bare land decreased from 4.77% to 2.48%, and bushland declined from 14.29% to 10.16%. These findings highlight the urgent need for effective land management strategies to address the ongoing land use conversion in Hawassa City.*

**Keywords:** Change detection, Geographic Information system, Land Use/Land Cover, Satellite image, Thematic Mapper

## 2.1 Introduction

Land is an important natural resource which has numerous social, economic, and biophysical uses. It used to create wealth and employment, grow economies and also use as a source of water, food and energy. It provides services such as conserving biodiversity, storing carbon, purifying and storing water and regulating the Earth's climate by absorbing the heat from the sun as well. Land use and land cover change is the two interrelated ways of observing earth's surface. The former represents the manner human population manipulate the biophysical attributes of the land and the purpose for which land is used while the later represents biophysical state of the earth's surface and immediate subsurface. LULC is perhaps the most prominent form of global environmental change and it occurs at spatial and temporal scales (Molla, 2014).

Land Use Land Cover (LULC) changes are parts of world environmental change and affect ecosystem processes and services. For instance, the growing demand for agricultural, industrial, or urban areas compromises the ability of natural forests, water bodies, and grasslands to care for mankind (Goldman-Benner et al., 2013). However, in recent years, a large number of changes in LULC have been found which were caused by different socioeconomic and biophysical drivers, such as population growth, agricultural expansion, and intensive biophysical drivers, such as population growth, agricultural expansion, and intensification, accessibility to infrastructure/markets and water availability or climate (Shiferaw et al., 2019).

Land use changes area unit advanced methods that arise from modifications within the land cover to land conversion process (Aboud, 2002). Despite this complexity, very little is understood concerning how human and environmental factors operate and the way they move to affect land use patterns (U.S-EPA, 2009). Consistent with Lambin et al., 2005) land use modification is driven by the interaction in house and time between biophysical and human dimensions. There are potential impacts on physical and social dimensions. consistent with (Gereta et al., 2001) throughout the whole history of human beings, intense human utilization of natural resources has resulted in vital changes in land use and land change (LULC). Since the time of industrial enterprise and fast growth, land use modification phenomena have powerfully accelerated in several regions. Land use changes in area units are often indicated to be one of the most human iatrogenic factors influencing the hydrological system (Akotsi et al., 2006). Agriculture has swollen into forests, savannas, and steppes altogether elements of the globe to satisfy the demand for food. Agricultural enlargement has shifted between regions over time; this followed the final development of civilizations, economics, and increasing population (FAO, 2000).

Although the urbanization method usually suggests accelerated economic performance for a country, the attendant rise in costs of urban land and its conversion from one type to a different affects the natural and cultural resources of the town. The inflow of individuals into the cities difficult the urban conditions difficult through structural growth (Redman, 1999, Xiao et al., 2006). The population increase naturally creates adjustment and readjustment of human and land use activities in areas inside urban systems inflicting lateral and structural changes (Luck and Wu, 2003). Lateral changes occur once the City expands in geographic boundaries resulting in sprawl and peripheral developments whereas structural growth relates to the extension in land use density inside urban centers. As demand for land uses will increase thanks to an increase in urban population, lateral growth or urban growth result. Also, as a lot of and a lot of land is being regenerated, thanks to rising population and land costs, tenacity areas step by step become subjected to intensive use and so become high-density or medium-density use (Redman,1999, Xiao et al., 2006).

Globally, cities are urbanizing at unprecedented rates, resulting in profound and unintended impacts on landscapes and urban hydrology (Seto, et al., 2011). In 2014, more than half (54%) of the world's population lived in cities, and by 2050, the urban population is projected to rise by 2.5 billion people, with 90% of this population anticipated to be concentrated in Asia and Africa, where 60% of this population is anticipated to live in slums (Miller et al.2014). There is now a wide consensus that cities in Asia and Africa are more vulnerable to the effects of flooding due to increased urbanization, climate change, poor planning, weak regulations, and poor adaptive capacity Li and Hao (2014). As a consequence, there is a critical need to understand the historical patterns of land-use change, the extent of future urbanization, and their resulting impacts on urban landscapes in these regions to inform flood risk management strategies.

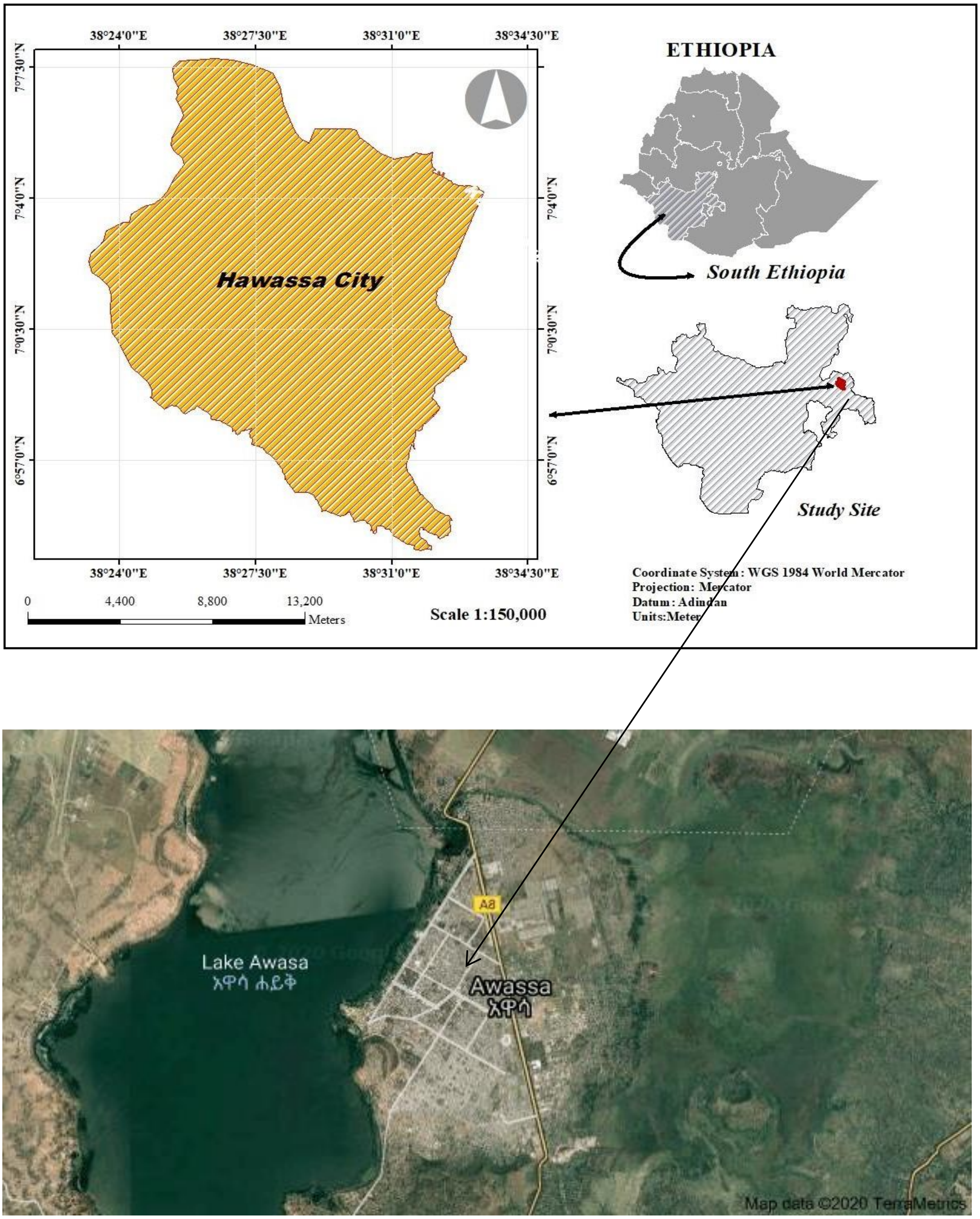
Urban growth within the case of Hawassa City isn't an associate degree exception to different Ethiopian cities however, exhibits a peculiar pattern and complexity due to its geographical setting. To an outsized extent, the City represents most of the characteristics, causes, and effects mentioned on top of. Identification of the patterns of sprawl and analyses of abstraction and temporal changes would greatly facilitate vastly within the coming up of infrastructure facilities. The current rate of increase and projected figures also signify the prime responsibility of the planning department to plan for a future development that's engaging, affordable, and property socially, economically, culturally, and environmentally (Marshall et al., 2009).

The main objective of this study was quantification of the LULC dynamic over three decades Hawassa space by group action Geographic information system (GIS) and Remote sensing techniques. Our analysis provides an important contribution to understanding the LULC maps of the study area for three decades, evaluating judge accuracy, looking at changes in land use, landscape metrics, and the tremendously rapid urbanization inside the study area. The results of this study may offer a reliable guide for the design department of Hawassa City Government, and property development of the study area; analysis may be a reliable guide for decision-makers and City planners towards the advancement of the standard of life in Hawassa City.

## 2.2 Study area

### 2.2.1 Description of the study area

This study was conducted Hawassa City, Ethiopia. Hawassa City is the capital of Sidama Regional State. Moreover, it is the executive center of the Sidama Regional State it was shaped on 18 June 2020. It’s a City Administration standing with eight sub-cities, twenty-one urban and twelve Rural Kebeles. It’s set on the international road that connects Addis Ababa with the national capital at a distance of 275 kilometers south of Addis Ababa. It lies on a comparatively flat plain within the vale topographical region having a mean elevation of around 1690 meters higher than the water level with approximate geographical coordinates of the town is found between Latitude: 7°03'43.38''North and Longitude: 38° 28' 34.86'' East (see Figure 2.1). The area that corresponds to the watershed is encircled by steep escarpments, however, the area itself the landscape is either flat or gently undulating (more than 50% of the slopes are flat to gentle (0-8%) with an extra 33% moderately sloping (8-30%) and solely 5 % steep to terribly steep (>30%) (Hawassa City Administration, 2020).




Figures 2.1 Location of study area. Source: US Geological Survey (USGS) (http://glovis.usgs.gov)

### 2.2.2 Climate

Hawassa City receives an average of 89. 60mm of rainfall each month, with a yearly average of 1075mm. (The greatest mean rainfall occurs in April). The amount of rain reduces from west to east. Months of the water year are classed as dry (January, February, November, and December), noticeably wet (March and October), and very rainy (April, May, June, July, August, and September). From March to October, the region receives an average of 100 to 200 hours of sunshine each month, with 200 to 300 hours per month during the dry season.

### 2.2.3. Data sources

To analyze 30 year LULC four Landsat satellite imagery of 1990, 2000, 2010, and 2020 were downloaded from the United States Geological Survey (USGS) official website (earthexplorer.usgs.gov). All the satellite imagination acquired represents the season and Landsat 5 TM Landsat8 and OLI sensing element information were taken into account. The LULC mapping for the realm was supported by Landsat 5 Thematic mapper (TM) of December 1990 and January 2000, November 2010, and Landsat 8 Operational Land Imager (OLI) and short wave Infrared (SWIR) 2020 (Campelbell and Wynne, 2011).

## 2.3. Materials and Methods

### 2.3.1. Land use land cover classifications

The analysis of land cover dynamics in the study area was conducted for the years 1990, 2000, and 2010 using Landsat images from these years. Prior to analysis, each image underwent preprocessing, a series of image processing steps aimed at enhancing image quality and improving the accuracy of the extracted information. The preprocessing steps included layer stacking, radiometric correction, topographic correction, and image enhancement. Initially, individual single-band images were stacked into a single multi-band output file. Image enhancement was then applied to reduce detector errors and maximize the data's brightness values. This process utilized histogram equalization with linear contrast stretching to redistribute pixel values within a specific range. Band combinations and false-color combinations were also used to aid in better identifying land cover classes.

For classification, both unsupervised and supervised methods were employed. In the unsupervised classification, the computer grouped the image pixels into natural clusters based on similar brightness values, with these clusters later being linked to actual land cover classes through ground verification. In contrast, the supervised classification method involved grouping pixels based on user-defined training classes, requiring prior knowledge of the area. In this method, the user selects training areas representing specific land cover types, and the computer uses this information to classify the image accordingly.

Landsat images from four different years (1) Thematic Mapper of 1990, (2), Enhanced Thematic Mapper Plus of 2000, and 2010 (3) Operational Land Imager or Thermal Infrared Sensor of 2020 were used for LULC classifications. These images were classified by using supervised classification with a maximum likelihood algorithm. The LULC types of the study area were classified into a built-up area, agriculture, bare land, built-up, forest, and water body.

All of the images were obtained with little cloud cover in order to study LULC change and urban growth. Aside from satellite images, field observation, and Google Earth were employed to provide ground truth points (training sites) for LULC mapping. Table 2.1 shows the source and description of the data utilized in this investigation.

Table 2.1 Details of acquired satellite imageries

| **Satellite type** | **Sensor ID** | **Wave length interval** | **Spatial resolution** | **Path/Row** | **Acquisition Date** |
|---|---|---|---|---|---|
| **Landat5** | TM | 0.45µm – 2.35µm | 30m*30m | 168/055 | 18, 12, 1990 |
| **Landsa5** | TM | 0.45µm – 2.35µm | 30m*30m | 168/055 | 28, 01, 2000 |
| **Landsat5** | TM | 0.45µm – 2.35µm | 30m*30m | 168/055 | 07, 11, 2010 |
| **Landsat8** | OLI & SWIR | 0.43µm - 1.38µm | 30m*30m | 168/055 | 19, 01, 2020 |

Source: US Geological Survey (USGS) (http://glovis.usgs.gov)

OLI= Operational Land Imagery SWIR = Short Wave Infrared.

To achieve the objectives of the study, the land use maps for three periods were required. This study utilized multi spectral satellite images of the year 1990, 2000, 2010 and 2020. These images were obtained from the U.S. Geological Survey (USGS) All the images were free from cloud effect. The Landsat images acquired from USGS were L5, L8 which were already geometrically and orthometrically corrected (USGS, 2014).

The pre-processing of the Landsat imagery applied in this study includes: a) conversion of the Digital Number values (DN) of the image to top of atmosphere reflectance (TOAR) with atmospheric correction according to the procedure in ERDAS IMAGINE software. All image processing, classification, and GIS analyses have been done using ERDAS imagine, ENVI, and ArcGIS desktop software's.

The LULC data is obtained from the multi-band formation imageries through the method of image interpretation and classification (Li et al., 2014). Image classification (supervised or unsupervised) is meant to Associate for automatic categorization of pixels with a standard coefficient range into specific LULC classes (Lillesand and Kiefer, 1994, Chica and Abarca-Hernandez, 2000). Supervised classification could be a user-guided approach that involves the choice of coaching sites as a reference for the categorization (Campbell 1996; Lillesand and Kiefer 1994). There are several ways obtainable that are being employed to implement the supervised classification like, parallelepiped classification, K-nearest neighbor, minimum distance classification, and so on (Zhuet et al., 2006). In the present study, we adopted a commonly used maximum likelihood classifier (Platt and Goetz, 2004) for LULC classification using Arc GIS 10.3 and ERDAS IMAGINE 2013 software.

Spatial analysis of land use changes and urban growth is a critical tool for understanding the dynamics of urbanization and its impact on the environment and local communities. This analytical approach employs various methodologies, including Geographic Information Systems (GIS), remote sensing, and spatial statistics, to visualize and quantify changes in land use patterns over time. By mapping urban expansion, researchers can identify trends in land conversion, such as the transformation of agricultural land into residential or commercial areas, and assess the implications of these changes for sustainability and resource management (Zhuet et al., 2006).

Through spatial analysis, it becomes possible to examine the relationships between urban growth and various socio-economic factors, such as population density, economic activity, and infrastructure development. This analysis can reveal how urban sprawl affects surrounding rural areas, leading to increased pressure on agricultural land, water resources, and natural ecosystems. Furthermore, spatial analysis allows for the identification of hotspots of urban growth, enabling planners and policymakers to target interventions more effectively and develop strategies that promote sustainable land use practices.Additionally, spatial analysis can facilitate the assessment of environmental impacts associated with urbanization, such as habitat loss, changes in land cover, and alterations to local climate patterns. By integrating environmental data with land use information, researchers can evaluate the ecological consequences of urban growth and propose measures to mitigate negative effects, such as implementing green spaces or preserving critical habitats (Zemenfes Gebregiabher etal, 2014).

Ultimately, spatial analysis of land use changes and urban growth provides valuable insights that inform urban planning and policy decisions. By understanding the spatial dimensions of urbanization, stakeholders can better navigate the challenges of rapid urban growth, ensuring that development is balanced with the preservation of natural resources and the well-being of local communities. This comprehensive approach is essential for fostering sustainable urban environments that can adapt to the needs of a growing population while safeguarding the ecological integrity of surrounding areas.

### 2.3.2 Accuracy assessment

The reference data used for accuracy assessment were obtained from GPS points during fieldwork and the original mosaic image. The GPS points used in the classification accuracy assessment were independent of the ground truths used in the classification. Based on the error matrix overall accuracy and kappa statistics were used to illustrate the classification accuracy. Therefore an overall accuracy of 86%, 87%and 89% was achieved for the Land sat TM of 1984. Land sat ETM+ of 2001 and Land sat ETM 2018 respectively. These imply excellent classifications of Land sat images.

### 2.3.3 Land use land cover change detection

One of the most powerful advantages of remote sensing images is their ability to capture and preserve a record of conditions at different points in time, to enable the identification and characterization of changes over time. Therefore, after doing supervised classification, change detection was done to see which land use was changed to which one and in what amount or percentage. These help to decide whether the change is positive or negative, and the amount and rate of change from time to time during the selected study period. Finally, the table matrix was also generated which holds overall information about the change matrix between study periods from 19990 to 2020.Total area (TA), changed area (CA), change extent (CE), and annual rate of change (CR) variables were used to determine the magnitudes of change in terms of LULC. The variables were calculated as follows computed as equation 1 (Daniel et al., 2012).

$$CA= TA(t_2) - TA (t_1)$$

$$CE= (CA/TA (t_1))* 100 \text{-----------------------------------------------------------------}(1)$$

$$CR= CE/ (t_2 - t_1)$$

**2.3.4 Evaluating Classification Error Matrices**

First, we can begin to appreciate the need to consider overall, producers, and user's accuracies simultaneously. In this example, the overall accuracy of the classification is 65%. This would potentially lead one to the conclusion that although the overall accuracy of the classification was poor (65%), it is adequate for the purpose of mapping class. In fact, if the number of classes is small, such a random assignment could result in a surprisingly good apparent classification result a two-category classification could be expected to be 50% correct solely due to random chance. The kˆ"kappa" or "KHAT") statistic is a measure of the difference between the actual agreement between reference data and an automated classifier and the chance agreement between the reference data and a random classifier conceptually, kˆ can be defined as This statistic serves as an indicator of the extent to which the percentage correct values of an error matrix are due to "true" agreement versus "chance" agreement. The kˆstatistic is computed as equation 2.

$$\hat{k} \frac{N\sum_{i=1}^{r} x_{ii-}\sum_{i=1}^{r}(x_{i+}.x_{+i})}{N^2-\sum_{i=1}^{r}(x_{i+}.x_{+i})} \text{-----------------------------------------------------------------------------}(2)$$

Where

r= number of rows in the error matrix

$x_{ii}$= number of observations in row i and column i (on the major diagonal)

$x_{i+}$= total of observations in row i (shown as marginal total to right of the matrix)

$x_{+i}$= total of observations in column i (shown as marginal total at bottom of the matrix)

N= total number of observations included in matrix. Equation 3 has been computed.

$k1 = \frac{UB-UA}{UA}\frac{1}{T}\times\ 100\%$ ------------------------------------------------------------------------(3)

Where K1 is the land use dynamics index, measuring the rate of target LULCC t; UA and UB are the areas of the target LULCC type at the beginning and end of the study period, respectively; and T is the length of the study period. K1 can concisely express the overall characteristics of certain during LULCCs a study period but usually misses some information on the spatial process of the LULCC. Thus, another index for the rate of change of a single LULCC type, K2, was proposed as shown in the equation 4 (Peng et al., 2008).

$K = \frac{\Delta Uin-\Delta Uout}{Ua}\times\frac{1}{T}\times 100\%$-------------------------------------------------------------------- (4)

Where K2 is a land use dynamics index measuring the rate of change of the target LULCC type; U in and U out are the areas of the target LULCC type conversion from or to other LULCCs types, respectively; and T is the length of the study period. When focusing on the process of LULCC, K2 reflects the area ratio of the conversion from and to the target LULCC type. In general, K2 measures the total ‘loss or gain’ conversion of the target LULCC type, while K1 reflects the algebraic summation of conversion loss and gain of the target LULCC type. The absolute value of K1 expresses the relative difference between conversion loss and gain; with a positive sign representing the dominance of conversion gain from other LULCC types to the target LULCC type and a negative sign representing the dominance of conversion loss (Pieterse, 2008).

Various types of spectral indices extract different types of LULC. The major LULC types in the urban land are green vegetation, water, wetland, barren land, and settlement. Thus, MNDWI (Xu 2006), NDBI (Zhao and Chen, 2005), NDVI (Tucker, 1979), and NDBI (Zha et al., 2003) were the chosen spectral indices as these can extract water body, bare land settlement, and vegetation by applying their numerical thresholds (Chen et al., 2006). Based on the analysis of the unique spectral responses of built-up areas and other land covers in seven Landsat TM bands, the original NDBI approach developed by Zha et al., 2003.

The Normalize Difference Build-up Index value lies between -1 to +1. Negative value of NDBI represents water bodies whereas higher value represents build-up areas. NDBI value for vegetation is low. The built-up areas were extracted by the following equation 5

BU = NDBI – NDVI ---------------------------------------------------------------------------(5)

Where BU b is the resultant binary image with only the built-up and barren pixels having positive value, thus allowing built-up areas to be mapped automatically (Zha et al. 2003).

The Normalized Difference Vegetation Index (NDVI) is the most commonly used vegetation index for observe greenery globally. Other commonly used vegetation indices Enhanced Vegetation Index (EVI), Perpendicular Vegetation Index (PVI), Ration Vegetation Index (RVI) equation 7.

NDVI = (NIR – Red) / (NIR + Red)-------------------------------------------------------------(6)

## 2.4. Data preprocessing

Image preprocessing could embody the detection and restoration of bad lines, geometric rectification or image registration, radiometric standardization, atmospheric correction, and topographic correction. Correct geometric rectification or image registration of remotely perceived information could be a necessity for a mix of various supply information in an exceeding classification method. Several textbooks and articles have delineated this subject thoroughly (Jensen 1996, Toutin 2004).

Once multi-temporal or multi-sensing element information is used, atmospheric standardization is necessary. This can be very true once multi-sensing element information, like Landsat TM and SPOT, and measuring system information is integrated for image classification. A range of strategies, starting from easy relative standardization and dark object subtraction to standardization approaches supported by advanced models, are developed for radiometric and atmospheric standardization and correction (Markham and Barker 1987, Gilabert et al. 1994, Chavez 1996, Stefan and Itten 1997, Vermote et al., 1997, Tokola et al., 1999, Heo and Fitz 2000, Song et al. 2001, Du et al. 2002, McGovern et al. 2002, Hadjiitsis et al., 2004). Geographic correction is another necessary side if the study space is found in rugged or mountainous regions (Teillet et al. 1982, Civco 1989, Colby 1991, Meyer et al. 1993, Rannikko 1999, Gu, Gillaespie 1998, Haleand, 2003).

The Maximum likelihood classified to categorized the Landsat 5 TM 1990, 2000 and 2010, Landsat 8 OLI and SWIR 2020 has produced map showing the distributions of six prevalent LULC classification .The ArcGIS software and spatial analyst tools and demarcated the boundary of the study area. The detailed methodology adopted is given in Figure 2.2.

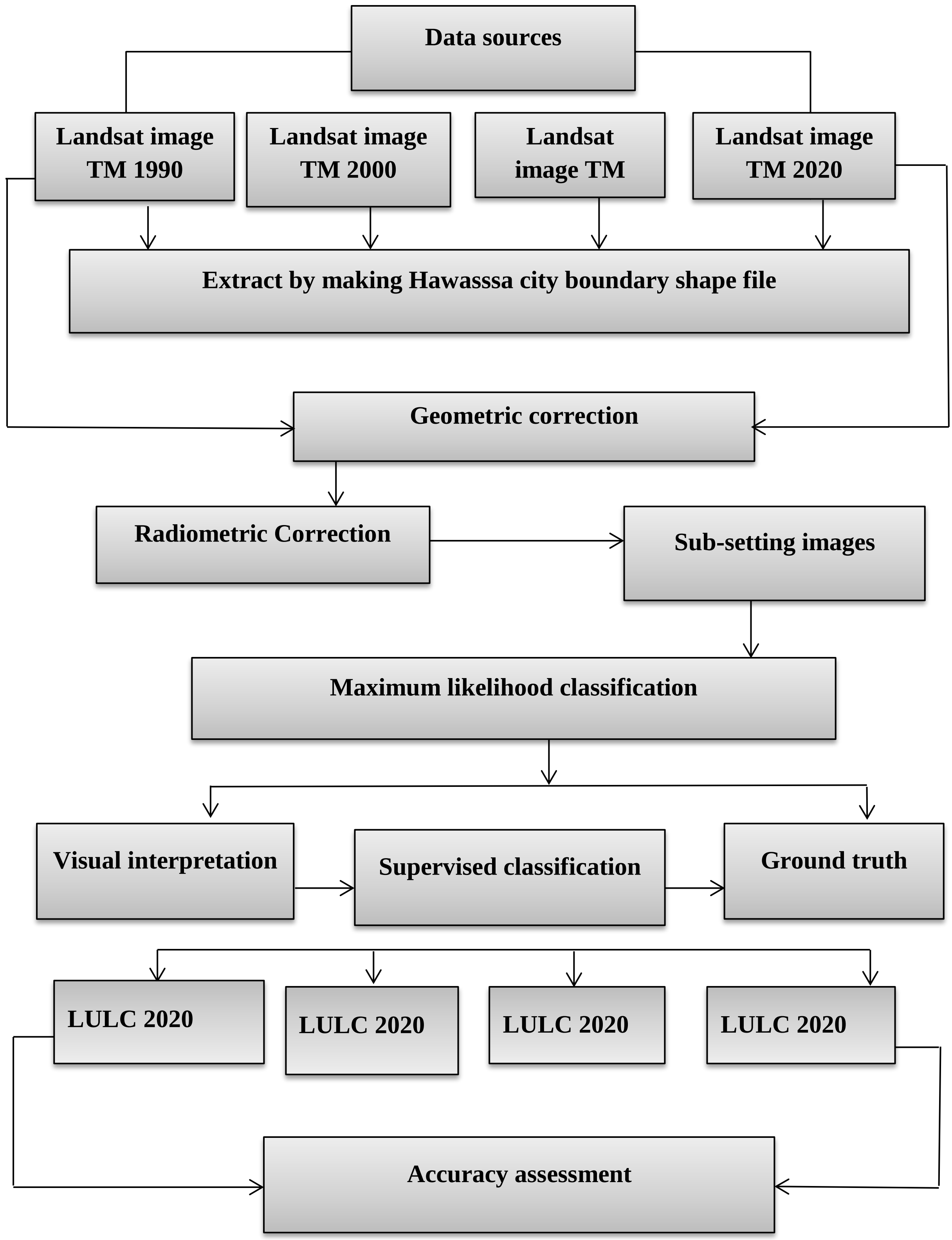



Figure 2.2 Data processing flow chart**.** Source: Author's construct, 2020

## 2.5 Results and discussion

### 2.5.1 Land use/land cover change of Hawassa City

In this study, LULC types of study areas were classified from Landsat images of 1990, 2000, 2010, and 2020. The LULC classes of the study period (1990, 2003, and 2020) were classified into Agriculture, bare land, built-up area, and bushland, forest, and water body (Figure 2.3). Water body and agricultural land dominated LULC classes in the study area but the agricultural land declined during the last decade of 2010 to 2020 by 1.35% this is due to an increment of built-up area in 1.91% in the same period.

### 2.5.2 Trend of land use/land cover change of Hawassa City

The land cover classes in Hawassa City from 1990 to 2020 are shown in Table 2.2 and Figure2.3. The supervised classification result revealed the same land use type, however, the degree of coverage varied depending on the kind of cover. Other contributing aspects to the LULCC include built-up regions with the spatiotemporal dynamics of urban expansion, land use change processes linked to population increase and national economic transformation programs.

Agriculture expanded from 26.51% to 28% of the total area between 1990 and 2000, according to the highest incremental LULC classes in the study area, whereas built-up areas increased from 12.76 to 14.25%. In general, throughout this time, the total amount of bushland, bare land, and forest decreased substantially by 3.21, 1.06, and 0.10 respectively.

According to the data from Indicated Landsat TM, the built-up area increased at the greatest rate in the study region from 2010 to 2020, at 1.91%. The structure grew mostly in the northeasterly to southeasterly direction at a pace of 0.136%.Per annual rate of change. Additionally, the percentage of bare land converted to agriculture increased from 1990 to 2010, increasing by 26.5%, 28%, and 30.11%, respectively. However, the area of agricultural land from 2010 to 2020 decreased by 78.50 km2 (30.11%) to 74.97 km2 (28.76%) with a ten-year rate of 1.35% due to a number of mega projects that increased built-up that was established in the study area. This implies that built-up areas have tremendously increased the expense of agriculture and bare land in the study area. The shrinking of both agricultural and bare land is mainly due to urban expansion to surrounding rural communities and the related sake of land for residence, commerce, administrative institutions, services, roads, and other urban functions.

Agriculture has the highest area share in the study region, accounting for 73 km2 (28%) of the total area, while bare land has the lowest proportion at 9.68 km2 (3.71%), according to the LULC data for the year 2000. The other land groups were forest land, which made up 21.63 km2 (8.3%) of the land, built-up land, which made up 37.15 km2 (14.25%), and water bodies, which made up 90.34 km2 (34.65%) of the land due to the existence of Lake Hawassa. This indicates that barren areas made up the least amount of land in the City and that agricultural land had the largest land share.

The largest area coverage in the Land use the land cover of 2010 in the study area shows Agriculture which contains 78.50 km2 (30.11%) of the total area and the least land class area was bare land which contains 8.17 km2 (3.13%) of the total area, built-up 38.96 km2 (14.94%) and bushland 27.44 km2 (10.53%) from the total area of the land classes. This implies that there are increments of the agriculture and built-up area and bare land area decrease because of the growth of population in the City after the year 2000 up to 2010.

Table 2.2 indicates the land category within the years 1990 and 2020 study area. Constant land use type was shown from the result of supervised classification, but the amount of coverage was different for different cover types. The built-up area which totaled 33.26 km2 in 1990 increased to 37.15 km2, 38.96 km2 and 43.93 km2 in the years 2000, 2010 and 2020 respectively. Despite fluctuation water body during different years, has gained an overall increase of 30 years of periods, water occupied 86.72 km2 in 1990 it increased to 90.34 km2 in 2000, and decreased to 87.42 km2 in 2010 but the coverage increase to 91.31 km2 in 2020. The water body of the land cover category stays nearly constant study amount.

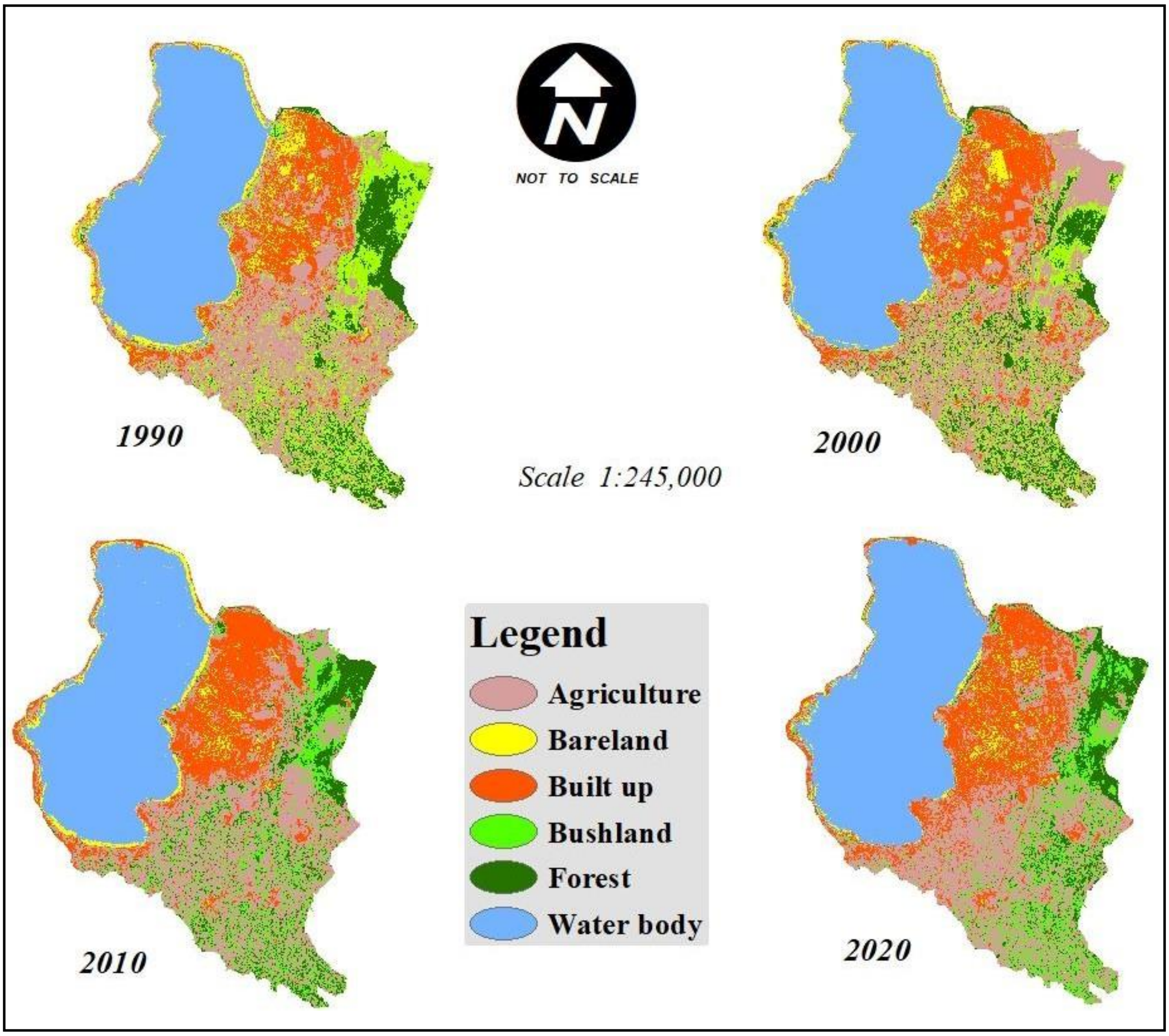



Figure 2.3 Classified LULC maps of Hawassa City for years 1990, 2000, 2010and 2020**.**

Source: US Geological Survey (USGS) (http://glovis.usgs.gov)

Table 2.2 Area statistics of LULC of years 1990, 2000, 2010 and 2020

| S.N | LULC Class | Year 1990 | | Year 2000 | | Year 2010 | | Year 2020 | |
|---|---|---|---|---|---|---|---|---|---|
| | | **Area (Km2)** | **%** | **Area (Km2)** | **%** | **Area (Km2)** | **%** | **Area (Km2)** | **%** |
| **1** | Agriculture | 69.12 | 26.51 | 73.00 | 28.00 | 78.50 | 30.11 | 74.97 | 28.76 |
| **2** | Bare land | 12.44 | 4.77 | 9.68 | 3.71 | 8.17 | 3.13 | 6.47 | 2.48 |
| **3** | Built up | 33.26 | 12.76 | 37.15 | 14.25 | 38.96 | 14.94 | 43.93 | 16.85 |
| **4** | Bush land | 37.26 | 14.29 | 28.90 | 11.08 | 27.44 | 10.53 | 26.50 | 10.16 |
| **5** | Forest land | 21.89 | 8.40 | 21.63 | 8.30 | 20.20 | 7.75 | 17.52 | 6.72 |
| **6** | Water body | 86.72 | 33.26 | 90.34 | 34.65 | 87.42 | 33.54 | 91.31 | 35.03 |
| **Total** | | **260.69** | **100** | **260.69** | **100.00** | **260.69** | **100** | **260.69** | **100** |

| **1990 – 2000** | **2000-2010** | **2010-2020** |
|---|---|---|
| -3.88 | -5.5 | 3.53 |
| 2.76 | 1.51 | 1.7 |
| -3.89 | -1.81 | -4.97 |
| 8.36 | 1.46 | 0.94 |
| 0.26 | 1.43 | 2.68 |
| -3.62 | 2.92 | -3.89 |

Source: US Geological Survey (USGS) (http://glovis.usgs.gov)

### 2.6. Rate of land use/land cover changes of the Hawassa City from 1990 to 2020

During 1990–2000, the bush land was decreased by 10.56 km2, bare land 5.97 km2 and forest was declined by 4.37 km2. Agriculture and built-up area were increased by 5.85km2 and 10.67 km2 respectively. Over the study period 1990–2020, bush land, bare land, and forest cover classes were decreased (see Figure 2.4).

They have emphasized that since all of the newly incorporated rural Kebeles of land were taken from the periphery, a significant number of the newly added plots of land are planned to be used for residence, followed by special function and urban agriculture. Furthermore, a substantial portion of this area is expected to be used for the growth of public service sectors, including roads, schools, health facilities, as well as administrative centers like Kebeles and sub- City centers. In relation to how the land was previously used before the insertion of additional territory, the municipality and City administration are very comparable. However, as a result of the growth in municipal government, the City has changed how it uses its territory.

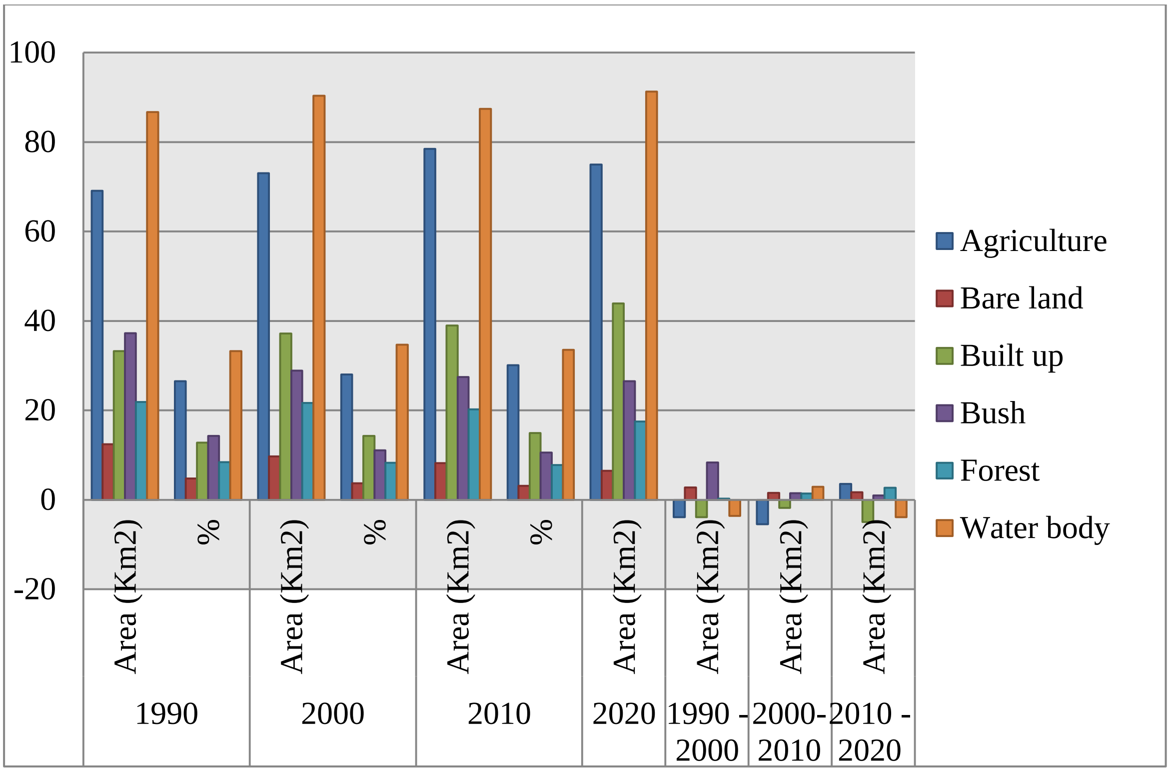



Figure 2.4 Net gain and loss of each LULC classes from other land uses for the period of 1990 and 2020**.** Source: US Geological Survey (USGS) (http://glovis.usgs.gov).

### 2.7 Accuracy assessment

For this study, accuracy assessment of LULC for 1990, 2000, 2010 and 2020 years produced the overall classification accuracy of 88.41%, 93.48%, 88.41% and 89.86%, respectively. The overall LULC classification Kappa statistics for the study periods were 0.8609, 0.9217, 0.8609, and 0.8783, respectively (see Table 2.3).

The accuracy assessments were performed for classified images of 2020, a minimum of twenty-three random points was generated per class using a stratified random sampling approach for efficient accuracy assessment. The corresponding reference category for every

Table 2.3 Accuracy assessment of classified LULC maps of years 1990, and 2020

| **Years** | **Land use/cover Class** | **Reference Totals** | **Classified Totals** | **Number Correct** | **Producers Accuracy** | **Users Accuracy** |
|---|---|---|---|---|---|---|
| | Agriculture | 25 | 23 | 21 | 84.00% | 91.30% |
| | Bush land | 22 | 23 | 21 | 95.45% | 91.30% |
| | Bare land | 22 | 23 | 18 | 81.82% | 78.26% |
| **1990** | Built-up | 19 | 23 | 19 | 100.00% | 82.61% |
| | Forest | 28 | 23 | 23 | 82.14% | 100.00% |
| | Water | 22 | 23 | 20 | 90.91% | 86.96% |
| | Totals | 138 | 138 | 122 | | |
| Overall Classification Accuracy =88.41% | | | | | | |
| Overall Kappa Statistics = 0.8609 | | | | | | |
| | Agriculture | 25 | 23 | 23 | 92.00% | 100.00% |
| | Bush land | 25 | 23 | 23 | 92.00% | 100.00% |
| | Bare land | 22 | 23 | 19 | 86.36% | 82.61% |
| **2000** | Built-up | 21 | 23 | 21 | 100.00% | 91.30% |
| | Forest | 24 | 23 | 23 | 95.83% | 100.00% |
| | Water | 21 | 23 | 20 | 95.24% | 86.96% |
| | Totals | 138 | 138 | 129 | | |
| | Overall Classification Accuracy =93.48% | | | | | |
| | Overall Kappa Statistics = 0.9217 | | | | | |
| | Agriculture | 22 | 23 | 20 | 90.91% | 86.96% |
| | Bush land | 22 | 23 | 21 | 95.45% | 91.30% |
| | Bare land | 25 | 23 | 18 | 72.00% | 78.26% |
| **2010** | Built-up | 20 | 23 | 19 | 95.00% | 82.61% |
| | Forest | 26 | 23 | 23 | 88.46% | 100.00% |
| | Water | 23 | 23 | 21 | 91.30% | 91.30% |
| | Totals | 138 | 138 | 122 | | |

Overall Classification Accuracy =88.41%

Overall Kappa Statistics = 0.8609

| | | | | | | |
|---|---|---|---|---|---|---|
| | Agriculture | 21 | 23 | 20 | 95.24% | 86.96% |
| | Bush land | 23 | 23 | 21 | 91.30% | 91.30% |
| | Bare land | 26 | 23 | 21 | 80.77% | 91.30% |
| **2020** | Built-up | 24 | 23 | 21 | 87.50% | 91.30% |
| | Forest | 24 | 23 | 21 | 87.50% | 91.30% |
| | Water | 20 | 23 | 20 | 100.00% | 86.96% |
| | Totals | 138 | 138 | 124 | | |

Overall Classification Accuracy = 89.86% Overall Kappa Statistics = 0.8783

Source: US Geological Survey (USGS) (http://glovis.usgs.gov)

The growth of the built-up area is mostly responsible for the change in the LULC in the study region, according to the Table 2.3 conversion matrix for the years 1990 to 2020. Over the past 30 years, LULCC trends have indicated a tendency for more land to be developed. These provided statistics explicitly say that the conversion of bare land and bushland to urban built-up areas as a result of population growth mostly leads to the destruction of trees and other natural vegetation.

## 2.8 Normalized Difference Built-up Index (NDBI)

The Built-up Index (BU) is a key indicator used to analyse urban expansion patterns by combining two indices: the Normalized Difference Built-up Index (NDBI) and the Normalized Difference Vegetation Index (NDVI). This index helps identify areas that are developed or barren, with higher positive values indicating built-up areas. Essentially, the BU index allows for the automatic mapping of urban built-up areas, distinguishing them from non-urban land uses.

The formula for calculating the Built-up Index is:

$BU = NDBI - NDVI$

$BU = NDBI - NDVI$

NDBI Calculation

The NDBI itself is a relatively simple and straightforward index to calculate, particularly compared to more complex image classification techniques like supervised and unsupervised classification. While those classification methods can be lengthy and require multiple steps and operations, the NDBI provides a direct way to differentiate urban built-up areas from other land cover types, making it easier to analyse. The accuracy of the results from more traditional classification methods depends largely on the skills of the image analyst and the classification approach used.

The NDBI is calculated using the following formula:

NDBI=SWIR−NIRSWIR+NIR

NDBI=SWIR+NIRSWIR−NIR

Where SWIR refers to the Short-Wave Infrared band and NIR refers to the Near-Infrared band. Specifically, for Landsat satellite imagery, the NDBI formula differs slightly depending on the satellite model:

For Landsat 7 data, the formula is:

NDBI=Band 5−Band 4Band 5+Band 4

NDBI=Band 5+Band 4Band 5−Band 4

For Landsat 8 data, the formula is:

NDBI=Band 6−Band 5Band 6+Band 5

NDBI=Band 6+Band 5Band 6−Band 5

The resulting NDBI values range from -1 to +1. A negative NDBI value generally indicates water bodies or low-reflectance surfaces, while higher positive values suggest built-up or developed areas. Vegetated areas, on the other hand, typically show low NDBI values, indicating the presence of dense vegetation rather than urban infrastructure.

Spatial Distribution of NDBI (1990–2020)

Analysing the spatial distribution of NDBI values over time provides valuable insights into the urban growth patterns in a region. For the period from 1990 to 2020, NDBI values show a marked increase, especially along the inner and outer peripheries of Hawassa City. The NDBI values in the City’s core areas remained relatively moderate, largely due to the higher presence of vegetation and water bodies in these zones.

By 2020, however, the central part of the City also exhibited significantly higher NDBI values, reflecting more intense urbanization and expansion in the urban core. This shift indicates a densification of built-up areas, likely driven by the growing population and economic development in the City centre.

Additionally, the images analysed show seasonal variations in the NDBI values. Dry season images tend to exhibit higher NDBI values compared to those taken during the summer, as the lack of vegetation and soil moisture during the dry season leads to more exposed and barren surfaces, which are easily detected as built-up areas.

From 1990 to 2020, the increase in NDBI values is particularly noticeable on the outskirts of the City, where urban sprawl has begun to encroach upon previously rural or agricultural lands. These areas typically show very high NDBI values, as they are characterized by drier soils, sparse vegetation, and more exposed, undeveloped land. These areas are also where rapid urban expansion has occurred, contributing to the high NDBI readings.

The results from this analysis highlight the intensifying urbanization in and around Hawassa City, showing that while the core of the City retains some vegetative cover and water features, the outer peripheries have experienced a significant loss of natural land cover, replaced by infrastructure, bare soil, and other indicators of urban development. This trend underscores the need for careful urban planning to ensure sustainable growth that balances development with environmental preservation, particularly in peri-urban areas that are directly affected by urban expansion.

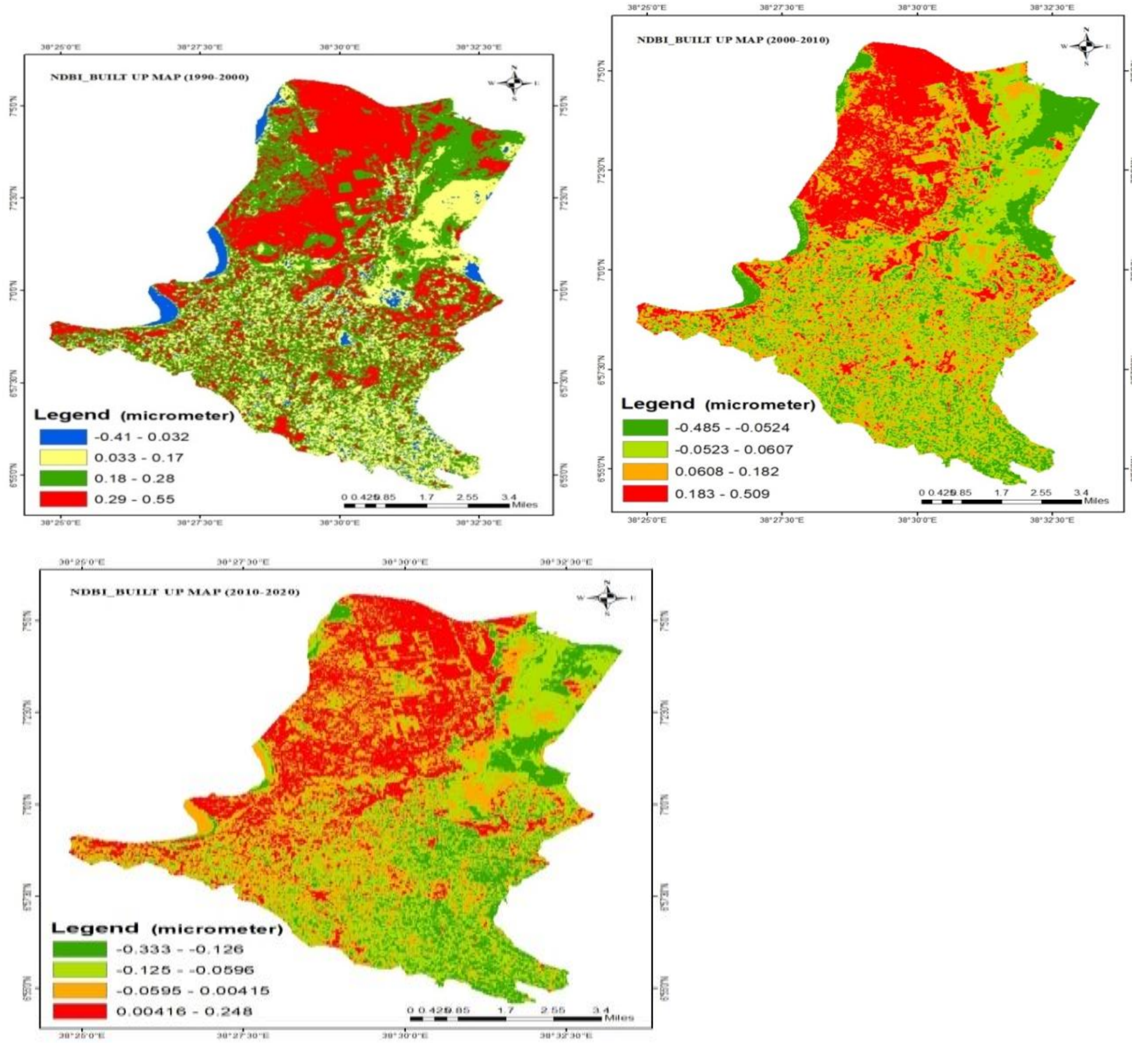



Figure 2.5 Spatial distribution of NDBI 1990-2020. Source: US Geological Survey (USGS) (http://glovis.usgs.gov)

From 2000 to 2020, Hawassa City experienced rapid urban growth, expanding at a rate of 1 km² per year, with built-up areas increasing from 12.2 km² to 19 km². However, from 2010 to 2020, this growth accelerated dramatically, with the City expanding at a rate of 4.3 km² annually, reaching 44.9 km² of built-up land by 2020. For comparison, Addis Abeba, Ethiopia's capital City with a population nearing 4 million grows at a rate of about 4 km² per year, although it operates on a vastly different scale than Hawassa. In addition to urban expansion, agricultural land within Hawassa's administrative boundaries has also increased, growing from 90 km² in 2000 to 104 km² by 2020.

As the City expands, the natural land within the urban boundary has significantly decreased. Key ecosystems, including forests, bare land, and other essential natural resources, have diminished from 71 km² in 2000 to just 19 km² in 2020. This decline represents a significant reduction in the City's natural capital, which is crucial for maintaining the environmental and human health of the area. Within the City's administrative boundary of 175 km², the remaining land is increasingly occupied by urban development and agriculture, leaving little room for the preservation of natural ecosystems.

The reduction of forest cover in the City and its surroundings poses not only environmental risks but also economic costs. For instance, maintaining 14% forest coverage within urban areas can improve air quality by up to 4% year-round, and as much as 10% during peak traffic hours (Escobedo et al., 2009). Urban parks or gardens with 60% tree coverage can reduce temperatures by up to 4°C (Bowler et al., 2010). Additionally, promoting urban agriculture could significantly mitigate environmental impacts. For example, 50 km² of urban agriculture could reduce carbon dioxide emissions by 100,000 tons per year (Gwan et al., 2015). These examples highlight the critical role that green spaces and sustainable land management play in the overall well-being of urban populations.

In response to the City's rapid growth, this study developed two potential scenarios for Hawassa's urban expansion, each aiming to address the City's land use challenges while promoting sustainable development.

**Scenario One: Expansion Within the Planning Boundary (Compact Development)**

The first scenario recommends focusing urban growth within the existing planning boundary, following the principles of the compact City model advocated by UN-Habitat. This approach encourages maximizing the use of available urban infrastructure and services, fostering social integration, protecting the environment, and enhancing economic efficiency. Compact development aims to reduce urban sprawl, promoting higher-density housing and more efficient land use. This model is particularly relevant to addressing Hawassa's pressing housing challenges while ensuring that urban growth remains sustainable. By concentrating development within the planning boundary, the City can better manage its limited land resources, promote mixed-use developments, and preserve green spaces and vital ecosystems.

**Scenario Two: Expansion beyond the Planning Boundary (Sustainable Growth beyond the boundary)**

The second scenario builds on the compact City model but acknowledges the pressures of Hawassa's growing population and the increasing demand for housing. The rapid urbanization observed between 2010 and 2020 highlights the City's struggle to provide sufficient affordable housing, which has led to informal settlements and uncontrolled land occupation. If the City administration does not implement a strategy to manage urban expansion in the coming decades, the situation may worsen, with informal settlements sprawling into sensitive areas such as forests, agricultural lands, and marginal lands.

This scenario advocates for a more proactive approach to expanding the City's boundaries, with careful planning to ensure that growth beyond the current urban limit is both sustainable and well-managed. Such an approach would include considerations for infrastructure, housing, environmental protection, and access to services. This scenario also emphasizes the importance of urban agriculture, green spaces, and the preservation of key ecosystems to mitigate the negative impacts of urbanization, ensuring that Hawassa City can accommodate its projected growth without compromising the quality of life for its residents or the environment.

According to Figure 2.6 conversion of the matrix for the years 1990-2020, the change in the LULC in the study area was largely attributed to the expansion of the built-up area. Last twenty years LULCC patterns showed a tendency towards more land settlements. This dramatic change might have been driven by several economic and social factors including the population and economic growth which initiatives a massive demand for housing and the subsequent expansion in housing construction including high-density road-density construction, urban building, and cooperative-based housing development in the City (Kassa et al.,2011) including the study area. These changes also contributed to the massive land degradation observed study area. This case study emphatically shows how rapid population increase may cause a chain reaction of environmental concerns, including soil degradation and loss of arable land as a result of forced urbanization. To meet the need for housing and related infrastructure, people will be pushed to relocate into protected areas (e.g., forests), productive land (e.g., agricultural land), and unsuitable marginal range lands. A thorough investigation of the region to prioritize property among desirable LULCC is thus critical for the environmentally sustainable economic and social development of the area, which is fraught with opposing interests.

### 2.9 Normalized Difference Vegetation Index (NDVI)

The Normalized Difference Vegetation Index (NDVI) is the most commonly used vegetation index for observing greenery globally. Other commonly used vegetation indices Enhanced Vegetation Index (EVI), Perpendicular Vegetation Index (PVI), Ration Vegetation Index

(RVI). In general, Healthy vegetation is a good absorber of the electromagnetic spectrum for visible reasons (see Figure 2.6).

Chlorophyll contains in greeneries highly absorbs Blue (0.4 - 0.5 μm) and Red (0.6 - 0.7 μm) Spectrum and reflects the Green (0.5 – 0.6 μm) spectrum. Therefore, our eye perceives healthy vegetation as green. Healthy plants having high reflectance in Near Infrared (NIR) between 0.7 to 1.3 μm. This is primarily due to the internal structure of plant leaves. High reflectance in NIR and high absorption in the Red spectrum, these two bands are used to calculate NDVI. So, the following formula gives the Normalized Difference Vegetation Index (NDVI).

NDVI = (NIR – Red) / (NIR + Red)

For Landsat 7 data, NDVI = (Band 4 – Band 3) / (Band 4 + Band 3)

For Landsat 8 data, NDVI = (Band 5 – Band 4) / (Band 5 + Band 4)

The NDVI value varies from -1 to 1. Higher the value of NDVI reflects high Near

Infrared (NIR), means dense greenery. Generally, we obtain following result:

- NDVI = -1 to 0 represent Water bodies
- NDVI = -0.1 to 0.1 represent Barren rocks, sand, or snow
- NDVI = 0.2 to 0.5 represent Shrubs and grasslands or senescing crops
- NDVI = 0.6 to 1.0 represent Dense vegetation or tropical rainforest

Further all NDBI and NDVI rate can be calculated using raster calculator in ArcGIS v.10.71.

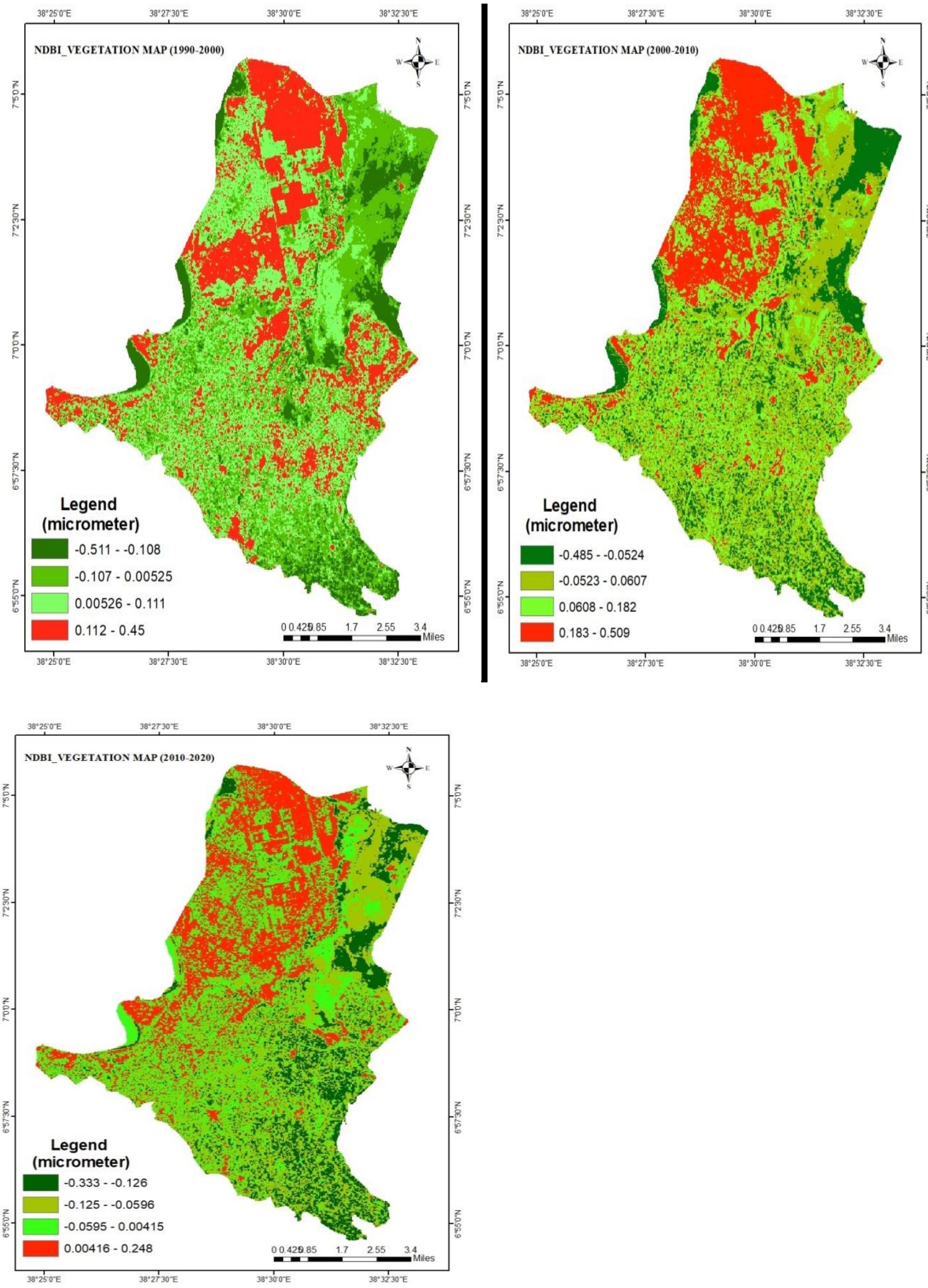



Figure 2.6 Spatial distribution of NDVI 1990-2020 Source: US Geological Survey (USGS) (http://glovis.usgs.gov).

## 2.10 Land Use/Land Cover Change of map from 1990-2020

According to Figure 2.7 conversion of the matrix for the years 1990-2020, the change in the LULC in the study area was by largely attributed to the expansion of the built-up area. Last twenty years LULCC patterns showed a tendency towards more land settlements. This dramatic change might have been driven by several economic and social factors including the population and economic growth which initiatives a massive demand for housing and the subsequent expansion in housing construction including high-density road-density construction, urban building, and cooperative-based housing development in the City (Kassa et al.,2011) including the study area. These changes also contributed to the massive land degradation observed study area. This case study clearly shows that rapid population growth could trigger a chain of environmental problems including land degradation and loss of fertile land due to forced expansion of urban centres. People will be forced to move into forests, agricultural land, and unsuitable marginal rangelands in order to satisfy their demand for housing and associated infrastructure. A detailed study of the area to prioritize land among desired LULCC is therefore very crucial for environmental-friendly economic and social development of the area where conflicting interests abound.

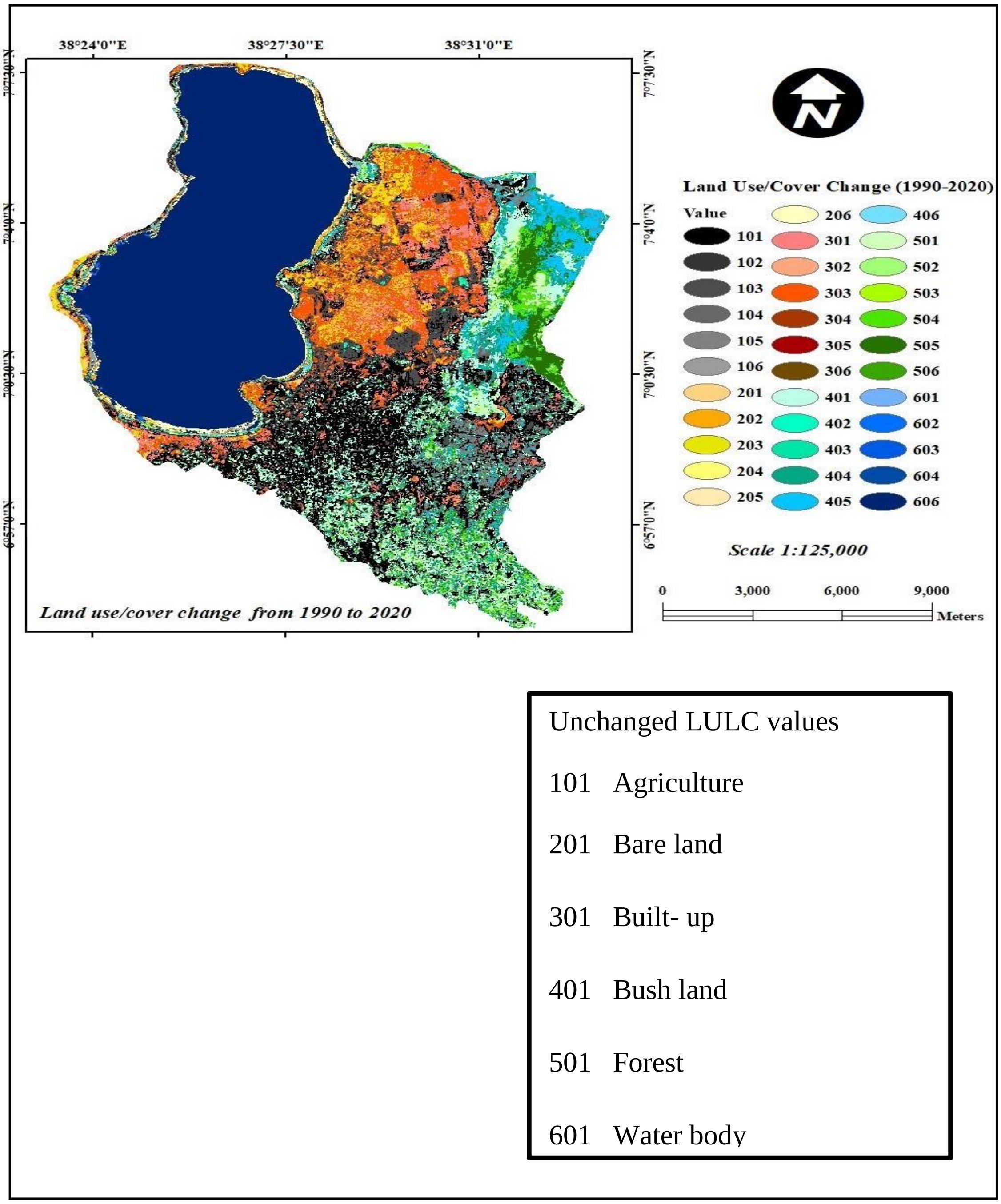



Figure 2.7 Land use/land cover conversion matrix from 1990 and 2020 Source**: US** Geological Survey (USGS) (http://glovis.usgs.gov).

### 2.11 Business land use zoning

The existing land uses in the City indicate the availability of different types with varying character, density, and/or cluster. Low-density residential uses are the dominant land use type in the City. Except for some condominium buildings of G+2 types, located in different areas of the City, there are no other high-density buildings in the City.

Most commercial activities are concentrated along some major roads (see Figure 2.8) with different levels of density of employment. However, these areas are not supported by adequate parking spaces and thus the City needs to consider parking spaces in such busy commercial corridors, namely Arab Sefer, Piazza, Old Bus Station, Sefere Selam, Atote Membo/ Hawassa College of Teacher Education, Hawessa Industrial Park and Hawssa University, and the New Bus Station surroundings. The back roads in some of these corridors are very proximate to slums and dilapidated kebele houses.

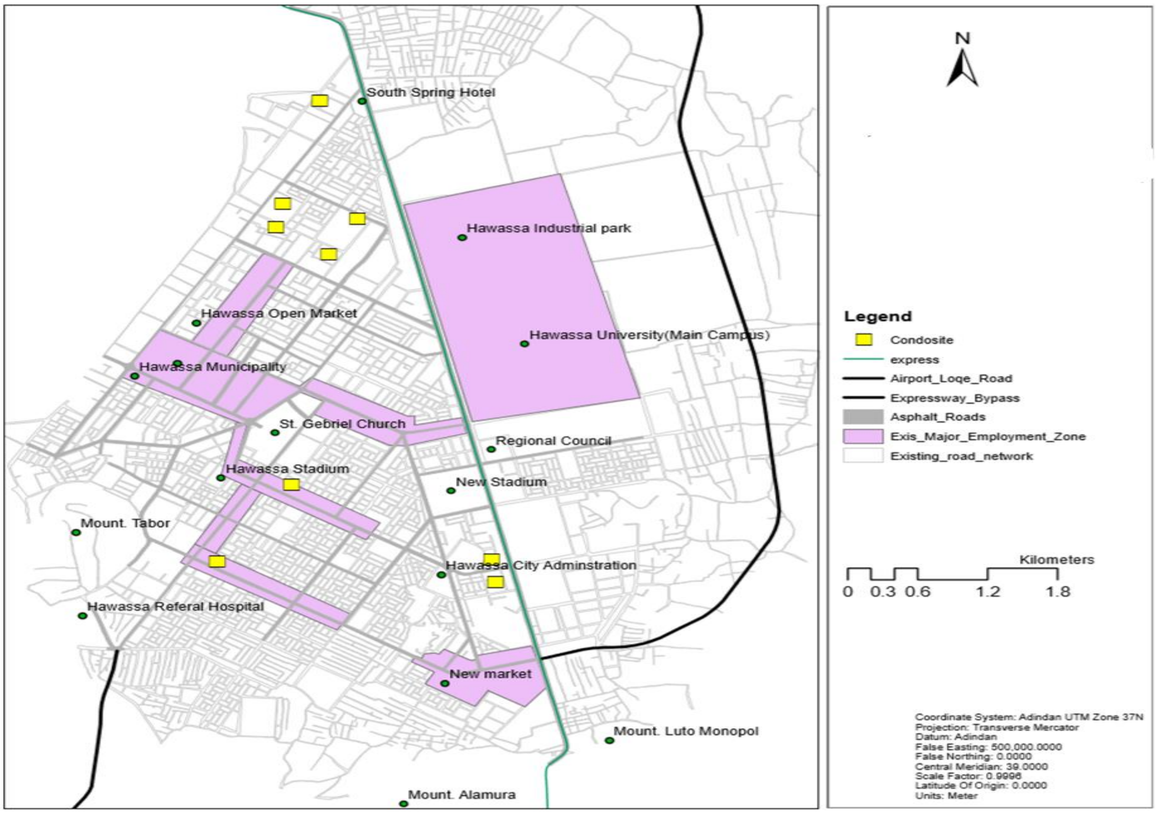



Figure 2.8 Business land use zoning. Source: Hawassa City Municipality

## 2.12. Future expansion direction

Hawassa City has grown significantly, from a surface covering of 4.98 km2 in the 1983s to built-up area coverage of around 48.29 km2 in 2018. These values demonstrate how the City has expanded exponentially out of the planning boundary 37 square kilometers occupying agricultural land and encroaching natural systems. Due to the current uncontrolled development pattern and expansion of informal settlement, the City could not possibly expand towards the north, east, and west direction Figure 2.9.

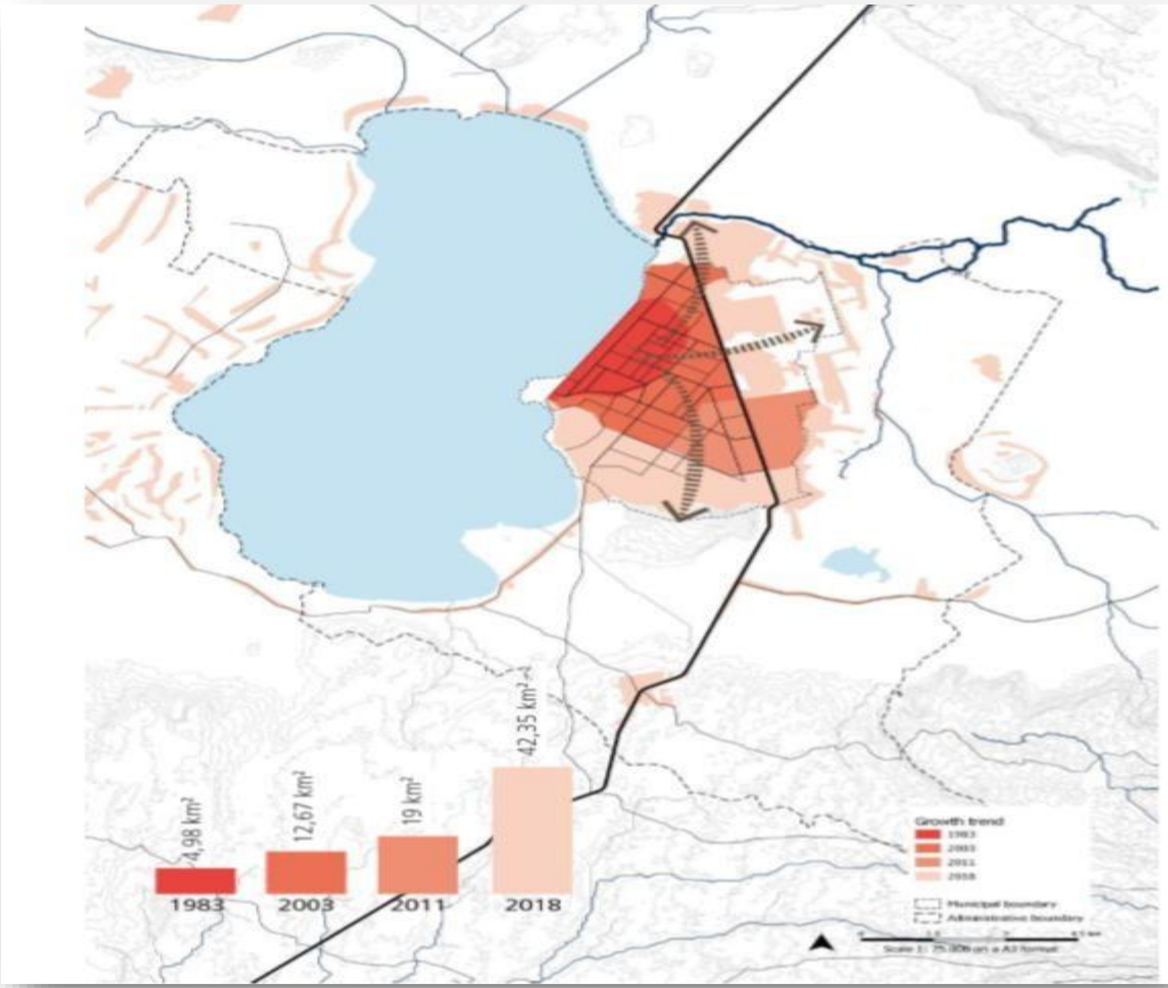



Figure 2.9 Map of existing land grading in 1983, 2003, 2011 and 2018 Source: Hawassa City Municipality

Land grading is a regulation that is believed to describe the rank of locations based on their importance within a City. It also shows strategic investment areas and identifies the investment focus area of the City. The City has four types of land grades: Grade One, Grade Two, Grade Three and Grade Four. Grade one refers to the most valuable land while Grade Four is the least. Each type of grade has also three sub-grades depending on the location, and adjacency of main corridors and back roads (see Figure 2.10). Grading is simply made starting from the main City centers and moving outwards. This makes lakefront areas less valuable than Grade One areas. In Principle Lake front areas should be among the highest grades**.**

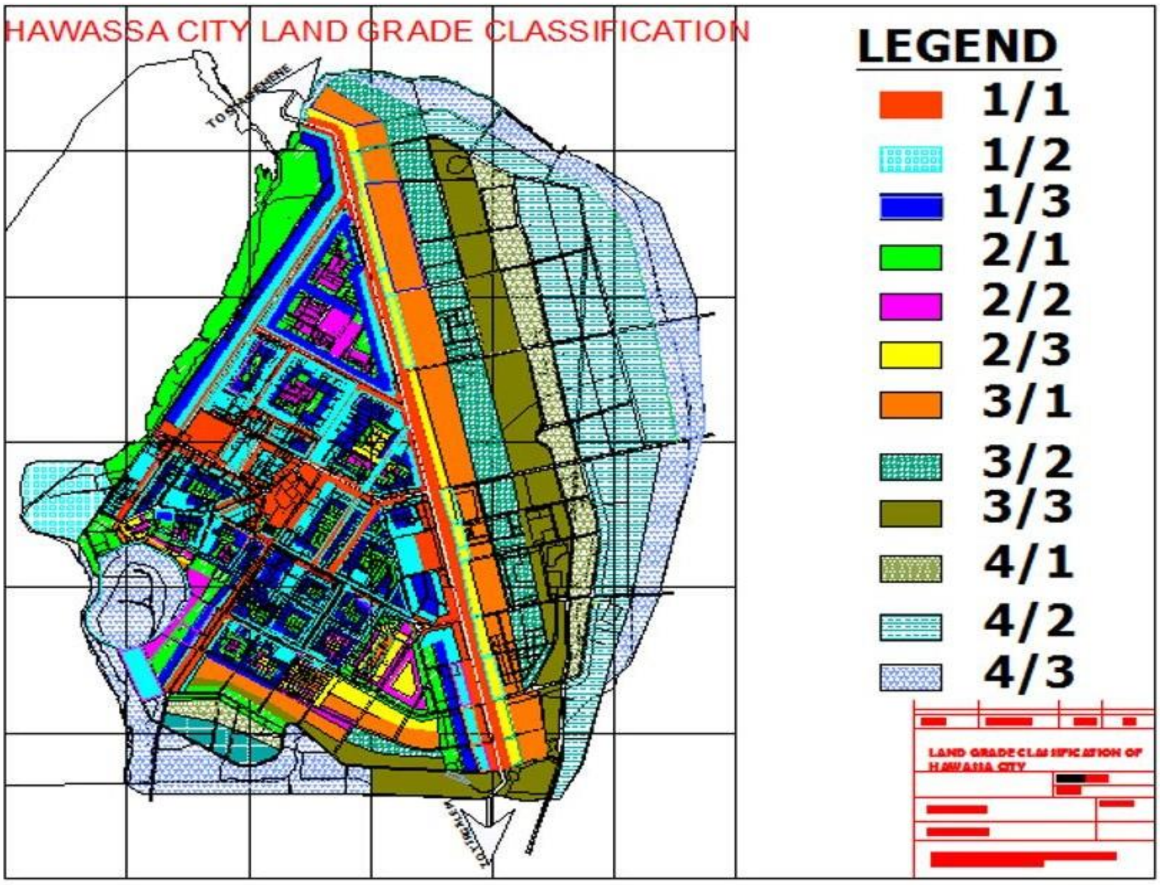



Figure 2.10 Rank size distribution of Hawassa City land grade classification

Source: Hawassa City Municipality

### 2.13 Conclusions

Software packages like ArcGIS for image analysis and map preparation, ERDAS (Earth Resources Data Analysis System) Imagine 2020 for RS application in order to process satellite images including image enhancement, pre-processing, and LULC classification were used for this study. Based on the satellite images and field observation, the land use land cover classes to be analyzed for changes were categorized. ERDAS IMAGINE software was used in image processing i.e. land use land cover classification, and ArcGIS software was used in, Vectorization, area calculation, and thematic map preparation of the study area. In order to detect the land use land cover changes, both remote sensing data and field survey were applied for interpreting the four Land sat satellite images.

This study has quantified the dynamics of LULC and explored the drivers over the past thirty years (1990−2020) within the study area. Analyses of LULC dynamics over three decades of victimization GIS and remote sensing tools created six types of LULC classes. Land use categories intimate distinguished land cover dynamics throughout the study period. Quantitative spatio-temporal proof created through interpretations of satellite images showed that the study area has undergone important LULCCs since 1990.

LULCCs have a big selection of consequences at all spatial and temporal scales. Due to these effects and influences it's become one of the main issues for environmental modification as natural resources management. Characteristic the complicated interaction between changes and its drivers over house and time is vital to predict future developments, set decision-making mechanisms and constructing scenarios.

Land use and land cover (LULC) changes are one of the world-wide variations which have the most significant effects on the natural environment and ecosystem due to human activities. Hawassa City is facing enormous changes in LULC patterns without any good arrangement from the last few years. Projections of urban population of Hawassa for July 2017 by the Central Statistical Agency (CSA) estimate the urban population to be 335,000 excluding 120,000 rural populations which resided within the administrative boundary of the City Administration). Thus, the total population within the administrative boundary of the City was estimated to be 455,658.

This study has been conducted by integrating GIS, remote sensing and spatial modeling tools. So as to sight and analyze changes in land cover categories, these techniques were enforced.

Within the 1st section, is satellite information for the study periods of 1990, 2000, 2010, and 2020.GIS and remote sensing techniques were applied to come up with land cover maps through the most chance supervised image classification? The accuracy assessment and change detection processes have additionally been done. The overall accuracy of LULC maps generated during this study had got an appropriate worth on top of the minimum threshold. The knowledge of image classification accuracy became necessary for the modeling procedure. Within the last section, land use modeling was applied to investigate dynamic changes in built-up areas as a result of different driving factors. The conversion of bare land into agricultural land has increased in percentage between 1990, 2000, and 2010, respectively by 26% 5%, 28%, and 30. 11%, but the surface of agricultural land from 2010 to 2020 compared to 1990- 2000 and 2002. -2010, where the area decreases from 78. 50 square kilometers (30. 11%) to 74. 97 square kilometers (28. 76%) with a rate of decline of 1. 35% in ten years due to several mega-projects that increase construction in the study area.

Rapid urbanization occurring at an alarming rate in Ethiopia's major cities is creating a huge demand for infrastructure and housing. Hawassa bears witness to this situation, as it is the center of large-scale economic activity, such as the Hawassa Industrial Park. The City's population is expected to double in ten years from the current number, which has doubled in less than ten years. Currently, almost half of the City’s population lives in overcrowded, inadequate and/or informal housing. These living conditions arise mainly from renting and not from ownership. The City has been unable to meet housing needs, especially for low- and middle-income residents, largely due to ineffective policies, lack of funding, and lack of land within the City's planned boundaries. . These problems are exacerbated by the lack of capa City of the municipality. The result is evident in the lack of affordable housing in the City and the expansion of informal settlements, leading to unplanned physical growth and a high level of land speculation. The long-term demand is also overwhelming, requiring appropriate design methods to guide the development of the City in a more sustainable way.

The same type of land use was shown by the supervised classification result, but the degree of coverage differed for different types of coverage. From 1990 to 2020, the growth of built-up and agricultural land, as well as bare land, bushland, and forests, has decreased over the year compared to the previous year. Satellite images showed that an increase during this period was linked to several factors. Built-up areas with the spatio-temporal dynamics of urban growth, land use change processes that are linked to population growth and the country's economic transformation policies are also other factors responsible for LULCC.

UN-Habitat recommends the adoption of the compact City model to address the current challenges facing the City of Hawassa, especially the housing challenge. The compaction of the City favors the maximization of infrastructure and urban services, social integration, environmental protection and economic efficiency for sustainable urban development. The following scenario reflects the compact approach of the City and is consistent with the intended goals of the Hawassa City administration.

## 2.14. Recommendations

Based on the results of the previous pages, the researcher makes the following concluding remarks.

- Appropriate urban planning for landscape and natural resource management and sustainable urban development must be implemented.
- A detailed study of the area to be developed between the desired land use classes/territory coverage guarantees the economic and social development of the area where interests are in conflict.
- The kebele administrations of neighboring communities that are not yet integrated into the municipal administration as well as those that are already integrated into it should begin mitigating the works against the alarming changes in land use in the study area. This is possible through essential program development and implementation through the urban safety net and related programs aimed at reducing urban poverty.

# CHAPTER THREE

## 3. Public Perception on the Role of Urban Green InfrastructureDevelopment and Land Use Management: The case of Hawassa City, Ethiopia

***Abstract***

*Urban green areas are essential elements of cities and contribute to the quality of life in numerous ways by maintaining and regulating the environment. However, increased urbanization and development have placed urban green areas under extreme pressure, while unplanned urban growth has resulted in the loss of urban landscape and ecosystem. This study's objective was the public perception on the role of urban green infrastructure and land use management. The 385 sample house- holds were selected by using random sampling method. Descriptive and econometric analyses were used for analyzing both quantitative and qualitative data by using SPSS version 25. Among the major factors influencing the urban green infrastructure by respondents perception were education, income, family size, sex of respondent, marital status, type of employment, ownership of house, participation on public involvement, and frequency of visit to nearer planning which are significant variables in the model. Individuals visited the given green structure at least twice a week, and those not done it were 47.9% and 52.1%. The amount of individuals who visited it twice a week in positive perceivers was 64%, and the amount of those who have not done it was 36%. The Chi-square value of 10.9 was very big and telling us that the frequency of visit was determinant factor of perception. It is vital to keep in mind that while the built-up area and the agricultural areas are rising due to urbanization, the core-ecosystem land is being "eaten" as a result of the past and present land uses inside the administrative limits, as well as the services they provide. In the last 6 years, the rate at which the most precious ecosystems are disappearing has tripled. The population, which reflects the demand for these services and benefits, is still growing, putting more strain on the environment. The recommendations include: Public involvement in urban green space planning and development was determinant and core variable of the study. The government of the town administration should prepare the meeting. The result showed a high correlation between urban green planning and land use changes.*

**Keywords** Public perceptions, Land use/land cover changes, Green infrastructure, Recreational areas, Hawassa City

## 3.1. Introduction

The globe is getting more urban, and the number of people living in cities is expanding quickly. The United Nations Department of Economic and Social Affairs predicted that by 2030, more than 60% of the world's population will live in cities (UNDESA 2014). Cities now cover only 2. 7% of the Earth's area, yet they account for 75% of total energy consumption, 80% of greenhouse gas emissions, and have typically depleted natural resources (Gret-Regamey et al. 2013). To address the issues brought by urbanization, urban green infrastructures are becoming increasingly popular across the world. The phrase "urban green infrastructure" refers to the combined structure and connection of recreational parks and other sorts of green areas that provide several advantages for the urban environment (Jennings et al. 2016; Wolch et al. 2015).

The benefits of urban green infrastructure have been cited in the literature. In general, it has social (Kaczynski and Henderson, 2008), economic (Anguluri and Narayanan, 2017) ecological (Mohamed and Zhirayr, 2013), as well as planning benefits (Attwell, 2000; Baycan-Levent et al., 2009). From the social point of view, it improves social cohesion and interaction (Tabassum and Sharmin, 2013); provides places for physical activity; contributes to the social well-being and the health of the community. Thus, at present days, urban green infrastructure is embraced by many cities of developed nations to have the aforementioned benefits and create a sustainable urban environment (Foster et al., 2011).

Cities are an important habitat for an array of physical, economic, social, political, and cultural capital (UN-HABITAT 2016). Given this importance, it is significant to think carefully about the nature, operation, and form of cities particularly in respect to the challenging issue of sustainability, and cities; however, today stand in the face of grave danger in the form of uncurbed urbanization and climate change. As a result of this phenomenon, they are facing problems like biodiversity and natural habitat loss, air pollution exceeding safe limits, and urban flooding (UCCRN, 2014).

Worldwide mobility restrictions have been implemented to stop the COVID-19 virus from spreading. These limitations presented managers of Urban Green Spaces (UGS) with hitherto unheard-of difficulties, including (1) interpreting confusing, constantly changing national and sub-national rules, (2) creating protocols to control access to UGS, and (3) putting those protocols into practice, disseminating them, and enforcing them. The fact that over 90% of COVID-19 cases occur in urban set- tings (United Nations 2020) complicates matters further. As a result, demand for access to UGS increased during COVID-19 as people's awareness of the importance of UGS in promoting social cohesion and health increased among residents globally (Sainz-Santamaria and Martinez-Cruz, 2022).

Generally, land use/land cover changes (LULCC) and urban green infrastructure serve to beautify the City environment, purify the air, and provide a place for residents to relax and enjoy (Blanco et al.,2009). As (Dahmann et al.,2010) reported LULCC and green infrastructure are diverse, varying in size, vegetation cover, species richness, environmental quality, and proximity to public transport, facilities, and services (Fuller and Gaston 2010). LULCC and green infrastructure, if properly planned, managed, and well connected with its surrounding area, can improve the urban environment by enhancing community development, and social cohesion, and attract tourism investment also increasing the sustainability of urban development (Milton, 2002).

LULCC and urban green infrastructures are important to maintaining the existence of habitat, biodiversity, infiltration of water, subsurface and underground water, fresh air, and normal noise (Holm 2000). If the storm water needs to be absorbed by the soil, plants play a crucial role in slowing down the speed of the runoff. So that con-contaminated/toxic surfaces & rainwater can be treated in the soil. This scientific analysis should be indoctrinated in the mind of citizens (UN- HABITAT 2014). Some studies have suggested that from the total urban land areas, 10% of tree cover is necessary to create an ecologically sustainable City (Qureshi et al., 2010).

Responding to these challenges such as unprecedented urban growth lays innovative development of green infrastructure, which not only ensures resilience but also includes environmental and well-being benefits (United Nations, 2015). How- ever, it is equally significant to manage the development of green infrastructure to deliver an effective and efficient transition to a sustainable urban form that further enhances urban resilience to multiple social, economic, and environmental stressors (Girma et al., 2019). Findings show that perception is a momentary event in which a person perceives his or her environment, for example, by using the senses such as seeing, hearing, or touching. While another study, by Faehnle et al. (2014), stated that the interpretation process is guided by peoples' deeply held values about what is good and what is not good. Local communities' perceptions can also contribute to building scientific information on LULCC and green infrastructure development and planning. Moreover, perception is considered a learned phenomenon that influences thoughts and actions (Krajterostic et al., 2017).

Local community perception of the use of LULCC and urban green infrastructure is crucial to designing appropriate development and management strategies, especially in poor countries that are highly vulnerable to the impacts of global warming and climate change (Qureshi et al., 2010). When we come to Africa, particularly Ethiopia, the study and development of urban green infrastructure is very limited. As a result, the researcher does not know the existing condition of LULCC and urban green infrastructure, what factors contributed to these gaps, and to what extent people are using the existing LULCC and urban green infrastructure. Many studies have been done earlier regarding the development of urban green space (Bizuayehu, 2018) determinants of green area management under urban landscape in Bahir Dar, (Samson 2010) assessment of urban green infrastructure in Addis Ababa, (Gebeyehu, 2014), and assessment of green area development in Addis Ababa, (Gashu and Gebre-Egziabhe, 2019) local communities' perceptions and use of urban LULCC and urban green infrastructure in two Ethiopian cities Bahir Dar and Hawassa.

Important data from LULCC research are needed for urban green infrastructure planning and management (Yang et al., 2014). According to previous research (Miller and Hobbs 2002), studies of conventional urban environments have not considered green infrastructure. However, LULCC and urban green infrastructure give City dwellers a chance to engage with nature both visually and physically. Any metropolitan region with a green infrastructure network is important because the goal provide residents with the best possible features of the experience and mitigate the disadvantages of living in a built urban environment (Mansor et al., 2012). Furthermore, a more comprehensive understanding of the links between land use and green infrastructure change requires that the underlying mechanisms, patterns and processes of land conversion, as well as the response of the urban environment, are considered in all formal decision-making processes (Zhang et al., 2013).

Urban planners and policymakers can comprehensively assess the effects of different land use scenarios, providing a scientific basis on which to base future green infrastructure planning and regulation. Regarding green infrastructure, the spatiotemporal analysis of LULCC can help to understand the dynamics of environmental change of green infrastructure, serve as a basis for sustainable development, and provide critical knowledge needed for planning and scheduling (Hu et al. 2008 Teferi et al 2016). This study highlights the crucial links between LULCC and urban green infrastructure. According to previous studies (Kambites and Owen 2006; Tzoulas et al. 2007; MoUDH 2015), a form of UTC, which is an interconnected network of multifunctional sites, mostly unbuilt that support ecological and social activities, is known as the name "e". green infrastructure.” The structure and scope of green infrastructure services change with changes in land use and land types (Lei and Zhu 2017).

When the researchers arrived in Hawassa, the total planned area of the City was 15,800 hectares, of which 655.4 hectares were planned for green infrastructure, but currently 52.64 hectares are developed and the remaining 602.76 hectares are not developed. As mentioned before, the views of the communities on the urban green infrastructure for the sustainable development of the City are not well understood. So far, the current state of housing and urban green infrastructure is not known, and the determinants of community perception have not been studied. That is why the researcher is inspired to conduct the study and the research can be expected to evaluate the determinants of the perception of the local community, evaluating the current state of the green infrastructure and the habitat and the green infrastructure in the study area. Thus, the research of this research focuses on these questions. Maintaining a balance between economic, social, and biological ecosystems is becoming increasingly important as habitat and green infrastructure evolve toward rapid urbanization (Song et al. 2016). The objective of this study is to examine land use, climate change and green infrastructure, as well as their planning and development.

## 3.2 Materials and Methods

### 3.2.1 Study Area Description

Hawassa City rests in the southern region of Addis Ababa, Ethiopia. Geographically, the City stretches 275 km along the Addis Ababa-Moyal international high- way, and is embedded between Tikur-wuha River on the Alammura Mountain on the South, Chelelaka-marshy on the East and Lake Hawassa on the West (EDRI 2017). The City of Hawassa has an average elevation of approximately 1690 m above sea level and extends on a partially flat plain in the rift valley (Hawassa City Municipality 2020). Hawassa City borderland geographical coordinates extend approximately between Latitude: 7° 03′ 43.38″ North and Longitude: 38° 28′ 34.86″ East covering a total area of 15,800 hectare. The borderland contains eight woredas within Oromia National Regional State Shashemene, Arsi Negele, Kofele and Siraro and Southern Nations Nationalities and People's Regional (SNNPR) Hawassa Zuria, Shebedino, Dale, and Boricha (Hawassa City Municipality 2020).

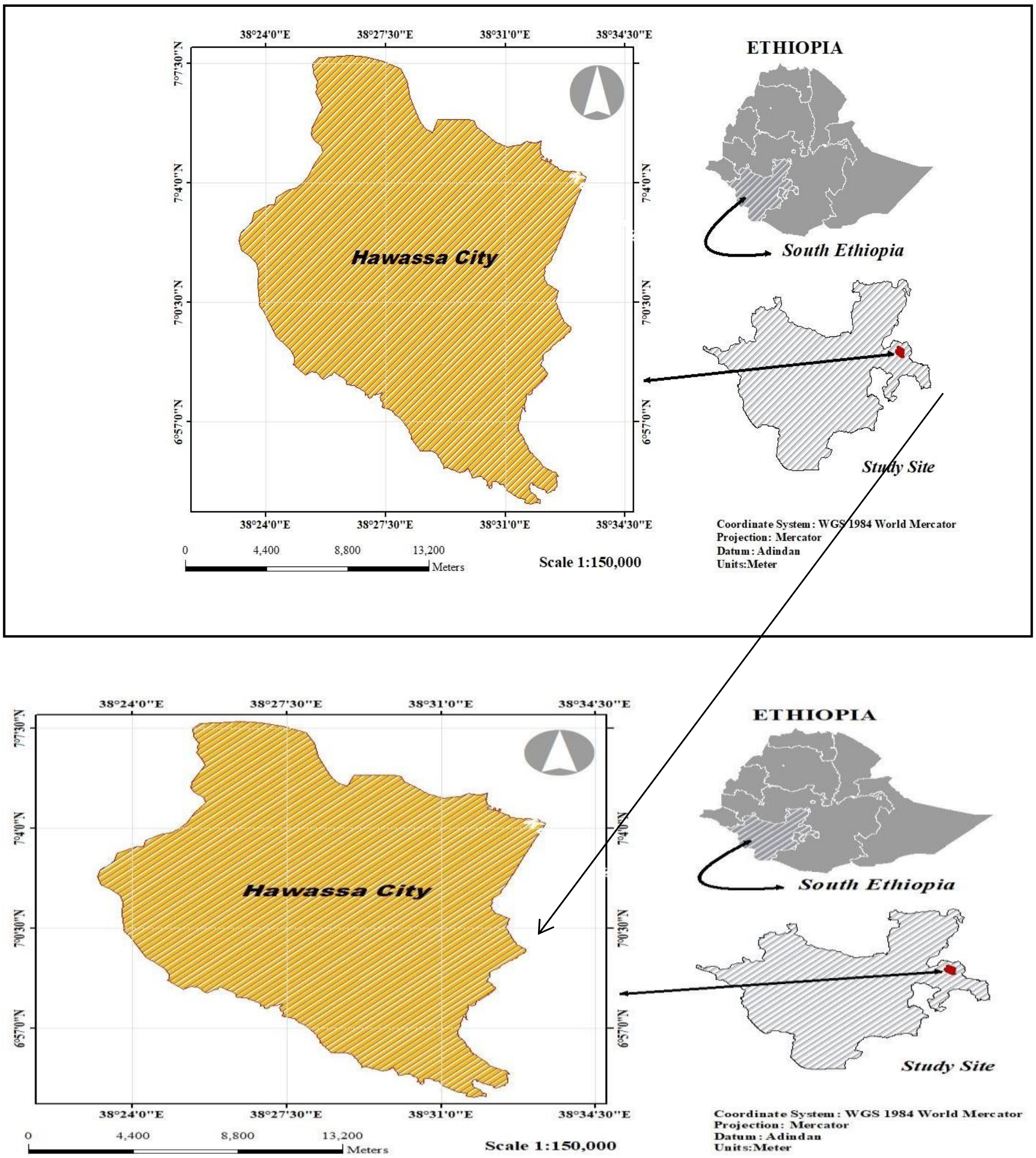



Figure 3.1 Location of study area Source: US Geological Survey.

Currently, there are many recreational facilities in the City and its hinterlands. Those available recreational facilities which are found in the City are lodges, an international airport, international stadiums, public libraries, seashore boating, fish markets, etc. Wabeshebele Hotel is also one recreational area found in Wondo-genet woreda. It has many recreational facilities like hot springs and a park. Many people from the study region always come to refresh themselves in this area on weekends. This indicates that there is a strong linkage between the City and its hinterland in terms of recreational facilities

One of the main attractions for tourists to a City is its urban greenery, cleanliness/sanitation, and accessible public space (comparative advantage). To preserve and further improve the City's culture and reputation for cleanliness and sanitary conditions, the City administration should place a priority on creating and managing new and existing urban greenery as well as public space. Development and promotion of the hospitality and tourism services sector: Private sector businesses and investors received targeted incentives and concerted efforts to ensure that the City offers high-quality but affordable hospitality services so that it is a pleasant, affordable destination for both domestic leisure travelers and foreign business travelers.

The City's structural design suggests creating a buffer zone on the coasts of Lake Hawassa for environmental protection reasons. The development of recreational, environmentally friendly transportation infrastructure is observed. It is suggested that bike and walking/jogging paths be built along the buffer zone on the City's side of the Lake to enhance the City's tourism attractions and to encourage healthy lifestyles among its citizens. The suggested lanes might extend from the protected park/forest near the City's northern entrance, Tikur-wuha, all the way to the bottom of Tabor Hill. In addition to being able to walk and jog along the shores of the lake, the City's residents, tourists, and visitors could rent bikes along the trek/lane for small fees from, say, a youth cooperative that maintains the trek/lanes or any other entity that would provide such rental services. In addition, it is proposed that an econ-friendly cable car line be built to provide ordinary and leisure transport from the top of Tabor Hill up to the top of Alamura Hill.

Facilitate development and promotion of tourism into Sidama hinterland and culture: In collaboration with pertinent authorities/government offices of the larger Sidama region and other stakeholders, the City Administration shall support and facilitate the development of the tourism potential of Sidama to attract an increasing number of domestic and international tourists to the region who would be almost by default spending part of their visit time in Hawassa City. In addition, the development and management of additional cultural recreational facilities and public spaces within the City itself would also increase the attractiveness of the City for foreign and domestic tourists. These efforts shall include supporting the establishment and development of culturally themed artistic, recreational, and hospitality (e.g., restaurants, lodges) facilities in the City.

Protect and facilitate the development of Burqito hot springs: In addition to protecting developing and properly managing the existing popular tourist attractions such as the lake itself, Tikur-wuha protected forest, Amora-gedel fish market, Grand-gudumale, Alamura, and Tabor hills and King Haile Selassies' seasonal pal- ace at Kuttuwa, the City Administration shall protect and promote the development of the Burqito natural hot springs. These have been traditionally used by the local communities for recreational and their purported medicinal properties. The proposal here is to modernize and protect the area from damage and contamination and modernize it for not only maintaining the traditional use of the hot springs but also as one of the tourist attractions of the City.

What is key from a planning point of view are that different kind of ecosystems (cultivated fields, grasslands, forests) provide ecosystem services of different types and with different extent of effectiveness. Even more practically, it is possible to identify a linkage between land uses and ecosystem services provisioning. Identifying this linkage and being able to assess the ecosystem services provided by specific land uses, can enable planners and decision makers to make land use decisions that can maximize the provision of specific services that are crucial for the City of Hawassa.

### 3.2.2 Climate of Hawassa City

The average mean monthly rainfall in Hawassa City is 89.60 mm, whereas the annual mean annual rainfall is 1075 mm. (Maximum mean rainfall occurs in April.) The amount of rainfall decreases from west to east. Based on the rainfall coefficient values, months in the water year are classified as dry months (January, February, November, and December), distinctly rainy months (March and October), and big rainy months (April, May, June, July, August, and September). The area receives an adequate sun- shine hour of 100 to 200 h per month from March to October and 200 to 300 h every month in the dry season. The average daily temperature of Hawassa City is 20.3 °C. The maximum daily temperature reaches up to 30.07 °C in March, and the minimum temperature drops to 10.44 °C in November (Hawassa City Municipality 2020).

## 3.3 Research Design

An adequate study design is necessary to accomplish the stated research objectives (research questions). This research used a mixed design that incorporates both qualitative and quantitative methodologies because it was challenging to achieve the objectives using a single research strategy. Due to the significance of this research approach for source triangulation and interpretation (to minimize the weaknesses of one method by making up for them with the strengths of another since they are complementary).

The required materials and software packages include: GPS and reconnaissance survey for data collection, QGIS, ARCGIS version 10.3 for image processing and analysis, and SPSS (statistical package for social sciences) and descriptive statistics for the analysis of the driving forces, local community perception toward the change.

### 3.4 Sampling Techniques

The sampling procedure was a combination of purposeful and random sampling techniques. The first step was a purposeful selection of Kebeles and sub-villages that are located in study areas. The second stage was the simple random sampling of households from the list of villages. To facilitate this final stage, lists of names of households in each selected village were obtained from the Local Kebele Chairpersons or any other key informants such as the field extension officers and technical support organizations operating in the study areas. The names were assigned numbers and using a table of random numbers, a total of households were selected to be interviewed.

Amount of accuracy required and characteristics of the target population (Kothari, 2004). The total household population, as indicated above, was 16,640; therefore, the sample size of household heads was determined by using the following formula as the number of population was greater than 10,000, thus n = z2pq/d2, where the level of acceptable margin of error was 5%. If the population is *N* > 10,000, the sample size was as follows:

$n=z^2pq/d^2$ = ,Where n=, the desired sample size

Z =, confidence level (95=1.96)

P =, estimated characteristics of study population (0.5)

q =1-p =1-0.5= (0.5)

d = level of statistical significance which was set margin of error (5%) which taken for this research(0.05)

Therefore, assuming that the size of the targeted population was greater than or equal to 10,000 the sample size of the study was, $n=z^2pq/d^2$ n= (z =1. 96, p=0. 5, q=0. 5, d=0. 05), subsequently the product was,

$$\frac{\mathbf{(1.96)^2(0.5)(0.5)}}{\mathbf{(0.05)^2}}\mathbf{=385}$$

Since the total population, households of the study were 16,640 which were greater than or equal to 10,000. According to, the formula that developed by Cochran, if the sample size of the population is "greater than 10,000" the desired sample size was the result of the above formula, therefore the study sample size were, 385 people.

### 3.5. Methods of data analysis

Data were collected from both primary and secondary sources analyze, summarize and present by means of quantitative and qualitative methods of data analysis because the objectives of the study and the nature of the data. More specifically, the quantitative data were gathered through closed ended questions were analyzed using the descriptive statistics (frequency and percentage), standard deviation, and mean to identifying the status of household housing , determinates of respondents housing problems and to alleviate housing problems. The qualitative data from different sources was analyzed contextually and gives fact description about the problem of housing. On the other hand the qualitative data was collected through FGD and key informant interview were analyzed through qualitative way (by narration/discussion). Econometric regression analysis was used to estimate the relationship between the dependent and explanatory variables. Finally, to make the findings easily understandable for the reader's tables, figures, charts, photos and maps and different pictures were used, with the help of Statistical Package for Social Science (SPSS) version 25.

### 3.6. Model expression

The Binary Logit Econometric model was used to analyze factors affecting the perception of local community on use of green infrastructure. Logit model was used in a binary choice (positive perception versus negative perception) of outcomes. Factors included in the model are exogenous i.e. currently taken as given by the households. The model provides empirical estimates of how change in these exogenous variables influences the probability of local community perception in urban green infrastructure development. (Nkonya et al., 1997).

Thus, a logistic function including odds ratios was used to derive coefficients of explanatory variables likely to influence local community perception on use of urban green infrastructure. For this analysis, status of perception was the dependent variable and thirteen selected factors were the independent variables.

Since the dependent variable of this study which was Assessment of local community perception and use of urban green infrastructure for Sustainable Development, dichotomous, the value of 1 was assigned to positive perceivers 0 was assigned for negative perceivers in the econometric model.

Following Gujarati (1995), the functional form of logit model is specified as follows:

$P_i = E(Y=\frac{1}{xi}) = \frac{1}{1+e^{-(\beta0+\beta1x1)}}$ …………………………………………………………… (1)

For the case of exposition, we write (1) as;

$P_i = \frac{1}{1+e^{-zi}}$ ……………………………………………………..………………………….. (2)

The probability the given respondent is negative perceiver is expressed as by (2) while, the probability of positive perceiver is;

$1\text{-}P_i = \frac{1}{1+e^{zi}}$ ………………………………………………………………………..…..(3)

Therefore, we can write;

$\frac{Pi}{1-Pi} = \frac{1+e^{zi}}{1+e^{-zi}}$ ……………………………………………………………………….....(4)

Now (Pi/1-Pi) is simply the odds ratio in favor of perception. The ratio of the probability that respondent was perceiver to the probability of that it was negative perceiver.

Finally, taking the natural log of equation (4) we obtain:

$L_i = \ln(\frac{Pi}{1-Pi}) = Z_i = \beta_o + \beta_1X_1 + \beta_2X_2 +$ ……………………..+ $\beta_nX_n$ ………………….…(5)

Where $P_i$ = is a probability of being positive perceiver they range from 0 to 1

Zi = is a function of an explanatory variables (x) which is also expressed as:

$Z_i = \beta o + \beta 1X1 + \beta 2X2 + \cdots + \beta nXn$ …………………………………………………. (6)

$\beta o$, is an intercept, $\beta_{1,}$ $\beta_{2,}$.................. $\beta_n$ are slopes of the equation in the model

Li = is log of the odds ratio, which is not only linear in Xi but also linear in the parameters.

Xi = is vector of relevant respondent characteristics

If the disturbance term (Ui) is introduced, the logit model becomes

$Z_i = \beta_o + \beta_1 X_1 + \beta_2 X_2 + \ldots\ldots\ldots\ldots\ldots\ldots + \beta_n X_n + U_i$........................................... (7)

### 3.7. Variables and hypothesis

#### 3.7.1. Dependent variable

The dependent variable was an assessment of the local community's perception of the use of urban green infrastructure in the study areas. The binary logistic regression was used to explore the relationship between the dependent and the independent variables. Binary logistic regression was appropriate for categorical dependent variables and it can help to examine several variables simultaneously. In addition, it is flexible and was widely applied to different variables that had different characteristics (Landau and Everett, 2004). The pattern of association between the response and explanatory variables was assessed by Perceiver's correlation, which was also used to evaluate the presence or absence of multicollinearity among the explanatory variables.

#### 3.7.2. Independent variables

Independent variables are variables that affect the dependent variable and are not changed by the other variables. But cause a change in the dependent variable(s). The independent variables for this study were identified based on the review of different literature and carefully identified only those that affect the local community's perception of the use of urban green infrastructure considered by the study.

To reduce bias, considering relevant variables that were included in the Binary Logit was very vital. However, empirical evidence and different theories were used to identify variables that affect communities' perception of the use of urban green infrastructure considered by the study. Based on this, the variables including household's personal and demographic variables; economic variables; institutional variables; and social variables were identified as independent variables for this study. The following independent variables (as shown in the conceptual framework) were explained most probably to influence the local community perception and use of urban green infrastructure in the study area.

**Definition of independent variables and their hypothesized relations with perception**

**I. Demographic variables**

**1. Age (AGE)**: It is a continuous variable and is measured in the number of years. The age of respondents can generate or erode confidence. With age, the age of the respondents influences whether the respondent benefits from the experience of an older person, or has to base its decision on the risk-taking attitude of a younger person. There also may be a significant difference in the distribution of household age of the sampled households between positive perceivers and negative perceiver respondents. In other words, as the age of the household increases, the probability of positive perception decreases because, with age, respondents can become more risk-averse and then tend to be reluctant to green infrastructure. Therefore, in this study, it is hypothesized that the age of the household is more likely to affect the local community's perception of the use of green infrastructure negatively/positively (Hillsdon et al., 2006; Aziz 2012; Zhou and Rana 2012; Molla et al., 2017).

**2. Sex of the household (SEX):** It is the maleness and femaleness of the household. It is a nominal variable used as a dummy, which takes a value of one if Male, and zero if Female. Gender difference is found to be one of the factors influencing. It was hypothesized that men have more favorable perceptions of green infrastructure than females (Jim 2013; Molla et al., 2017).

**3. Education level (EDUCLEV):** It is defined as the number of schooling years maintained by the respondents. It is a continuous variable. It enables respondents to have access to new information and ideas. Based on his study, the household head’s educational level was thus expected to influence the probability of positive perception of the use of urban green infrastructure. Many evidences reveal that those individuals with better educational status are more willing to participate in urban green infrastructure development and use of green infrastructure than less educated (Verlic et al., 2016).

## II. Socio Economic Variables

### 1 Total annual income

Income was the amount of money that a respondent earns per month using the domestic currency of Ethiopian Birr. It is the total annual income of the respondents. It was hypothesized that the households with higher income have high chance to think and perceive positively towards the green infrastructure.

### 2 Marital Status of respondents

The marital status of respondents was hypothesized to affect the perception of green infrastructure. It has a positive relationship with perception. Likewise, a study conducted in Italy by Sanesi and Chiarello (2006) showed that marital status significantly affects the patterns of green infrastructure use. Similarly, Bedimo-Rung et al., (2005) indicated that the frequency of visits to green infrastructure by married respondents is directly correlated with periodic timing, i.e., the greater the gap between potential leisure opportunities, the higher the observed involvement. The duties that married individuals occasionally accept, however, made this appear logical (Sanesi and Chiarello, 2006).

### 3. Type of employment the respondent engaged in

Type of employment the respondent engaged. It was perceived hypothesized to influence the perception level of respondents towards green infrastructure. It refers to the type of employment the respondent was engaged in to earn income for livelihood.

### 4. Ownership of house

The chance of individuals becoming the owners of houses has an influence on the perception of green infrastructure. It measures the housing tenure of the respondent (Sikorska et al., 2017).

### 5 Family numbers

Family numbers were hypothesized to influence the perception of green infrastructure. It is a continuous variable that is determined by household size.

**III. Institutional Variables**

**1. Awareness level of respondents on GI**

The awareness level of the respondents was hypothesized to affect the perception of individuals towards green infrastructure. It is the level of awareness of the respondents about green infrastructures. It was coded '1', if a respondent has awareness about green infrastructure concepts and types and '0', if not

**2. Public participation in green infrastructure development and planning**

It refers to participation by the respondent in green infrastructure development and planning in the form of maintenance and protection, financial support, technical support, etc. It was coded '1', if a respondent participated in green infrastructure development and planning and '0', if not Studies have shown that participation is concerned with the involvement of users in the maintenance and future planning of green infrastructure (Syme et al., 2001). Distance from the nearest green infrastructure

It was hypothesized that the average distance between a home and the nearest green infrastructure site it's an impact on people's perception of urban green infrastructure.

**IV. Biophysical Variables**

**1. Frequency of visits to green infrastructure**

Is the number of visits by the respondent to any type of green infrastructure? It was hypothesized to affect the perception of individuals toward the green Lafortezza et al., 2009.

**2. Type of green infrastructure**

It refers to the type of green infrastructures a respondent visited. A value of "1" was given if the type of green infrastructure visited by the respondent was public parks, open spaces, or sports fields, and a value of "0" was assigned if the type of green infrastructure visited by the respondent was other than the ones mentioned Mollaet al., 2017b.

Table 3.1 Summary of variables

| S.N | Variables Code | Description | Measurement | variable type | Expected sign |
|---|---|---|---|---|---|
| **I.** | Dependent (Y=perception) | Assessment of local community perception on use of urban green infrastructure in the study areas. | 1 positive perceivers<br>0 negative perceivers | Dummy | |
| **II.** | Independent Variables | | | | |
| **1** | AGE | Age of household head | Measured in Years and put in to ranges | Continuous | - |
| **2** | SEX | Sex of household head | 1=male, 0=female | Dummy | - |
| **3** | EDUCLEV | Education level of household head | Measured in number and put in to ranges | Continuous | + |
| **4** | FAMLY | Family number | Measured in number and put in to ranges | Continuous | - |
| **5** | INCOME | Total income of the household head | Measured in number and in to ranges | Continuous | + |
| **6** | MARITAL | Marital status of respondents | 0= Married, 1= Single, 2= Divorced, 2= Widowed | Dummy | - |
| **7** | EMPELOYE | Type of employment of the respondents | 0= Employed by government, 1= others | Dummy | + |
| **8** | DISTANCE | Distance from the nearest green infrastructure | Measured in km and put in to ranges | Continuous | - |
| **9** | AWERNESS | Awareness level of respondent on GI | 0=no awareness on green infrastructure concepts 1=has | Dummy | + |
| **10** | FREQUENT | Frequency of visit to green infrastructure | 1= If the respondent has visited any type of green infrastructure at least once a week. 0=not | Dummy | + |
| **11** | HOUSE | Ownership of house | 0=no own house 1= Has his own house | Dummy | + |
| 12 | Type of green infrastructure | | 1= If the type of green infrastructure visited by respondent was green parks open spaces plaza and festival site. 0=not | Dummy | + |
| **13** | Public participation in GI dev.t and planning | | 0=the respondent participated in green infrastructure development and planning 1= not | Dummy | + |

## 3.8 Results

### 3.8.1 Family number

The family number was hypothesized to influence the perception of the green infrastructure. As shown in Table 3.2, the total average family number of respondents was 5.2 with a standard deviation of 1.6. The mean and standard deviation for positive perceived respondents were 5 and 1.32, respectively. Also, for negative receivers, the mean and standard deviation were found to be 5.7 and 1.65, respectively. The *t*-value of 41.2 also shows the relationship between family numbers and the perception of respondents. There was a mean difference between positive and negative perceived which showed the presence of a relationship between the perception of green infrastructure and family number.

Table 3.2 Family number

| Family number | Positive perceivers | Negative perceivers | Total |
|---|---|---|---|
| Mean | 5 | 5.74 | 5.2 |
| Standard deviation | 1.32 | 1.65 | 1.6 |
| Maximum | 8 | 8 | 8 |
| Minimum | 2 | 2 | 2 |

*t*- Value = 41.2

*P* = 0.065*

*Significant at less than 10% probability level

Table 3.3 Summary of the result of dummy explanatory variables

| S. N | Dummy variables | $x^2$ values | *P*-value |
|---|---|---|---|
| 1 | Sex of respondent | 3.35 | 0.087 |
| 2 | Marital status of respondent | 14.8 | 0.076 |
| 3 | Type of employment | 3.2 | 0.014 |
| 4 | Ownership of house | 3.42 | 0.044 |
| 5 | Awareness for green infrastructure | 1.62 | 0.191 |
| 6 | Participation public involvement | 12.14 | 0.000 |
| 7 | Frequency of visit to green infrastructure | 10.9 | 0.001 |
| 8 | Type of green infrastructure | 0.37 | 0.84 |

### 3.8.2 Summary of descriptive Statistics

The summary of the descriptive analysis part of this study brings the findings from descriptive or quantitative analysis, and the qualitative results analysis (FGD, personal interviews, and researchers' observation). In the descriptive analysis part, 13 independent variables were hypothesized to affect the dependent variable which means perception and use of green infrastructure.

Tables 3.3 and 3.4 represent the summary of the hypothesized continuous and discrete variables included in the model. Out of the total eight dummy variables, five variables were significant. That is, the sex of respondents, marital status, and type of employment, ownership of house, participation, and frequency of visits to green infrastructure were significant at less than 1.5 and 10% probability levels. The rest of the dummy variables such as awareness about green infrastructure and the type of green infrastructure found near to the respondent are not significant variables.

### 3.8.3 Summary of the Descriptive Statistics (Continuous Variables)

From five continuous variables, three of them revealed significant effects on the perception of green infrastructure. That is, all three significant variables (education level, income, and family size) were significant at a 10% level of significance. The rest of the two continuous variables like distance from the nearest green infrastructure and age of respondents were not significant.

Table 3.4 Summary of the result of Continuous Explanatory Variables

| S.N | Continuous variables | Mean | Std. | t-value | P-value |
|---|---|---|---|---|---|
| **1** | Age | 41.9 | 10.9 | 1.84 | 0.13 |
| **2** | Education level | .6.23 | 4.4 | 17.92 | 0.092 |
| **3** | Income | 6289 | 2797 | 29 | 0.052 |
| **4** | Distance from nearest green infrastructure | 0.45 | 0.2 | 1.58 | 0.1 |
| **5** | Family size | 5.2 | 1.6 | 41.2 | 0.065 |

### 3.9 Public participation in green infrastructure development and planning

Table 3.5 shows that those who participated in public involvement in planning and development from positive perceivers were 62.9% and those who did not participate were 37.1%. The reverse also was true of negative perceivers. The Chi-square value of 12.14 was a significant number. Therefore, public participation involvement in green infrastructure development and planning has a relationship with perception.

Table 3.5 Public participation in green infrastructure development and planning

| **Participation** | **Positive perceivers** | | **Negative perceivers** | | **Total** |
|---|---|---|---|---|---|
| | No | % | No | % | % |
| **Not participated** | 76 | 37.1 | 115 | 64.1 | 49.7 |
| **Participated** | 129 | 62.9 | 65 | 35.9 | 50.3 |
| **Total** | 205 | 100.0 | 180 | 100.0 | 100.0 |
| | $\chi^2$ =12.14 | | P-value=0.000*** | | |

***Significant at less than 1% probability level

#### 3.9.1.Frequency of visit to green infrastructure

As indicated in the Table, 3.6 individuals visited the given green infrastructure at least twice a week and those not done it were 47.9% and 52.1%. The number of individuals who visited it twice a week in positive perceivers was 64% those who did not do it were 36%. The Chi-square value of 10.9 was very big telling us that the frequency of visits was the determinant factor of perception. Therefore, the frequency of visits has a relationship with perception.

Table 3.6 Frequency of visit to green infrastructure

| **Frequency of visit** | **Positive perceivers** | | **Negative perceivers** | | **Total** |
|---|---|---|---|---|---|
| | No | % | No | % | % |
| **Not visited** | 73 | 36.0 | 70 | 38.5 | 52.1 |
| **Visited** | 131 | 64.0 | 11 | 61.5 | 47.9 |
| **Total** | 205 | 100 | 180 | 100 | 100 |
| | $\chi^2$ =10.9 | | P-value=0.001*** | | |

***Significant at less than 1% probability level

### 3.9.2.Type of green infrastructure

Out of the total respondents in the study area, about 48.5% and 51.5% responded that there were public parks and the like green infrastructures and other than those green infrastructures respectively. The Chi-square value of 0.37 was a very small and non-significant number. Therefore, the type of green infrastructure that an individual visited has no relationship with perception (see Table 3.7).

Table 3.7 Type of green infrastructure

| Type of green infrastructure | Positive perceivers | | Negative perceivers | | Total |
|---|---|---|---|---|---|
| | No | % | No | % | % |
| other than this | 106 | 51.7 | 87 | 48.7 | 48.5 |
| Public park | 99 | 48.3 | 92 | 51.3 | 51.5 |
| Total | 205 | 100.0 | 180 | 100.0 | 100.0 |
| | $\chi^2$ =0.37 | | P-value=0.84 | | |

Not significant

## 3.10 Family number

The family number was hypothesized to influence the perception of green infrastructure. As shown in Table 3.8, the total average family number of respondents was 5.2 with a standard deviation of 1.6. The mean and standard deviation for positively perceived respondents were 5 and 1.32, respectively. Also, for negative perceptions, the mean and standard deviation were found to be 5.7 and 1.65, respectively. The t-value of 41.2 also shows the relationship between family numbers and the perception of respondents. There was a mean difference between positive and negative perceptions which showed the presence of a relationship between the perception of green infrastructure and family number

Table 3.8 Family number

| Family number | Positive perceivers | Negative perceivers | Total |
|---|---|---|---|
| **Mean** | 5 | 5.74 | 5.2 |
| **Standard deviation** | 1.32 | 1.65 | 1.6 |
| **Maximum** | 8 | 8 | 8 |
| **Minimum** | 2 | 2 | 2 |
| **t-value=41.2** | **P=0.065*** | | |

*Significant at less than 10% probability level

### 3.11. Summary of Descriptive Statistics

The summary of the descriptive analysis part of this study brings the findings from descriptive or quantitative analysis, and the qualitative results analysis (FGD, personal interviews, and researcher's observation). In the descriptive analysis part, 13 independent variables were hypothesized to have an effect on the dependent variable which means, perception and use of green infrastructure.

Tables 3.9 and 3.10 represent the summary of the hypothesized Continuous and Discrete variables included in the model. Out of the total 8 Dummy variables, 6 variables were significant. That is, the sex of respondents, marital status, and type of employment, ownership of house, participation, and frequency of visits to green infrastructure were significant at less than 1.5 and 10% probability levels. The rest of the dummy variables such as awareness about LULCC and green infrastructure and the type of green infrastructure that was found near to the respondent are not significant variables.

Table 3.9 Summary of the result of dummy explanatory variables

| S.N | Dummy variables | $\chi^2$ values | P-value |
|---|---|---|---|
| **1** | Sex of respondent | 3.35 | 0.087 |
| **2** | Marital status of respondent | 14.8 | 0.076 |
| **3** | Type of employment | 3.2 | 0.014 |
| **4** | Ownership of house | 3.42 | 0.044 |
| **5** | Awareness for green infrastructure | 1.62 | 0.191 |
| **6** | Participation public involvement | 12.14 | 0.000 |
| **7** | Frequency of visit to green infrastructure | 10.9 | 0.001 |
| **8** | Type of green infrastructure | 0.37 | 0.84 |

## 3.12. Econometric analysis

### 3.12.1. Determinants of the perception and use of green infrastructure

In this study, the dependent variable is a dichotomous choice variable, where respondents were classified into two categories: negative perceivers of green infrastructure (0) and positive perceivers of green infrastructure (1). To examine the factors influencing respondents' perceptions, a Binary Logistic Regression (BLR) model was applied. The BLR model is suitable for analyzing the relationship between a binary dependent variable and a set of explanatory variables, allowing us to assess the likelihood of a respondent being a positive perceiver of green infrastructure based on various predictors.

The explanatory variables included in the model were hypothesized to influence the perception of green infrastructure. These variables were selected based on prior research and theoretical considerations regarding the factors that might shape attitudes toward green infrastructure. To perform the analysis, SPSS version 21 a widely used statistical software package was utilized.

In addition to the logistic regression model, the contingency coefficient was computed to examine the strength of the association between the various dummy variables. The contingency coefficient is a measure derived from the Chi-square statistic, which quantifies the degree of association between categorical variables. In this context, the contingency coefficient helped assess whether any of the explanatory variables were highly correlated with each other, which could lead to issues such as multicollinearity (discussed further below).

### 3.12.2. Multi-collinearity diagnosis

Before applying the logistic regression model to analyze the determinants of perception and use of green infrastructure, it was crucial to check for the potential existence of multicollinearity among the explanatory variables. Multicollinearity occurs when at least one independent variable is a linear combination of the others, meaning that the variables are highly correlated with each other. The presence of multicollinearity can distort the results of the regression analysis, as it may cause the estimated coefficients to have incorrect signs, inflated standard errors, and smaller t-ratios. This could lead to misleading conclusions about the relationships between the explanatory variables and the dependent variable.

To detect multicollinearity in this study, both continuous and discrete (dummy) explanatory variables were assessed. Two primary measures were used to check for multicollinearity:

**Variance Inflation Factor (VIF):** This measure is used to assess multicollinearity among continuous explanatory variables. The VIF quantifies how much the variance of an estimated regression coefficient is inflated due to the correlation with other explanatory variables in the model. A high VIF indicates a high degree of multicollinearity, which can cause instability in the regression coefficients. According to Gujarati (2003), a VIF value greater than 10 typically indicates problematic multicollinearity. If the VIFs for the continuous variables in this analysis were found to be below this threshold, it would suggest that multicollinearity is not a significant issue.

**Contingency Coefficients:** For the dummy variables, which represent categorical explanatory variables, the contingency coefficient was calculated. This statistic is derived from the Chi-square test and provides a measure of the association between categorical variables. A high contingency coefficient (close to 1) indicates a strong association between the dummy variables, suggesting potential multicollinearity. By analyzing these coefficients, we could determine whether any of the dummy variables were highly correlated and needed to be addressed to prevent issues in the logistic regression model.

The VIF and contingency coefficient measures were employed as diagnostic tools to ensure that the regression analysis would produce reliable results, with accurate coefficients and valid statistical inferences. If significant multicollinearity was detected, steps such as removing correlated variables or combining similar variables would be taken to mitigate its effects and ensure the robustness of the model's estimates.

**Variance Inflation Factor (VIF) Explained**

According to Gujarati (2003), the Variance Inflation Factor (VIF) for a given explanatory variable is defined as the ratio of the variance of the estimated regression coefficient for that variable to the variance of the regression coefficient in a model where that variable is uncorrelated with the other explanatory variables. Mathematically, VIF for a variable XiXi is expressed as:

$$\text{VIF}(x) = \frac{1}{1 - R^2}$$

Where, $R^2$ is is the coefficient of determination obtained by regressing the explanatory variable against all other explanatory variables in the model. The $R^2$ value indicates how well the variable can be predicted by the other explanatory variables. A higher $R^2$ value means that variable is highly correlated with the other variables, leading to a higher VIF.

If the VIF value for a given variable is significantly greater than 1, it suggests that there is substantial multicollinearity. As the VIF increases, the standard errors of the regression coefficients also increase, leading to less precise estimates. Therefore, a VIF greater than 10 is typically considered an indicator that the variable may be causing multicollinearity, and it may need to be removed or transformed.

In summary, the diagnostic process for multicollinearity, using both the VIF for continuous variables and the contingency coefficients for dummy variables, is an essential step in ensuring that the logistic regression analysis produces valid and reliable results. This thorough approach helps identify and address potential issues before drawing conclusions about the factors influencing respondents' perceptions and use of green infrastructure.

The contingency coefficient is computed as: $C = \sqrt{\frac{\chi^2}{n + \chi^2}}$

Where, C=Coefficient of contingency,

$\chi^2$ =Chi-square random variable and

N=Total sample size

The decision rule for contingency coefficients is that when its value approaches 1, there is a problem of association between the discrete variables.

Table 3.10 Contingency coefficient for the dummy variables of binary logit regression

| Dummy Variables | SEX | MRT | EMPLO | HOUS | AWER | PTCP | FRQV | INFRA |
|---|---|---|---|---|---|---|---|---|
| **SEX** | 1 | 0.32 | 0.13 | -.062 | -.033 | -.036 | -.107 | -.119 |
| **MRT** | | 1 | -.164 | -.339 | .127 | .193 | .177 | -.164 |
| **EMPLO** | | | 1 | .130 | -.206 | -.177 | .033 | .130 |
| **HOUS** | | | | 1 | -.413 | -.078 | -.021 | -.413 |
| **AWER** | | | | | 1 | .263 | .224 | .263 |
| **PTCP** | | | | | | 1 | 0.21 | 0.43 |
| **FRQV** | | | | | | | 1 | 0.16 |
| **INFRA** | | | | | | | | 1 |

Based on the Table 3.10, the Dummy variables were co-related. The Contingency Coefficient, which measures the association between various dummy variables based on chi-square, was computed to check the degree of association among the Dummy explanatory variables or the existence of the multi-colinearity problem. The decision rule for the Contingency Coefficient states that when its value of 0.75 or above indicates a stronger relationship between the explanatory variables**.**

Table 3.11 Variance Inflation Factor (VIF) for the continuous explanatory variables

| S. No. | Continuous Variables | Tolerance | Variance inflation factor (VIF) |
|---|---|---|---|
| **1.** | Age | 0.89 | 1.114 |
| **2.** | Education level | 0.935 | 1.07 |
| **3.** | Income | 1 | 1 |
| **4.** | Distance from nearest green infrastructure | 0.93 | 1.07 |
| **5.** | Family size | 1 | 1 |

As shown in Table 3.11, the values of the VIF for the five continuous variables were found to be small (that means value less than 10) indicating the data have no serious problem of multi-colinearity. As a result, all seven continuous variables were retained and encoded into binary logistic regression analysis.

### 3.13 The model Output

In the preceding section, variables characterizing the respondents and their differences among the positive and negative perceiver groups were identified. However, in the logit model analysis, we emphasize on considering the combined effect of variables between positive and negative perceiver respondents in the study area. Therefore, the emphasis was on analyzing the variables together, not one at a time. By considering the variables simultaneously, we can incorporate important information about their relationship.

Thirteen variables were hypothesized to explain the factors affecting the perception of green infrastructure. Out of these, 9 of the variables were found to be significant, while the remaining 4 were non-significant in explaining the variations in the dependent variable among sample respondents.

The maximum likelihood estimates of the logistic regression model show that the major factors influencing the perception of green infrastructure by respondents were education, income, family size, sex of respondent, marital status, type of employment, ownership of the house, participation in public involvement and frequency of visit to nearer infrastructure. The parameter estimation results presented in Table 3.12 was discussed in more detail.

For the purpose of this study, the discussion was focused on the variables, which were significant in Table 3.12. One of the specific objectives of the study is to identify the determinants of the perception of green infrastructure in the study area. Whether the particular respondent perceived negatively or positively on the green infrastructure for better development of urban green infrastructure. The variables like the age of respondents, distance, awareness, and the type of green infrastructure were less powerful in explaining the determination of perception of green infrastructure.

Table 3.12 Binary Logistic Regression on the perception status of HHs

| **Explanatory variables** | **B** | **S.E.** | **Wald** | **Odds Ratio(Exp(B))** | **Sig.** |
|---|---|---|---|---|---|
| AGE | -.030 | .020 | 2.297 | .971 | .130 |
| SEX | 761 | .444 | 2.933 | .467 | .087 |
| EDUCLEV | 150 | .089 | 2.847 | 1.162 | .092 |
| INCOME | 000 | .000 | 3.770 | 1.000 | .052 |
| MARTAL | -2.711 | 1.526 | 3.156 | .066 | .076 |
| EMPLOYE | -1.084 | .441 | 6.046 | 2.955 | .014 |
| HOUSE | 916 | .455 | 4.050 | .400 | .044 |
| AWERNESS | -535 | .410 | 1.707 | .585 | .191 |
| DISTNCE | 1.899 | 1.155 | 2.702 | 6.676 | .100 |
| PARTCIPT | 2.081 | .507 | 16.840 | .125 | .000 |
| FREQUENT | 1.458 | .427 | 11.644 | 4.297 | .001 |
| TYPE | -.084 | .417 | .041 | .919 | .840 |
| FAMLY | 250 | .136 | 3.401 | .779 | .065 |

***-Significant at less than 1% probability level

**-Significant at less than 5% probability level

*-Significant at less than 10% probability level

Observations: N=167

-2Log likelihood 49.74

Model chi-square 151.75

Sensitivity/Correct prediction of positivity 78.7

Specifi City/Correct prediction of negativity 79.5

Over all cases correctly predicted 79

The data collected from Focus Group Discussions (FGDs) participants revealed several key factors contributing to the decline in the quantity of urban green infrastructure in the city. One of the most frequently mentioned reason for this decrease was the lack of implementation of structural plans for urban development. Participants noted that despite the existence of urban plans, the municipality has failed to effectively execute them. This failure to implement the city's structural plan is primarily attributed to three main challenges: insufficient budget allocation, lack of community participation, and the absence of skilled professionals within the municipal government. These factors, according to the FGD participants, are major barriers to the successful realization of urban green infrastructure plans. This observation was further corroborated by field visits and interviews conducted with municipal core process stakeholders, which also highlighted these challenges as contributing to the decline in green infrastructure.

Additionally, several FGD participants pointed out that the misuse of green infrastructure spaces significantly undermines their availability and accessibility. One common issue identified was the frequent dumping of solid waste in areas designated for green spaces. Such practices not only degrade the quality of the green infrastructure but also limit its accessibility and functionality. These observations reflect a lack of proper management and respect for green spaces, which could otherwise serve as valuable urban assets.

Moreover, FGD participants also emphasized the lack of integration among key stakeholders involved in urban planning and management. This lack of coordination between various actors such as municipal authorities, community groups, urban planners, and environmental organizations—has led to fragmented efforts in managing green infrastructure. Without a unified approach, the maintenance and expansion of green spaces are not prioritized, further contributing to the decline in urban green infrastructure.

These findings align closely with those reported by Zenebe et al. (2021), whose study similarly identified low levels of green infrastructure accessibility and provision as being primarily caused by the failure to implement proposed structural plans and inadequate management practices. Zenebe and colleagues also noted that without a clear and enforced strategy for urban green infrastructure, coupled with poor management, the city's green spaces suffer from neglect and misuse, further diminishing their presence and impact.

From these findings, it becomes clear that the accessibility and provision of green infrastructure in the city are influenced by several interrelated factors. The lack of effective implementation of structural plans, mismanagement of green space, insufficient integration among relevant stakeholders, and lack of proper management systems are all critical barriers to ensuring the sustainability and expansion of urban green infrastructure. These challenges highlight the need for a more coordinated and strategic approach to urban planning, one that involves all stakeholders, ensures proper allocation of resources, and emphasizes the long-term management and protection of green spaces. Only through such efforts can the quantity and quality of urban green infrastructure be improved, ultimately benefiting both the environment and the quality of life of urban residents

### 3.14. Land requirement

Land demand for the planning period, based on the compact medium to high-density planning principle, is about 2000 to 4000 hectares of land. In this regard, the City should prepare and/or provide at least 200 hectares of developed land per year for housing purposes only. Taking demand for housing as a base for calculating demand for other land use types, the City should prepare and/or provide an additional 500 hectares of developed land for these types of land use categories. This accounts for at least one-third of the existing urbanized land of the City. However, the City is not in a position to provide the aforesaid amount of land every year for housing purposes, due to the shortage of land for expansion within its administrative boundary.

The City should fulfill the required land for housing through, inner City redevelopment (200 hectares), expanding to Wondo-tika areas (600 hectares), changing the use of land currently occupied by the agricultural research center for mixed-use residences (122.7 hectares), using the old airstrip for mixed-use housing (17.8 hectares), using areas behind Hawassa industrial park including land sub-divided for re-settlers for mixed-use residence (142 hectares), through land readjustment in the newly included six Local Development Plan areas (600 hectares), infilling Tula town and its surroundings (200 hectares), plot subdivision in the compounds of federal, regional, and zonal government institutions and private holdings such as Hawassa University, Regional Agriculture Bureau, SOS, and other large compounds of government or private holdings with available underutilized land, etc. (117.5 hectares). This could happen at the time of National Development Plan Preparation, and New Local Development Plan Preparation toward Loge town with the concept of land readjustment (100 hectares).

Land must be prepared and/or made available through a land readjustment process in the regions that are specifically needed for other supporting land use types at the City's periphery. These land use categories include municipal and social land uses, road and transportation infrastructure, and other physical constructions. The following subsections provide the specifics of the land use proposal's many components.

According to the focus group discussions (FGD) with respondents who participated in the research, enhancing the capacity to plan, manage, and finance urban growth is a critical aspect of effective urban governance. For a government to effectively manage urban areas, it must possess the necessary skills, resources, and capacity to oversee both physical and socioeconomic planning processes. This ensures that urban development is both sustainable and aligned with the needs of the population. However, municipalities across the country face significant challenges in this regard. They often lack the necessary technical skills, institutional capacity, and financial resources to meet their obligations and manage urban growth in a coordinated and inclusive manner.

This issue highlights a significant green infrastructure system, both at the national and local levels. The existing policy does not adequately address the challenges faced by municipalities in managing urban growth. It fails to consider the limitations that many city face, particularly in terms of administrative capacity and resources. The policy does not provide sufficient alternatives or strategies to bridge these gaps. As a result, local governments struggle to plan and manage urban development effectively, which can lead to inefficient land distribution, inadequate infrastructure, and uneven socioeconomic development. Without addressing these administrative shortcomings, the green infrastructure system cannot fully meet the needs of urban dwellers or promote sustainable urban growth. Therefore, there is a pressing need for a more comprehensive approach that includes strengthening municipal capacities, providing financial support, and creating alternative solutions to address the challenges faced by urban administrations.

### 3.15 General Land Use

Currently, 27.61% of the City's land is urbanized in Hawassa. The population and demographic study projected that the City's current population (372,721) will reach 900,710 by 2030. To meet this increasing demand for urbanization, the City should either increase its urbanized land by more than double-fold or should undertake massive redevelopment activities for the next 10 years. The block-based general land use proposal is then categorized into nine major classifications such as housing; commerce and trade; administration; services; manufacturing and storage; recreation and environmental; road and transport; urban agriculture; and special functions. Two different types of classifications are created based on two distinct borders: planning and administrative boundaries. If the classification is based on the newly delineated planning boundary (of 6528.98 hectares), housing accounts for the majority (37.77%) of the proposed land use classification, followed by road & transport (23.76%), recreation & environmental (11.67%), and service (9.67%) (see Figure 3.2).

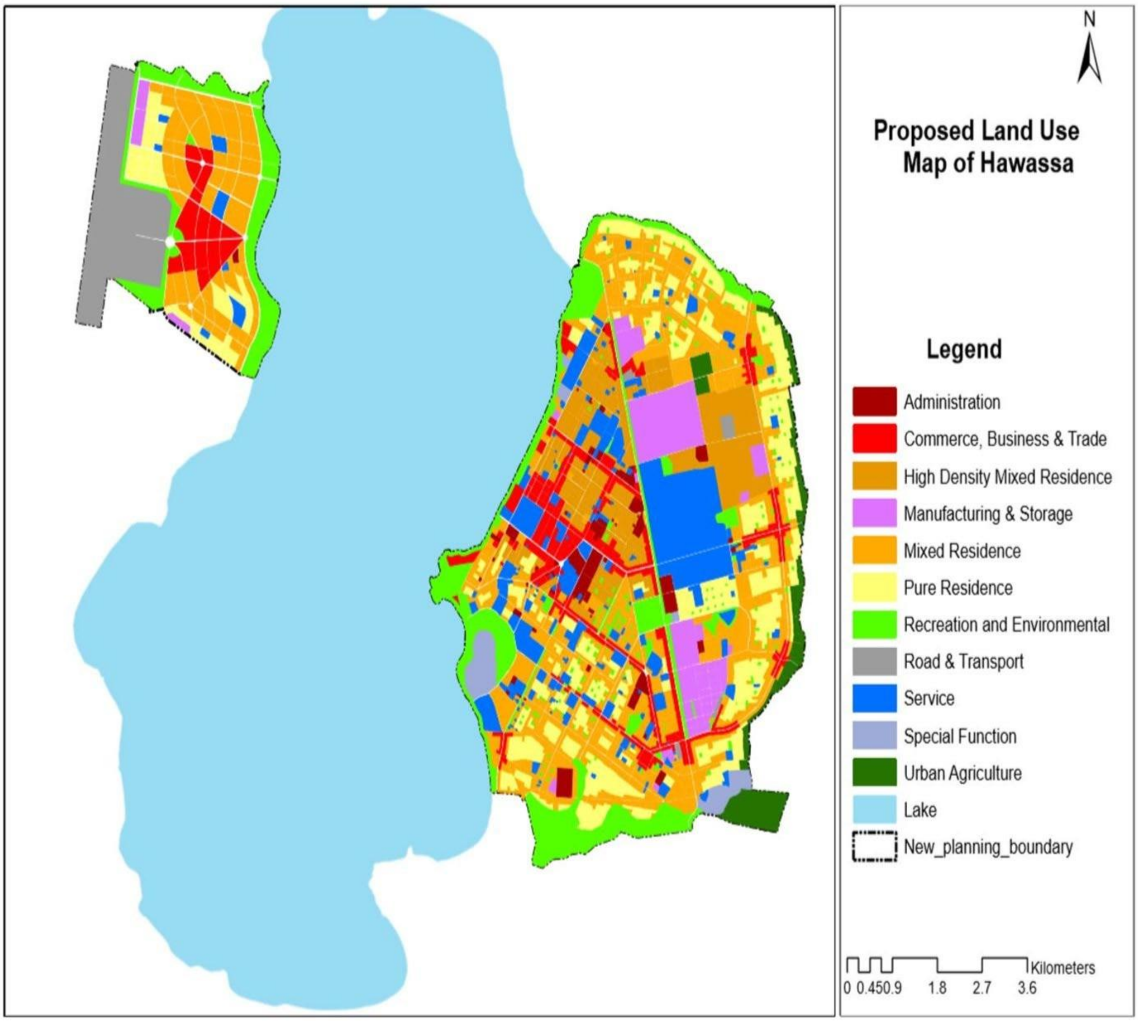



Figure 3.2 Land use classification map within the planning boundary. Source: Hawassa City Municipality (2020)

### 3.16 Recreation and Environmental Plan

Various recreational land uses (such as open space, formal greens, and sports facilities) and environmental land uses are allotted space under the recreation and environmental land use plan (such as forests, buffer zones, nursery sites, and environmentally fragile areas). The specifics of the two plans are described in the following subsection.

#### Open Spaces

The open spaces are spaces reserved within the community that serve as meeting or gathering places outside individual plots, accessible by all community members, and have recreational and aesthetic value to the community. The proposal reserves 17.4 hectares of open spaces of which 10.84 hectares is for play lots and 6.56 hectares for playgrounds. The proposal retained the existing play lots and reserved new neighborhood-level plots for play lots and playgrounds specifically in the periphery of the City. Each lot is defined by local roads to avoid encroachment threats from adjacent private holdings. In the old dilapidated settlement areas of the City where redevelopment and land readjustment, play lots and playgrounds were allocated at the time of National Development Plan Preparation.

**Formal Green**

Recreational elements categorized under formal green include communal green areas, parks, lakes, riverside resort centers, etc. These areas are the areas that contribute to residents' physical and mental aspects, strengthening the community identity, quality of life, and social sustainability. The proposal reserves 157.83 hectares for green areas and 130.85 hectares for parks (Tikur-wuha protected forest/park). Like open spaces, each of the specific land use types is defined by local roads to avoid potential encroachment from adjacent private holdings. In the old and dilapidated settlement areas of the City where redevelopment and land readjustment are taking place, green areas should be allocated at the time of Local Development Plan Preparation (LDPP). Furthermore, the City should rehabilitate the existing and proposed formal green areas and street sides to attract users and to be safe, accessible, and pedestrian friendly.

The recreational green spaces are proposed primarily for access to visual comfort and recreational comfort by taking into consideration the inflow of local and international tourists into the City. The proposal considers the economic benefits of urban green areas such as the creation of job opportunities, providing services to local people and tourists in green areas, employment of people responsible for the maintenance of these areas, etc.

Well-planned green areas and green infrastructures increase the attractiveness of local and international tourists to the City. Urban greenery, cleanliness/sanitation, and accessible public spaces are among the major pulling factors for tourists into the City ("comparative advantage"). Therefore, the City Administration shall prioritize developing and managing existing and new urban greenery and public space; maintaining and further strengthening the culture and brand of cleanliness and sanitation in the City. To realize the strong potential for growth of both local and international tourist inflows, the following recommendations are put forth.

- Hospitality and tourism services industry development and promotion: Concerted efforts and targeted incentives shall be provided to private sector enterprises and investors to make sure that high-quality but affordable hospitality services are offered in the City to ensure that the City is a pleasant, affordable, and convenient destination for local leisure tourists and international business travellers.
- Development of recreational, Eco-friendly transport infrastructure: The City buffer zone on the boundary of Lake Hawassa for environmental protection purposes. From the perspective of developing the tourist attraction of the City and to promote healthy lifestyles for the residents of the City, it is proposed that bike and walking/jogging lanes shall be constructed along the buffer zone on the City's side of the Lake. The proposed lanes could run from the protected forest/park near the northern entrance of the City Tikur-Wuha up to the foot of Tabor Hill. In addition to being able to walk and jog along the shores of the lake, the City's residents, tourists, and visitors could rent bikes along the trek/lane for small fees from, say, a youth cooperative that maintains the trek/lanes or any other entity that would provide such rental services. In addition, it is proposed that an econ-friendly cable car line be built to provide ordinary and leisure transport from the top of Tabor Hill up to the top of Alamura Hill (with stops in between as necessary). After technical and economic feasibility considerations, the cable car transportation shall be powered using solar power.
- **Facilitate development and promotion tourism into Sidama hinterland and culture:** In collaboration with pertinent authorities/government offices of the larger Sidama region and other stakeholders, the City administration shall support and facilitate the development of the tourism potential of Sidama with a view to attract an increasing number of domestic and international tourists to the region who would be almost by default – spending part of their visit time in Hawassa. In addition, development and management of additional cultural recreational facilities and public spaces within the City itself would also increase the attractiveness of the City for foreign and domestic tourists. These efforts shall include supporting establishment and development of culturally themed artistic, recreational and hospitality (e.g. restaurants, lodges) facilities in the City.
- **Protect and facilitate development of Burqito hot-springs:** In addition to protecting, developing and properly managing the existing popular tourist attractions (such as the lake itself, Tikur Wuha protected forest, Amora Gedel Fish Market, Grand Gudumale, Alamura and Tabor Hills and King Haile Selassies' seasonal palace at Kuttuwa) the City Administration shall protect and promote the development of the Burqito natural hot springs.

These have been traditionally used by the local communities for recreational and their purported medicinal properties. The proposal here is to modernize and protect the area from damage and contamination and modernize it for the purpose of not only maintaining the traditional use of the hot springs but also as one of the tourist attractions of the City.

### 3.17 Functional Green Areas

Functional green areas are areas found in institution grounds, churchyards, and cemeteries. Some of these green spaces could be allocated for recreational purposes; however, their principal purpose is the function they have such as use for education, worship, and cemeteries.

#### Sport Centers

The sports center's proposal includes a gymnasium, club, circus, ground tennis, and stadium. The space required for the gymnasium, club, and circus is too small to be illustrated in the land use proposal of the structure plan so space for all should be reserved at the time of National Development Preparation (NDP) based on the pre- defined standards of the country. Considering the stadium, the proposal maintains the space allocated for the two stadiums: the old and new stadium. The two stadiums should be surrounded by collector, sub-arterial, or arterial roads. The City should also encourage private sectors to engage in the provision of sports facilities and services.

#### Linear Green Spaces

Linear green space along the side of major transport routes of the City such as on the right side of the existing main highway (in front of Hawassa University and Hawassa Industrial Park as we run south to north, on the route starting from Shell through Old bus station, St. Gabriel to Piazza, from St. Gabriel to Referral Hospital, from Atote to Wanza, from Wondo junction to Airport, from Tulla to Airport and from Monopol to Tulla) should be provided with linear green spaces planned for recreational and aesthetic purposes. The linear green space covers 146.06 hectares of land.

### 3.18 Proposed Environmental Plan

The environmental plan consists of forest land, a buffer zone, a nursery site, and environmentally fragile areas such as marshes, lakes, rivers, and groundwater potential. The detailed plan of each land use is as follows:

**Forest Land**

The proposal retained land for forest development on top of Alamura Hill and its surroundings and the southeastern hilly area of the City. It accounts for 304.76 hectares of land. The City should promote the reforestation activity through incentives, to push people from the informal settlements to move their homes and use the land for tree-planting activities only. The City should ensure coordination among the forestry department, Rift-valley River basin office, and NGO's forestry activities, identify priority areas and start implementing urgently new forestry activities both upstream and downstream.

**Buffer Zone**

The plan proposed a 50 to 100-meter buffer zone along the sides of Lake Hawassa. For practical purposes, a 50-meter buffer is allocated in the already developed section of the lakeside. In this zone, all physical structures should be removed, and the lakeside area should be free and accessible by all residents of the City. For any other future development demand, however, the City should preserve at least a 100-meter buffer. In Wondo-tika however, the proposed buffer width extends beyond 100 Meters. All lakeside buffers of various widths are proposed to have 10-meter sidewalks. The buffer has to be considered not only for activities needing a building but also for cattle and urban agriculture. The plan proposes other types of buffer along the sides of the current sanitary fill (20 Meters width) and proposed sanitary fill (50-m width). In general, the proposed buffer zone covers 151.37 hectares of land.

**Nursery Sites**

The plan maintained the existing fish nursery site located close to the fish market and allocated 0.263 hectares of land for seedlings along the sides of Tikur-wuha River and Chleleka wetland.

**Environmentally Fragile Areas**

The plan identified about 20 environmentally fragile areas of 2708.41 hectares within the City's administrative boundary. The plan maintained these areas as protected areas for the sake of preserving the City's biodiversity and ecological value. Lakeside areas of this type are proposed to be possible locations for the creation of artificial wetlands, to limit the pollution of the lake from storm waters, and to limit floods, for the entire proposal of recreation and environmental (Figure 3.3).

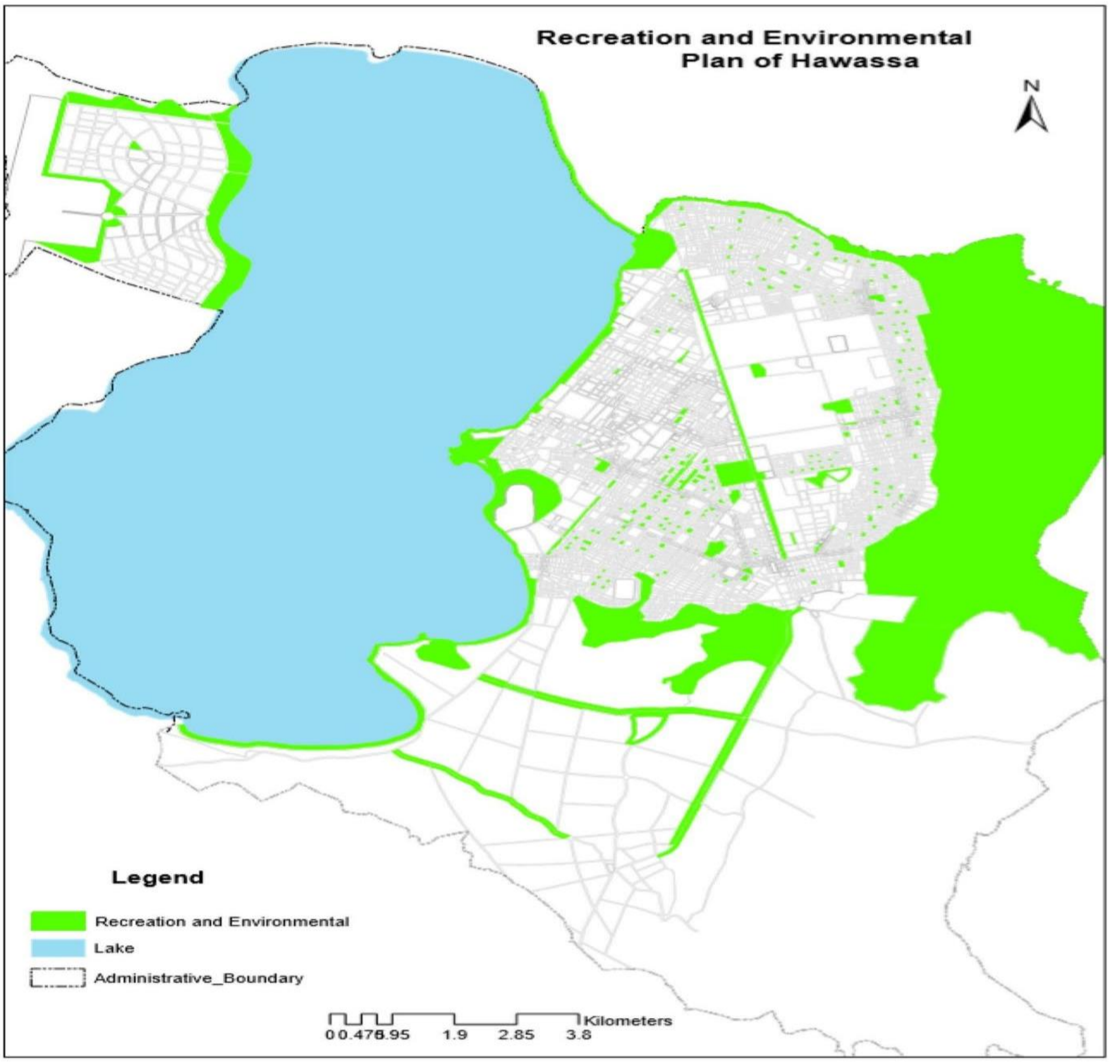



Figure 3.3 Recreation and environmental map of Hawassa**.** Source: Hawassa City Municipality (2020)

### 3.19 Proposed Distribution of Density

The current average density of the City is 12,656 persons per km2. Its distribution ranges from 1090 persons per km2 in the predominantly scattered settlement of Tulla sub -City, to as high as 31,700 persons per km2 in the high-density Bahil- adarash sub- City of Hawassa.

To address this structural difference, an area-specific density distribution is proposed for the next 10 years (Figure 3.4). The average density for Hawassa City for the next 10 years is proposed to be 20,000 persons per km2. Figure 4 shows five different densities distributed across the City's administrative boundary. As shown in the Figure, the major City center areas such as Piassa, Old market surroundings, Old bus station areas, Shell, Turufat, Atote, and areas in front of Hawassa Industrial Park are the most strategic areas that accommodate major commercial activities and employment zones for the residents. It is essential to encourage relatively very high-density residential development to provide homes close to these employment zones, and hence, a very high density of at least 30,000 persons per km2 is proposed for these specific areas. The City will achieve this density through redevelopment that considers the important role of the existing major economic activities of the area, and the higher land value of the surrounding settlements that enable the City to create new commercial and employment hubs for the City.

In the immediate surrounding areas of the major City centers and employment areas, a high residential density of 25,000 persons per km2 is proposed. In the recent expansion areas of the City such as Dato, Chefe, Monopol, and Wondo-tika, a medium residential density that accommodates 20,000 persons per km2 is proposed. Most parts of the Tula sub- City and areas surrounding the lake fall under low and very low-density zones with proposed densities of 15,000 and 10,000 persons per km2, respectively.

A study by Luck and Wu (2002) recognized that urbanization is one of the most important driving forces behind LULCC in Jinan City (China). According to Kong and Nakagoshi (2006), the policies that have an impact on the growth and control of urban green infrastructure are the driving drivers. However, Byomkesh et al., (2012) noted that among other factors, rapid population growth brought on by rural-to-urban migration, economic development, and a lack of awareness among City managers and residents are the causes of changes in green infrastructure. Improper regulations and rules that fail to protect urban green infrastructure, a lack of financing for their administration and maintenance, and political pressure to stop illegal conversion and leasing of green infrastructure are additional challenges.

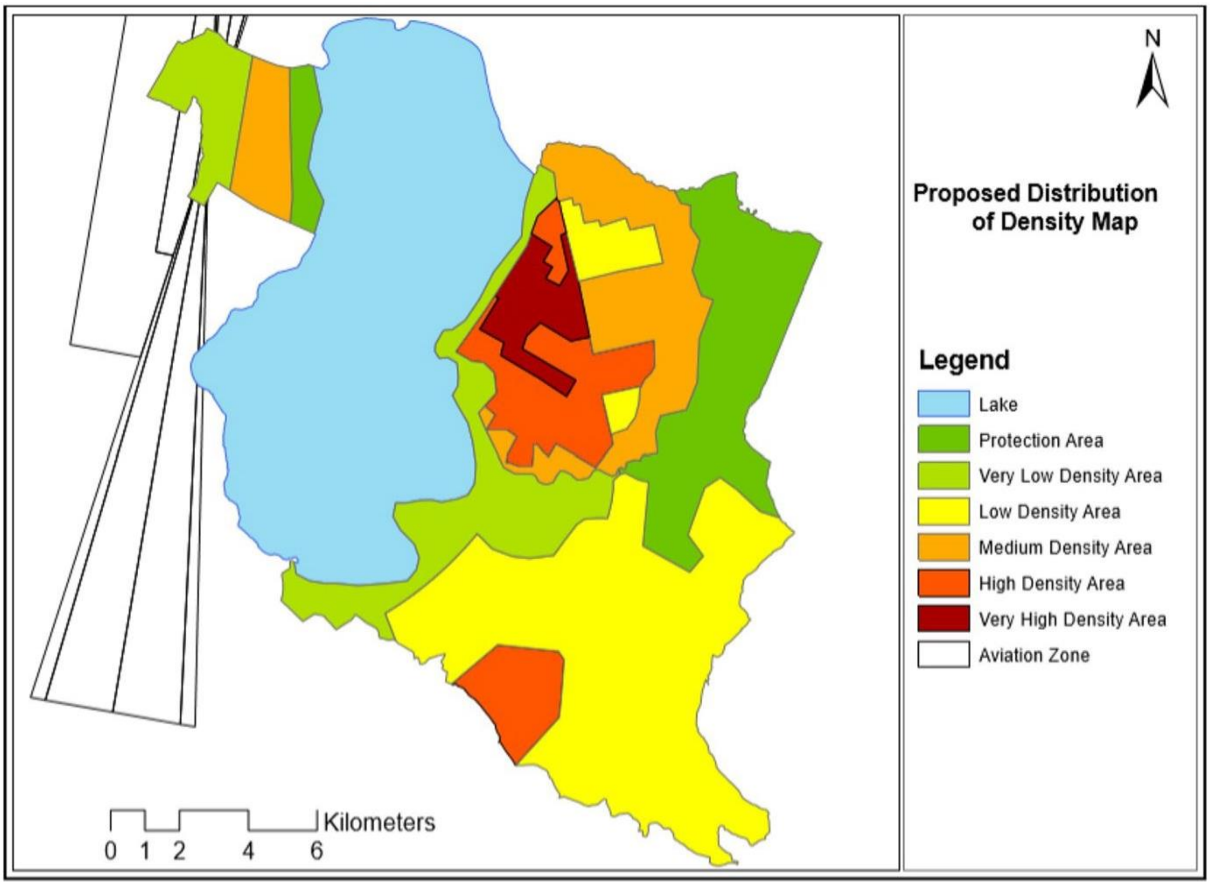



Figure 3.4 Proposed distribution of density within the administrative boundary. Source: Hawassa City Municipality (2020)

### 3.20 Discussion

The majority of the area that is officially part of Hawassa is undeveloped. The entirety of the undeveloped region is made up of several ecosystems (or ecological units) that offer a variety of functions and advantages, including flood mitigation, air purification, carbon dioxide storage, food production, and wood supply. Ecosystem services are the services provided by ecosystems.

Planning must take into account the fact that different types of ecosystems, such as forests, cultivated fields, and grasslands, provide distinct kinds and levels of ecosystem services. Even more plausibly, there is a link between the usage of land and the provision of ecosystem services. By recognizing this connection and having the ability to assess the ecosystem services provided by various land uses, planners and decision-makers can maximize the provision of some services that are crucial for the City of Hawassa.

In addition to the overall decrease of ES, what is relevant to note are shifts in terms of types of ES provided? In this regard, Table 3.13 shows that, due to land use changes from 2005 to 2017, the most affected category of ES is the regulating ES. This means that the territory is providing less global and local climate regulation, less water flow regulation, less nutrient regulation, and less natural hazard regulation. Because of the increase in agricultural land, many provisioning services increased or kept their values. Recreational services also decreased. This means that, overall, the resilience and the support for human well-being are decreasing and measures should be taken to address these trends.

The lack of proper natural capital to sustain the City not only limits some benefits (recreational areas, nice fish for cooking, valuable landscapes, rich biodiversity) but also implies costs. For example, in recent years, the City of New York, due to the deforestation of hectares of a forest along its rivers, realized that the water of the Hudson became suddenly polluted. The City administration assessed that the construction of a water purification plant to do the same job that the forest cut used to do would have cost five billion dollars. They decided to replant the trees (which implied the costs of the purification plant to obtain the same benefits). In the design of a City and in the decisions taken related to land uses, this should be considered.

Table 3.13 Land use and average ES provisioning in Hawassa City, 2005 and 2017

| Land use | Average ES prov. For the land use | Area in 2005 ($km^2$) | Area in 2017 ($km^2$) | Trend of land use from 2005 to 2017 |
|---|---|---|---|---|
| Built up | 0,45 | 12,2 | 44,9 | ↑ |
| Airport | 0,06 | 0,0 | 4,3 | ↑ |
| Mineral extraction site | 0,25 | 0,5 | 0,5 | → |
| Agricultural areas | 1,42 | 89,7 | 104,4 | ↑ |
| Pastures/natural lands | 1,16 | 70,8 | 19,1 | ↓ |
| Forests/protected | 3,22 | 2,0 | 2,0 | → |
| Water bodies | 2,23 | 95,1 | 95,1 | → |

Source: Hawassa City Municipality (2020)

Table 3.13 and Figure 3.5 show the results of such a computation, which show that from 2005 to 2017, built-up and agricultural land increased, protected areas (forests) and the lake remained stable, and natural land (linked to ES provisioning values for pastures) decreased significantly. Forests, lake, and natural areas are the land uses that provide the most ES; nonetheless, the total ES supply dropped from 2005 to 2017. Figure 3.5, in particular, shows where the greatest amount of ES occurs (on a scale of 0 to 5, with 5 indicating land useful to offer the greatest amount of ES and 0 representing land usage that provides no ES). By charting the current and previous land uses inside the administrative limits, as well as explaining the services they give, it is vital to remember that although the built-up and agricultural areas expand due to urbanization, the core ecosystem land is being "eaten." The rate at which the most important ecosystems disappear (together with the services and benefits they provide) has quadrupled over the previous six years. Meanwhile, the population (which reflects the need for such services and benefits) continues to grow, putting greater pressure on the environment.

In particular, Figure 3.5 shows where the highest amount of ES occurs (on a scale from 0 to 5, where to 5 corresponds the land usable to provide the highest amount of ES and 0 is the land use not providing any ES). By mapping the present and past land uses within the administrative boundaries, and by explicating the services they provide, it is important to consider that while the built-up area and the agricultural areas are increasing on urbanization, the core-ecosystem land is being “eaten.” The speed at which the most valuable ecosystems are disappearing (together with the services and benefits they provide) tripled in the last 6 years of interval. In the meantime, the population (which represents the demand for such services and benefits) keeps increasing and so does its pressure on the environment.

In addition to the overall decrease of ES, what is relevant to note are shifts in terms of types of ES provided? In this regard, Table 3.14 show that, due to land use changes from 2005 to 2017, the most affected category of ES is the regulating ES. This means that the territory is providing less global and local climate regulation, less water flow regulation, less nutrient regulation, and less natural hazard regulation. Because of the increase in agricultural land, many provisioning services increased or kept their values. Recreational services also decreased. This means that overall, the resilience and the support for human well-being are decreasing and measures should be taken to address these trends value of its landscape, within the administrative boundary of Hawassa City, it is possible to identify protected areas.

Table 3.14 Ecological system (ES) provisioning and trends in Hawassa, 2005 and 2017

| (ES) | 2005 | 2017 | Trend |
|---|---|---|---|
| Regulating ES | | | |
| Global climate regulation | 325,5 | 247,75 | ↓ |
| Local climate regulation | 458,4 | 428,2 | ↓ |
| Air quality regulation | 99,7 | 114,4 | ↑ |
| Water flow regulation | 739,75 | 709,5 | ↓ |
| Water purification | 200,2 | 200,2 | → |
| Nutrient regulation | 463,8 | 418,8 | ↓ |
| Erosion regulation | 303,4 | 313,4 | ↑ |
| Natural hazard regulation | 461,8 | 416,8 | ↓ |
| Pollination | 97,9 | 112,4 | ↑ |
| Pest and diseases control | 644,6 | 591,6 | ↓ |
| Regulation of waste | 448,5 | 522,25 | ↑ |
| Provisioning ES Crops | | | |
| | 624,4 | 638,4 | ↑ |

| | | | |
|---|---|---|---|
| Biomass for energy | 844,7 | 619,7 | ↓ |
| Fodder | 394,2 | 95,5 | ↓ |
| Livestock (domestic) | 452,5 | 526,2 | ↑ |
| Fiber | 10 | 10 | → |
| Timber | 10 | 10 | → |
| Wood fuel | 380,4 | 380,4 | → |
| Fish | 475,5 | 475,5 | → |
| Aquaculture | 637,8 | 533,0 | ↓ |
| Wild foods and resources | 275,1 | 319,3 | ↑ |
| Bio-chemicals and medicines | 475,5 | 475,5 | → |
| Freshwater | 2,6 | 2,6 | → |
| Mineral resources | 682,5 | 445,9 | ↓ |
| Abiotic energy sources | 769,5 | 762,8 | ↓ |
| Recreational ES Recreation and tourism | 674,4 | 667,7 | ↓ |
| Landscape aesthetics and inspiration | 752,9 | 728,3 | ↓ |
| Knowledge system | 220,6 | 286,0 | ↑ |
| Religious and spiritual experience | 811,7 | 709,36 | ↓ |
| Cultural heritage | 374,1 | 314,4 | ↓ |

Source: Hawassa City Municipality (2020).

Figure 3.5 show the map of protected areas in Hawassa City. These can be divided into three main groups: protected areas inside the planning boundary that are valued for their aesthetic, recreational, and cultural/religious value; protected areas outside the planning boundary that stand as the foundation of the ecological network and the region's natural capital. Unfortunately, even though the buffer is recognized as a protected area by the building code of the City, the policy is not properly implemented. The lack of implementation is because the majority of buildings and activities within the buffer were established before the policy neither (which is retroactive) nor due to the informality of the activities that occupied the buffer after the policy was established.

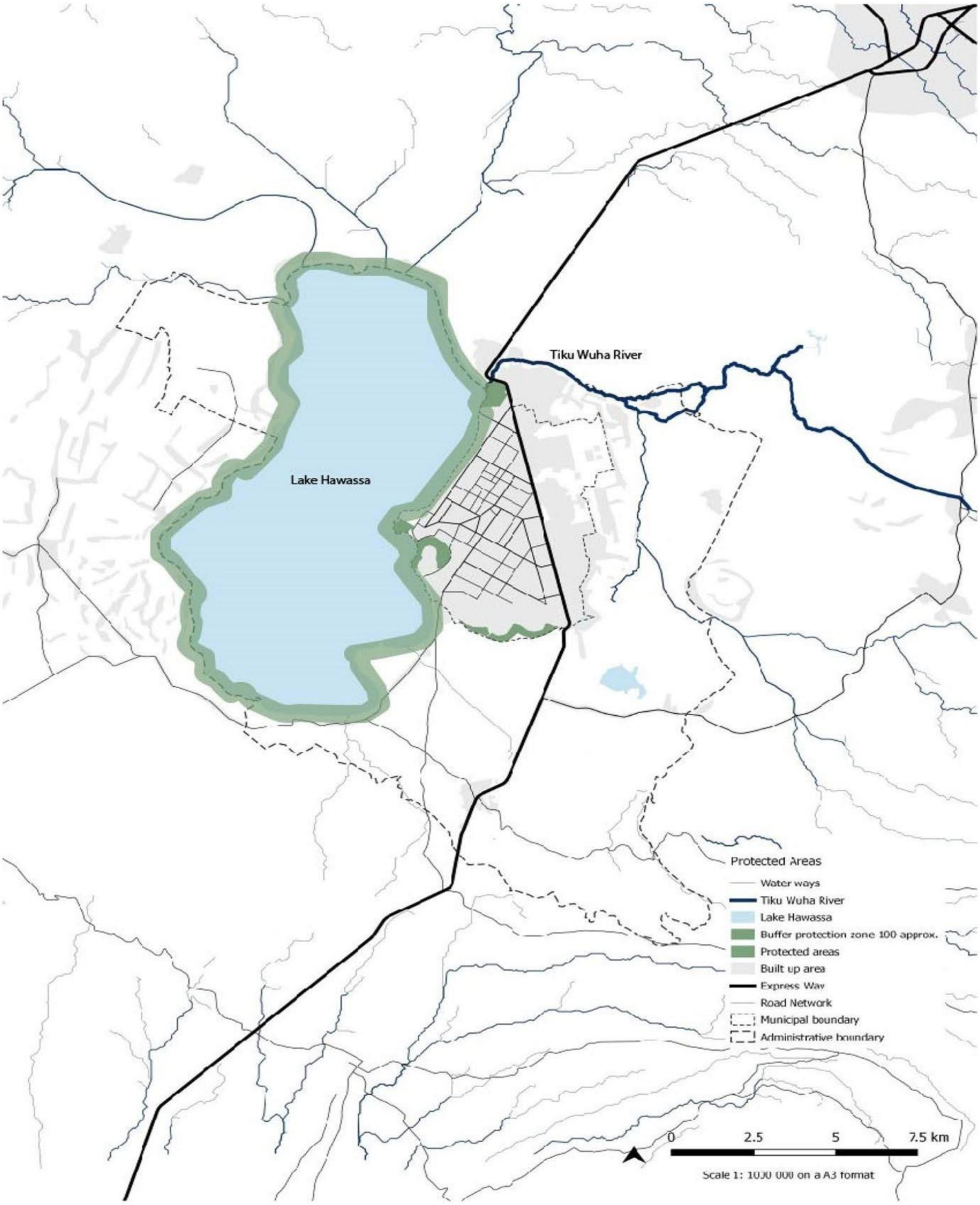



Figure 3.5 Protected areas map**.** Source: Hawassa City Municipality (2020)

### 3.21 Conclusion

The study was conducted in Hawassa City, Southern Ethiopia; the green infrastructure was one of the major targets of the government. The objective of the study was to assess the perception of the use of green infrastructure with the sampled respondents. Green infrastructure in different parts of Hawassa City such as street trees, public parks, and play fields emerged and was planned for different purposes/ benefits in the community. The major factors affecting the status of people's perception toward those green infrastructures' were not known in the study area. Different sources of related literature were reviewed to understand what has been obtained from different related studies. The systematic random sampling method was employed by using probability proportional to size.

Urban open space availability in the City has changed throughout time. There are currently fewer open spaces and green areas in the City with each significant construction. This demonstrates that despite the growing need for recreation in society, the issue of urban green areas has not received more attention in municipal development policies. The urban green zones have been excluded from the structural or development plan that has been put into action. This indicates a significant risk to the growth of urban green spaces in the metropolis.

Descriptive statistics and econometric models were used for analyzing both quantitative and qualitative data by using "SPSS version 21" software. In addition to this, FGD and Key informant interviews were triangulated to ensure the validity and reliability of the research. According to the analysis of data, the major factors affecting the status of the local community's perception toward the use of green infrastructure were analyzed by using a binary logit regression model. Raw data were passed through different processes of tests such as t-test and Chi-square test, and to check for multi-collinearity, VIF (variance inflation factor for continuous variables) and contingency coefficient (for categorical variables) were applied before processing the logit model to assess factors affecting local community perception. As the results of descriptive statistics and logit model, it was found that the positive and negative perceptions had a combination of factors personal and demographic, economic institutional and biophysical factors, and other different influencing factors that discourage the positive perception toward the green infrastructure.

According to the result of the descriptive statistics, the variables like education level, income, family size, sex, marital status, type of employment, ownership of the house, participation in public meetings, and frequency of were found to be significant determinants of the perception of green infrastructure. The result shows that increasing education level income, family size, sex, ownership of the house, participation in public meetings, and frequency increases the chance of being positively perceived. The chance of being positively perceived decreases with an increase in marital status and type of employment. According to the result, the perception status of the town was seen that the majority of the participants were negative perceivers of green infrastructure that need their thinking change to bring the development of green infrastructure. This result was found due to the different variables.

The type of employment an individual engages in determines the perception status. As individuals become government-employed, the chance to become positive thinkers increases. This could be due to mostly the government-employed individuals not freely moving and having no extra income for recreation. Ownership of the house was one of the core variables of the study. As the individual becomes the house owner, the chance to think positively increases. This is because homeowners have no burden of freight toward survival and recreating in nearby resources. Participation in public involvement in green infrastructure planning and development was determinant core variable of the study. As an individual participates more and more in public meetings, he/she gets better and additional knowledge of green infrastructure.

Protected areas of Hawassa are known within the country for their richness in terms of biodiversity and ecological value. For this reason, and also for the recreational and aesthetic value of its landscape, within the administrative boundary of Hawassa City it is possible to identify protected areas. Among these, we can distinguish among three main categories: protected areas within the planning boundary that are recognized because of their aesthetics, recreational, and cultural/religious value. A second category is protected areas outside the planning boundary that represent the pillars of the ecological network and natural capital within the region. To conclude, a third type of protected area is represented by the Hawassa Lake and its buffer of 100 meters. Unfortunately, even though the buffer is recognized as a protected area by the building code of the City, the policy is not properly implemented. The lack of implementation is because the majority of buildings and activities within the buffer were established before the policy (which is not retroactive) and due to the informality of the activities that occupied the buffer after the policy was established.

The amount of urban green infrastructure in the City has been changing over time. Currently, whatever there is a large development, the number of open spaces and green spaces is decreasing in the City. This shows that the issues of urban green space do not have been given attention in the development of policies of the City, even though society’s need for recreation is increasing. This is observed in the structure or development plan of the City as well. Even if most of the proposals in the structural or development plan had been implemented, the urban green space was left out. This shows a serious threat to the future development of urban green areas in the

CHAPTER FOUR

# 4. Physical and Socio-Economic Driving Forces of Land Use and Land Cover Change, A case Study of Hawassa City, Ethiopia


## Abstract

*The study primarily utilized advanced technologies such as Geographic Information Systems (GIS) and remote sensing to gather accurate and reliable data. Information was collected through various methods, including questionnaires, interviews, and key informant interviews. The collected data were then analyzed using a range of techniques, including figures and tables. Descriptive and econometric models were employed for data analysis, with probit regression models specifically used to assess the impact of urban expansion on the lives of displaced farmers in surrounding areas. A multivariate analysis of variance (MANOVA) was conducted to evaluate the effect of urban expansion on several combined dependent variables—land use, socio-economic activities, culture, and environmental changes. The results showed a statistically significant impact (F (8, 616) = 12.704, p = 0.000, Wilk's Lambda (λ) = 0.737, partial eta squared = 0.142, observed power = 1.000). Urban expansion led to notable changes in land use, with agricultural land, built-up areas, and forests increasing by 19.46% to 26.51%, 11.97% to 18.71%, and 0.07% to 4.51%, respectively. Additionally, the study measured social relations and values before and after land expropriation. Before the expropriation, the mean score for social relations and values was 3.21 (with a standard deviation of 0.79), but after the expropriation, the mean dropped significantly to 1.7 (with a standard deviation of 0.852). This indicates a negative impact of the land expropriation on farmers' social relations and values, as they experienced a decline in social interaction and community ties post-displacement. Furthermore, the study highlighted that political and strategic shortcomings in the urban expansion program, coupled with governance issues, have hindered the City's growth and created serious challenges for effective governance in the region.*



**Keywords:** Hawassa Industrial Park, Land use, Livelihood, Probit model, Urban Expansion

## 4.1. Introduction

Urbanization refers to the increasing proportion of people residing in urban areas and the physical expansion of existing urban centers (Koroso et al., 2021). This process, which has been occurring since the dawn of human civilization dating back to the Babylonians (Zewdu, 2021) has seen significant transformations, especially over the past century. A key shift has been the rapid growth of urban populations relative to rural populations. In 1950, only about 30% of the global population lived in urban areas, but by 2014, that number had risen to around 54%. Projections suggest that by 2050, nearly two-thirds (66%) of the global population will live in urban centers (Karutz et al., 2023).

The acquisition and use of urban land are critical and sensitive issues, with far-reaching implications for human societies. Land is the fundamental resource on which communities build their livelihoods and improve their living standards. Beyond its role in food production, land performs essential ecological functions, such as regulating temperatures by absorbing solar heat, conserving water, supporting biodiversity, and acting as a carbon sink (Mikias, 2015). Changes in land use or land cover (LULCC) refer to alterations in how humans interact with and utilize land, affecting both the biophysical attributes of the land and the specific purposes for which it is used. LULCC is one of the most significant forms of global environmental change and occurs at both spatial and temporal scales (Barrett et al., 2002).

Urban expansion, however, often results in the loss of agricultural land, natural landscapes, pastures, and green spaces. In Ethiopia, the rapid pace of urban expansion has been largely driven by natural population growth, rural-to-urban migration, and spatial urban development (Abebe, 2020). Although urbanization is often associated with economic development and improved living standards (Asghar-Pilehvar, 2021), it also poses challenges, particularly in less-developed countries like Ethiopia (Dfid, 1999). These challenges are further exacerbated by inadequate compensation for those displaced by urban growth. As Alemu and Tolossa (2022) note, compensation for farmers who lose their land is often insufficient, and the processes for determining and implementing compensation are unclear, creating social tensions and leaving rural migrants vulnerable to increased poverty, unemployment, and food insecurity.

In examining the effects of urbanization on livelihoods, the "livelihoods framework" developed by Dfid (1999) provides a useful lens for understanding the components of peri-urban livelihoods and how these components interact. This framework helps clarify the complexity of peri-urban livelihoods, highlighting the various factors economic, social, and environmental that affects communities displaced by urban growth. Urbanization’s impact on peri-urban environments can be both positive and negative. Well-planned and managed urban growth can bring economic benefits, such as increased demand for agricultural products, improved access to extension services, and new off-farm employment opportunities (Satterthwaite & Tacoli, 2003; Alaci, 2010). However, unregulated urbanization, particularly in many developing countries, often has detrimental effects on the environment and local livelihoods, including degradation of natural resources and loss of community cohesion (United Nations Human Settlements Programme, 2010).

Urbanization remains an essential driver of economic development, particularly in developed nations (Henderson, 2003), but it is also an ongoing challenge in less-urbanized countries such as Ethiopia, where governance issues and inadequate policy implementation further complicate the process (Woldehanna, 2008). In this context, urbanization is not only a physical transformation but also a political and economic intervention, influenced heavily by government policies. The effects of urbanization on peri-urban environments and livelihoods must be carefully assessed, as they can lead to significant changes in both the social and environmental fabric of these areas. Impact assessment, as defined by the World Bank (2003), involves systematically identifying the positive and negative effects whether intended or unintended of development activities on local communities and the environment.

Land use patterns in any region are shaped by a combination of natural factors and human activities over time. The way land is used can have profound implications for future development, making land-use data critical for planning and decision-making. Understanding land use helps guide the selection of land for various purposes, ensuring that it is used in a way that supports long-term sustainability (Zubair, 2006). Natural and human-induced factors both contribute to changes in land use, as human activities continue to transform many of the earth’s natural landscapes (Burka, 2008; Hamza and Iyela, 2012). Since the mid-19th century, approximately 6 million square kilometers of forests and grasslands have been converted to agricultural land to meet the growing global demand for food and fiber (Lambin et al., 2003; Hamza and Iyela, 2012).

Urban sprawl, the outward expansion of urban areas, is a widespread phenomenon observed in both developed and developing countries. However, urban sprawl tends to have more pronounced negative consequences in developing nations. Urban growth typically involves both horizontal and vertical expansion of urban infrastructure, including the spread of residential, commercial, and industrial areas (Talema and Nigusie, 2023). The factors driving urban sprawl—such as geography, transportation, land use, and social structure are often deeply intertwined with the population size and economic activity of a City.

Despite its growing importance, climate change research often focuses narrowly on quantifying climate trends using remote sensing technology, without fully considering the socio-economic factors that drive or exacerbate these trends. Studies on climate change in Ethiopia have primarily relied on remote sensing data to describe climatic shifts but have not sufficiently addressed the social and economic drivers behind these changes (Mohamed & Worku, 2019). This study aims to bridge this gap by assessing the impacts of climate change on Hawassa City, considering not only the physical climate data but also the socio-economic factors influencing urbanization and its associated effects on the environment.

In monitoring land use and land cover change (LULCC), remote sensing technologies have proven essential. Various methods, such as pixel-based classification and object-based image differentiation, have been used to map and detect changes in land cover over time (Dingle-Robertson & King, 2011; Wang et al., 2012). This study employs satellite data from 1990, 2000, 2010, and 2020 to analyze land use dynamics in Hawassa City and the underlying drivers of these changes. The objective is to better understand the forces shaping land use patterns in the City and to propose sustainable management strategies to control urban growth. These strategies will include measures to prevent the displacement of farmers from peri-urban areas, assess the effects of agricultural and non-agricultural land use patterns, and support sustainable urban development while preserving the City's natural resources

## 4.2 Materials and methods

### 4.2.1 Study area

Hawassa City is located in the southern part of Ethiopia, approximately 275 kilometres south of Addis Ababa, along the Addis Ababa-Moyale International Highway. The City is geographically surrounded by several prominent natural features. To the north, it is bordered by the Tikur-Wuha River, while to the south; it lies at the foothills of the Alammura Mountains. To the east, Hawassa is adjacent to the Chelelaka Marshlands, and to the west, it is flanked by the picturesque Lake Hawassa. The City is situated at an average elevation of about 1,690 meters (5,543 feet) above sea level, contributing to its temperate climate and scenic landscapes (Hawassa City Municipality, 2020).

Hawassa's geographic boundaries extend roughly between the coordinates of 7°03'43.38" North latitude and 38°28'34.86" East longitude, covering a total land area of approximately 8,282.6 square kilometers. Within the Oromia region, Hawassa's borderlands include four Woredas (districts): Shashemene, Arsi Negele, Kofele, and Siraro. In the City is surrounded by the Woredas of Hawassa Zuria, Shebedino, Dale, and Boricha.

This strategic positioning places Hawassa at the crossroads of two important regional states, enhancing its role as a vital urban centre in southern Ethiopia. The City acts as a major hub for economic, cultural, and administrative activities, with strong connectivity to both regional and national markets. The proximity to natural resources such as Lake Hawassa, the river systems, and surrounding agricultural land also boosts the City’s economic importance, particularly for industries related to tourism, agriculture, and trade.

As the capital of the Sidama National Regional State, Hawassa has become one of the fastest-growing cities in Ethiopia. With ongoing urbanization and infrastructural development, it serves as a key centre for both local governance and regional development, helping to drive growth in the surrounding areas.

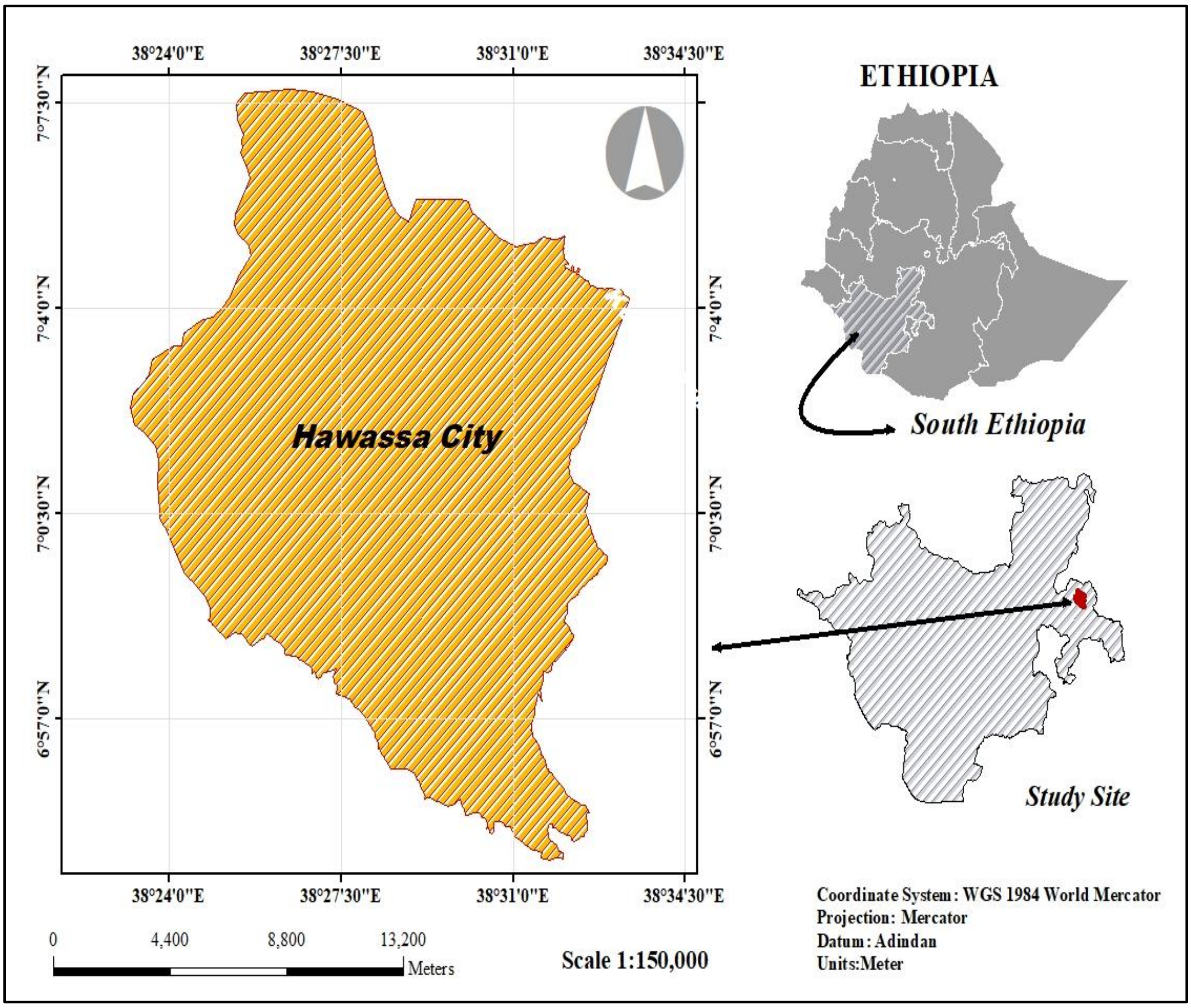



Figure 4.1 Location map of study area**.** Source: US Geological Survey (USGS) (http://glovis.usgs.gov).

### 4.2.2. Research design

The qualitative approach was utilized to gather detailed, nuanced insights into the data, allowing for a deeper exploration of alternative explanations and perspectives. This method was particularly valuable because it enabled data collection and analysis within the context of real-world social conditions, fostering an in-depth understanding of the phenomena under study. By focusing on the complexities and subtleties of human experience, qualitative research facilitated a comprehensive exploration of the research topic.

On the other hand, a quantitative approach was employed due to its ability to provide clear, structured, and measurable data. This approach allows for the precise definition and specification of variables, making it highly effective for analysing patterns, relationships, and trends in a way that can be systematically quantified (Hoepfl, 1997). The structured nature of quantitative research ensures that data can be analysed statistically, offering a more objective view of the subject matter.

To provide a well-rounded analysis, the researcher adopted a mixed-methods approach, which combined both qualitative and quantitative techniques. This approach allowed for the integration of primary and secondary data sources, enabling a more holistic understanding of the research questions. By combining the strengths of both methods, the researcher was able to present a comprehensive picture of the study's key issues and achieve the specific research objectives. This mixed-methods design not only enriched the depth of the findings but also ensured that the study was grounded in both the qualitative richness of social realities and the statistical rigor of numerical data.

**4.2.3. Data sources**

This study employed both primary and secondary sources to gather a comprehensive range of quantitative and qualitative data. The primary data were primarily sourced from household heads of displaced farmers, who provided valuable firsthand insights into the impacts of displacement. Key informants, including government officials from the municipal administration and other relevant municipal staff, also played a crucial role in offering expert perspectives on urban expansion and its effects on local communities. Their input helped to contextualize the experiences of displaced farmers within broader policy and administrative frameworks.

In addition to individual interviews, group discussions were held as part of the data verification process. These discussions were designed to cross-check and validate the information gathered through the questionnaires, ensuring the reliability and accuracy of the findings. By involving a range of stakeholders—such as displaced farmers, government officials, and other community members the study was able to triangulate data from multiple sources, enhancing the robustness of the conclusions. This mixed approach of using both individual and group-based data collection methods allowed for a more nuanced understanding of the complexities surrounding the displacement and its socio-economic consequences.

### 4.2.4. Data collection

**Survey**

A structured questionnaire was distributed to participants, enabling them to provide detailed responses to a series of carefully designed questions. This method allowed the respondents to offer valuable and relevant information necessary for the study's objectives. To encourage a broader range of responses and ensure a more diverse sample, the questionnaire included multiple-choice questions, allowing participants to select from a set of predefined options. This approach not only made the survey process more efficient but also helped to capture a wider variety of perspectives, which in turn expanded the sample size.

By offering respondents the flexibility to choose from a range of options, the study was able to gather more comprehensive data, enhancing the richness of the information collected. The larger sample size resulting from this approach also contributed to the reliability of the findings, providing a more accurate representation of the views and experiences of the target population. Ultimately, this design helped to increase the depth and relevance of the data, which was crucial for addressing the research questions effectively.

**Key informant**

A field study was carried out to directly observe the physical and socio-economic dynamics shaping the rapid urban growth and its effects on urban life. To complement the data collected through other methods, the researcher conducted detailed observations in the study area. These observations were guided by a set of structured checklists, which helped ensure that key aspects of the urban expansion process and its impact were systematically captured.

The researcher focused on several key locations within the peri-urban area, including residential homes, farms, and surrounding environments where the respondents lived and worked. These areas were selected to provide a comprehensive view of how the growth of the City is influencing both the physical landscape and the socio-economic conditions of the local communities. Observations were made in and around the respondents' homes and farms to better understand the changes occurring in their daily lives, livelihoods, and overall well-being due to the pressures of urbanization.

By combining observational data with other forms of data collection, such as interviews and questionnaires, the study was able to provide a richer, more contextualized understanding of the complex effects of urban growth. The field observations allowed the researcher to capture real-time, on-the-ground changes that might not be fully reflected through surveys or secondary data alone, adding depth and authenticity to the study's findings

**Focus group discussion**

Focus group discussion is a qualitative research method that involves a structured, interactive conversation among a group of participants, typically guided by a facilitator. This technique is designed to gather rich, in-depth insights and perspectives on a specific topic or issue. During the discussion, participants are encouraged to share their thoughts, experiences, and opinions in a collaborative setting, which allows for the exploration of diverse viewpoints and the emergence of nuanced understandings.

The primary goal of a focus group is to capture the collective views of a group, often highlighting common themes, differences, and key issues related to the research question. Unlike individual interviews, focus groups provide an opportunity for participants to engage with one another, discuss their opinions, and respond to each other's ideas. This dynamic exchange can lead to deeper insights, as participants may build on or challenge each other's responses, helping to uncover underlying attitudes, beliefs, and social dynamics.

Focus group discussions are particularly valuable for exploring complex, subjective topics, where the researcher is seeking to understand not just individual perspectives but also the social context in which these views are formed. The method is often used to gain a deeper understanding of people's motivations, perceptions, and behaviour’s, making it an essential tool in qualitative research. Additionally, the group setting can encourage participants to express themselves more freely, as they feel part of a collective conversation, making the data gathered richer and more contextualized.

### 4.3 Samples size determination

The study area was deliberately selected based on the researcher's conviction that it offered a wealth of data and information from various sources, providing a comprehensive understanding of the severity of the issue being studied. The City is divided into eight sub-City administrations, encompassing a total of 32 kebeles (neighborhoods). For the purposes of this study, five kebeles located in peri-urban areas were specifically chosen: Alammura, Dato, Tulla-Rural, Guwe-Stadium, and Millennium-Adeboye. These areas were selected because they are representative of the urban expansion pressures and challenges that are central to the research topic.

From the 11,711 households across these five kebeles, a sample of 317 households was selected. This sample size was determined using a calculation method proposed by Kothari (2004). The researcher used a simple random sampling technique to select the households, ensuring that each household had an equal chance of being included in the study. To gather data, every selected household was interviewed, providing first-hand insights into the research topic.

A semi-structured questionnaire was developed for the interviews, allowing flexibility in the data collection process while ensuring that all relevant topics were covered. The questionnaire was pre-tested to ensure its effectiveness in gathering the necessary information. To achieve statistically reliable results, the study used a 95% confidence level, which is considered the standard for social research of this nature.

The population in the study area is relatively homogeneous, with similar economic activities, income levels, education levels, and infrastructure. This characteristic made the sampling process more straightforward, as the sample was representative of the overall population. The sample size was calculated based on the research design, desired confidence level, and the degree of accuracy required. The formula used for the sample size calculation, as outlined by Kothari (2004), considers these factors to ensure that the sample adequately reflects the population being studied.

By following this methodological approach, the study was able to gather reliable and relevant data to address the research objectives and provide insights into the impact of urban expansion on the peri-urban population. The calculated sample size, random sampling method, and structured data collection process all contributed to the rigor and validity of the study's findings.

$$\frac{z^2 x p x q x N}{e^2(N-1)+Z^2 P.q} \mathbf{n} = \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where: n = stands for estimated sample size

e = the acceptable error (0.05)

N = number of population under the study (11,711)

p = sample proportion of successes (0.5)

q = 1 – p=0.5

z = standard confidence level (1.96). (It is for a 95 % confidence level.

As we have not been given the P value as the proportion of defectives in the universe, let us assume it to be P = 0.5. If there is no prior information about P available to obtain a conservative estimate of the required sample size, we use p=q= 0.5. The researcher used a 95 % confidence level and, the corresponding standard normal. Deviate z=1.96, and the desired level of significance e=0.05. Thus, p=0.5 and q=1-p=1-0.5=0.5. Assuming confidence level 95 %; N=2452; e = 0.05; z=1.96; p = 0.5 and q = 1-0.5=0.5.

We obtain the following formula provided by (Kothari, 2004).

$$n = \frac{Z^2 \times p \times q \times N}{e^2(N-1) + Z^2 \times Pq}$$

$$\frac{(1.96) \times 0.5 \times 0.5 \qquad 11{,}711}{(0.05)^2(13{,}713 - 1) + (1.96) \times 0.5 * 0.5} = \frac{11{,}711}{35.27} = 332$$

As stated above, the sample size of 332 households was selected proportionally from each kebele's. Therefore, the sample was arrived at by first selecting a random starting point and then picking up every" K" on an element in the population among households of each independent Kebele's sampling frame.

As show Table 4.1 out of the 332 intended respondent from questionnaires sampled size were distributed and addressed,317 (95.5%( of them filled out questionnaires properly and returned.

**Table 4.1 Distribution of Sample Households among the Selected Kebeles**

| S.N | Name of Kebele | Total Household | Sample Household |
|---|---|---|---|
| 1 | Alammura | 2500 | (2500*317/11,711) =**67** |
| 2 | Dato | 2000 | (2000*317/11,711) **=54** |
| 3 | Tulla-rural | 1800 | (1800*317/11,711) =**49** |
| 4 | Millennium-adebeye | 2650 | (2650*317/11,711) **=72** |
| 5 | Guwe-stadiun | 2761 | (2761*317/11,711) =**75** |
| **Total** | | 11,711 | **317** |

**Source: Hawassa City Municipality (2020)**

### 4.4 Method of data analysis

Data processing is a crucial step in the research process, involving a series of tasks aimed at organizing and preparing the data for analysis. These tasks include editing, coding, data entry, cleaning, and consistency checks, all of which ensure the accuracy and reliability of the data before analysis. In this study, the investigator was responsible for overseeing and carrying out each of these tasks. The data processing workflow was designed to ensure that the collected data were properly structured and ready for in-depth analysis.

For the analysis, the study employed descriptive statistics to summarize and present the key findings. Measures such as the mean, frequency, and percentages were used to describe the patterns and trends observed in the data. Additionally, remote sensing images from Landsat 5, 7, and 8, sourced from the United States Geological Survey (USGS), were utilized to examine changes in land use and urban growth over time. These satellite images provided visual insights into the extent of urbanization and its impact on the surrounding areas.

The study also employed statistical tests to assess the relationships between various variables and to identify significant socio-economic forces driving urban growth. Specifically, the Chi-square test was used to examine the statistical significance of dummy (binary) and discrete variables. This test helped determine whether there were meaningful associations between different socio-economic factors and urban expansion, allowing the researcher to explore how these factors influence the growth of the City.

In addition to descriptive statistics and Chi-square analysis, the study incorporated discrete regression models to further analyze the impact of urban growth. Discrete regression models are used when the dependent variable takes on discrete values, such as categories or counts, rather than continuous values. These models were used to identify the main socio-economic forces driving urban growth and to assess the efficiency of variables associated with urban expansion. By applying these analytical techniques, the study was able to gain a deeper understanding of the dynamics of urban growth and its socio-economic implications.

The simplest of these models is the one in which the dependent variable Y is binary (it can take only two values denoted 0 and 1), as described by Amemiya (1981), Gujarati (2002), and Maddala (1998). The fundamental problem with the linear probability model is that it is not logically very attractive because it assumes that the marginal or incremental effect of the explanatory variables remains constant, i.e. Pi = E (Y = 1/X) increases in line with X (Maddala, 1998); Gujarati, 2002). The shortcomings of the linear probability model suggested that there was a need for an appropriate model in which the relationship between the probability of an event and the explanatory variables is non-linear (Amemiya, 1981; Madalla, 1998; Gujarati, 2002). The same authors suggest that the sigmoid or S-shaped curve, which closely resembles the cumulative distribution functions (CDF) of random variables, be used to model regressions where the response variable is dichotomous, taking values from 0 to 1. To explain the behavior of dichotomous dependent variables, we need to use an appropriately chosen cumulative distribution function (CDF).

The dependent variable is the standard of living of farm families displaced from the surrounding area due to urban expansion. The independent variables are age, gender, family size, farm size, education, income, TLU, occupation, wage compensation, and land, use dynamics, socio-economic activities, culture, environmental changes, and social status about expropriation. Since the dependent variable for this purpose is the standard of living of farming families displaced from surrounding areas due to urban expansion, which is dichotomous and takes the value 0 if it is a family before displacement due to urban expansion and 1 if it is after displacement, a binary probit model will be used (Gujarati, 2002).

### 4.4.1 Model Specification

The logit model (Griffiths et al., 1993; Gujarati, 2009) is employed in this study to analyze how various socio-economic factors influence the likelihood of peri-urban farmers being displaced due to urban expansion. The logit model is particularly useful when the dependent variable is binary, meaning it takes on one of two possible outcomes. In this case, the binary response variable represents the probability that peri-urban development leads to farmer displacement. A value of "1" indicates that urban expansion has resulted in farmer displacement, while a value of "0" denotes that there was no urban expansion prior to the displacement of farmers.

This binary nature of the dependent variable makes the logit model an appropriate tool for studying the factors that affect the likelihood of displacement due to urban growth. By using this model, the study is able to estimate the relationship between various independent socio-economic factors (such as income levels, education, land ownership, and access to resources) and the probability of a farmer being displaced by urbanization.

Before estimating the model, a test for multicollinearity among the explanatory variables was conducted using the Variance Inflation Factor (VIF). In the context of the binary logit function analysis, some correlation between explanatory variables was anticipated, particularly since collinearity among levels of participatory variables has long been recognized as a persistent issue. As such, problems of multicollinearity are often considered inherent to these types of models. Nevertheless, it has been argued by some researchers, including Gujarati (1995), that multicollinearity may not necessarily pose a significant problem unless it reaches very high levels. In this analysis, the VIF values for all the variables included in the model were found to be consistently low, all well below the threshold of 10, suggesting that there was no substantial multicollinearity problem present among the explanatory variables.

Additionally, to check for heteroscedasticity (the presence of non-constant variance of the error terms), the Breusch-Pagan test was applied. The result of this test indicated that heteroscedasticity was not a concern in the models, as the p-value (0.145) was well above the commonly used significance level of 0.05. This suggests that the error terms of the model exhibit constant variance, supporting the assumption of homoscedasticity.

Furthermore, to ensure that no important variables were omitted from the models, the Ramsey RESET test was employed. The results of the RESET test showed no evidence of omitted variable bias, with a p-value of 0.21, indicating that the model did not suffer from a lack of relevant variables.

To further understand the relationship between demographic and economic factors and compliance with urban land use planning guidelines, Chi-square tests of independence were used. The analysis revealed that several demographic and economic variables significantly influenced compliance. These factors included income, ethnicity, the development of a site plan, and occupation.

For each of these variables, the Chi-square statistic, degrees of freedom (df), and significance level (p-value) were reported, confirming the existence of statistically significant relationships between these demographic and economic factors and compliance with urban land use regulations. These findings suggest that targeting these specific factors could be a useful approach for improving compliance with land use planning guidelines in urban settings.

Overall, the analysis not only provides insights into the significant factors influencing compliance but also ensures that the model used is robust, with no significant issues of multicollinearity, heteroscedasticity, or omitted variables

The logit model predicts the probability of an event occurring (in this case, displacement due to urban expansion) as a function of the socio-economic variables that are hypothesized to influence the outcome. The function for the logit model is typically expressed as a logistic function, which transforms a linear combination of the independent variables into a probability value between 0 and 1. Mathematically, this can be represented as follows (Equation 2):

$i = In\ (\frac{pi}{1-pi}) = \beta 0 + \beta 1 X 1 + \cdots \pm \beta i X i$……………………………………….....………………......(2)

The cumulative logistic distribution function is as follows:

Pi = E(Y = 1 |X i) $= \frac{1}{1+e^{-(\beta 0+\beta 1 Xi \ldots\ldots\ldots+\beta i Xi}} = \frac{e^{-zi}}{1+e^{-zi}}$…………………………………..……....(3)

Where Li is the logit, which is the natural log of the odds ratio, Pi is the probability that a farmer will sell his/her land for non-agricultural use, 1 − Pi is the probability that farmer displacement with value of 1(Yes) or there is no urban expansion before farmer displacement 0 (No). In general, the model can be βi is the ith parameter of the model to be estimated, zi = β0 + β1X1 +…… + βiXi. The specific model form for the econometric analysis is given by Li=In $(\frac{pi}{1-pi})$ =β0+β1SEXi+β2AGEi+β3FAMSIZEi+ β4FLANSIi+β5EDUi + β6COMPONSi + β7INCOMEi+β8TLUi + β9OCCUPIi+ β10SOCRSHIi + µi…………………………………………………………………………(4)

Where:-

Y = dependent variable

$X_1 \ldots X_n$ = independent variables

$\beta_o$ = Intercept

$\beta_1 \ldots . \beta_n$= Coefficient of independent variables ; and $e_i$= error term

Given that the data collected for this study is at the individual level, the method of maximum likelihood estimation (MLE) was employed to estimate the model parameters. MLE is a commonly used technique in statistical analysis, particularly for models involving binary or discrete outcomes, as it allows for the estimation of model parameters that maximize the likelihood of observing the given data (Aldrich et al., 1984; De Maris, 1992). This approach is particularly suitable for our study, as we are dealing with a binary dependent variable (whether urban expansion leads to displacement or not) and several independent variables that may influence this outcome.

In the logit model used in this study, the independent variables represent socio-economic characteristics that are hypothesized to affect the likelihood of displacement due to urban growth. These variables include both discrete (categorical) and binary factors, and they capture key demographic, economic, and social aspects of the respondents' lives. The specific independent variables included in the model.

Table 4.2 List of factors (variables) included in the logistic regression model

| **Variables Code** | **Nature of Variables** | **Definitions of variables** | Meaning | **expected sign** |
|---|---|---|---|---|
| Dependent (Y) | Dichotomous | no urban expansion and urban expansion | 0 and 1 | **(-/+)** |
| X1 (SEX) | Dummy | Sex of households | 1 and 0 | (-) |
| X2 (AGE) | Continuous | Age of households | Years | (+) |
| X3 (FAMSIZE) | Continuous | Family size of households | Scale | (+) |
| X4 (FLANSI) | Categorical | Farm land size | Hectare | (+) |
| X5 (EDUC) | Continuous | Education of households | Continues | (+) |
| X6 (COMPONS) | Continues | Compensation paid | Birr | (+) |
| X7 (INCOME) | Continuous | Income | Birr | (+) |
| X8 (TLU) | Continuous | Tropical livestock unit | TLU | (+) |
| X9 (OCCUPI) | Categorical | Occupation of respondents | Categorical | (+) |
| X10 (SOCRSHI) | Categorical | Social relationship | Categorical | (+) |

### 4.4.2. Description of variables

In the literature, peri-urban areas are commonly defined by the PLUREL project as regions characterized by discontinuous built-up development, which includes settlements with fewer than 20,000 inhabitants and an average population density of around 40 people per square kilometer (Ravetz et al., 2012; Friedberger, 2000). In his work, The Rural-Urban Suburb in Late 20th Century America, Friedberger further describes rural-urban suburbs as areas located approximately 10 to 15 miles from the central core of the largest cities. However, accurately determining the precise boundaries of urban areas can be challenging. According to Simon et al. (2012) and other researchers, a 30–50 km radius from the urban center is often considered a reasonable estimate for the extent of peri-urban zones around major cities.

In the context of this study, the independent variables are household characteristics that account for differences between individual households and their observable attributes. These variables include gender, age, marital status, education level, family size, family income sources, and income level. These factors help control for the diversity within the sample and capture the socio-economic conditions that may influence how households are impacted by urban expansion.

The dependent variable in this urban expansion model is the occurrence of farmer displacement due to urban growth, which is analyzed using logistic regression. The binary outcome is coded as Y = 1 when urban development leads to the displacement of farmers, and Y = 0 when there is no urban expansion prior to displacement. This binary classification allows for the investigation of the relationship between socio-economic factors and the likelihood of displacement, as explored in previous studies by Osman et al. (2016).

By using logistic regression, the study can assess how different household characteristics contribute to the probability of displacement, shedding light on the socio-economic drivers of urban expansion and its effects on peri-urban farmers

### 4.4.3 Satellite image and GIS data collection

Field data on the current land cover types, historical land use/land cover change (LULCC) trends, and potential drivers of these changes in the study area were collected using a series of Landsat satellite images. These images were obtained from various Landsat missions over multiple years, including Landsat 5 TM (1990), Landsat 7 ETM (2000), Landsat 5 TM (2010), and Landsat 8 OLI (2020). The selection of Landsat 5 through 8 was based on the availability of satellite data for these time periods.

To minimize the effects of cloud cover and seasonal variations on the classification results, the researcher aimed to use satellite images taken during the same time of year specifically the dry season, which typically spans from November to February in Hawassa. This period is characterized by relatively clear skies and minimal cloud cover, making it ideal for obtaining consistent and accurate imagery. The dry season also corresponds to a time when the Earth's surface experiences less seasonal variation, further improving the reliability of the satellite data.

Landsat imagery was chosen for this study over other multispectral datasets, such as point images, for several key reasons. As Campbell and Wynne (2011) note, Landsat images offer several advantages, including their free availability, the inclusion of mid-infrared bands that are essential for detecting changes in land cover, and the long history of Earth observation data provided by the Landsat program. These images are also widely used in land use/land cover change (LULCC) analysis due to their consistency and the ability to access long-term time-series data, which is crucial for monitoring trends over extended periods. Additionally, the use of Landsat data facilitates legal data exchange between ministries and donor organizations, making it an accessible and reliable source for environmental monitoring and land use analysis.

Table 4.3 provides further details on the specific Landsat data used in the study, highlighting the timeframes and relevant satellite bands that were utilized to assess land cover changes in the region.

Table 4.3 Description of satellite data

| Satellite type | Sensor ID | Wave length interval | Spatial Resolution | Path/Row | Acquisition Date |
|---|---|---|---|---|---|
| Landsat 5 | TM | 0.45µm – 2.35µm | 30m*30m | 168/055 | 18, 12, 1990 |
| Landsat 7 | ETM | 0.45µm – 2.35µm | 30m*30m | 168/055 | 28, 01, 2000 |
| Landsat 5 | TM | 0.45µm – 2.35µm | 30m*30m | 168/055 | 07, 11, 2010 |
| Landsat 8 | OLI & SWIR | 0.43µm - 1.38µm | 30m*30m | 168/055 | 19, 01, 2020 |

Source: US Geological Survey (USGS) (http://glovis.usgs.gov)

To achieve the study's objectives, land use maps for three periods were required. This study utilized multispectral satellite images from the U.S. Geological Survey (USGS) for the years 1990, 2000, 2010, and 2020.

All the images were free from cloud effects. The Landsat images acquired from USGS were L5, and L8 which were already geometrically and orthometrically corrected (USGS, 2014). The pre-processing of the Landsat imagery applied in this study includes a) conversion of the Digital Number (DV) values of the image to the top of atmosphere reflectance with atmospheric correction according to the procedure in ERDAS IMAGINE software. All image processing, classification, and GIS analyses have been done using ERDAS Imagine, ENVI, and ArcGIS desktop software.

In analyzing the data, both qualitative and quantitative data would be employed depending on the nature of the data. The quantitative data would be analyzed and interpreted by using descriptive statistics such as frequency, mean, Standard deviation, percentage, table, and figures were computed to analyze the collected data. Whereas, text narration was employed to evaluate the qualitative data. Using descriptive statistics it was also possible to compare and contrast different characteristics of the sample households along with the econometric model.

**4.5 Satellite image classification**

The process of image classification involves analyzing the spectral characteristics of different elements within the study area. The spectral properties of each pixel in the dataset are compared numerically with predefined categories, allowing each pixel to be classified and labeled according to the corresponding land use/land cover (LULC) type. This technique was applied to extract thematic information from the satellite images. To detect changes in land cover over time, the study relied on thematic maps from different years, leveraging both quantitative data and local knowledge about the area.

To ensure accurate LULC detection, reference data were used, including Global Positioning System (GPS) data to verify the current land cover, Google Earth images, and aerial photographs from previous years to support the classification process. These reference sources were essential for verifying the accuracy of the classifications and for comparing land cover across different periods.

The analysis of LULC changes was conducted through both quantitative methods (to assess the extent of land cover change) and qualitative methods (to examine the underlying drivers of these changes). The study specifically focused on the periods of 1990 and 2020 to observe and analyze significant shifts in land use, with the selection of these years based on the availability of data and the relevance of these timeframes to the study area's development. The study also considered current trends in the area to identify ongoing patterns of urbanization and land use.

For data processing and analysis, QGIS version 3.2 and ArcGIS 10.3 software were utilized. These tools were used for various tasks, including image preprocessing, image classification, accuracy assessment, and the creation of a change map. The preprocessing step involved correcting and preparing the images for classification, while the classification process itself categorized the land cover types. Accuracy assessments ensured that the classification results were reliable, and the change map visually represented the differences in land cover between the selected periods.

### 4.6 Supervised classification method

The satellite images from different years were classified using the supervised classification method to identify the various land cover types in Hawassa City. Specifically, the maximum likelihood classifier was employed to classify the images and generate base maps for detecting land cover changes (Chipman et al., 2004). Supervised classification was selected because it allows for the categorization of land uses based on predefined training sites, which are manually selected by the classifier. These training sites are used to teach the classification algorithm how to identify different land cover types. For each image, the classification process was carried out using reference data to ensure accurate classification based on the distinct characteristics of each land cover type. This method helps improve the precision of the land cover classification by incorporating ground truth data and expert knowledge about the study area.

### 4.7 Change Detection

The successful application of remote sensing for detecting land use change heavily relies on a thorough understanding of both the study area and the satellite imaging system, as well as familiarity with various land cover extraction techniques. Such knowledge is essential for accurately identifying and analyzing changes in land use, which is the primary objective of this study (Yang and Lo, 2002). In change detection analysis, remote sensing data plays a crucial role in tracking alterations in land use over time by providing consistent, high-resolution imagery that captures shifts in the landscape (Singh, 1989).

Following the initial image classification, post-classification change detection is carried out to assess the transitions in land cover. This involves comparing classified images from different time periods to identify specific changes in land use. The analysis is typically framed in terms of “from-to” change detection, which identifies which land cover types have been converted to others over time. For example, it could show how agricultural land has been transformed into urban areas, or how forests have been cleared for development. This approach was further evaluated and refined by Macleod and Congalton (1998), who emphasized the importance of comparing the classified images to accurately detect and quantify land use changes. By examining these "from-to" changes, the study can better understand the dynamics of land use transformation and provide insights into the underlying processes driving urban expansion in the region.

Finally, the table matrix was created, which contains general information about the change matrix during the study periods from 1990 to 2020. The variables total area (TA), changed area (CA), the extent of change (KE), and annual rate of change. (CR) were used to determine the magnitude of change in terms of LULC. The variables were calculated as follows (Addis, 2010; Abate and Anassa, 2016).

$$CA= TA(t_2) - TA(t_1)$$

$$CE= (CA/TA(t_1))* 100$$

The Maximum Likelihood Classifier was employed to classify the Landsat data from multiple years, including Landsat 5 TM (1990, 2000, 2010), Landsat 8 OLI, and SWIR data for 2020. This classification process generated a thematic map illustrating the spatial distribution of seven major land use/land cover (LULC) categories across the study area. The classification was based on the spectral characteristics of the satellite images, and the seven LULC categories represent the predominant land cover types in the region during these specific years.

To support the analysis, ArcGIS software was used along with its spatial analysis tools to delineate the boundary of the study area and accurately assess the spatial distribution of the different land cover types. These tools allowed for the precise mapping of LULC changes over time and facilitated the identification of patterns and trends within the study area.

Additionally, the study explored the linear relationships between various variables to understand how different factors might influence land use changes. These relationships help to provide a more comprehensive understanding of the drivers behind urbanization and land transformation in the region.

The detailed methodology employed in this study, including the steps taken for data classification, analysis, and interpretation, is illustrated in Figure 4.2, which provides a visual summary of the processes used to achieve the research objectives. This methodology integrates remote sensing data, GIS tools, and statistical analysis to detect and analyze land use changes over the selected time periods.

$$CA = TA(t_2) - TA(t_1)$$

$$CE = (CA/TA(t_1)) * 100$$

$$CR = CE/(t_2 - t_1)$$

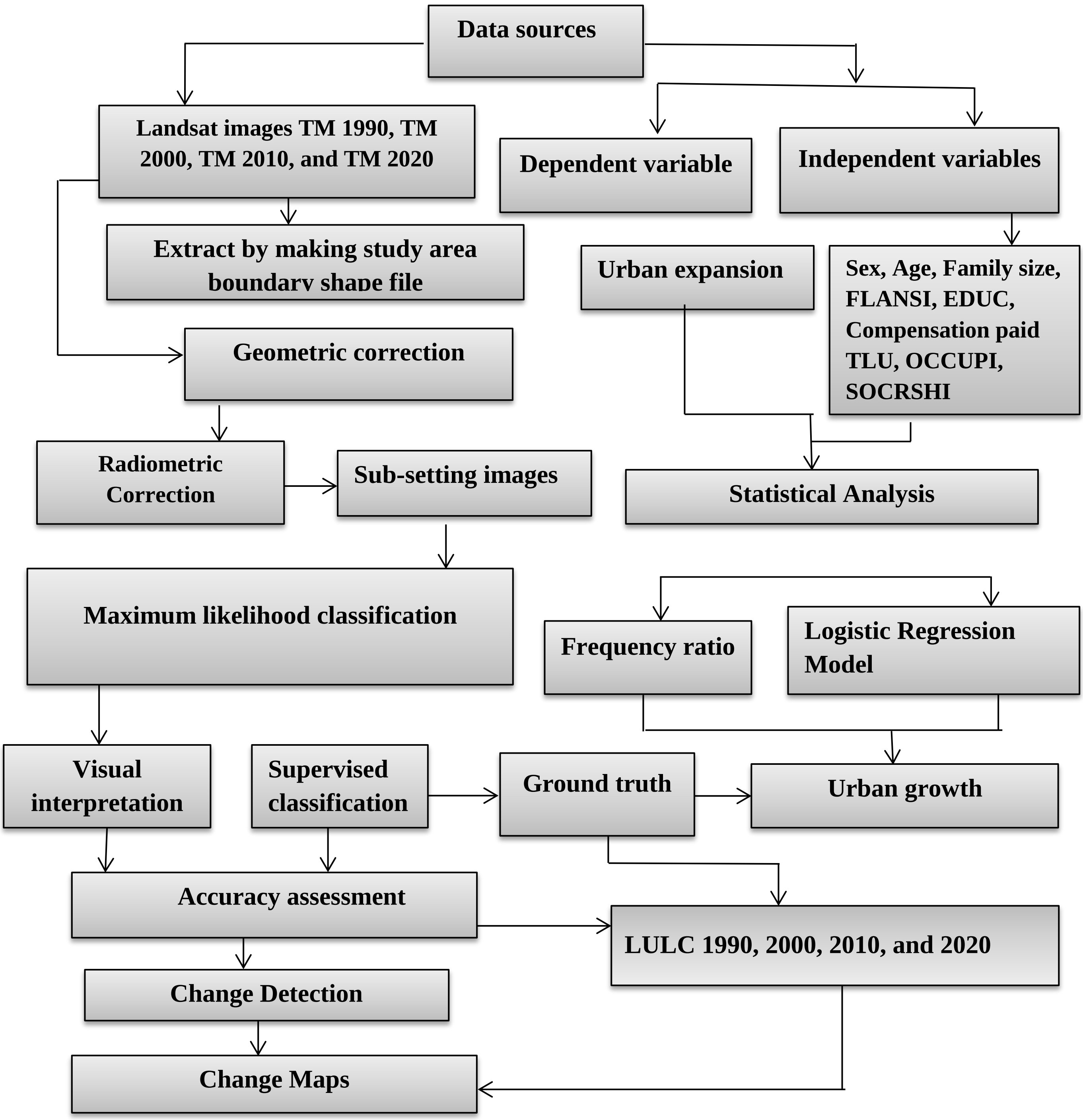



Figure 4.2 Flow chart showing methods of land use/land cover change detection

## 4.8 Results

This section outlines the key findings of the study regarding the effects of urban expansion on the livelihoods of farmers living in the surrounding peri-urban areas. The results presented here aim to fulfill the primary objective of the research, which is to examine the socioeconomic consequences of urbanization on the farmers residing on the outskirts of urban areas. Specifically, the study focuses on comparing the livelihood patterns of these farmers before and after they were displaced by urban growth. By analyzing these shifts, the research seeks to better understand how urban sprawl impacts agricultural communities and their ability to sustain their livelihoods.

In addition, the study explores the coping mechanisms that displaced farmers have developed in response to the loss of land and agricultural opportunities. It looks at how these households have adapted to new economic realities, identifying strategies they have employed to secure alternative sources of income. This chapter provides a comprehensive view of the challenges faced by peri-urban farmers due to urban expansion and highlights the resilience and adaptive capa City of the affected communities as they navigate the changes brought about by rapid urban growth.

### 4.8.1 Socioeconomic impact of urban expansion

To evaluate both the positive and negative impacts of urban expansion, as well as to identify the key factors driving these changes, peri-urban farmers were surveyed about how the City's growth has affected their families' quality of life and the surrounding community. A three-point Likert scale ranging from Low (0), Moderate (1), to High (2) was used to collect descriptive statistics, including mean and standard deviation values. According to this scale, a mean score between 0 and 1.5 is considered low, 1.5 to 2.5 is considered average, and scores above 2.5 are classified as high

As shown in Table 4, the majority of respondents' 171 individuals (55.7%) rated the rate of City expansion as high, while 143 respondents (45.1%) considered it moderate. Only 3 respondents (1.1%) viewed the expansion as low. The mean score for this item was 2.55, with a standard deviation of 0.522, suggesting a strong consensus among participants regarding the rapid pace of Hawassa City's expansion into the surrounding rural Kebele areas

The findings also reveal concerns about the management of this urban growth. Respondents noted that the expansion of Hawassa City is not being effectively regulated by the relevant authorities. Specifically, urban land is being taken from peripheral communities without adequate consideration for the proper implementation of land use regulations. There is a clear call for respecting and enforcing urban land policies, including the establishment of fair compensation systems for those losing their land. Without such measures, urban land is not being fully utilized or managed in a way that benefits the affected communities.

To address these issues, it is critical to allocate sufficient funding and human resources to ensure that the communities at risk of losing their land are properly identified and supported. Strengthening the restoration policies surrounding urban land management in Hawassa City is necessary for mitigating the adverse effects of urban expansion. Moreover, effective urban land use requires the active participation of all relevant stakeholders within the City's administration. This collaboration is essential for the successful integration of urban expansion and the needs of the surrounding population.

Further research into the sustainable and modern use of urban land, as well as the adherence to existing urban land expansion rules and regulations, would be beneficial. By ensuring that urban growth is managed in line with legal frameworks and offering adequate compensation to those displaced by expansion, the City can promote more efficient land use. This approach would not only improve the economic and productive conditions of the City but also enhance the social well-being of the urban population.

The current study highlights the significant impact of urban growth on the socioeconomic dynamics of the surrounding neighborhoods. This aligns with findings from Dociu and Dunarintu (2012), which argued that urbanization fundamentally, transforms regions through various factors, including the intensification of land use and the development of infrastructure. As urban areas expand, they bring people into closer contact with established labor markets, leading to shifts in employment patterns and a realignment of skills to meet the needs of the growing urban economy. This process also affects the local population's ability to earn income, thereby influencing their overall quality of life.

Additionally, changes in fertility rates have been observed in areas affected by urban expansion. As the socio-economic landscape shifts, demographic patterns, including birth rates, may adjust in response to the new economic conditions and lifestyle changes brought about by urbanization.

#### 4.8.2. The housing challenge and Hawassa Industrial Park

As part of the Ethiopian government's Growth and Transformation Plan II (GTP II), the country has been actively developing industrial parks in Addis Ababa and other regional cities. These parks, primarily focused on the textile and garment industries, are being managed and coordinated by the Industrial Parks Development Corporation (IPDC). The Hawassa Industrial Park (HIP), which commenced operations in 2016, was the first of its kind. Currently, HIP employs around 20,000 workers, along with an additional 2,000 indirect workers. The plan is to expand this workforce to 40,000 direct employees by the end of 2020 and to reach a peak of 84,000 workers by 2025.

According to the HIP Tenants Association, the workforce comprises various categories. Approximately 16,000 of the workers are basic operators, while 3,000 are mid-level technical and managerial staff from Ethiopia. The remaining 1,000 are expatriate staff, primarily in technical and managerial positions. This distribution is expected to change in the coming years, with the proportion of expatriates declining, although the total number of workers is likely to continue increasing. The vast majority of operators are young women, aged between 18 and 30, who have migrated to Hawassa City from rural areas in search of employment. These women typically do not bring dependent family members with them. The mid-level Ethiopian staffs are predominantly young male university graduates. By 2025, the workforce at HIP is projected to quadruple, reaching 84,000 workers. Such rapid growth is expected to place significant pressure on Hawassa City, particularly in terms of housing availability, and will require the City and industrial park management to address the emerging housing crisis (Figure 4.3).

One of the major challenges in Hawassa City is the affordability of urban land. The limited availability of land, combined with the urban land lease policy, has made it difficult for many residents, especially those from lower-income households, to access land at affordable prices. The existing land lease law is structured in a way that favors higher-income groups, making it more accessible to wealthier individuals while excluding those from middle- and lower-income brackets. This disparity in access to land is further exacerbated by the fact that many in these lower-income groups resort to purchasing land illegally in peri-urban areas, where prices are more affordable than formal land leases (Ling et al., 2018).

Research from the World Bank (2019) and Adamu (2014) has highlighted the shortcomings in the management of urban land. These studies point to issues such as corruption, lack of transparency, and inefficiencies in land allocation processes. Despite efforts by the municipality to address these challenges, including public announcements encouraging wider participation in open lease competitions, the system remains skewed in favor of wealthier individuals. High-income groups tend to dominate these land lease opportunities, outbidding others and driving up prices beyond the initial allotment. As a result, the wealthiest individuals and privileged groups often secure access to urban land, while middle- and lower-income residents are left at a disadvantage.

The growing demand for land due to rapid urban expansion, alongside these inefficiencies in land distribution, highlights the urgent need for reforms in the land lease system. There is a clear need for a more inclusive, transparent, and equitable approach to land allocation in Hawassa, one that considers the needs of all socioeconomic groups and ensures that urban growth benefits a broader segment of the population.

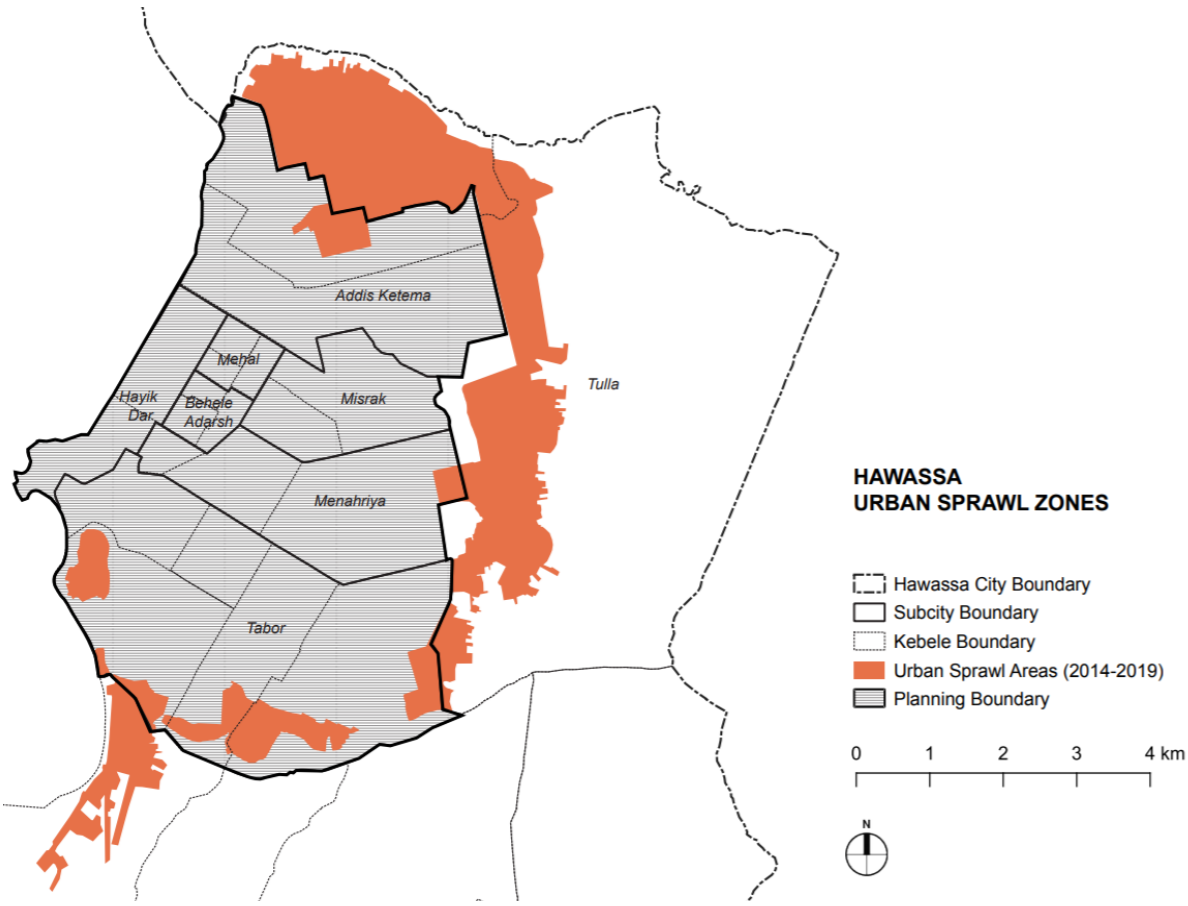



Figure 4.3 Map showing the majority of H.I.P locations within the informal settlements

### 4.8.3. Econometric model analysis

The data collected for this study was entered into STATA version 14 and analyzed using a probit model. Prior to running the model, the explanatory variables were examined for potential issues of multicollinearity and heteroscedasti City to ensure the robustness of the analysis. Specifically, the study checked for multicollinearity, which could distort the estimated relationships between variables. To assess this, two common measures were employed: the Variance Inflation Factor (VIF) for continuous explanatory variables, and the Contingency Coefficient for dummy variables.

The results of the multicollinearity tests showed that the VIF values ranged from 1.116 to 3.755, and the Tolerance index ranged from 0.896 to 0.266. These values suggest that there was no significant issue of multicollinearity among the independent variables in the model. This indicates that the regression coefficients were unlikely to be distorted by correlations between explanatory variables, which are a key assumption for reliable model estimation.

To assess the overall goodness of fit for the model, several criteria were applied. First, it was confirmed that the correlations between the dependent and independent variables were statistically significantly different from zero ($\rho \neq 0$). This confirmed that the probit model was appropriate for the data, as it indicated that the relationship between the dependent and independent variables could be consistently estimated using this model. In fact, the probit model's validity was supported by this finding, as the relationship between the variables could be consistently estimated under the assumption that the error terms are uncorrelated.

However, it is important to note that while the probit model is widely used, it is not always the most efficient approach, as it does not account for potential correlation between the error terms of the underlying stochastic functions (Maddala, 1998; William, 2003). Despite this, the probit model is still considered a valid method for this type of analysis. To ensure the validity of the model, the likelihood ratio (LR) test and the Wald test were conducted. The results of the LR test indicated that the model fit the data well, with the $\chi^2$ (10) statistic = 87, which was significant at a level below 1%. This suggests that the model parameters were statistically significant and that the null hypothesis could be rejected with a high degree of confidence.

The binary probit model was employed in this study to assess the impact of urban expansion on the livelihoods of displaced farmers in the surrounding areas. This statistical model was chosen because it is effective in analyzing the relationship between a binary dependent variable such as whether or not a farmer's livelihood is affected by urban expansion and a set of independent variables that might influence this outcome. Specifically, the model estimated the likelihood of urban expansion both before and after the displacement of farmers, helping to shed light on the specific changes that occur in the farmers' livelihoods as a result of this expansion.

The model incorporated a range of key variables that were identified as being statistically significant. These variables were selected based on their potential to influence the likelihood of urban expansion and its subsequent effects on the displaced farmers. Among the variables considered were factors such as the proximity of the farmers' land to the urbanizing areas, the type of crops or activities previously engaged in by the farmers, the compensation provided to displaced farmers, and the availability of alternative livelihoods. These factors were important in determining how urban expansion influenced farmers' decisions about their future livelihoods, as well as their ability to adapt to the changing environment.

By using the binary probit model, the study was able to quantify the probability of various outcomes, such as whether displaced farmers would remain in agriculture, migrate to urban areas for new opportunities, or shift to non-farming activities. The statistical significance of the identified variables helped to clarify the specific factors that most strongly affected these decisions, offering insights into how urban expansion could be better managed to minimize negative impacts on the livelihoods of displaced farmers.

This approach provided a clear understanding of the underlying dynamics at play and highlighted the complex relationship between urban growth and agricultural livelihoods. The results from the model allowed for the identification of potential policy interventions aimed at mitigating the adverse effects of urban expansion on displaced farmers, ensuring that their needs are taken into account in future urban planning and land use policies.(as presented in Table 4.4).

In addition to the statistical analysis, the study also considered the broader implications of urbanization, particularly in terms of the sustainability of the City and the land use patterns. The relationship between urban land use and the sustainability of the City is not just a matter of proportions or land area. How natural resources, including non-built-up land, are spatially distributed within the City plays a critical role in ensuring equity the fair distribution of the benefits that natural spaces provide to urban residents.

For instance, the environmental benefits of having a single large park in the City differ significantly from the benefits offered by the same total area of green space distributed across multiple smaller parks. A single large park may provide more significant ecological benefits, such as habitat preservation or larger recreational spaces, but it could also limit access for residents who live further away. Conversely, many smaller parks scattered throughout the City can provide more equitable access to green spaces for a wider range of residents, though they may not deliver the same scale of environmental benefits. Therefore, the green infrastructure of Hawassa City cannot simply be a random selection of spaces based on available land. It needs to be planned thoughtfully to ensure that the natural areas are well-distributed and properly integrated into the urban fabric, supporting both the environmental sustainability and the social equity of the City.

Thus, the distribution and management of green spaces are critical for ensuring that all residents can access the benefits provided by these natural areas. Thoughtful planning of green infrastructure in Hawassa City will be essential for balancing urban growth with environmental sustainability and providing equitable access to the resources that contribute to the overall quality of life for all residents.

**Gender**

In the analysis, gender is treated as a dummy variable; with gender differences identified as one of the key factors that may influence a household's livelihood outcomes. Specifically, female-headed households are often expected to have fewer resources and lower capacities to sustain the family’s livelihood. This is due to the historical and social constraints that women face, such as limited access to land, capital, education, and decision-making power, particularly in rural settings. As a result, female-headed households typically have fewer opportunities to improve their livelihood status compared to male-headed households.

**Age**

Age is measured as a categorical variable based on the years of the household head. The age of the household head is expected to have a positive influence on the household's livelihood, as older individuals typically accumulate more knowledge and experience in managing livelihoods, particularly in agricultural settings. As the household head ages, they are likely to develop a deeper understanding of the local environment, the agricultural practices, and the social dynamics that contribute to a sustainable livelihood (Kindane & Kundhlande, 2005). Thus, an older household head is expected to have better decision-making abilities and more effective strategies to maintain or improve the household’s livelihood, contributing positively to the outcome.

**Family Size**

The size of the household plays an important role in determining livelihood outcomes. Larger families often have a higher number of individuals who are able to contribute to income-generating activities, such as farming or household chores. As such, households with more members engaged in economic activities tend to have a positive influence on the likelihood of improving their livelihood status. The involvement of multiple family members in the household's work provides more human resources for income-generating activities, thus increasing the potential for economic improvement. As noted by Dibaba and Goshu (2019), larger families are better positioned to improve their livelihood status due to the collective efforts of household members.

**Farmland Size (FAMSIZE)**

The size of farmland was found to have a significant positive relationship with the livelihoods of displaced farmers in the context of urban expansion. The regression analysis revealed that the amount of land a household owns is an important determinant of its food security and overall livelihood. As expected, households with larger landholdings have a lower probability of experiencing food insecurity compared to those with less farmland. The study indicated that urban expansion leads to a reduction in the available farmland for surrounding farmers, which negatively impacts their livelihoods. The findings suggest that urban encroachment on farmland reduces agricultural productivity and, by extension, the economic stability of farming households. Specifically, the analysis revealed that for every additional hectare of land, the probability of improved livelihoods for displaced farmers increased by 15.61%. This is consistent with previous studies, such as the work of Holden et al. (2020), which highlighted the importance of land size in determining livelihood outcomes.

**Education Level (EDUC)**

Education level is another factor expected to positively influence the livelihood outcomes of displaced farmers. Higher educational attainment equips individuals with better skills, knowledge, and the ability to adapt to new livelihood strategies, which is critical in a rapidly changing socio-economic environment. This study's findings align with previous research by Bezemer and Lerman (2002), which emphasized the importance of human capital in improving livelihood outcomes. Educated individuals are more likely to make informed decisions regarding their livelihood strategies and are better positioned to take advantage of opportunities for employment or income diversification. Therefore, increased levels of education are expected to positively impact the livelihoods of displaced households, improving their economic well-being and food security.

**Compensation (COMPONS)**

Compensation for displaced farmers plays a crucial role in their ability to rebuild their lives after being relocated due to urban expansion. The study found that the compensation amount was negatively associated with the livelihoods of displaced farmers at a 1% probability level. This suggests that although compensation is meant to mitigate the loss of land and property, many displaced farmers do not receive sufficient financial support to sustain their livelihoods. As a result, these farmers often find themselves with inadequate resources to rebuild their lives, especially if the compensation amount is small and does not cover the costs of relocation or creating alternative sources of income. The study also revealed that for every Birr increase in compensation, there was a slight increase in the probability of supporting urban expansion, by 3.91e-06. This implies that higher compensation may improve the perception of the urban expansion program, potentially leading to greater support for urbanization initiatives.

**Total Livestock Unit (TLU)**

Livestock ownership is another key determinant of livelihood outcomes. Livestock, which includes animals such as cows, oxen, goats, sheep, and poultry, is an important asset for rural households, providing both income and a store of wealth. The study found that the loss of livestock due to urban expansion was significantly associated with a decline in household welfare. Approximately 28% of farmers in the study areas owned livestock before their land was expropriated for urban development. The loss of these assets, particularly in the context of urban encroachment, exacerbates food insecurity and economic hardship for displaced farmers. Farmers with more livestock are generally considered wealthier and more resilient to economic shocks. The findings suggest that the loss of livestock assets directly hampers the ability of displaced farmers to maintain or improve their livelihood, underscoring the importance of livestock in rural economies.

**Household Income**

The analysis of household income revealed a significant but negative impact of urban expansion on the livelihoods of displaced farmers, with a 5% probability level. While income from both farm and non-farm sources typically improves livelihood outcomes, the study found that the loss of land and agricultural assets due to urban expansion reduces the overall household income. However, the analysis also indicated that for every unit increase in annual income, there was a 17.46% increase in the likelihood of improved livelihoods for displaced farmers. This result is consistent with findings from Tsegaye and Bekele (2010), who noted that higher income levels enhance the food security and economic resilience of households, which is particularly important for displaced communities facing the challenges of urbanization.

**Occupation (OCCUPI)**

The study found that occupation plays a significant role in shaping the livelihoods of displaced farmers. Occupation was negatively associated with livelihood outcomes, particularly as displaced farmers were forced to shift from agricultural activities to non-agricultural employment due to the loss of farmland. The study revealed that when agricultural livelihood assets are lost and no alternative economic systems are in place, farmers are compelled to seek alternative income sources. Although some farmers diversified into non-farm activities, the income generated from these activities did not fully compensate for the loss of agricultural income. As a result, while occupational diversification may offer short-term relief, it is not always sufficient to replace the income derived from farming. The results showed that most respondents were primarily engaged in farming before urban expansion, but after displacement, they increasingly sought non-farm activities as alternative sources of income. Specifically, the study found that for every 1-unit increase in occupational diversification, the likelihood of farmers shifting from agricultural activities to non-agricultural occupations increased by 17.1%. This underscores the significant impact of urban expansion on the occupational structure and income generation of displaced farmers, as they are forced to adapt to a new economic reality.

Table 4.4 Maximum likelihood Estimation result for the Binary Probit model

| Livelihoods of surrounding displace farmers | Coefficient | St. error | Z-value | P-value | Marginal |
|---|---|---|---|---|---|
| GENDER | -.1413 | .3149 | -0.45 | 0.478 | -0.0554 |
| AGE | 0.0515 | 0.0323 | 1.59 | 0.100 | 0.0202 |
| FAMSIZE | -1.6440 | 0.1477 | 4.36 | 0.741 | 0.2528 |
| FLANSI | 1.6712 | 0.9103 | 1.84 | 0.035** | 0.1561 |
| EDUC | 0.0162 | 0.2740 | 0.06 | 0.425 | .53120 |
| COMPONS | 0.1149 | 0.4266 | 0.03 | 0.009*** | 0.3910 |
| INCOME | -0.5871 | 0.4414 | 1.33 | 0.031** | 0.1746 |
| TLU | 0.1500 | 0.1680 | 3.87 | 0.002*** | 0.288 |
| OCCUPI | .107 | 0.0160 | 0.04 | 0.049** | 0.1714 |
| SOCIAL RELATIONSHIP | .0180287 | .0212 | 0.85 | 0.029 ** | 0.2580 |
| CONSTANT | -15.21207 | 3.1841 | -4.78 | 0.6374 | 0.000 |
| **Number of obs =317, LR chi2(10) = 121.44 ,Prob> $chi^2$ = 0.0000** | | | | | |
| **Pseudo $R^2$ = 0.7160, Log likelihood = 76.963017** | | | | | |
| *****, ** and * indicates 1%, 5% and 10% level of significance respectively** | | | | | |

Source: Own computation from survey data, 2020

### 4.9 Farmland size of displaced farmers

As illustrated in Figure 4.4, the size of farmland held by displaced farmers is a crucial factor influencing their livelihoods. However, due to the limited availability of land in the urban areas, the majority of farmers have relatively small landholdings. Specifically, 132 respondents (41.6%) report owning less than 0.5 hectares of land, making this the most common land size category. A slightly smaller group, 112 respondents (35.3%), have land sizes ranging from 0.5 to 1.5 hectares. Meanwhile, 56 respondents (17.7%) manage land parcels between 1.5 and 2.0 hectares, and only 14 respondents (4.4%) possess land in the 2.0 to 2.5 hectare range. A very small proportion, 3 respondents (1.0%), have landholdings between 2.5 and 3.0 hectares. In total, a significant majority of respondents 244 individuals, or 76.9%—own less than 1.5 hectares of farmland. This trend reflects the challenges faced by displaced farmers in securing larger land plots, particularly in areas where land is scarce and competition for available resources is high. The distribution of land sizes highlights the vulnerability of these farmers, who often rely on small-scale farming to sustain their livelihoods amidst urban expansion.

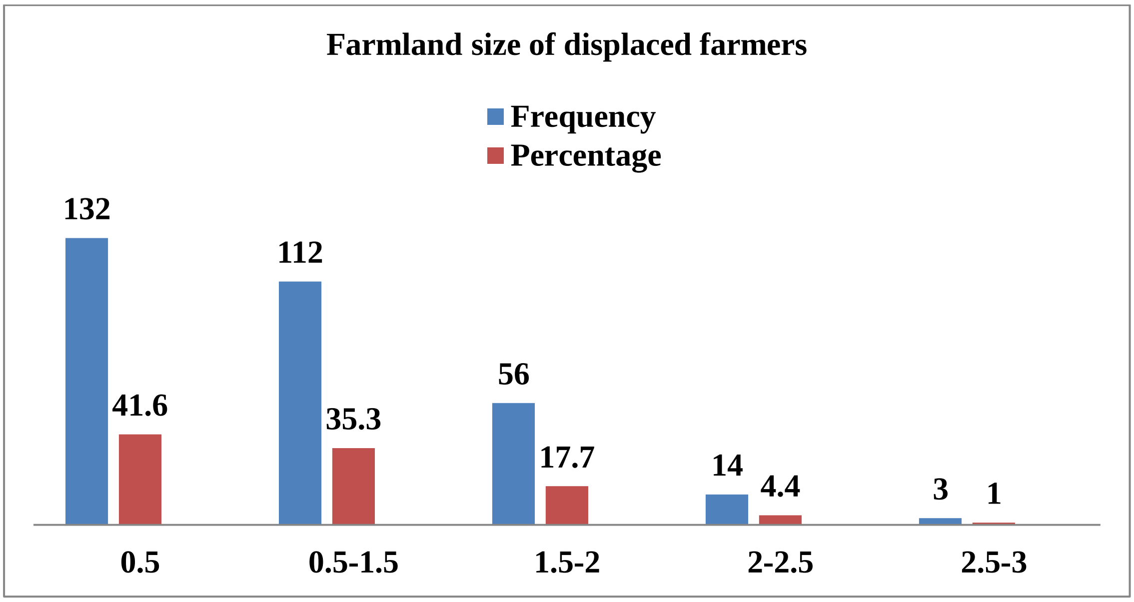



Figure 4.4 Farm land size of displaced farmers Source

Land liquidity, deposit mobilization, and investment linkages are fundamentally tied to the capital value of land and property, which accounts for a substantial portion of a nation's wealth often ranging from half to three-quarters of total assets. This proportion is typically higher in less developed countries, where domestic capital is limited, and land plays a more central role in wealth accumulation. The significance of land and property as assets is not only evident at the national level but also at the individual and family levels, where they frequently represent the largest class of wealth. For this reason, land and property management are crucial to fostering inclusive economic growth, particularly for the bottom 40% of the population, whose per capita income is typically lower. Efficient land registration systems can enhance the collection of property taxes, thereby improving public resource mobilization and contributing to a more equitable distribution of wealth and services (World Bank, 2019).

When land management systems are poorly implemented, a range of negative consequences can emerge. Ineffective land governance fosters land speculation, where investors buy and sell land purely for profit rather than productive use. This practice drives up land prices and contributes to the expansion of informal settlements, such as slums and squatter communities, which often lack basic infrastructure and services. Additionally, poor land management exacerbates environmental degradation, as land use may not be regulated to prevent overexploitation or habitat destruction. Urban development, too, becomes inefficient, as poorly planned growth leads to disorganized cities with inadequate transportation, housing, and public services. As a result, the cost of doing business in these cities rises due to inefficiencies in the infrastructure and regulatory environment.

The lack of effective land management also fuels urban land-related conflicts, where disputes over land ownership, usage rights, and boundaries are common. This may lead to violations of the region's urban development plan or zoning laws, further undermining the ability of cities to grow in a sustainable and organized manner. Moreover, the failure to address these issues can perpetuate a cycle of poverty and inequality, as marginalized communities are disproportionately affected by the lack of access to formal land rights and secure tenure. In sum, the mismanagement of land resources hinders the development of cities and contributes to broader socioeconomic instability (World Bank, 2019).

### 4.10 Compensation paid to displaced farmers

As illustrated in Figure 4.5, the compensation paid to farmers displaced due to land expropriation particularly for the loss of permanent agricultural plantations and houses built on the land they previously owned varied significantly. The one-time compensation payments received by the respondents ranged from 100,000 to 500,000 Birr. The majority of farmers, 193 respondents (60.9%), received compensation below 100,000 Birr, while 65 respondents (20.5%) were compensated between 100,000 and 200,000 Birr. A smaller group, 40 respondents (12.6%), received compensation ranging from 200,000 to 300,000 Birr. Only 7 respondents (2.2%) were compensated between 400,000 and 500,000 Birr, and another 7 respondents (2.2%) received compensation exceeding 500,000 Birr.

On average, each displaced farmer was awarded 161,075 Birr in compensation for the loss of agricultural production, which reflects a general trend of financial disparity among the farmers. The total compensation paid to the 317 sampled respondents is estimated at 49,450,000 Birr for the agricultural losses incurred due to displacement.

This distribution of compensation suggests that farmers who had higher incomes before displacement, often due to more productive agricultural enterprises or larger land holdings, received more substantial compensation than those with lower earnings or less productive agricultural operations. Additionally, non-displaced farmers, who did not face expropriation, likely received better compensation packages than the displaced farmers, indicating that the compensation system may not have fully addressed the economic hardship faced by the displaced agriculturalists. This disparity highlights potential issues of fairness in the compensation process, particularly for those whose livelihoods were more reliant on their agricultural land.

The primary grievances voiced by displaced farmers were the inadequacy of the compensation offered to them and the lack of sufficient time to relocate from the affected areas. During interviews, many displaced farmers shared that, as part of the compensation package, they were provided with 500-square-meter plots of land in the City to build new homes. However, the remaining land, which was expropriated from them, was taken without clear information regarding the compensation or the payment rate per unit of land. This ambiguity surrounding the compensation process raises concerns about potential corruption and administrative mismanagement, as there is no transparency regarding the valuation and payment for the land taken from these farmers.

In general, it is often assumed that landowners can be fully compensated through alternative methods, particularly when the property in question is not deemed unique in terms of its location or characteristics. According to DFID (1999), compensation approaches vary depending on the nature of the property and its importance to the landowner's business operations. For example, land that is not essential to a landowner's livelihood or business may not require full replacement or compensation in kind, but may instead be compensated through cash payments or other means.

In cases where the property is considered unique whether because of its location, historical significance, or specific use the valuation process must account for the difficulty in replacing the asset. The valuation of such properties is often based on an assessment of the current labor and materials needed to recreate a similar property with comparable utility, especially when market values are not readily available or applicable (Ndjovu, 2003). This approach is typically used in situations where the local real estate market is underdeveloped or when the value of the property cannot be easily determined through conventional market transactions.

While this method can offer a more objective means of determining compensation in areas with unclear or unreliable property markets, it also underscores the complexities and potential shortcomings of the compensation process in urban expansion and land expropriation. In such cases, where the valuation is not straightforward, there is a greater risk of inconsistency and inequity in how compensation is calculated, further fueling dissatisfaction among displaced landowners. Therefore, more transparent, standardized, and accountable compensation frameworks are necessary to ensure fairness and prevent exploitation or abuse.

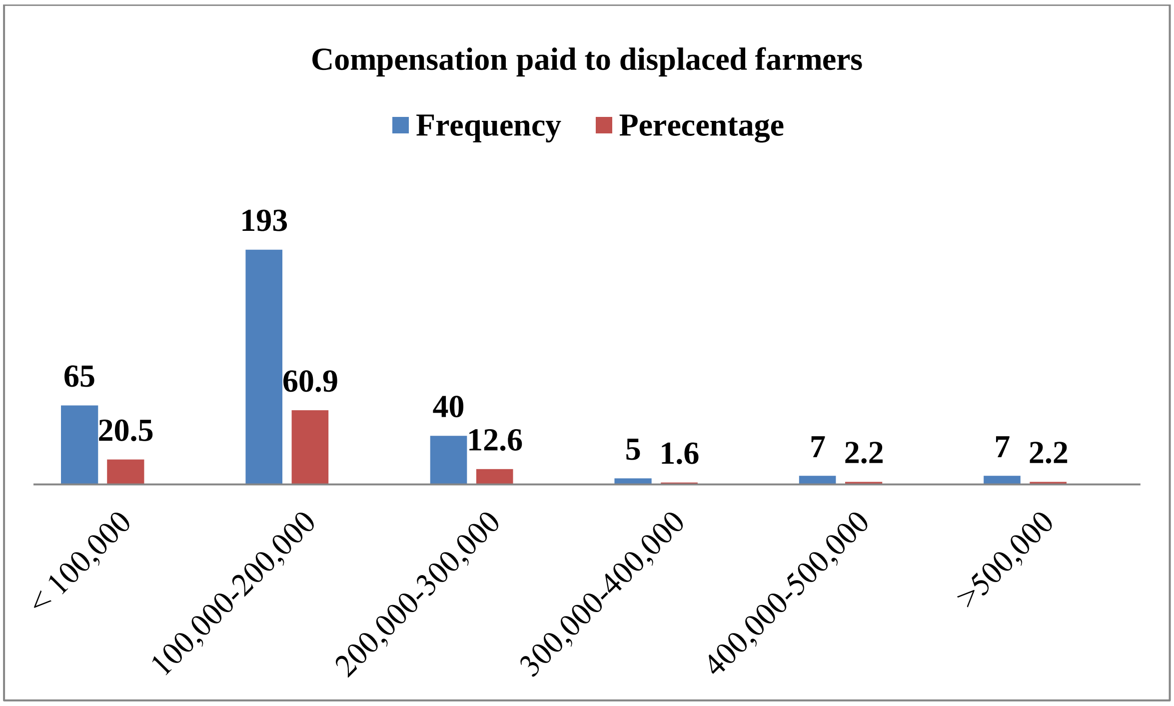



Figure 4.5 Compensation paid to displaced farmers

**4.11. Level of social relationship and values**

Respondents were asked to rate their social relationships and values both before and after the expropriation of their land, using a five-point Likert scale that ranged from "very low" (0) to "very high" (4). The data gathered from the sample of respondents, as shown in Table 4.5, reveals a significant shift in the social dynamics of displaced farmers due to land expropriation.

Before the land expropriation, the mean score for respondents' social relationships and values was 3.21, which falls in the "high" category on the scale, with a standard deviation of 0.79. This indicates that, prior to displacement; the farmers had strong social connections and values. However, after the expropriation, the mean score dropped to 1.7, categorized as "moderate," with a standard deviation of 0.852. This marks a noticeable decline in the quality of their social relationships and values following the loss of their land.

The comparison between these two mean scores highlights the negative impact of land expropriation on the social fabric of farmers' communities. The decline from a "high" to a "moderate" level suggests that the process of land expropriation not only disrupts their economic livelihood but also weakens the social ties that once existed. The social relationship scores, both before and after displacement, indicate that farmers' connections and social values before displacement were generally considered strong, but after displacement, they fell into a range between "low" and "moderate."

This shift can be attributed to the emotional, psychological, and social disruptions caused by land expropriation. The loss of land, a primary source of livelihood and identity for many farmers, can lead to a sense of social disintegration, reducing their engagement in community activities and diminishing their social capital. These findings suggest that land expropriation not only affects the farmers economically but also erodes the social networks that are vital for their well-being and resilience.

Table 4.5 Level of social relationship and values

| | **Level of social relationship and values** | | | | | **Statistics** | |
|---|---|---|---|---|---|---|---|
| | 0<br>Very low | 1<br>Low | 2<br>Moderate | 3<br>High | 4<br>Very high | Mean | Std. Deviation |
| **After** | 12 | 131 | 125 | 40 | 9 | 1.7 | 0.852 |
| | 3.9 | 41 | 39.4 | 13 | 2.9 | | |
| **Before** | 0 | 14 | 28 | 150 | 125 | 3.21 | 0.79 |
| | 0 | 4.6 | 9.1 | 47.3 | 39.4 | | |

**4.12 Average annual income**

In a similar vein, respondents were asked to rate their average annual income both before and after land expropriation using a five-point Likert scale ranging from "very low" (0) to "very high" (4). The data collected from the respondents, as summarized in Table 4.6, highlights a significant decline in the economic well-being of farmers due to the expropriation of their land.

Before the expropriation, the mean score for respondents' average annual income was 2.16, categorized as "moderate" on the scale, with a standard deviation of 1.23. This suggests that, prior to displacement; most farmers had a moderate level of income, likely derived from their agricultural activities. However, after the land expropriation, the mean score dropped to 1.032, which falls into the "low" income category, with a standard deviation of 1.244. This significant reduction in income level reflects the adverse economic consequences of losing access to farmland, which was a primary source of income for many respondents.

The comparison of these mean scores demonstrates that the land expropriation program has had a detrimental effect on farmers' economic stability. The decline from a "moderate" to a "low" income level indicates that the expropriation has led to a substantial decrease in the farmers' income, likely due to the loss of their land and the associated resources for agricultural production. With a wider spread in income levels, as indicated by the higher standard deviation after expropriation, it is also clear that there is greater variability in income among the displaced farmers, further highlighting the economic hardship faced by some individuals more than others.

These findings underscore the negative impact of land expropriation on farmers' economic livelihoods. The significant reduction in average annual income demonstrates that, beyond the social and emotional costs, the economic repercussions of land loss are severe. For many farmers, land is not only a source of livelihood but also a key asset for sustaining their families and communities. Consequently, land expropriation can lead to significant financial hardship, particularly for those who have limited alternative sources of income.

Table 4.6 Average annual income

| | | **0** | **1** | **2** | **3** | **4** | **Statistics** | |
|---|---|---|---|---|---|---|---|---|
| | | very low | Low | moderate | High | very high | Mean | Std. Dev |
| **After** | F | 122 | 76 | 72 | 24 | 23 | 1.032 | 1.244 |
| | % | 38.5 | 24 | 22.7 | 7.8 | 7.5 | | |
| **Before** | F | 10 | 79 | 104 | 91 | 33 | 2.16 | 1.23 |
| | % | 3.3 | 24.9 | 32.8 | 28.7 | 10.4 | | |

### 4.13 Major means of farmers' income before and after land expropriation

As illustrated in Table 4.7, the respondents' primary sources of income underwent a dramatic shift as a result of land expropriation, as shown in the transition matrix above. Prior to land expropriation, a significant majority of respondents 206 individuals, or 67.1% relied solely on agriculture as their main source of income. However, after their land was expropriated, a substantial change occurred in their income-generating activities. Of the original group, 187 respondents (60.9%) transitioned entirely to non-agricultural pursuits, seeking alternative ways to support themselves and their families. Additionally, 19 respondents (6.2%) adopted a mixed approach, combining both agricultural and non-agricultural activities in an attempt to diversify their income sources.

Remarkably, none of the respondents continued to rely exclusively on agricultural activities after the expropriation. This shift indicates a fundamental change in the economic structure of the respondents' livelihoods. The forced displacement and loss of land pushed the majority of farmers to abandon agriculture as their primary source of income, highlighting the vulnerability of individuals who depend solely on farming for their economic survival. This transition to non-agricultural activities reflects the broader challenges displaced farmers face in adjusting to new economic realities after land expropriation, where opportunities for agricultural work are severely limited or no longer available.

The data emphasizes the long-term effects of land expropriation, not only in terms of loss of land but also in terms of the drastic adjustments that individuals must make to their livelihoods. The shift away from agriculture may involve learning new skills, engaging in different types of work, or migrating to urban areas where employment opportunities in other sectors are more abundant. However, this transition can also bring about new challenges, such as lack of experience in non-agricultural industries or limited access to capital or networks to successfully transition into new economic activities.

Table 4.7 Major means of farmers' income before and after land expropriation

| | | After land expropriation | | | |
|---|---|---|---|---|---|
| **Before land expropriation** | Statistics | Agriculture | Non agriculture | Both | Total |
| **Agriculture** | F | 0 | 193 | 19 | 212 |
| | % | 0 | 60.9 | 6.2 | 67.1 |
| **Non agriculture** | F | 3 | 0 | 0 | 3 |
| | % | 1 | 0 | 0 | 1 |
| **Both** | F | 7 | 58 | 37 | 102 |
| | % | 2.3 | 18.3 | 12.1 | 31.9 |
| **Total** | F | 10 | 241 | 56 | 317 |
| | % | 3.3 | 78.5 | 18.2 | 100 |

### 4.14 The results of inferential statistics regarding the effect of urban expansion on the community

As previously discussed, the researcher used a multivariate analysis of variance (MANOVA) in combination with descriptive statistics to assess the impact of urban expansion on the community. The relationship between the dependent variables was further explored using the Statistical Package for Social Sciences (SPSS), version 20, with the Pearson Correlation coefficient applied to test for linear relationships between the variables. The outcomes of the correlation analyses among the variables from the questionnaires are presented.

The multivariate test results in Table 4.8 reveal that urban expansion has a statistically significant effect on the combined dependent variables land use, socioeconomic activities, culture, and environmental change. Specifically, the F-statistic is 12.704 (with degrees of freedom of 8 and 616), and the p-value is 0.000, which confirms that the observed effects are highly significant. The Wilks' Lambda ($\lambda$) value is 0.737, indicating that there is a substantial difference between the groups being studied. Furthermore, the partial eta squared (partial $\eta^2$) is 0.142, which suggests that approximately 14.2% of the variance in the combined dependent variables can be explained by the effect of urban expansion. Additionally, the observed power of the test is 1.000, indicating a very high probability of detecting a true effect, should one exist.

Bivariate correlation, on the other hand, examines whether there is a linear relationship between two variables meaning, as one variable changes, the other either increases or decreases in a predictable manner. The Pearson product-moment correlation coefficient is commonly used to quantify the strength and direction of this linear relationship. This coefficient can range from +1 to -1, where a value of +1 indicates a perfect positive linear correlation (i.e., as one variable increases, the other also increases), a value of 0 indicates no linear correlation (i.e., changes in one variable are unrelated to changes in the other), and a value of -1 indicates a perfect negative linear correlation (i.e., as one variable increases, the other decreases in a perfectly predictable manner).

When Pearson's correlation coefficient (r) is close to +1, it signifies a strong positive relationship between the two variables, suggesting that changes in one variable are closely associated with changes in the second variable. Conversely, if r is close to 0, it indicates a weak or no linear relationship, implying that variations in one variable are not systematically related to variations in the other. If r is close to -1, there is a strong negative correlation, meaning that as one variable increases, the other tends to decrease in a closely predictable pattern (Pedhazur, 1982). This method is essential for understanding the nature and strength of relationships between variables, providing valuable insights into how urban expansion might be influencing various aspects of the community, such as land use, economic activities, cultural shifts, and environmental changes (Malhotra and Birks, 2017).

Table 4.8 Multivariate tests on the effect of urban expansion on the combined dependent variables

| Effect | | Value | F | Hypothesis df | Error df | Sig. | Partial Eta Squared | Observed Power[d] |
|---|---|---|---|---|---|---|---|---|
| Intercept | Pillai's Trace | .983 | 4552.175[b] | 4.000 | 308.000 | .000 | .983 | 1.000 |
| | Wilks' Lambda | .017 | 4552.175[b] | 4.000 | 308.000 | .000 | .983 | 1.000 |
| | Hotelling's Trace | 59.119 | 4552.175[b] | 4.000 | 308.000 | .000 | .983 | 1.000 |
| | Roy's Largest Root | 59.119 | 4552.175[b] | 4.000 | 308.000 | .000 | .983 | 1.000 |
| Urban Expansion | Pillai's Trace | .276 | 12.392 | 8.000 | 618.000 | .000 | .138 | 1.000 |
| | Wilks' Lambda | .737 | 12.704[b] | 8.000 | 616.000 | .000 | .142 | 1.000 |
| | Hotelling's Trace | .339 | 13.016 | 8.000 | 614.000 | .000 | .145 | 1.000 |
| | Roy's Root | .273 | 21.103[c] | 4.000 | 309.000 | .000 | .215 | 1.000 |

As presented in Table 4.9, the impact of urban expansion on various socioeconomic and cultural factors, as well as on land use by farmers in surrounding areas, was found to be significant. The results from the multivariate analysis of variance (ma nova) revealed that there are notable differences in the mean scores for land use, cultural impact, and socioeconomic changes, depending on how respondents perceive the extent of urban expansion. Specifically, the analysis indicated that the level of perceived urban expansion significantly influences these factors.

Given the significant differences observed across the different levels of perceived urban expansion, the researcher proceeded with a post hoc analysis to further investigate these within-group differences. The post hoc analysis allows for a more detailed examination of where the significant differences lie within the groups, providing a deeper understanding of how different levels of perceived urban expansion correlate with variations in land use practices, cultural shifts, and socioeconomic impacts among the farmers.

Table 4.9 Multivariate analysis of variance on the effect of urban expansion

| Source | Dependent Variable | Type III Sum of Squares | Df | Mean Square | F | Sig. | Observed Power[e] |
|---|---|---|---|---|---|---|---|
| Corrected Model | Socioeconomic effect | 648.826[a] | 2 | 324.413 | 11.700 | .000 | .994 |
| | Cultural effect | 821.119[b] | 2 | 410.559 | 9.066 | .000 | .974 |
| | Environmental effect | 116.273[c] | 2 | 58.137 | .940 | .392 | .212 |
| | Land use | 803.620[d] | 2 | 401.810 | 12.598 | .000 | .996 |
| Intercept | Socioeconomic effect | 326931.255 | 1 | 326931.255 | 11791.02 | .000 | 1.000 |
| | Cultural effect | 387375.626 | 1 | 387375.626 | 8554.273 | .000 | 1.000 |
| | Environmental Effect | 287688.574 | 1 | 287688.574 | 4653.569 | .000 | 1.000 |
| | Land use | 217739.238 | 1 | 217739.238 | 6826.782 | .000 | 1.000 |
| Urban Expansion | Socioeconomic effect | 648.826 | 2 | 324.413 | 11.700 | .000 | .994 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Cultural effect | 821.119 | 2 | 410.559 | 9.066 | .000 | .974 |
| | Environmental Effect | 116.273 | 2 | 58.137 | .940 | .392 | .212 |
| | Land use | 803.620 | 2 | 401.810 | 12.598 | .000 | .996 |
| Error | Socioeconomic effect | 8623.139 | 317 | 27.727 | | | |
| | Cultural effect | 14083.467 | 317 | 45.284 | | | |
| | Environmental Effect | 19226.351 | 317 | 61.821 | | | |
| | Land use | 9919.300 | 317 | 31.895 | | | |
| Total | Socioeconomic effect | 348123.000 | 317 | | | | |
| | Cultural effect | 415966.000 | 317 | | | | |
| | Environmental Effect | 316280.000 | 317 | | | | |
| | Land use | 239359.000 | 317 | | | | |

The results from the multiple comparisons conducted using the Least Significant Difference (LSD) post hoc analysis reveal significant differences in perceived socioeconomic, cultural, and land use impacts based on respondents' perceptions of urban expansion.

Regarding the socioeconomic effects, the analysis found a notable difference between those who perceive urban expansion as low and those who view it as medium. The mean difference (M) between these two groups was -3.1442, with a standard error (SEr) of 0.71400. The 95% confidence interval for this difference ranged from -4.5491 to -1.7393, suggesting that respondents who perceive medium urban expansion report significantly different (more pronounced) socioeconomic impacts than those who perceive low expansion. Furthermore, a similar significant difference was found between respondents who perceive low urban expansion and those who view it as high. The mean difference in this case was -3.1545 (SEr = 0.77860), with a confidence interval from -4.6865 to -1.6225, indicating that high levels of perceived urban expansion are associated with more substantial socioeconomic effects compared to low levels of expansion.

In terms of the cultural effects, the post hoc analysis revealed significant differences between those who perceive low urban expansion and those who perceive medium urban expansion, with a mean difference of -3.3679 (SEr = 0.91248). The confidence interval for this difference ranged from -5.1633 to -1.5725, indicating that the perceived cultural impact is more pronounced in areas with medium urban expansion compared to those with low expansion. Additionally, there was a significant difference between those perceiving low and high urban expansion, with a mean difference of -3.7530 (SEr = 0.99503). The confidence interval for this comparison was between -5.7109 and -1.7952, showing that the cultural effects of urban expansion are even stronger in areas where high levels of urban expansion are perceived.

Finally, the post hoc analysis also highlighted differences in land use perception. Respondents who perceive low urban expansion report significantly different land use changes compared to those who perceive medium expansion. The mean difference between these groups was -2.6846 (SEr = 0.76579), with a confidence interval ranging from -4.1914 to -1.1779, indicating that medium urban expansion is associated with more significant changes in land use compared to low expansion. Additionally, a significant difference was observed between respondents who perceive medium urban expansion and those who perceive high urban expansion, with a mean difference of 3.6466 (SEr = 0.77321) and a confidence interval from 2.1253 to 5.1680. This suggests that respondents who perceive high levels of urban expansion report even more substantial changes in land use compared to those who view urban expansion as being at a medium level.

In conclusion, the post hoc analysis confirms that the perceived level of urban expansion has significant effects on the socioeconomic, cultural, and land use outcomes experienced by respondents. Those who perceive higher levels of urban expansion tend to report more significant impacts across all three areas, underlining the profound influence of urban growth on local communities, particularly in terms of economic, cultural, and land-use dynamics (see Table 10).

Table 4.10 Least significant difference (LSD's) post hoc analysis of the difference

| Dependent Variable | (I) Urban Exp | (J) Urban expansion | Mean Difference (I-J) | Std. Error | Sig. | 95% Confidence Interval | |
|---|---|---|---|---|---|---|---|
| | | | | | | Lower Bound | Upper B. |
| Socioeconomic effect | Low expansion | Medium | -3.1442* | .71400 | .000 | -4.5491 | -1.7393 |
| | | High | -3.1545* | .77860 | .000 | -4.6865 | -1.6225 |
| | Medium expansion | Low expansion | 3.1442* | .71400 | .000 | 1.7393 | 4.5491 |
| | | High Expansion | -.0103 | .72093 | .989 | -1.4288 | 1.4082 |
| | High expansion | Low expansion | 3.1545* | .77860 | .000 | 1.6225 | 4.6865 |
| | | Med. Expansion | .0103 | .72093 | .989 | -1.4082 | 1.4288 |
| Cultural effect | Low expansion | Medium | -3.3679* | .91248 | .000 | -5.1633 | -1.5725 |
| | | High | -3.7530* | .99503 | .000 | -5.7109 | -1.7952 |
| | Medium expansion | Low expansion | 3.3679* | .91248 | .000 | 1.5725 | 5.1633 |
| | | High Expansion | -.3852 | .92133 | .676 | -2.1980 | 1.4277 |
| | High expansion | Low expansion | 3.7530* | .99503 | .000 | 1.7952 | 5.7109 |
| | | Med. Expansion | .3852 | .92133 | .676 | -1.4277 | 2.1980 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Environmental Effect | Low expansion | Medium | .2934 | 1.0661 | .783 | -1.8043 | 2.3912 |
| | | High | 1.4900 | 1.1626 | .201 | -.7976 | 3.7775 |
| | Medium expansion | Low expansion | -.2934 | 1.0661 | .783 | -2.3912 | 1.8043 |
| | | High Expansion | 1.1965 | 1.0764 | .267 | -.9216 | 3.3146 |
| | High expansion | Low expansion | -1.4900 | 1.1626 | .201 | -3.7775 | .7976 |
| | | Med. Expansion | -1.1965 | 1.0764 | .267 | -3.3146 | .9216 |
| Land use | Low expansion | Medium | -2.6846* | .76579 | .001 | -4.1914 | -1.1779 |
| | | High | .9620 | .83507 | .250 | -.6811 | 2.6051 |
| | Medium expansion | Low expansion | 2.6846* | .76579 | .001 | 1.1779 | 4.1914 |
| | | High Expansion | 3.6466* | .77321 | .000 | 2.1253 | 5.1680 |
| | High expansion | Low expansion | -.9620 | .83507 | .250 | -2.6051 | .6811 |
| | | Med. Expansion | -3.6466* | .77321 | .000 | -5.1680 | -2.1253 |
| Based on observed means. The error term is Mean Square (Error) = 31.895. *. The mean difference is significant at the .05 level. | | | | | | | |

In the current study, the environmental impact of urban expansion was not found to have a statistically significant independent effect on the surrounding environment. This contrasts with the findings of Seifollahi et al., (2022), who demonstrated that land degradation resulting from urban expansion is largely driven by socioeconomic factors, particularly population growth and urban sprawl. According to their research, these factors create complex environmental issues that are exacerbated by urbanization. Their perspective frames peri-urban areas as socio-environmental systems undergoing significant changes in response to rapid socioeconomic transitions. While the current study did not observe such an environmental impact, it aligns with the broader view that urbanization interacts with various socioeconomic processes, often leading to environmental stress in surrounding regions.

Another important aspect highlighted in the literature is the bi-directional influence between urban and rural areas, particularly how urban growth affects the socioeconomic conditions of adjacent rural communities. Urban and rural areas are not isolated, but rather influence one another through commerce and the exchange of practical resources, ideas, and labor. These interactions lead to changes in both urban and rural ways of life. As noted by Torquati et al., (2020), the peri-urban environment is increasingly recognized as a hybrid space that blends urban and rural characteristics, creating a unique set of socioeconomic and environmental dynamics. This concept emphasizes the importance of understanding peri-urban regions as spaces of transition, where urban expansion and rural life intersect in complex ways.

In terms of socioeconomic impact, the study found that the effects of displacement were not uniform across different educational levels of household heads or the overall diligence of family members. Specifically, families with better-educated household heads and smaller family sizes were more likely to experience better socioeconomic outcomes. This finding supports the conclusions of Kasa et al., (2011), who found that households led by older, male, literate heads, with access to better transfer income and proximity to transport hubs, were more likely to engage in non-agricultural livelihood strategies. These factors provided these households with greater flexibility to adapt to changes brought on by urban expansion.

Furthermore, Kasa et al., (2011) highlighted that despite the varying livelihoods of peri-urban households, displacement status plays a crucial role in determining the economic resilience of affected families. Specifically, their study found that fully displaced households received lower compensation than those who were partially displaced or not displaced at all.

Moreover, the average per capita expenditure for fully displaced households was significantly higher, suggesting that these families faced greater financial strain. This finding aligns with the current study's observation that compensation alone is often insufficient to restore displaced families to a comparable economic position. For fully displaced households, the inability to re-establish a stable income source often leads to asset-depleting consumption—a situation where families may dip into their savings or liquidate assets to sustain their consumption levels, further deepening their economic vulnerability.

This highlights the difficulties faced by fully displaced individuals, who, despite receiving compensation, often struggle to rebuild their livelihoods in a way that allows for sustainable, long-term economic stability. Even with compensation, these households often cannot maintain a comparable standard of living, forcing them to adopt short-term consumption strategies that ultimately undermine their financial well-being. This reinforces the idea that displacement particularly full displacement can have lasting socioeconomic consequences that go beyond the immediate loss of land, creating challenges that are difficult to overcome through financial compensation alone.

### 4.15 Land use classification map within the planning boundary

When using the City's administrative boundary as the basis for classifying land use, the proposed distribution shows notable variation in how different areas are designated for various purposes. According to the proposed plan, urban agriculture occupies the largest portion, accounting for 41.87% of the total land area. This emphasizes the significant role that agriculture plays within the urban context, reflecting the ongoing importance of farming activities even as the City expands. Following urban agriculture, land allocated for recreational and environmental purposes takes up 21.74%, underscoring the City's commitment to green spaces, parks, and areas dedicated to environmental preservation.

Housing is the third largest category, covering 16.15% of the land area, which is reflective of the City's need to accommodate its growing population through residential development. In addition, 10.85% of the land is earmarked for roadways and transport infrastructure, highlighting the City's efforts to enhance mobility and connectivity as it expands.

These land use categories reflect the City's priorities as it seeks to balance urban development with the preservation of essential agricultural, recreational, and environmental spaces. The allocation also suggests a strategy that aims to integrate urban agriculture within the urban fabric, possibly to maintain food security and support local farming livelihoods, while simultaneously addressing the growing need for housing and infrastructure. This distribution is a clear indication of how land use planning in rapidly urbanizing areas attempts to juggle competing demands and achieve a sustainable balance between development and the preservation of key resources. The proposed land use percentages, as shown in Figure 4.6, therefore, provide a framework for understanding how the City envisions its future growth, both in terms of urban expansion and the maintenance of essential functions like agriculture and environmental conservation.

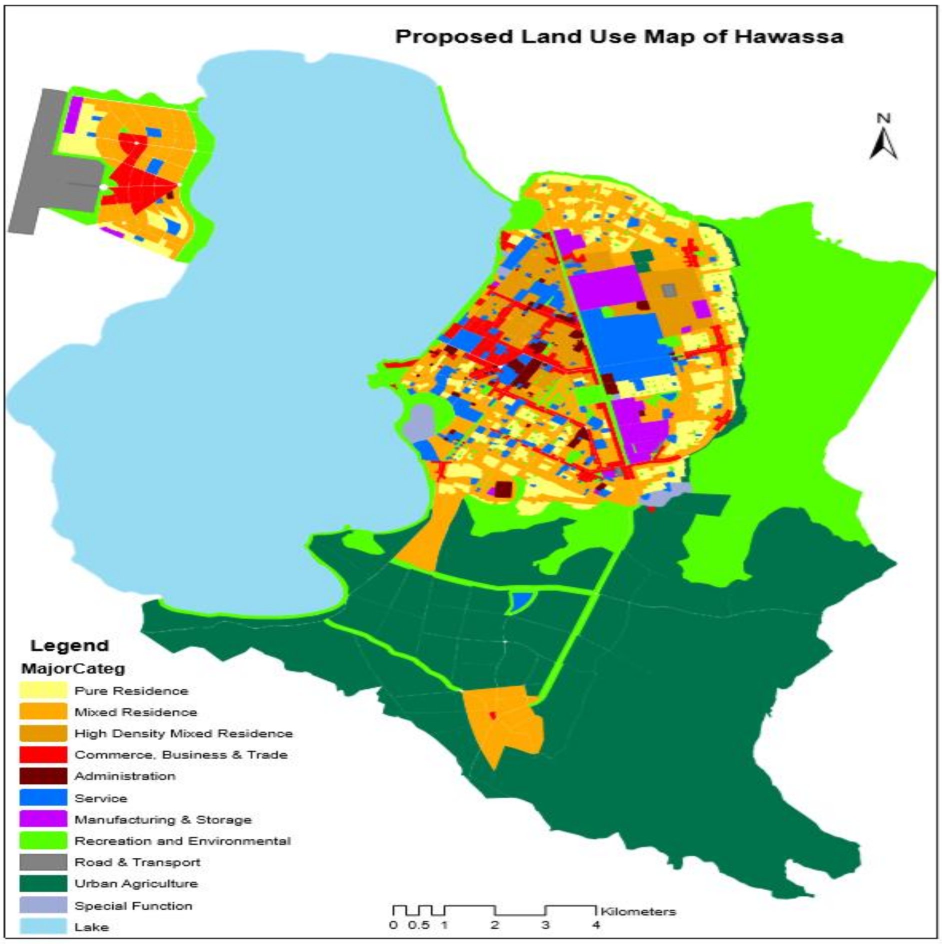



Figure 4.6 Land use map within the administrative boundary Source: Hawassa City Municipality, 2020.

**4.16 Physical aspects of Hawassa City**

Hawassa City, the largest urban center in Ethiopia's Southern region, plays a pivotal role in the political, economic, and social fabric of the surrounding area. It serves as the main hub for governance, business, and employment within the regional state. In addition to its local significance, Hawassa is one of Ethiopia's premier tourist destinations. A key factor in its popularity is the presence of Lake Hawassa to the west of the City, which not only enhances the City’s natural beauty but also attracts both international and domestic tourists. This proximity to the lake also serves as a catalyst for investment and economic growth, providing opportunities for various industries and boosting the local economy.

Hawassa covers an expansive area of 178.3019 square kilometers, encompassing a variety of land uses, including residential, commercial, industrial, recreational, and agricultural spaces. More than 60% of the City’s land is rural, highlighting the significant role that agriculture continues to play in the region's economy. The City is divided into eight sub-cities and 32 kebeles, which are the smallest administrative units in Ethiopia. One notable area is Tula, where 77% of the land area falls within the jurisdiction of the Tula sub- City, with the remaining 23% spread across other sub-cities.

The City’s terrain is varied, with the northern part being predominantly flat and the southern part characterized by hilly and mountainous areas. The highest point in Hawassa City is located at the southernmost tip, reaching an elevation of 2,140 meters above sea level. The land around Lake Hawassa, as well as the City’s oldest settlement areas, is relatively flat, with a gentle slope of between 0% and 5%, covering about 86% of the total land area. In contrast, the southern region, especially around the Tabour and Alammura Mountains, is more rugged, with slopes greater than 10%, making up 7% of the City’s land. These hilly areas are largely undeveloped and serve as forested zones, ideal for recreational activities and maintaining green spaces.

Hawassa City lies within the Hawassa sub-basin drainage system, a natural water network that includes both seasonal and perennial rivers. One of the key rivers is the Tukur-wuha River, which gathers water from the nearby highlands and flows into Lake Hawassa. This river, along with others in the City, plays an essential role in managing runoff, particularly in the more elevated and southern regions of the City. In these areas, water runoff tends to flow toward the lake, except in the eastern and southern sections, as well as the flatter, lower parts of the City, where the flow dynamics are different.

Overall, the natural features of Hawassa its diverse topography, the presence of Lake Hawassa, and the surrounding rivers create a unique and vibrant environment that supports the City's economic activities, including tourism, agriculture, and urban development. These physical characteristics also influence how the City manages water, land use, and its broader ecological health, making Hawassa a dynamic and increasingly important urban center in Ethiopia.

### 4.16.1 Existing settlement structure/pattern

Hawassa City is primarily organized with a grid layout, featuring a network of rectangular blocks. This layout is facilitated by the City's relatively flat topography, which enhances its overall landscape and makes navigation through the City easier. The grid pattern contributes to the efficient circulation system, improving accessibility and connectivity across different parts of the City. The settlement structure in Hawassa, however, varies in different regions, reflecting the City's growth and development over time.

In the central areas, particularly along major corridors like Piassa and the Old Bus Terminal routes, as well as at key nodal points such as Sidama Square, the settlement patterns are denser and more consolidated. These areas are marked by a network of roads radiating outward, with notable roads extending toward Tirufat and the Regional Health Bureau area. The architecture in these zones is evolving, with an increasing number of multi-story buildings emerging as the City becomes more urbanized. These areas are also more developed in terms of infrastructure and offer better services compared to other parts of the City, making them key commercial and administrative centers.

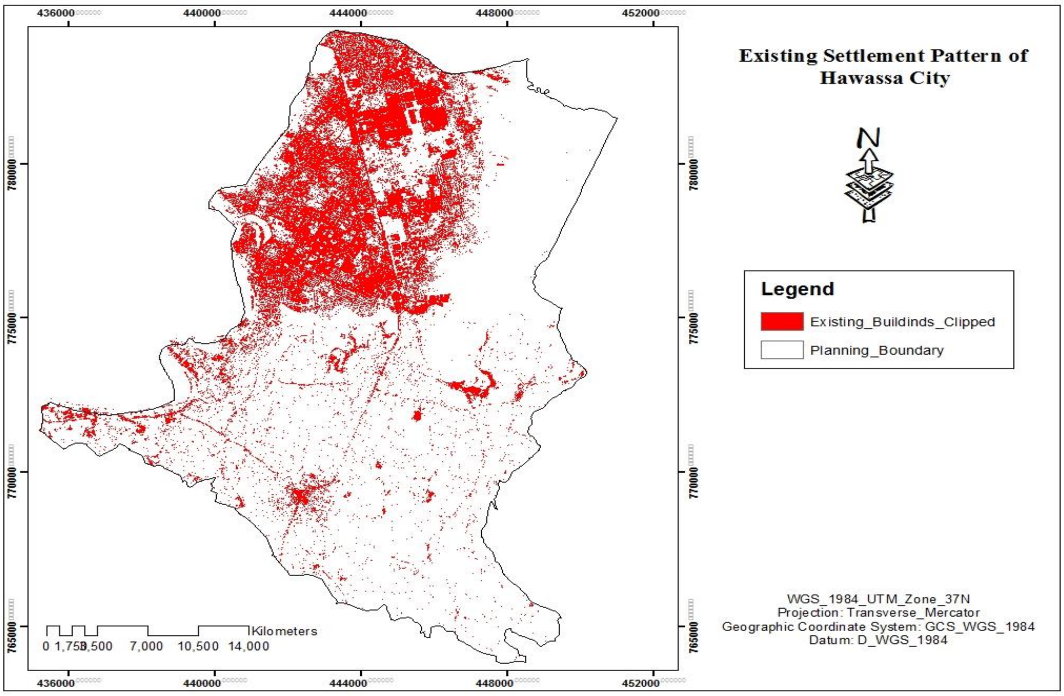



Figure 4.7 Existing settlement pattern of Hawassa City. **Source**: US Geological Survey (USGS) http://glovis.usgs.gov

Currently, Hawassa City lacks a clear hierarchy of central areas or districts. Instead, the City's various activities and functions are spread out across different parts of the urban area. Unlike cities with distinct central business districts or specialized zones, Hawassa's core functions are dispersed throughout the City. For example, central services and activities such as government offices, restaurants, banks, shopping centers, and educational institutions are not confined to a specific central area but are instead located along the main roads, from major arterial routes to smaller local streets.

The most significant commercial and public functions tend to be concentrated along the major arterial roads and sub-arterial routes that run through the City. These key roads host the City's primary hubs for business and government services. For instance, areas along these roads feature a variety of important services, including restaurants, financial institutions, and supermarkets, which cater to both residents and visitors. These central services are strategically placed to ensure accessibility, but they are not concentrated in a singular "central" area, thus reflecting the City's non-hierarchical urban structure.

### 4.16.2 Existing land use classification

The land use classification of Hawassa City, as studied in this research, is predominantly shaped by residential areas, and with a significant portion of the urban space allocated to mixed-type settlements. The City's land is used for a wide range of purposes, reflecting its dynamic and evolving urban structure. Key land use categories in Hawassa include residential, commercial, administrative, mixed-use, service-related areas, manufacturing and industrial zones, recreational spaces, urban agriculture, and transport infrastructure.

Among these, residential areas dominate the urban landscape, comprising the largest proportion of land use. This is followed by roads and transport networks, which are critical for facilitating movement and connectivity throughout the City. Service-oriented facilities, which encompass public amenities and infrastructure, also occupy a significant share of land. These services are essential for maintaining the functionality of the City, providing residents with access to education, healthcare, and other public resources.

Manufacturing and industrial areas are another key component of Hawassa's land use, supporting economic growth and employment. These zones are typically located in designated industrial parks or areas that are strategically positioned for access to transport routes, enabling efficient distribution of goods and services. Recreational spaces and green areas also contribute to the City's livability, offering residents spaces for leisure, physical activity, and social interaction.

In addition to these more traditional land uses, commercial and trade areas are dispersed throughout the City, particularly along major roads and transport corridors. These zones support a variety of retail, hospitality, and other business activities, contributing to the City's economic vibrancy. Finally, urban agriculture plays a role in the City's land use, providing a source of food production and employment for local residents, especially in peripheral areas or smaller plots of land within the urban boundary.

The land use distribution in Hawassa presents a diverse and dynamic urban landscape, where residential areas are the dominant land use but are complemented by crucial infrastructure and economic activities. This diverse mix of land uses underscores the City's evolving urban character and reflects its balanced development approach. Figure 4.8 provides a visual representation of the various land use categories, highlighting that residential zones occupy the largest share of land in the City. Following residential areas, significant portions of land are dedicated to essential urban infrastructure, including transport networks, public services, and industrial zones, all of which are critical for the City's functioning and growth.

In addition to these key land uses, other types, such as recreational spaces, commercial areas, and urban agriculture, are also integrated into the City's layout. Recreation areas offer green spaces and facilities for leisure, sports, and community engagement, which enhance the quality of life for residents. Commercial zones, meanwhile, contribute to the City's economic vibrancy by providing spaces for retail, business, and services. Urban agriculture, although occupying a smaller share of land, plays an important role in local food production and livelihoods, particularly in the peripheral areas of the City.

This blend of land uses is a testament to Hawassa's growth and development as a City that combines residential living with economic, social, and environmental functions. The integration of various activities within the urban fabric reflects the City's approach to urbanization, where land use is not siloes but rather interwoven to address the diverse needs of its population. This urban pattern facilitates economic development while promoting sustainability and livability. By incorporating a range of uses such as industry, recreation, commerce, and agriculture, Hawassa is shaping itself into a more resilient, adaptable, and well-rounded urban environment.

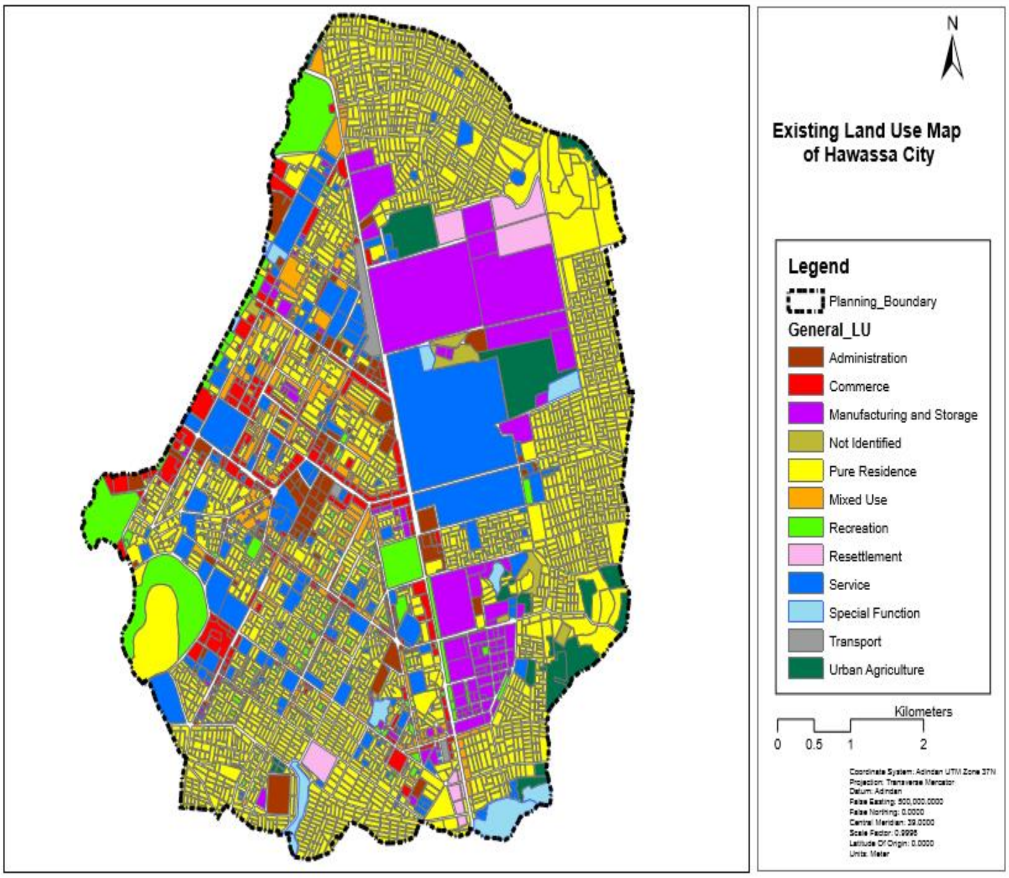



Figure 4.8 Existing land use of Hawassa City**.** Source: Hawassa City Municipality, 2020

### 4.16.3 Proposed distribution of density

Hawassa City currently has an average population density of 12,656 people per square kilometer, with significant variations across different parts of the City. The density ranges from a relatively low 1,090 people per square kilometer in the more sparsely populated areas of Tulla sub- City, to a much higher 31,700 people per square kilometer in the densely populated Bahil-adarash sub- City. This variation in density reflects the uneven distribution of population across the City's different neighborhoods, highlighting areas with both low-density, scattered settlements and others with highly concentrated urban living.

In response to this spatial disparity, a targeted density distribution plan has been proposed for the next 10 years, which aims to address the structural differences in population density. According to this proposal, the average density for the City over the next decade is projected to increase to 20,000 people per square kilometer. Figure 4.9 illustrates a five-tier density distribution across the City's administrative boundaries, with different areas being assigned specific density targets based on their function, location, and potential for growth.

Strategic zones in the City, such as Piazza, the old market, the old bus station area, Shell, Turufat, Atote, and the area in front of HIP (Hawassa Industrial Park), are identified as key locations that currently serve as hubs for commercial activities and employment. These areas have been earmarked for more concentrated development due to their economic importance and accessibility. To better accommodate the growing population and support the City's development goals, very high-density residential development is recommended in these zones, aiming for a density of at least 30,000 people per square kilometer.

Achieving this proposed density in these strategic areas will be facilitated through redevelopment projects, which will focus on making efficient use of land while promoting sustainable urban growth. These redevelopment efforts will capitalize on the existing commercial activities and the higher land value in these areas, helping to transform them into new commercial and employment hubs. By doing so, the City can create more affordable housing options close to employment centers, reducing the need for long commutes and fostering more sustainable urban living patterns.

This approach also acknowledges the critical role that these high-density areas play in the local economy. Concentrating development around existing commercial and industrial zones will help maximize the use of available land, improve access to jobs and services, and contribute to the overall economic growth of the City. By strategically planning for higher densities in key locations, Hawassa aims to accommodate its growing population while enhancing its urban infrastructure and maintaining a balanced, sustainable urban environment.

Hawassa City's population density varies significantly depending on the proximity to major urban centers and employment areas. In the areas closest to the City's key commercial and employment hubs, residential density is notably high, reaching up to 25,000 people per square kilometer. These high-density zones are typically found near the City's most developed districts, where there is significant demand for housing due to the concentration of economic activities and job opportunities.

In contrast, the City has also experienced recent growth in areas that were previously less developed. Districts such as Dato, Chefe, Monopol, and Wondo-Tika are characterized by medium residential density, with an expected capa City of 20,000 people per square kilometer. These neighborhoods have emerged as the City expands outward, providing housing and services to a growing population. The medium-density areas are often located near the expanding infrastructure and new developments, balancing residential needs with ongoing urbanization.

On the other hand, areas with lower residential densities are primarily found in the Hawella-Tula sub- City and along the shores of Hawassa Lake. These regions are proposed to have densities of 15,000 people per square kilometer in the Hawella-Tula sub- City and 10,000 people per square kilometer along the lakefront. The lower density in these areas is reflective of both the physical characteristics of the land such as the lake's proximity and the hilly terrain in some parts and the need to preserve open space and recreational areas. These regions are seen as more residential or recreational, offering less intensive development to maintain the area's environmental quality and to provide residents with more spacious living conditions.

This varied distribution of residential densities across Hawassa City is part of a broader urban planning strategy aimed at accommodating the City's rapid growth while ensuring sustainable development. By allocating different densities based on location and function—high density near central urban areas, medium density in newly developing districts, and lower density in more peripheral or environmentally sensitive areas the City can better manage its population growth, improve accessibility to employment, and preserve important natural spaces. This zoning strategy helps balance urbanization with livability and sustainability, ensuring that growth occurs in a way that meets the needs of the residents without overwhelming the infrastructure or the environment.

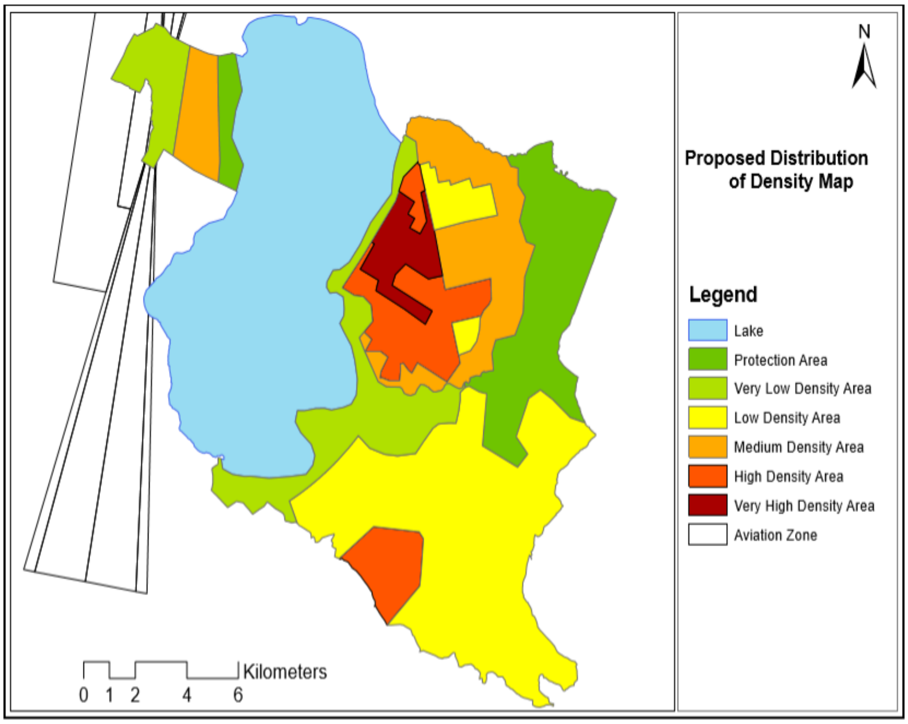



Figure 4.9 Proposed distribution of density within the administrative boundary**.** Source: Hawassa City Municipality, 2020

### 4.17 LULCC in the study area since 1990 and 2000

The study area demonstrated significant urban growth and changes in land use, with clear patterns of transformation over time. This growth trend was confirmed through image classification and the analysis of land use/land cover (LULC) patterns, as depicted in Figures 4.10 and 4.11, which illustrate the shifts in LULC throughout the study period. These figures show how the urban landscape has evolved, highlighting the dynamic nature of land use in the region.

The urban regions of the study area were categorized into seven distinct land use/land cover (LULC) classifications, based on a combination of field observations and historical data. These classifications represent the various types of land and how they have changed over time. The seven LULC categories identified through field data and satellite imagery include: bare land, built-up areas, bushland, cropland, farmland, forest land, and water bodies.

Bare land refers to areas that are largely undeveloped or unutilized, often characterized by exposed soil or rock. Built-up areas are those regions that have been developed for human habitation and infrastructure, such as residential, commercial, and industrial zones. Bushland encompasses areas covered with shrubs, bushes, or small trees, often found in semi-urban or transitional zones. Cropland represents areas specifically cultivated for crop production, while farmland refers to land used for both crop farming and livestock grazing. Forest land includes areas covered by dense trees and vegetation, important for ecological balance and biodiversity. Finally, water bodies cover lakes, rivers, and other water features within the study area.

By focusing on these seven LULC classes, the study aimed to provide a comprehensive understanding of the land use changes in the region. The combination of satellite imagery and field data allowed for a more accurate assessment of the transformation of the urban and rural landscapes, offering insights into how the City's expansion and changing land use have affected the environment and local communities. This classification system serves as a valuable tool for monitoring land change and guiding future urban planning and environmental management strategies.

### 4.17.1. LULCC between 1990 and 2000

The results of the supervised classification analysis between 1990 and 2000 reveal significant changes in the land use and land cover (LULC) of the study area. Key land use categories such as farmland, built-up areas, bare land, and water bodies all showed growth during this period. Specifically, farmland increased from 28.57% to 31.79%, built-up areas expanded from 5% to 8.99%, bare land grew from 1.58% to 3.32%, and water bodies saw a slight increase from 34.20% to 35% (as shown in Table 4.12 and Figure 4.10).

Conversely, other land use categories such as cropland, forest, and bushland experienced a decline. The percentage of cropland decreased from 9.70% to 5.38%, forest land reduced from 9.79% to 5.82%, and bushland remained constant at 9.70%, indicating limited change in that category during the period.

In 1990, the study area was predominantly covered by farmland and bushland, reflecting the area's relatively low population density, limited urban development, and relatively stable environmental conditions. This was a period of less intense land transformation, with agriculture and natural vegetation being the dominant land uses. The relatively undisturbed nature of the area during this time can be attributed to a combination of factors, including the lack of significant urban expansion and population pressures.

However, over the subsequent decades, the landscape of the area began to change due to increasing rural settlement expansion under municipal management. Many areas that were once primarily farmland and bushland have now been transformed into built-up land and remain farmland. This transition reflects the growing urbanization and the expansion of infrastructure, as well as the increased demand for housing and commercial space in response to population growth.

The shift in land use observed between 1990 and 2000 illustrates the broader trend of urbanization and the pressure placed on agricultural and natural areas as the City expands. As a result, land that was once used for farming and natural vegetation is now being increasingly occupied by urban developments, while the remaining agricultural and natural areas continue to play a crucial role in the region’s overall land use pattern. The shift in LULC from farmland and bushland to built-up areas signals the growing urban pressure on the surrounding environment, highlighting the need for sustainable land management practices to balance urban growth with environmental conservation.

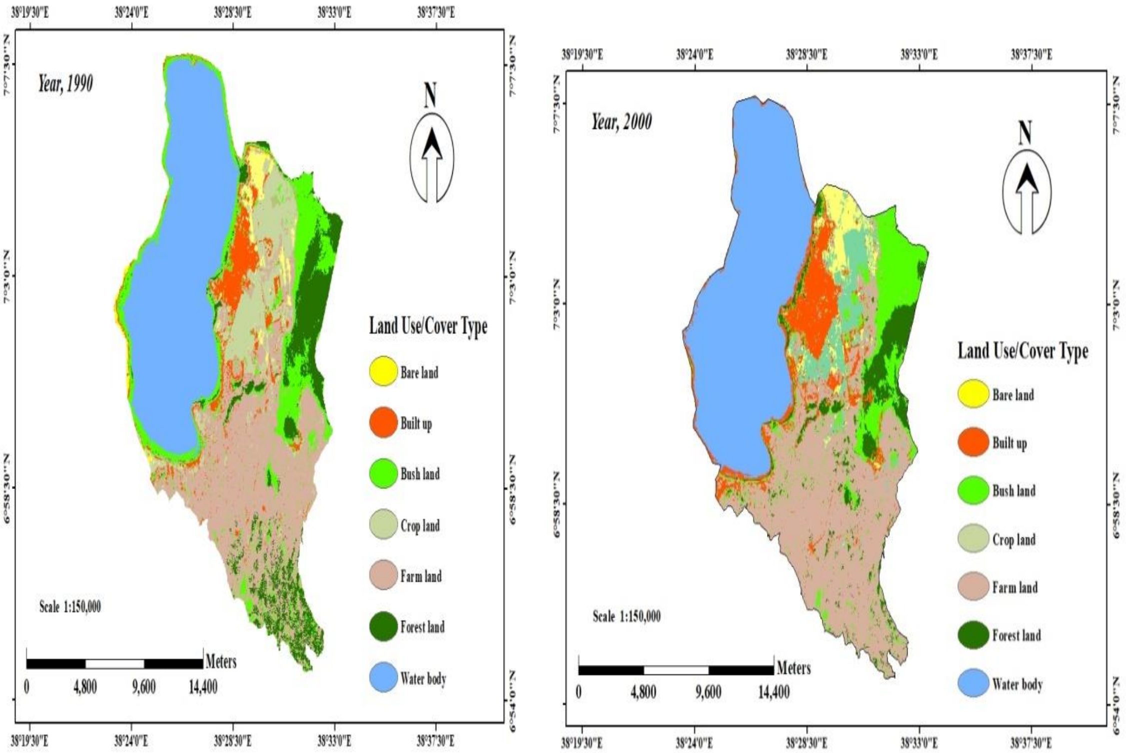



Figure 4.10 Land use/land cover classification map of 1990 and 2000. Source: US Geological Survey (USGS) (http://glovis.usgs.gov)

### 4.17.2 LULCC between 2000 and 2010

Over a span of 10 years, from 2000 to 2020, the most significant increases in land use and land cover (LULC) classes occurred in built-up areas, forest land, and water bodies. Built-up areas saw the largest growth, expanding from 8.99% to 11.97%, while forest land grew from 5.82% to 7.87%. The proportion of water bodies remained constant at 35.67%. On the other hand, farmland experienced a substantial decline, decreasing from 31.79% to 19.46%. This shift highlights a clear trend of urban expansion, with built-up areas and forest land experiencing significant growth, while farmland saw a considerable reduction, reflecting the ongoing process of urbanization and changing land use dynamics.

The reduction in farmland is indicative of the increasing urbanization and the expansion of the City, driven by factors such as population growth and the demand for housing. The growing population, in particular, has resulted in higher demand for housing, especially in urban areas like Hawassa, which has seen a rapid increase in people moving to the City, both for higher education and investment opportunities. As a result, the demand for housing is outpacing the available supply, putting immense pressure on urban land resources.

In Hawassa City, the urban-rural linkages have manifested in three main ways that impact housing demand. First, the influx of people to the City many of whom are coming for educational purposes or to invest in the City’s growing economy has contributed to a high demand for housing in both the formal and informal sectors. Second, there has been a growing trend of City dwellers purchasing land illegally from farmers in nearby peasant associations (rural communities). These informal land transactions often lead to the establishment of unauthorized housing settlements on agricultural land, exacerbating the issue of informal communities in the City’s periphery.

This informal growth of settlements poses a significant challenge to the planned urban development of the City. These illegal dwellings tend to spring up in areas designated for future urban expansion, complicating efforts to manage the City’s growth and infrastructure. This trend of unregulated development not only places pressure on the City’s infrastructure but also makes it harder to implement zoning laws and urban planning regulations.

Given these challenges, there is an urgent need for local government intervention to address the growing gap between housing supply and demand. The government must make concerted efforts to balance urban growth with the provision of adequate housing. This could involve implementing stricter land use regulations, promoting affordable housing projects, and exploring sustainable urban planning solutions that integrate both the needs of the growing urban population and the preservation of essential agricultural land. Furthermore, efforts to formalize land transactions and improve land tenure security for both urban and rural residents could help mitigate the growth of informal settlements and ensure more organized, sustainable urban development in the future.

#### 4.17.3 LULCC between 2010 and 2020

Between 2010 and 2020, significant changes were observed in the land use and land cover (LULC) patterns in Hawassa City. The areas occupied by farmland, built-up areas, and bushland increased considerably. Specifically, farmland expanded from 19.46% to 26.51%, built-up areas grew from 11.97% to 18.71%, and bushland saw a rise from 3.07% to 4.51%. Conversely, areas covered by bare land, cropland, and water bodies experienced a decline. Bare land decreased from 2.84% to 0.91%, cropland shrank from 19.12% to 8.91%, and water bodies reduced from 35.67% to 33.17%. This shift in land use indicates that farmland and built-up areas have remained the dominant land cover types throughout this period, with the City's urbanization playing a key role in reshaping the landscape.

The growth of built-up areas has been particularly striking, expanding at the expense of bare land and forest land. As Hawassa expanded, land previously covered by natural vegetation, including forests and bushland, was repurposed for residential, commercial, industrial, and infrastructural uses. The increase in bushland can be attributed to the intentional planting of trees along urban spaces such as buildings, roads, and recreational areas, which helped improve the urban environment.

Between 1990 and 2020, there was a notable increase in built-up areas, alongside significant decreases in bushland and bare land. The growing urban sprawl in the study area had a considerable impact on agricultural land and land use in the peri-urban areas, as urban development encroached on farmland and natural areas. This phenomenon aligns with similar studies, such as those by Salvati and Zitti (2008), which highlighted how urban expansion contributes to land degradation in peri-urban regions. These changes reflect the complex interactions between natural processes and human activities, as well as the consequences of spatial and temporal dynamics in land use.

According to the Hawassa City Administration, the population of the City in 2018 was approximately 400,000. However, due to an estimated annual growth rate of 7.5% driven by ambitious projects like the Hawassa Industrial Park (HIP), a new international airport, and a dry port the City's population is projected to grow to 825,804 by 2030. The rapid influx of people, many of whom are moving to the City for employment opportunities, has placed substantial pressure on the housing market. For example, the Hawassa Industrial Park is expected to employ around 84,000 people by 2025, significantly contributing to the demand for housing. As a result, housing prices have surged, and finding adequate and affordable housing has become a major concern for both residents and local authorities.

The rapid urban growth driven by industrialization, education, and migration has led to significant housing shortages. In response, there is an urgent need for strategic urban planning to manage the City's expansion and address the rising demand for affordable housing. The City administration, in collaboration with the corporate sector and civil society, must develop a cohesive strategy to ensure that future growth is sustainable and that the needs of both new and existing residents are met. This will require careful urban planning, development of affordable housing solutions, and the expansion of urban infrastructure to accommodate the growing population.

Moreover, Hawassa City has been expanding to incorporate new land from neighboring rural areas, with an estimated 20 square kilometers being added to the City's jurisdiction from surrounding rural kebeles. This expansion is part of the City's 10-year master plan, which aims to address the City's rapid urbanization and growing housing demand. This process of integrating rural land into the urban boundaries is reflected in the ongoing urban transformation and is indicative of the increasing pressure to accommodate the City's growing population and economic activities.

Satellite image analysis revealed that much of the urbanization from 2010 to 2020 was driven by agricultural extension programs and a desire to maximize agricultural output, which led to the expansion of farmland and settlements in the peri-urban zones. These developments are a result of urban expansion, which is often associated with land degradation in rural areas, as shown by previous studies. This trend is consistent with findings in other parts of Ethiopia, such as Alemu et al. (2015), who reported a reduction in woodland areas and an increase in agricultural land in response to urbanization.

The bushland areas around the City, such as those on the Alammura and Tabore hills, are characterized by a dense mix of shrubs, bushes, and trees, with varying density across different sections. These areas serve as transitional zones between urban settlements and the surrounding natural landscapes, contributing to the City's aesthetic appeal and ecological balance. However, the increasing urbanization is gradually encroaching upon these natural spaces, changing the landscape and creating challenges for the preservation of green spaces within the City.

In conclusion, the urban expansion of Hawassa City has significantly impacted the surrounding landscape, with notable increases in built-up areas, farmland, and bushland, and declines in forest land and cropland. The rapid urbanization has created significant challenges for housing, land management, and sustainable urban planning, necessitating a comprehensive approach to balance urban growth with the preservation of essential natural resources and the provision of adequate housing for the growing population.

**4.18 LULCC map encroachment between 1990 and 2020**

The study utilized conversion change maps to analyze the transformation of land use and land cover (LULC) over time, specifically between 1990 and 2020. These maps were generated using ArcGIS Desktop 10.8 with the Spatial Analyst Extension, which facilitated the overlaying of classified satellite images over the study period. By comparing the classified images from each decade, the conversion maps illustrated the changes in land use categories, revealing the gross gains and losses in each land cover type. The analysis showed distinct shifts in land use over the course of the 30-year period, with varying levels of conversion between different LULC categories (Figures 4.9 and 4.10).

According to the findings, built-up areas experienced a significant expansion, growing from just 5% (12.56 sq. km) of the City's total land area in 1990 to 18.71% (47.07 sq. km) by 2020. This dramatic increase underscores the City's urbanization, as land that was previously used for other purposes transitioned into residential, commercial, and infrastructural uses. Despite this growth, bushland, though decreasing in area, remained the most dominant land use category in the region, though its share shrank from 11.21 sq. km in 1990 to just 4.5% in 2020.

In contrast, significant reductions were observed in other land cover categories during the same period. Bare land, farmland, forest land, cropland, and water bodies all saw substantial decreases in both their geographical coverage and spatial distribution. These changes reflect the ongoing transformation of the City as it urbanizes and industrializes, leading to the conversion of natural and agricultural land into built-up areas to accommodate growing populations and economic activities. The spatial distribution of these land cover changes over time, from 1990 to 2020, is further illustrated in Table 4.12 and Figures 4.9 and 4.10.

One of the key drivers behind this land use change is the population growth in Hawassa, which has been accelerating due to urbanization and economic development. The opening of the Hawassa Industrial Park (HIP) in 2016 played a major role in this demographic shift. Initially employing 20,000 direct workers and 2,000 indirect workers, the HIP is projected to grow substantially, reaching a total of 84,000 workers by 2025. This influx of workers has contributed to increased demand for housing, and as a result, the City has seen a shift in housing preferences. Many residents are now opting for bungalow-type homes (single-tenant houses), rather than the traditional compound houses (multiple-tenant residences). This shift is reflective of broader architectural changes in the region, influenced by the rising demand for housing as a result of urban population growth and economic expansion.

The increased demand for housing in Hawassa is largely driven by market forces rather than coordinated urban planning. As the City expands and urbanizes, much of the development has been driven by private investments and speculative real estate activities, rather than being part of a comprehensive, long-term urban development strategy. This unregulated expansion can lead to informal settlement growth, posing challenges for City planners and exacerbating the pressure on housing infrastructure.

The growth of built-up areas in Hawassa, driven by rapid urbanization, industrial growth, and a surging population, has significant implications for the City's land use patterns and its future development trajectory. As the City continues to grow and evolve, addressing the challenges of sustainable urban expansion, affordable housing, and land use management will require careful planning and policy coordination to balance the City's economic needs with its environmental and social goals.

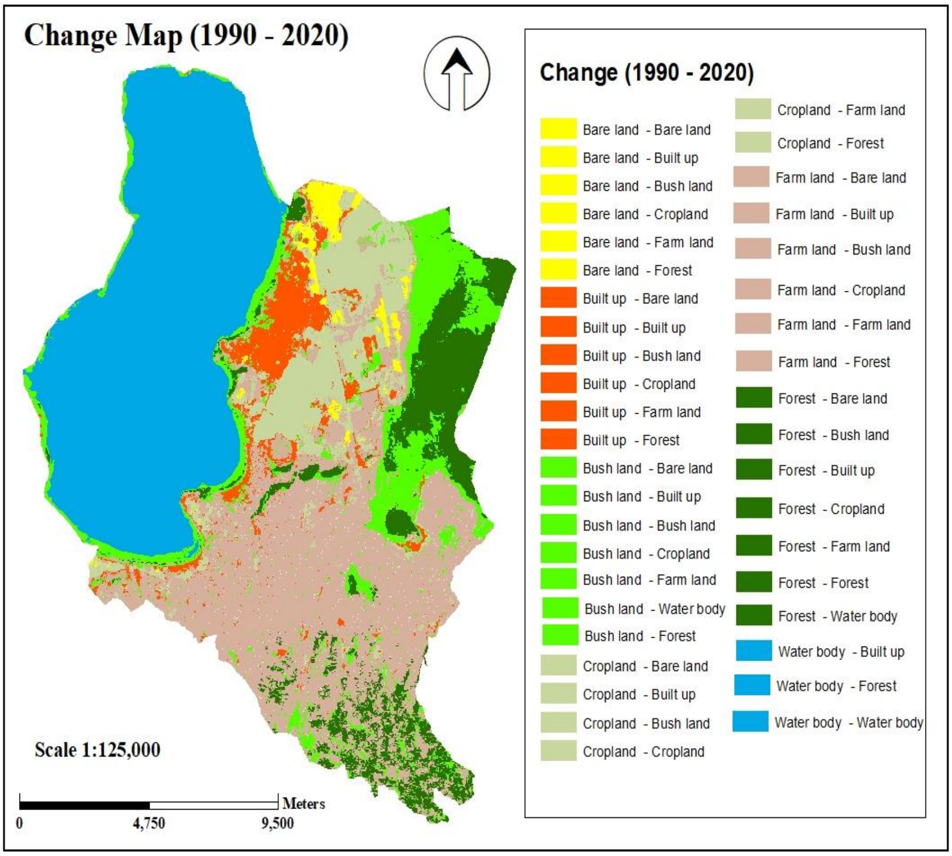



Figure 4.11 Illustrates the LULC encroachment between 1990 and 2020.

Source: U.S. Geological Survey (USGS) http://glovis.usgs.gov

## 4.19 Discussion

This study investigates both the physical and socioeconomic driving forces behind land use and land cover (LULC) change, with a particular focus on Hawassa City. A total of 317 households from the peripheral areas surrounding the City were surveyed to understand the impacts of urban expansion on the local communities. The study utilized a combination of remote sensing tools, including ArcGIS 10.8, GPS, and GPS receivers, to capture LULC data. Additionally, primary data on the social and economic impacts of urban growth were gathered through questionnaires, key informant interviews, and focus group discussions.

The analysis of LULC change was conducted using descriptive statistics, including means, frequencies, and percentages. Landsat satellite images from USGS (Landsat 5, 7, and 8) were used to track land use changes over time. In terms of the statistical analysis, the study also applied the Chi-square test to examine the relationship between different socioeconomic variables and the observed land use changes.

Key findings of the research show significant shifts in land use over the study period (1990 to 2020). Built-up areas expanded dramatically from 5% of the land area in 1990 (12.56 sq. km) to 18.71% in 2020 (47.07 sq. km), reflecting the rapid urbanization of the City. While bushland remained the most common land use category, its coverage decreased from 11.21 sq. km (1990) to 4.5 sq. km by 2020. In contrast, other land categories, such as farmland, cropland, forest land, and water bodies, experienced a significant reduction in coverage. This shift in land use reflects the City’s ongoing growth and urbanization pressures.

The factors driving this expansion of built-up land are multifaceted and include physical, socioeconomic, and policy influences. Physical factors such as topography, access to infrastructure, and land availability are critical, as well as socioeconomic factors like population growth, migration, and demand for housing. Policy factors, while crucial, are difficult to quantify and spatially analyze. Therefore, the study used physical and socioeconomic factors as proxies for policy factors, assuming that policies interact with these elements to drive urban growth. Notably, urban land expansion is often driven by a mix of government policies, market forces, and local socio-economic conditions, a dynamic that can lead to uneven or uncoordinated development patterns.

The geographical detector methodology, applied in this study, proves effective in assessing the influence of various factors on urban expansion. This method, which has the ability to identify the relative importance of different drivers and their interactions, is particularly useful in regions lacking comprehensive historical data. By analyzing spatial and temporal variations in driving factors, the geographical detector enables researchers to uncover complex relationships between socio-economic processes and urban development. This approach could be adapted for future studies in larger areas with access to more extensive historical data.

In relation to Hawassa City's urban expansion, the study highlights that the City has a master plan for the next decade. This plan has driven significant growth, including the incorporation of surrounding rural areas into the City's jurisdiction. Over the past few years, both government and private sector projects have been launched at a rapid pace, resulting in an increase in demand for residential and commercial land. This demand has been further exacerbated by urbanization, population growth, and the influx of people seeking employment in the City's expanding economic sectors, such as the Hawassa Industrial Park (HIP).

Comparing this case with urban development trends in other parts of the world, such as the Greater Cairo Metropolitan Region (GCMR), reveals similar patterns of rapid urban sprawl despite the existence of urban plans. In the case of GCMR, urban sprawl rates have increased significantly, from 3.4% annually in the 1990s to more than 6.3% in the 2010s (Osman et al., 2016). This increase in sprawl is largely attributed to the failure of urban plans to consider the real demands of local communities, resulting in unchecked land use outside designated urban areas. In both Hawassa and GCMR, it is clear that more effective urban planning practices are needed to guide development and prevent haphazard sprawl.

The study also examines the impact of urban expansion on the livelihoods and socioeconomic conditions of peripheral farmers. The results reveal that many farmers have experienced significant challenges as a result of the rapid urbanization of Hawassa. These challenges include the loss of agricultural land due to encroachment, illegal and uncontrolled sewage disposal, and the broader effects of cultural diffusion and psychological stress. Farmers are also facing increasing pressure as urban development intrudes upon their land, reducing their ability to maintain their livelihoods.

One critical issue raised by the participants is the government's approach to land acquisition. Many farmers have reported that their land has been taken by authorities without adequate compensation, a practice that exacerbates the social and economic impact on local communities. This, coupled with the growing influence of private developers, has further fueled urban expansion, especially in the peripheral areas of the City. Mismanagement, lack of effective policy enforcement, and corruption in land acquisition processes have contributed to uncontrolled urban growth, which often undermines the City's planned development.

In light of these findings, the study recommends that the City administration take a more proactive role in managing urban expansion and its effects on the peripheral communities. Specifically, the government should avoid policies that undermine the livelihoods of farmers and rural households. Practices such as offering inadequate compensation, displacing farmers without proper support, and failing to provide agricultural extension services must be reconsidered. There is also a pressing need for the City to develop better strategies for accommodating the increasing population through effective horizontal expansion, as well as providing better economic opportunities for displaced individuals.

To support this transition, the City should establish a dedicated office to coordinate technical support, including training and education for displaced farmers. This office could help facilitate the relocation process, create alternative livelihood opportunities, and provide a stable economic environment for those affected by urban growth. Such an approach would ensure that the benefits of urbanization are more evenly distributed, and that the socio-economic costs to vulnerable populations are minimized.

In conclusion, the study highlights the critical role of urban planning in managing the impacts of urban expansion on both land use and the surrounding communities. By considering the complex interplay of physical, socioeconomic, and policy factors, and by ensuring that the voices of local communities are incorporated into decision-making, Hawassa City can better navigate its rapid urban growth while minimizing the negative impacts on peripheral residents.

Based on the findings of this study, the following recommendations are proposed to ensure the sustainable and equitable management of urban expansion in Hawassa City. These suggestions focus on addressing the challenges associated with rapid urban growth, promoting community participation, and fostering effective planning strategies that balance the needs of both urban and rural populations.

Anticipate and Plan for the City's Future Growth: Urban planning authorities and City officials in Hawassa should take a proactive approach to urban growth, anticipating the long-term consequences of rapid and unbalanced physical expansion. It is essential to understand the implications of urban sprawl on infrastructure, public services, and environmental resources. Future planning should incorporate forecasts for population growth, economic development, and the evolving needs of the City's residents. Planners should prioritize infrastructure upgrades (e.g., transportation, sanitation, utilities) in tandem with urban growth to ensure that the expansion is sustainable and that public services are distributed equitably across the City.

Engage Local Communities in the Urban Planning Process: The current urban expansion strategy has largely excluded local communities, particularly those living on the periphery of the City, from the planning and implementation stages. This lack of community involvement has led to displacement and disruption of livelihoods without adequate preparation. It is critical that future urban planning processes include community consultations, allowing residents to express their needs, concerns, and suggestions. Prior to any displacement or relocation, it is recommended that the local government provide targeted livelihood support programs for affected families. These programs could include vocational training, skills development, financial literacy workshops, and other initiatives designed to diversify household income sources and prepare families for the economic shifts caused by urbanization.

Establish a Fair and Comprehensive Compensation System: As urban expansion progresses, many rural families will lose agricultural land to development, leading to displacement. The government must establish a dedicated agency or body responsible for ensuring fair compensation for displaced residents. Compensation should go beyond monetary payouts; it should include the provision of alternative land for resettlement, access to housing, and assistance with finding new livelihood opportunities. An effective compensation package should seek to replace not just the physical assets (land, crops, etc.) lost by households, but also the socio-economic opportunities and security that come with agricultural land ownership. A transparent and accessible grievance redress mechanism should also be in place to resolve any disputes related to displacement or compensation.

Develop a Comprehensive and Forward-Looking Urban Planning Framework: To manage the rapid growth of Hawassa City effectively, a more comprehensive urban planning framework must be established, one that emphasizes long-term sustainability. Urban planning policies should prioritize well-organized land use, integrating residential, commercial, industrial, and green spaces in a balanced way. A master plan should be designed with flexibility, allowing for adaptive responses to unforeseen challenges or population changes. The plan must also consider environmental sustainability, ensuring that urban growth does not come at the expense of critical natural resources such as water, soil, and green spaces. Urban policies should also include provisions for mitigating environmental risks, such as flooding, pollution, and heat islands, which can arise from uncontrolled urban sprawl.

Strengthen City Management and Coordination: Effective urban management requires close coordination between various levels of government, urban planners, and other key stakeholders, including community leaders, local businesses, and non-governmental organizations. To ensure that urban growth remains orderly and sustainable, municipal officials and urban planners must work collaboratively to implement policies and regulations that guide development. The City should foster an environment of transparency and accountability, where residents and stakeholders can participate in decision-making processes. Moreover, inter-agency collaboration should be encouraged to address cross-sectoral issues such as transportation, housing, sanitation, and healthcare, all of which are interdependent in a growing urban environment.

Enhance Capa City Building for Urban Planning Professionals: For urban expansion to be well-managed there is a need for a robust cadre of skilled professionals in urban planning, architecture, engineering, and environmental management. Investment in training and capacity building for professionals is critical to ensure that they are equipped with the necessary skills and knowledge to deal with the complexities of modern urbanization. Planners and City officials should be trained on the latest tools and techniques in land use planning, GIS technologies, sustainable development practices, and community engagement strategies. This will enhance the City's ability to respond to challenges more effectively, plan for future growth, and integrate sustainability into all aspects of urban development.

Implement Proactive Monitoring and Evaluation Systems: A key recommendation is the establishment of a monitoring and evaluation system that tracks urban development trends and measures the impacts of urbanization on various aspects of the City, including social, environmental, and economic factors. Such a system would allow policymakers to identify potential problems early on and make data-driven decisions to adjust plans as necessary. Regular assessments of the effectiveness of urban planning policies and their implementation would enable the City to refine its strategies and ensure that urbanization remains balanced and beneficial for all residents, including those in peri-urban areas who are most affected by land use changes.

Prioritize Sustainable Development and Green Infrastructure: To mitigate the negative environmental impacts of urban expansion, Hawassa City must prioritize sustainable development practices. This includes incorporating green infrastructure, such as parks, tree-lined streets, and water conservation systems, into urban planning. Protecting natural resources and creating spaces for biodiversity should be central to the City's growth strategy. The integration of renewable energy solutions, waste management systems, and eco-friendly construction practices will help create a resilient urban environment that can withstand the pressures of rapid population growth and climate change.

By implementing these recommendations, Hawassa City can avoid the pitfalls of unchecked urban expansion and create a thriving, sustainable urban environment that benefits all of its residents. Through collaborative planning, fair compensation, community engagement, and sustainable policies, the City can manage its growth in a way that balances development with the well-being of its citizens, the environment, and future generations

### 4.20 Conclusion

Urban expansion is a global phenomenon occurring at varying rates and in diverse forms, driven by a complex set of factors. In Ethiopia, and particularly in the case of Hawassa City, several key drivers of urbanization include declining agricultural productivity and land fertility, the pressure of population growth on rural land, inadequate land tenure security, rural-urban migration, and natural population growth. In addition, the decentralization of power, the government's housing policies, urban bias, and the reclassification of rural areas into urban zones all contribute to the rapid urbanization of both rural and peri-urban spaces. Exaggerated perceptions of urban life, largely shaped by mass media and government promotion, also play a role in fueling the migration towards urban centers.

Hawassa City is experiencing significant residential density, particularly near the City center and its major employment hubs, where the population density reaches as high as 25,000 people per square kilometer. In newly urbanized districts such as Dato, Chefe, Monopol, and Wondo-Tika, the density is somewhat lower but still considerable, with an estimated 20,000 people per square kilometer. Meanwhile, districts such as Hawella-Tula and areas near the lake maintain relatively low population densities, with proposed targets of 10,000 to 15,000 people per square kilometer.

Urbanization in Hawassa, like in many cities, offers considerable economic, social, and cultural advantages. Urban areas provide access to more diverse employment opportunities, better services, enhanced economic activities, and technological advancements. Urbanization also facilitates cultural exchange, social integration, and political mobilization, which are critical for democratic growth and governance. However, urbanization also brings about several challenges, particularly in relation to land use and socio-economic inequalities.

Land, as a fundamental resource, is central to both identity and livelihood, particularly for rural communities. In the case of Hawassa, the government’s land expropriation processes, undertaken for urban development purposes, have often been controversial. Many families in peri-urban areas have lost their agricultural land without receiving fair compensation, leading to social unrest and deepened economic divides. This lack of fair compensation, particularly in the context of rapid urbanization, raises concerns about land security, unemployment, and the loss of community-based resources. The growing gap between rich and poor exacerbates the inequalities within the City, further driving social instability.

Hawassa City’s rapid expansion has resulted in both positive and negative consequences. The City’s demographic and infrastructural growth has created a range of opportunities for social and economic advancement. However, this progress has been accompanied by rising unemployment rates, social instability, and the emergence of new forms of dependency, such as addiction. Moreover, the incorporation of peripheral rural areas into the City’s boundaries has resulted in significant changes in land use. Former agricultural areas, including grasslands, forests, and open spaces, have been transformed into residential, industrial, and other urban uses, despite fluctuations in urban agricultural practices.

The City's expansion has been largely horizontal, with the City expanding outward into the surrounding rural and peri-urban lands, which offer relatively low land acquisition costs and a suitable landscape for settlement. However, this rapid horizontal expansion has negatively impacted local farming communities, many of whom have been displaced in the process. Despite the government's attempts to raise awareness about the urbanization process through public meetings and training, the farming communities have had little to no participation in key decisions regarding the land compensation process. Most significantly, the affected communities were excluded from discussions about the types and amounts of compensation they would receive for their lost property, land, and livelihood.

In Ethiopia, and many other developing countries, the involvement of local stakeholders in decisions about urban expansion and compensation is not typically a part of urban planning practices. As a result, the dissatisfaction with land compensation has been widespread. In the case of Hawassa, many displaced families received compensation amounts that were far below the market value of their land and property, and many were not provided with suitable housing or replacement plots. For some households, compensation decisions were made unilaterally by City authorities, without consultation or agreement from the affected families. This lack of transparency and stakeholder engagement has led to deep grievances within the affected communities.

In terms of policy gaps, the study found significant deficiencies in the planning and implementation of the urban expansion strategy. Farmers and displaced households were often not informed in advance about the urban expansion plans or provided with adequate educational support regarding the expropriation process. Many displaced families received compensation that was far lower than the value of their land or property, and in some cases, children under the age of 18 were denied access to any compensation, including land or housing. These shortcomings have led to a breakdown in governance and have created significant obstacles to the City's development.

The issue of land valuation and compensation is one of the most contentious aspects of urban expansion in Hawassa. Key informants and participants in focus group discussions highlighted that the methods used to value land and property for compensation were inconsistent, unfair, and did not align with national standards. This lack of fairness in the valuation process has contributed to a growing sense of injustice among affected communities, undermining the overall legitimacy of the urban expansion program.

In conclusion, while urbanization in Hawassa City has generated numerous benefits in terms of economic growth and social integration, it has also created a host of challenges, particularly for rural and peri-urban communities. The exclusion of these communities from the decision-making process, inadequate compensation for expropriated land, and the lack of transparent governance mechanisms have hindered the effectiveness of the urban expansion program. To address these challenges, it is crucial that future urban development policies ensure greater stakeholder participation, fair compensation, and a more transparent approach to land expropriation. Only then can the City's growth be managed in a way that is both equitable and sustainable.

# CHAPTER FIVE

## 5. Challenges of urban land management in the case of Hawassa City, Ethiopia


### Abstract

*The purpose of this study was to explore the challenges associated with urban land management and the enforcement of land use regulations, using a combination of both quantitative and qualitative research methodologies. The research employed a diverse set of* *data collection instruments, including surveys, interviews, focus groups, and official records, to capture a comprehensive view of the land management issues in the study area. The data were systematically organized, tabulated, transcribed, coded, and analyzed through various statistical and thematic approaches to identify key patterns and trends. One of the major findings of this study is the significant increase in land lease prices between 2015 and 2016, where the lease price rose by an alarming 457%. This drastic increase was found to have substantial implications for the affordability of land, particularly for low- and middle-income households. The statistical analysis revealed that the F-ratio was 91.656, with a highly significant p-value of 0.000, indicating that the price hike was statistically significant and had a notable impact on land accessibility. The analysis underscores the growing difficulty that lower-income groups face in securing land at the new lease prices, further exacerbating inequalities in urban land access. Given these findings, the study recommends several policy interventions to address the challenges of land accessibility in the study area. First, it is crucial for local government authorities to pay greater attention to the factors influencing the ability of middle- and low-income groups to access urban land. Local governors, in collaboration with the  City municipality, should prioritize providing sufficient land supply, ensuring that the land lease process is competitive and transparent, and addressing any unfair practices that may undermine access to land. Ultimately, the findings of this study suggest that a more equitable and accessible urban land management system is necessary to address the growing urbanization challenges.*

**Keywords:** Hawassa Industrial Park, land use, land management, Informal settlement, Variance Inflation Factor, urban area

## 5.1. Introduction

Land is a highly valued asset, representing approximately 30.5% of national wealth in developing countries. Land governance involves the management of land, property, and natural resources through policies, processes, and institutions at the global level. It encompasses decisions regarding land access, rights, use, and development. According to Deininger et al. (2011), land governance includes the policies, processes, and institutions that guide the management of land and resources, focusing on issues such as land access, land rights, land use, and spatial planning. As defined by the World Bank (2011), land governance is fundamentally about creating and implementing sustainable land policies that foster a strong relationship between people and land.

In rapidly developing countries like Ethiopia, the relationship between people and land is highly dynamic, driven by the fast-growing population. Effective land management is crucial to addressing the evolving needs of the population, as it helps prevent issues such as illegal land transfers, corruption, lack of transparency, and restricted community participation. One of the primary goals of land management systems are to serve the people efficiently and effectively (Williamson, 2015).

In Ethiopia, there is a lack of a cohesive urban land strategy that integrates the actions of all institutions involved in land management. The administration of land in urban areas is hindered by the limited capa City of central governments to facilitate land management, unclear roles between national and local governments, and weak collaboration with civil society. Furthermore, urban areas face a shortage of financial resources, insufficient institutional and professional competence, and cumbersome procedures that make effective urban land management challenging. According to Njenga (2009) and Kefyalew (2012), urban land management must adopt principles of good governance, such as efficiency, accountability, and transparency, to overcome these challenges.

In Hawassa City, urban land management faces several obstacles, including poor land use administration, an outdated City structural plan that fails to address informal settlements effectively, limited human resources, inadequate budgets, weak institutional capacities, and a lack of technical materials. The absence of effective land registration systems and a lack of commitment to improving land management further exacerbate these issues. Studies have shown that factors such as income levels, rent values, available facilities, and the nature of residential areas all contribute to poor land use planning, leading to non-compliance with land use guidelines. As a result, households often resort to traditional methods to find living spaces, contributing to unsustainable urban planning practices in many cities (Osumanu et al., 2016).

This study identifies several challenges in land management, particularly in urban areas like Hawassa City. It highlights issues with formal land acquisition processes, inefficiencies in land supply, and the inadequate institutional framework for implementing the City's master plan. The research also examines strategies for reducing the informal land market through more effective land management and administration. The findings aim to address these challenges by exploring potential solutions for improving land governance in urban contexts.

The study by Takele et al. (2014) highlights significant challenges to good governance in Hawassa, specifically in relation to land management. It underscores the critical role land plays in urban residents' ability to improve their living conditions, particularly for the urban poor who face severe affordability constraints when attempting to access land. The authors argue that urban residents, particularly low-income groups, are not sufficiently included in land delivery processes, which further exacerbates their struggles to improve their living conditions. This exclusion is largely due to the absence of effective administrative mechanisms to engage the public in the land allocation and management process.

According to Takele, B., et al. (2014) this lack of inclusivity and transparency in the land delivery process significantly undermines governance and is a major contributor to poor urban governance in Hawassa. This is consistent with the findings of the Sidama Regional State (2012), which assessed public opinion on good urban governance in Hawassa and other cities in the region. The assessment found that urban land management practices were viewed negatively by the public, with several concerns raised about the lack of transparency, fairness, and accountability in land allocation processes.

The criticisms of Hawassa's land administration include widespread corruption and the lack of transparency in the allocation of land. Municipalities, responsible for managing urban land, have been accused of engaging in unfair practices, including corrupt dealings that undermine the public trust. For example, land allocation is often described as being influenced by personal connections, with limited regard for merit or need. The involvement of middlemen in the land allocation process has compounded the problem, as they profit from illegal rent collection and brokering public land, leading to a further erosion of public trust.

Research by other scholars further supports these findings. In Ethiopia's rapidly urbanizing cities, land remains a crucial asset for economic and social mobility, and the poor are particularly vulnerable to exclusion from the formal land market (Tadesse, 2012). Tadesse points out that informal land markets, often governed by corrupt middlemen, are a significant feature of the land administration system in many urban areas, particularly where municipalities fail to regulate land access and allocation effectively. These informal land markets often lead to the exploitation of the urban poor, who may end up paying inflated rents or being coerced into illegal land transactions.

In similar studies, Fufa and Asnake (2013) emphasize that effective land administration is essential for fostering social inclusion and economic growth. The failure to ensure fair access to land can lead to deepening inequality, as those who cannot afford to pay rent or participate in the formal land market are left with limited options. Moreover, land insecurity and lack of proper documentation can prevent low-income residents from improving their living standards or accessing credit, further entrenching poverty.

The challenges faced by Hawassa, as documented by Takele et al., 2014 are emblematic of broader governance challenges in Ethiopia’s urban areas. The lack of effective governance mechanisms, including public participation in land management, corruption, and illegal practices, results in the exclusion of the poor and exacerbates urban inequality. Reforming land management practices, increasing transparency, and strengthening administrative structures to engage the public in decision-making are key steps needed to improve urban governance in Hawassa and other Ethiopian cities

## 5.2 Materials and methods

Hawassa, the capital of the Southern Nations, Nationalities, and Peoples' Region (SNNPR) of Ethiopia, is located in the Ethiopian Rift Valley, an area of significant geological and environmental importance. The City lies at an average elevation of approximately 1,690 meters above sea level, situated within a largely level plain that forms part of the broader Rift Valley system. This unique geographical setting provides the City with a moderate climate, which is an attractive feature for both residents and tourists alike. The proximity of Hawassa to Lake Hawassa, a key water body in the region, further enhances its environmental appeal.

The City’s geographical coordinates extend roughly between Latitude 7°03'43.38" North and Longitude 38°28'34.86" East, positioning it in a strategic location within Ethiopia. These coordinates place Hawassa in the heart of the Rift Valley, providing access to important regional transportation corridors that connect various parts of the country. The City is surrounded by picturesque landscapes, including hills, wetlands, and the expansive lake itself, making it both a natural and urban hub in the Southern region of Ethiopia.

Hawassa covers a total area of approximately 159 square kilometers, which includes both urban and rural zones. The City’s boundaries are primarily situated in the eastern part of the region, where it serves as an administrative, economic, and cultural center. The surrounding land is fertile, and the area is known for its agricultural activities, which include farming, fishing, and livestock keeping. As the population of Hawassa grows, there is increasing pressure on the surrounding land for urban expansion, putting a strain on local resources and requiring careful urban and land management.

The City’s location within the Rift Valley also places it in an area with a rich history of tectonic activity, which has shaped both the physical and cultural landscape of the region. Hawassa’s development has been influenced by the geological features of the valley, including the presence of fault lines and volcanic activity, which contribute to the area's fertility but also present challenges in terms of land stability and infrastructure development. The proximity to Lake Hawassa itself also plays a crucial role in the local economy, as it supports both tourism and various livelihoods based on fishing and water resources.

Given the City’s expansive size and the diverse landscapes it encompasses, Hawassa is at the intersection of urban growth and environmental sustainability. As the City continues to expand both geographically and demographically, the careful planning of land use and infrastructure becomes increasingly important to ensure that it can accommodate its growing population while maintaining the balance between urbanization and the preservation of the natural environment. The surrounding rural areas, with their agricultural focus, also face challenges from urban sprawl, which has led to the encroachment of urban development on traditional farmland, complicating the management of land resources in the region.

In conclusion, the geographical setting of Hawassa, with its flat plains, moderate altitude, and proximity to significant natural features such as Lake Hawassa, plays a central role in shaping the City’s urban dynamics. As the City continues to evolve, understanding the geographical and environmental context will be crucial to its sustainable development.

### 5.2.1 Historical Development of Hawassa City

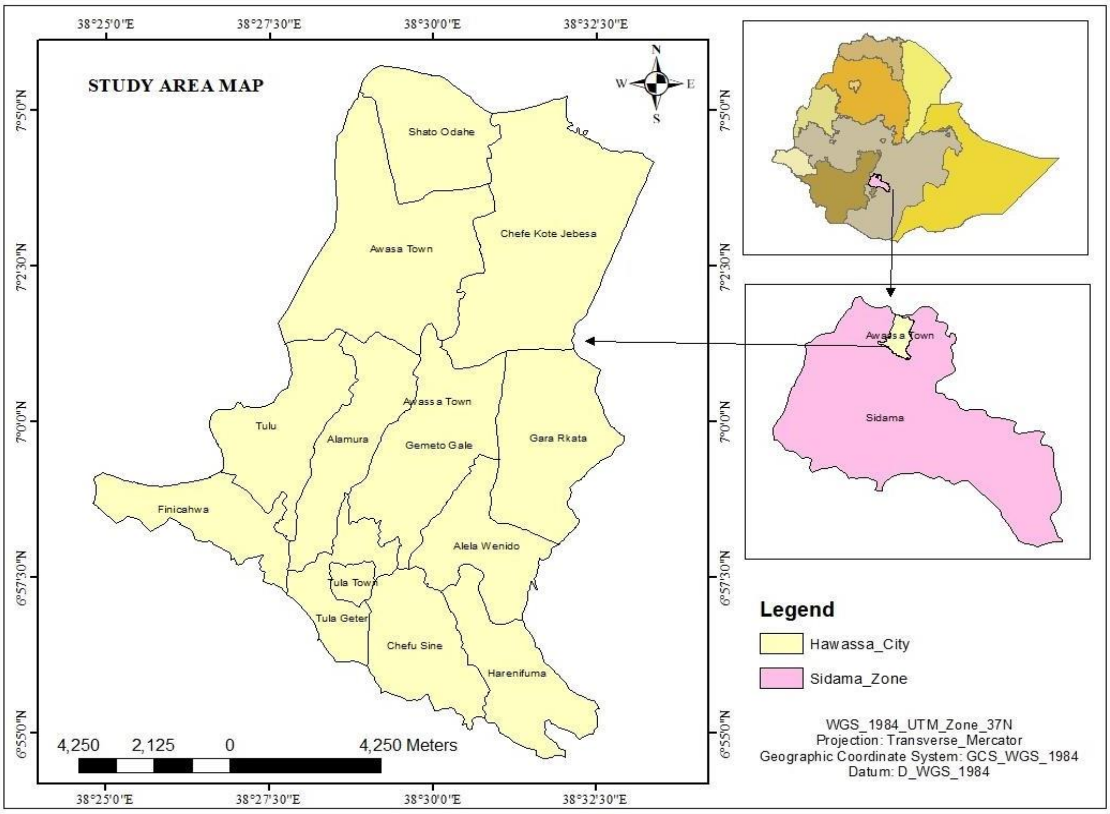



Figure 5.1 Location map of study area map

### 5.2.2 Research design

Descriptive research design is a methodological approach used to gather both quantitative and qualitative data to provide a detailed description of the issue or phenomenon being investigated, as it exists in its present form. This type of design is often employed to understand the current state of a problem or condition, offering a comprehensive view of the subject under study. To ensure the validity of the research design, the researcher conducted a pre-test of the data collection instruments before the actual study began. This preliminary testing allowed the researcher to assess whether the tools used for gathering information were appropriately designed and capable of capturing the necessary data accurately.

In terms of ensuring the reliability of the research design, the researcher took an additional step to confirm the consistency and dependability of the data collection process. This was done by administering the same set of data collection instruments to the same group of participants at different intervals, allowing for a comparison of results over time. By doing so, the researcher was able to assess whether the instruments yielded consistent responses, thus validating the reliability of the findings. This approach is particularly important in descriptive research, as it ensures that the observations and measurements obtained are both stable and reproducible, thereby enhancing the credibility and trustworthiness of the research outcomes.

Overall, the use of a pre-test to validate instruments and the repeated administration of data collection tools to the same participants were critical steps in ensuring that the descriptive research design effectively captured the current state of the issue under investigation and produced reliable, valid results. This methodological rigor helps to strengthen the overall quality of the study and supports the accuracy of the conclusions drawn from the research.

### 5.3 Sampling techniques and sample size determination

For this study, the researchers employed a multistage sampling technique, which is particularly useful in complex studies where there are multiple levels or groups of participants involved. This approach was selected because it allows for a more organized and efficient method of selecting key informants and other participants, who are considered valuable sources of information regarding both the broader urban land management issues and the specific challenges faced in the study area. By using multistage sampling, the researchers could ensure a more representative sample of the population, allowing for a comprehensive analysis of the problem at hand.

The focus of the study was on understanding the challenges of urban land management within the study area, which was chosen as the unit of analysis. This meant that the researchers aimed to gather insights from individuals who could provide a thorough understanding of the issues related to land management practices, policy implementation, and urban planning within the context of the City. To ensure the inclusion of a wide range of perspectives, both qualitative and quantitative data were collected, involving the participation of individuals with different experiences and knowledge of the urban land management system.

As part of the sampling process, questionnaires were distributed randomly to households in the study area. The selection of these households was based on a sampling frame that ensured a broad cross-section of the community, helping to capture diverse opinions and experiences. By randomly selecting households, the researchers minimized selection bias and ensured that the sample was representative of the broader population. This approach enhances the validity of the study by providing a more accurate picture of the challenges faced by the community in terms of urban land management.

Additionally, Table 5.1 (which likely provides further details about the sampling frame, distribution of questionnaires, and the specific number of households selected) offers a clear breakdown of how the sample was constructed, allowing for transparency in the research process. Overall, this multistage sampling technique ensured that the study included a wide variety of perspectives, making the findings more robust and applicable to the broader context of urban land management challenges in the area.

Therefore, assuming that the size of the targeted population was greater than or equal to10,000 the sample size of the study was, $n=z^2pq/d^2$ n= (z =1. 96, p=0. 5, q=0. 5, d=0. 05), subsequently the product was,

$$n = \frac{z^2 pqN}{e^2(N-1)+z^2pq} \quad \text{.........................................................................}(1)$$

| |
|---|
| ~~$n=z^2pq/d^2$ =~~ ,Where n=, the desired sample<br>sizeZ =, confidence level (95=1.96)<br>P =, estimated characteristics of study population<br>(0.5)q =1-p =1-0.5= (0.5)<br>d = level of statistical significance which was set margin of error (5%) which taken forthis research (0.05) |

$$\frac{(1.96)^2(0.5)\,(0.5)}{(0.05)^2} = 385$$

Finally, 385 houses were identified using basic random sampling processes. The number of respondents was determined using a probability proportionate to the population size of each kebele. The list of homes was obtained from kebeles to create the sampling frame, and the sample size was calculated using. The number of sample homes was estimated using Kothari's (2004) technique, which involved evaluating the allowable error margin and establishing the confidence level.

Table 5.1 Distribution of sample households among the selected Kebeles

| S.N | Name of Kebele | Total Household | Sample Household |
|---|---|---|---|
| **1** | Alammura | 2500 | **2500*385/16,640= 59** |
| **2** | Dato | 2000 | 2000*385/16,640= 46 |
| **3** | Tulla-Rural | 1800 | **1800*385/16,640= 42** |
| **4** | Millennium-Adebeye | 2650 | **2650*385/16,649= 61** |
| **5** | Pissa | 4929 | **4929*385/16,640= 114** |
| **6** | Guwe Stadiun | 2761 | **2761*385/16,640= 64** |
| Total | | 16,640 | 385 |

**5.4 Data Collection**

In this study, several primary data collection strategies were employed, selected for their relevance, effectiveness, and simple City in addressing the research objectives. These methods were carefully chosen to ensure comprehensive data gathering while also being practical in terms of implementation. The strategies included:

**Questionnaire**

In this study, both structured and unstructured questionnaires were designed and utilized as key instruments for data collection. The researcher developed the questionnaires to gather comprehensive information from the local community members. These questionnaires were distributed to residents in the study area to capture a range of data. The format of the questionnaire was a mix of closed and open-ended questions, allowing for both quantitative and qualitative insights. Closed-ended questions provided structured responses, while open-ended questions allowed participants to express their views and experiences more freely. This combination of question types ensured that the data collected was both detailed and versatile, offering a well-rounded perspective on the issues under investigation

**Interview**

The information obtained from the questionnaire was not enough to finalize the study, as it is necessary to have face-to-face contact with important people to get more information. To generate necessary data structured and unstructured interviews were conducted with 20 key informants. Those key informants who participated in this study were four City-level officials, 4 sub-cities-level officials, 6 Kebeles-level development committee coordinators, and 6 village- level development committee coordinators. The researcher believes that to consolidate the quantitative data from representative respondents, 20 key informant interviews were enough.

**Focused Group Discussion (FGD)**

The Focus Group Discussion (FGD) was conducted with a carefully selected group of individuals, ensuring that participants were chosen in proportion to their gender, regardless of age, educational background, religious beliefs, or economic status. The selection criteria for the FGD participants emphasized their experience in the community and their willingness to share personal insights and stories openly. Efforts were made to foster a relaxed and inclusive environment, where participants felt comfortable contributing without fear of judgment or domination by any individual. The discussion was intentionally designed to encourage free-flowing dialogue, ensuring that all participants had an equal opportunity to voice their opinions and share their experiences. The researcher assumed the role of facilitator, guiding the conversation and ensuring that the discussion remained focused on the study's objectives, while also promoting an atmosphere of mutual respect and engagement among the participants.

**Observation**

The researcher aimed to examine the challenges related to institutional structures and land management practices within the study area. This investigation involved closely observing the current state of key issues, such as the effectiveness of organizational service delivery and the performance of land management systems, particularly concerning land transfers for various purposes. The study sought to understand how well the institutions responsible for land governance are functioning, focusing on their ability to manage land transactions, allocate resources, and meet the needs of the community. By scrutinizing the processes of land transfers, zoning, and allocation for different uses, the researcher aimed to identify bottlenecks, inefficiencies, or gaps in the existing land management framework. The goal was to provide insights into how institutional factors impact urban land use, planning, and development, with an emphasis on the challenges faced in delivering land-related services effectively and equitably in the study area.

## 5.5 Methods for Data Analysis

The data collected through the four instruments outlined earlier were systematically organized, processed, and analyzed using a range of methods to ensure thorough examination. Initially, the data was compiled, tabulated, transcribed, coded, and categorized to facilitate a structured analysis. To better understand the patterns and trends in the data, the study employed both descriptive statistics and advanced statistical techniques. Descriptive statistics, such as frequency distributions and percentages, were used to summarize the characteristics of the sample and provide an overview of the key findings. In addition, a binary logistic regression model was applied to assess the relationships between variables and to predict outcomes based on the data. For the analysis, the study utilized the Statistical Package for Social Sciences (SPSS v.20), a widely used software for statistical analysis, which allowed for the processing and interpretation of both qualitative and quantitative data. This comprehensive approach provided a robust framework for examining the research questions and drawing meaningful conclusions from the study's findings.

### Econometric model specification

The binary logistic regression model is a suitable analytical approach when the dependent variable is categorical and consists of two distinct outcomes, typically represented as binary values (0 and 1) or more levels (Tathdil, 2002). In this study, the researcher applied a binary logistic regression model because the dependent variable (Y) is a binary outcome, while the independent variable (X) represents the factors that potentially influence or predict this outcome.

To better understand the relationship between these variables, the study employed a logistic distribution function. This function is used to model the probability that the dependent variable falls into one of the two categories based on the values of the independent variables. The logistic regression model transforms the predicted values into probabilities, which range between 0 and 1. This enables the researcher to assess the likelihood of the dependent event occurring as a function of the independent variables.

The mathematical representation of the logistic regression model used in this study is based on established works in the field, including those by Maddala (1986), Greene (1993), and

Gujarati (1995). These scholars outlined the theoretical foundation of logistic regression, providing a framework for interpreting the relationship between the binary dependent variable and the independent predictors. By applying this model, the study is able to offer insights into how various factors (X) influence the likelihood of a particular outcome (Y), contributing to a deeper understanding of urban land management challenges in the study area.

$Pi = \in (Y = 1/Xi) = 1\ 1 + e - (\beta 1 + \beta 2 Xi)$ …………………………..……..............................(1)

The multiple linear regression equation for this study is:

$Y = \beta 0 + \beta 1X1 + \beta 2X2 + \beta 3X3 + \beta 4X4 + \varepsilon$…………………………………………………(2)

Thus, non-linear logistic regression model is liberalized based on both its parameters and variables. “L” is called “logit” and models such as this called “logit models” (Gujarati, 1995). In these situations, Equation 3 is used for proper transformations:

$Pi = \in (Y = 1\ Xi1\ 1 + e - (\beta 1 + \beta 2X1 + \beta 3X2 + \cdots + \beta kXk)$ ……………………………………..(3)

Odds and odds ratio are significant terms in a logit model. Odds are defined as the ratio of the number of events that occurred to number of events that did not occur. “Odds ratio” on the other hand, is the ratio of two odds, in other words, the ratio of likelihood to another. In Equation 4, two probabilities, compliance and non-compliance probability of an event are proportioned .This is the odds of proportion. It is important to understand that possibility, odds, and logit concepts, are three different ways of explaining the same thing (Menard, 2002).

$Zi = \beta o + \varepsilon \beta iX + Ui$…………………………………………..…...............................(4)

Therefore, the above binary logit econometric model was used for the study to identify majorfactors affecting urban land use management compliance status.

### 5.6 Definition and measurement of study variables and hypothesis

#### 5.6.2 Independent Variables

The extent to which land use in the study area complies with planning regulations is influenced by a variety of independent variables, including economic, institutional, legal, and social factors. These factors are considered critical for understanding the dynamics of urban land management and the factors that may facilitate or hinder compliance with land use guidelines.

**Gender:** The gender of the household head is included as a dummy variable, where the value of 1 represents male-headed households, and 0 represents female-headed households. Gender is recognized as a significant factor influencing land use compliance. It is hypothesized that male-headed households may be more likely to adhere to land use regulations, due to differences in access to resources, decision-making power, and social expectations. Therefore, gender disparities are expected to impact the level of compliance with planning rules.

**Age:** Age is considered as a continuous variable measured in years. The age of the household head is expected to play a role in influencing the household's adherence to land use regulations. Older individuals may have more experience and be more accustomed to traditional land use practices, which could either positively or negatively affect their compliance with modern land use planning standards. On the other hand, younger household heads might be more open to adopting new land management practices, which could influence compliance in a different way. Hence, the relationship between age and land use compliance is hypothesized to be either positive or negative.

**Ethnicity:** Ethnicity is also treated as a dummy variable, where 1 represents native (indigenous) household heads, and 0 represents non-native or migrant household heads. Ethnic identity is believed to be a factor that may influence the degree of compliance with urban land use regulations. Native residents might have more established connections to the land and community norms, potentially leading to higher compliance with local planning rules. In contrast, non-native residents may be less familiar with or less inclined to follow urban land use guidelines, thus influencing the level of compliance.

**Education Level:** The education level of the household head is treated as a continuous variable, measured in terms of years of formal education. Education is considered a key determinant in shaping attitudes towards land use planning and compliance. It is hypothesized that higher levels of education may increase awareness and understanding of the importance of adhering to land use regulations. Educated household heads are more likely to comply with urban planning standards due to their greater capacity to navigate formal land use processes and their awareness of the long-term benefits of proper land use management. Conversely, lower educational levels may result in lower compliance due to limited awareness of the formal regulations or lack of access to information.

Each of these independent variables gender, age, ethnicity, and education plays a critical role in shaping the behavior of household heads and their level of compliance with land use planning regulations. By analyzing the relationships between these variables and the dependent variable of land use compliance, the study aims to uncover key factors that influence urban land management practices and offer insights into how policies and interventions might be better tailored to improve land use governance in the study area.

**Site Plan:** The presence or absence of a site plan for the household is considered a dummy variable. When a household has a site plan, the variable is assigned a value of 1, and if there is no site plan, the value is 0. The presence of a site plan has been identified as a key factor that can influence compliance with land use regulations. It is hypothesized that having a formal site plan may either encourage adherence to land use guidelines or, conversely, could present barriers to compliance depending on how the plan aligns with existing regulations and urban planning objectives. Therefore, the relationship between having a site plan and land use compliance may be either positive or negative, based on the household's understanding of and ability to implement the plan effectively.

Income Category: The income level of the household is a continuous variable measured in Ethiopian Birr (ETB). Household income is considered a significant determinant in the ability and willingness to comply with urban land use regulations. It is hypothesized that households with higher income may have greater access to resources, better understanding of land use regulations, and the financial means to follow planning rules. Conversely, lower-income households might face challenges such as limited access to land-use information, financial barriers to compliance, or even displacement due to rising land values. As a result, the income category is expected to be either positively or negatively related to land use compliance, depending on the income level and associated resources available to the household.

Mode of Land Acquisition: The mode by which the household acquired its land is also a continuous variable. This factor is measured in years and considers whether the land was obtained through inheritance, purchase, government allocation, or other means. The way in which a household obtained its land is hypothesized to influence the household's compliance with land use regulations. For example, those who acquired land through formal means (such as purchasing land from the government or private sellers) may be more likely to comply with urban land planning standards due to their familiarity with the formal land registration and planning processes. On the other hand, land acquired informally or through inheritance might be associated with lower compliance, particularly if the household is less familiar with formal planning requirements or if the land lacks proper documentation. Thus, the mode of land acquisition is anticipated to have either a positive or negative influence on land use compliance.

Urban Management Issues (Corruption): The urban management problem is treated as a dummy variable, where the value is 1 if the household head exhibits a tendency toward corruption or unethical behavior related to land use and 0 if they do not. This variable addresses the influence of corruption or mismanagement in urban land administration on compliance with land use regulations. In some cases, household heads may circumvent land use laws or regulations due to corrupt practices, such as bribing officials or engaging in illegal land transfers. Conversely, in areas with better governance and transparency, corruption may be less prevalent, and households may be more likely to adhere to land use guidelines. Thus, the urban management problem, including corruption, is expected to have either a positive or negative effect on land use compliance, depending on the degree of corruption within local governance and the household's willingness to comply with legal and planning rules.

In summary, these independent variables site plan presence, income category, mode of land acquisition, and urban management issues (corruption)—are all hypothesized to affect compliance with urban land use planning guidelines in complex and interrelated ways. The study posits that each of these factors can either facilitate or hinder adherence to planning regulations, depending on the specific circumstances of each household. By examining these variables, the research aims to identify key influences on land use compliance and to provide recommendations for improving urban land management practices in the study area.

## 5.7 Results and discussion

This chapter presents an in-depth analysis of the current state of urban land management, exploring the various challenges it faces, the potential prospects for improvement, and the key variables that exacerbate land management issues. Additionally, the chapter examines the negative socioeconomic consequences of poor land management in the study area. The data used for this analysis were gathered from a diverse group of respondents across six kebeles within the study area.

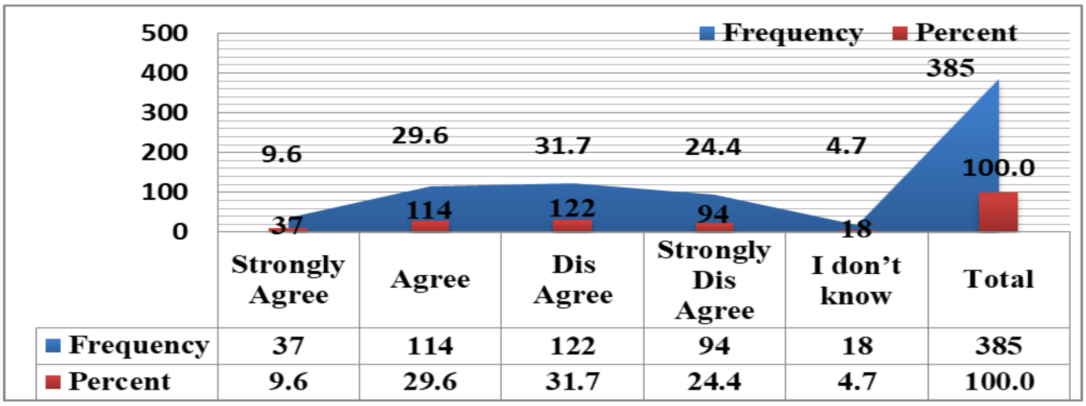
In this chapter, the findings from the study are thoroughly discussed and interpreted, drawing on data collected through multiple research methods, including questionnaires, structured and unstructured interviews, direct field observations, and focus group discussions. By analyzing these diverse sources of data, the chapter aims to provide a comprehensive understanding of the factors influencing urban land management in the region.

Furthermore, the chapter compares the findings of this study with previous research on similar topics, allowing for a broader contextualization of the issues identified. This comparison not only highlights the consistency or divergence of the study's results with earlier research but also helps to identify emerging trends, patterns, and potential solutions that could address the current challenges of urban land management. Ultimately, this chapter provides a thorough exploration of the complexities surrounding urban land management in the study area, offering insights into both the problems at hand and the opportunities for future improvement.

### 5.7.1 Fairness of initial land lease price for all income groups

According to Figure 5.2, out of the total respondents, 216 (56.1%) disagree or strongly disagreewith the fairness of the land leasing price, which is expressed by 122 (31.7%) and 94 (24.4%) respondents, respectively. On the other counts 114 (29.4%) and 37 (9.6 %/) respondents who chose the alternative rated agree and strongly agree respectively, and 151 (39.2%) have a positive response to the initial lease price. The insignificant rest number of the respondents 17 (4.4%) didn’t have any knowledge about the minimum lease price.

According to Dinsa, M.N. (2016), 98 % of respondents in his survey stated that the leasing law benefited the wealthy or rich. On the other hand, just 1% of respondents say that the middle class has benefited more. Surprisingly, none of the respondents thought that the leasing law benefited the poor. This assessment is crucial and raises concerns about the equality and application of leasing legislation. If one studies the objective of leasing legislation from the preamble, one will see that its primary goal is to serve the public through a sustainable economy, social welfare, and equitable resource distribution among citizens.




| | Strongly Agree | Agree | Dis Agree | Strongly Dis Agree | I don't know | Total |
|---|---|---|---|---|---|---|
| Frequency | 37 | 114 | 122 | 94 | 18 | 385 |
| Percent | 9.6 | 29.6 | 31.7 | 24.4 | 4.7 | 100.0 |

Figure 5.2 Initial land price determinations

### 5.7.2 City surveying for decision new initial price since 2012

According to City land officials, the land bidding process in the City took place 25 times over a five-year period, from 2012 to 2016. As shown in Table 5.2, the selling and lease prices experienced significant increases, with the lease price rising fourfold from its original amount. Additionally, in mid-2014, the City revised the initial price, further contributing to the upward trend. These frequent and substantial increases in the land lease prices resulted in a noticeable reduction in the participation of potential bidders, as many found the revised prices unaffordable.

The City's land lease pricing system was based on two primary approaches: the cost of development method and the sales comparison approach. The findings revealed that there was a significant disparity between the initial lease prices and the actual prices during the two periods examined. For instance, between 2012 and 2014, the lease price increased by an impressive 472% compared to the initial price, a drastic jump that greatly impacted the affordability and accessibility of land. In the subsequent period, from 2015 to 2016, the lease price continued to rise, though at a slightly lower rate of 457%, indicating a sustained but somewhat moderated increase.

These frequent price revisions by the municipality, particularly the sharp increases in the original lease price, resulted in a corresponding rise in the actual selling price of the land leases. This escalation in land costs has contributed to decreased participation in the land bidding process, as many prospective land lessees and investors found it increasingly difficult to meet the new, higher financial requirements. The increase in land lease prices, coupled with the lack of affordability for a significant portion of the population, has thus become a critical issue in the City's urban land management strategy.

Table 5.2 Land lease price information from secondary data

| **S.N** | **Years** | **2012-2014** | | | | **2015-2016** | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Sub cities | average initial lease price/ Sq.m | average selling lease price/ Sq.m | Difference | % | average initial lease price/ Sq.m | average selling lease price/ Sq.m | Difference | % |
| 1 | Menehariya | 525 | 2727.57 | 2202.6 | 419 | 904 | 4285 | 3381 | 374 |
| 2 | Hawella-tulla | 525 | 3030 | 2505 | 477 | 904 | 5803 | 4899 | 541 |
| 3 | Misrak | 525 | 3270.31 | 2745.3 | 522 | 904 | 5031 | 4127 | 456.5 |

The aim of the new urban lease-holding proclamation was to establish a suitable urban land administration system that is efficient and responsive to the growing demand for land, driven by the rapid and sustainable economic growth across all sectors and regions of the country. It seeks to ensure good governance, a robust free-market economy, and effective land management (Araya, 2013:26). The current land lease policy has two primary objectives: to address the increasing demand for urban land due to the country's fast economic development and to promote good governance through the creation of an efficient land market and a transparent, accountable land administration system. Additionally, the policy is designed to generate a sustainable source of revenue for municipalities, which can then be used to finance essential urban infrastructure. However, the demand for land in urban areas has significantly outpaced the supply of land allocated by city administrations (Yirga, 2014).

Under the current lease law, urban land is transferred using two main modalities. The first modality is the allotment mechanism, which is used for projects and programs that have welfare implications or national significance. The second modality involves market allocation through an auction system. Entities that have privileged access to land via the allotment system include displaced households in urban renewal projects, government agencies requiring office space, social service institutions run by the government or charitable organizations, government-supported housing development programs, religious institutions for places of worship and cemeteries, premises for micro and small enterprises, manufacturing industries, lawful tenants of kebele or government housing, diplomatic missions, international organizations, and projects of special national development significance (Proclamation No. 721/2011, 2011).

Despite these provisions, the land lease system in the country, and particularly in urban areas, has several limitations that push urban residents toward illegal or informal land ownership systems. According to the majority of respondents who participated in discussions, these limitations include insufficient attention to peri-urban areas, failure to consider the financial capacity of the city, inadequacies in the bidding system used for land transfer, limitations in the land administration system, and a lack of consideration for the economic realities faced by the urban poor.

### 5.8 Approach to acquiring land

Table 5.3 presents the respondents' perspectives on the land delivery system in Hawassa City. According to the data, the majority of respondents (131, or 34%) indicated that they acquired their property from speculators, particularly farmers, highlighting the prevalence of informal land transactions. A significant proportion of participants (50, or 12.9%) mentioned that they rented their land from the original owners. In contrast, only 108 respondents (28%) believed that the government provided land through a formal permit or allocation system, while 55 respondents (15.3%) were of the view that the government used a leasing system for land delivery. These findings are consistent with the data gathered from interviews with relevant City officials, further reinforcing the trend of informal land transactions in the City.

This study reveals a significant issue where urban land, which should be properly registered, remains unregistered. This lack of formal documentation creates a vulnerability that exposes the land to illegal encroachment, theft, and other forms of misappropriation. In some cases, individuals with ties to criminal activities, including drug dealers operating within the municipality, have exploited this gap in land registration. Their collusion has led to unlawful land appropriation and the manipulation of ownership records, further complicating efforts to address the problem.

Through a combination of interviews and group discussions, the study has been able to uncover the extent of these issues, illustrating how widespread and deeply entrenched these practices have become. The lack of proper land registration and the illegal dealings that result from it have not only caused financial and social harm but also undermined the trust in the legal systems meant to safeguard land ownership.

To address these challenges, it is crucial to pursue a comprehensive, legal approach in collaboration with municipal authorities. Special attention must be given to strengthening the registration process, ensuring that all urban lands are accurately documented and protected against illegal transactions. Municipal institutions must take a proactive role in preventing the illegal transfer of land, implementing strict controls and monitoring systems to detect and prevent fraudulent land deals. This should include tighter regulation, better enforcement of land laws, and more public awareness about the importance of land registration. By addressing the issue from both a legal and institutional perspective, we can work toward curbing illegal land activities and creating a more secure and transparent urban land management system.

The dominance of informal land markets in Hawassa indicates a gap in the effectiveness of the City's land management system. The City's management has struggled to exert control over the land markets, with a significant portion of land acquisition taking place outside the official channels. This situation aligns with findings from the United Nations Human Settlements Programme (UN-Habitat, 2003a), which reported that many cities in developing countries, like Hawassa, face challenges in providing access to land through formal systems. As a result, the land availability in these cities often ranges from fully legitimate transactions to semi-legal arrangements and, in some cases, entirely illegal or squatter settlements.

This phenomenon is also supported by the work of Faravaque and McAuslan (1992), who argued that the dynamics of land supply play a significant role in determining how land prices fluctuate in urban areas. In the absence of a well-regulated, formal land supply system, the price of land in Hawassa is influenced by these informal market dynamics, leading to a situation where land prices are highly variable and often detached from official valuation mechanisms. Consequently, the City faces considerable challenges in regulating land prices and ensuring equitable access to land for all residents, particularly for low- and middle-income households who are most affected by the irregularities in the land supply system.

Table 5.3 Respondents View on Land acquisition System in Hawassa City

| **No** | **Method of land acquisition** | **Frequency** | **Percentage** |
|---|---|---|---|
| 1 | By lease System | 108 | 28 |
| 2 | Permit System /allocation | 61 | 15.84 |
| 3 | Rents from original possessors | 50 | 12.9 |
| 4 | Buying from speculators (from farmers) | 131 | 34 |
| 5 | Other methods | 35 | 9.09 |
| | Total | 385 | 100 |

## 5.9 Land provision mechanisms for the low income group

As depicted in Figure 5.3, the majority of respondents (156 or 40.5%) expressed disagreement with the government's approach to providing land for low-income groups.

Additionally, 90 respondents (23.4%) strongly disagreed with the current mechanism. In total, approximately 246 respondents, or 69% of the sample, gave a negative response regarding the adequacy of the land provision system for low-income communities. On the other hand, 26 respondents (6.8%) strongly agreed, and 96 respondents (24.9%) agreed that the current land provision mechanisms were suitable for low-income groups. A small percentage of respondents (16 or 4.2%) indicated that they had no knowledge about the government's land provision system.

The results from Focus Group Discussions (FGDs) and interviews with key informants further corroborated these findings, highlighting that the land provision mechanism for low-income groups in Hawassa is seen as insufficient. Respondents emphasized that the land lease bidding system, which is the primary means of land allocation, has proven to be challenging in delivering accessible land to all residents, particularly those in lower-income brackets. The complexity and high costs associated with the bidding process have made it difficult for the most vulnerable groups to secure land through formal channels.

These findings underscore the need for a more inclusive and accessible land provision strategy that better addresses the needs of low-income residents in Hawassa. The current system, characterized by limited access and high barriers to entry, has resulted in a large portion of the population being excluded from formal land markets. As a result, many low-income individuals and families continue to rely on informal land acquisition methods, contributing to the growth of informal settlements and exacerbating challenges related to land security and urban planning.

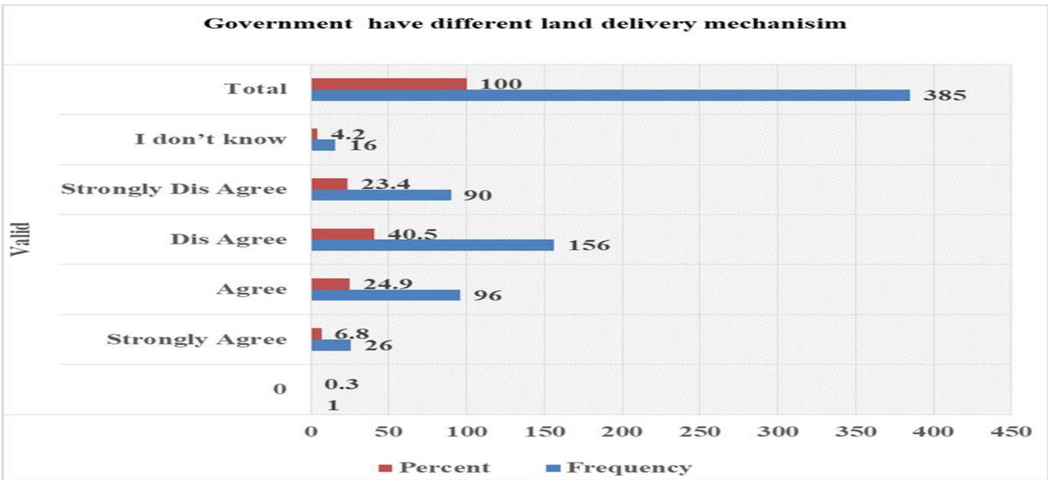



Figure 5.3 Land provision mechanisms for the low income

Land resources are essential for economic and social development, growth, poverty reduction, and governance. Access to land is fundamental to both rural and urban livelihoods. The diverse benefits of land require a thoughtful, well-executed approach that considers current land issues within the broader historical, political, economic, and social context.

However, the majority of key informants involved in the study indicated that the country's lease policy, and specifically that of urban areas, does not adequately account for the varying economic capacities of different towns. This results in challenges in supplying land to urban residents, as the policy does not fully consider the financial capacity to compensate landowners or provide sufficient infrastructure in leased areas.

One expert, with 16 years of experience working in the municipality and participating in key informant discussions, highlighted that a major challenge in supplying adequate land to urban dwellers is the lack of financial resources to compensate farmers for their land. This expert further emphasized that the policy fails to take into account the economic disparities between cities and does not explore alternative solutions to address these financial challenges.

### 5.10 The appropriateness of current land policies, rules, and regulations

The findings, as illustrated in Figure 5.4, reveal a significant dissatisfaction among respondents regarding the current land rules and regulations in place. A total of 130 respondents (33.8%) strongly disagreed, and 117 respondents (30.4%) disagreed with the effectiveness and suitability of the existing land policy directives and regulations, indicating that they believe the current system is inadequate for land provision.

In contrast, a smaller group of respondents, consisting of 84 individuals (21.8%), agreed, and 45 respondents (11.7%) strongly agreed that the current land policy and regulations are suitable for land provision purposes. These respondents felt that the existing directives adequately meet the needs of the community in terms of land allocation, particularly for residential housing. A small percentage of respondents indicated that they had no knowledge or opinion on the matter, reflecting a lack of awareness or involvement in the land provision process.

Overall, the majority of the respondents both those who strongly disagreed and those who disagreed believe that there is a significant gap in the current land policy and regulatory framework. They feel that the existing rules are not adequately addressing the demand for residential land, which has serious implications for urban development and housing availability. This feedback highlights the need for reforms and updates to the land policy and regulations to ensure that they are better aligned with the actual needs of the population and the growing demand for residential land in the City.

The results suggest that a comprehensive review of the current land management system is necessary to bridge these gaps and enhance the effectiveness of land allocation for housing, which is crucial for promoting sustainable urban growth and improving living conditions for the residents.

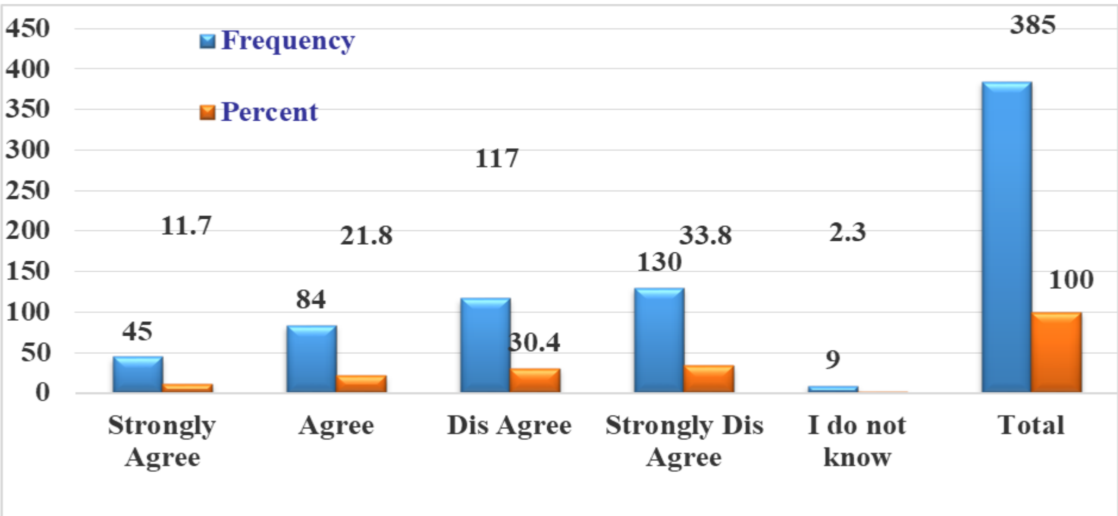



Figure 5.4 Current land polices rules and regulations

### 5.11 The institutional capacity of urban land management system

The institutional capacity of a government plays a pivotal role in determining the success or failure of policies, regulations, and programs, particularly in urban land management. The effectiveness of urban land management in any City is largely shaped by the presence or absence of this capacity. According to the Global Environment Facility (2006), institutional capacity refers to the ability of individuals, organizations, or organizational units to perform their functions effectively, efficiently, and sustainably. When this capacity is lacking, it significantly hampers the implementation of urban land management practices, leading to inefficiencies and poor governance.

In many cases, good governance strategies at the local level are either weak or completely absent. At the grassroots level, local stakeholders' understanding of sustainable land management practices often relies on traditional techniques that have been passed down through generations, which, while valuable, may not be sufficient to address the complex challenges of modern urbanization. A lack of financial resources further exacerbates the problem, as it limits the ability to reform or update land management policies in many developing countries.

This financial constraint also underscores the lack of investment in training and capacity-building initiatives aimed at enhancing the skills of key personnel involved in urban land management. Without adequate training programs, it becomes difficult to improve the competence of local officials, planners, and other stakeholders, which is crucial for advancing land management practices and adapting to new urban challenges.

Moreover, the absence of sufficient human resources and the lack of appropriate tools and equipment have contributed to the ineffective management of urban land in the City. The shortage of skilled professionals such as urban land development experts, urban planners, surveyors, Geographic Information System (GIS) specialists, land registration experts, and cadastral experts has created a significant gap in the City’s land management capacity. This absence of expertise and resources has led to the mismanagement of land, inadequate land information systems, and poor implementation of urban land policies, all of which hinder the City’s ability to manage its urban growth effectively.

As a result, these institutional weaknesses undermine the confidence of stakeholders, investors, and residents in the City's development processes. If these issues persist, they could discourage participation in urban development projects and deter investment, ultimately leading to stagnation and increasing poverty in the City. The lack of proper institutional support not only hampers the growth of the City but also contributes to a cycle of inefficiency, where land is underutilized or misallocated, and urban growth is hindered by poor planning and management practices.

In conclusion, the institutional capacity of Hawassa City, as revealed by the study, is not well-established, with serious deficiencies in terms of skilled personnel and essential equipment. This deficiency in human and material resources has had a direct impact on the effectiveness of urban land management, limiting the City’s ability to respond to the demands of rapid urbanization and sustainable development. Therefore, substantial investment in capa city building, human resource development and infrastructure is necessary to improve urban land management practices and ensure the City's long term growth and prosperity.

### 5.12 Effective land management to collect revenue in the City

Efficiency in urban land management is critical for ensuring sustainable urban growth and fostering a robust local economy. This can be achieved through the development of streamlined, efficient land delivery systems, which include mechanisms for land registration, cadastral services, information technology integration, land transactions, legal frameworks, land valuations, taxation, as well as processes for land consolidation and readjustment. Additionally, the provision of public services, particularly for the urban poor, and the management of informal settlements through partnerships with both private and non-profit sectors are key to improving land delivery. Integrating urban planning and management, alongside strengthening local revenue collection systems, are essential for promoting a more effective land management framework (Holger, 2002).

However, land management in the study area has been largely inefficient, and it has failed to contribute to the improvement of the City's revenue collection systems, which are vital for the development of urban infrastructure and services. Despite the need for effective land management to drive revenue, the current system in Hawassa City has struggled to meet these goals. An effective and functional administrative system is indispensable for the efficient execution of urban land management tasks, yet this is significantly hindered by inadequate financial resources and institutional support.

In order to assess the effectiveness of the land management system, data was gathered from household respondents through a survey questionnaire. The purpose was to gauge their perception of the role that the land management system plays in contributing to the municipality's revenue collection efforts. Most respondents indicated dissatisfaction with the land management system, expressing that it does not significantly contribute to the City's urban development revenue. Consequently, many residents felt that their expectations regarding land services and development had not been met.

As illustrated in Figure 5.5, the municipality's revenue collection over the years has been suboptimal. The actual revenue collected has consistently fallen short of the targets, with only about 56% of the expected revenue collected across the years considered. Specifically, the municipality's performance in achieving its revenue collection goals has been on a downward trajectory, with only 52% achieved in 2014, and even lower figures of 50.6% and 47.6% in 2017 and 2018, respectively. This declining trend highlights the systemic inefficiencies within the municipality's revenue collection framework.

One of the primary reasons for this underperformance is the inadequate preparation and management of land for various purposes, including urban development and land allocation. The study points to several key issues: the land management system is poorly organized, revenue collection methods remain outdated and manual, and the administrative capa City is insufficient. The lack of modernized systems, such as computerized land management and revenue tracking, further exacerbates these challenges. As a result, there are numerous problems including inadequate infrastructure, increasing informal settlements, a shortage of human resources, and insufficient office facilities due to budgetary constraints.

In summary, the study found that the City's income collection system is weak, inefficient, and poorly administered. The reliance on manual processes rather than modern, computerized systems has hindered the municipality's ability to collect the necessary revenue for urban development. This inefficiency in land management and revenue collection has directly contributed to the City's poor infrastructure and the rapid growth of informal settlements. Without significant improvements in both the land management system and the revenue collection framework, the City faces continued challenges in addressing urban growth and providing essential services to its residents.

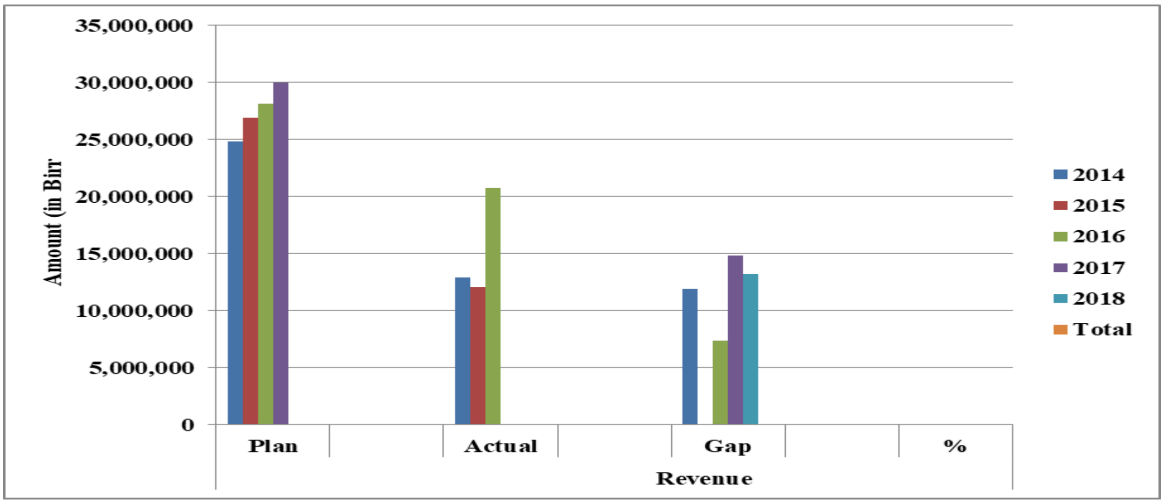



Figure 5.5 Collection of revenue in the Hawassa City

As Urbanization accelerates, the demand for land in cities grows exponential, exacerbating the competition for these limited resources. As land values rise, both public officials and private individuals become increasingly to exploit corrupt practice to secure lucrative opportunities. Corruption in the informal land market not only impedes the fair distribution of land but also fosters a culture of exclusion, where the wealth and well-connected individuals can access land through illicit means, while those less privileged remain locked out of the formal market. This dynamics further deepens socio-economic inequality, particularly in urban environments where access to land is pivotal for economic stability and upward mobility.

One of the most damaging aspects of this corruption is its perpetuation of a system that rewards illegality over transparency and fairness. Public officials who should be the guardians of urban planning and land regulation, become come complicit in corrupt activities, such as approving fraudulent land transaction, falsifying land titles, or overlooking illegal encroachments in exchange for bribes. As a result, urban land markets become increasing unreliable and unjust, with legal and regulatory frameworks often undermined by corruption.

Furthermore, the lack of transparency in urban land management system makes it difficult for citizens to access essential information about land ownership, zoning regulations, and development plans. Without clear and accessible information, individuals are unable to make informed decision about land transaction or challenge illegal land practices. This opacity allows corruptions to flourish, as individuals and organizations with insider knowledge or connections are able to manipulate the system to their advantage, often with little fear of being held accountable.

The consequences of such widespread corruption are far-reaching. In cities where land is a key asset for economic development, corrupts practice stifle the potential for equitable growth. Those who are excluded from the formal land market due to the high costs of bribes or the opaque nature of land transactions are often forced to rely on informal or illegal means to secure land. These informal settlements, while providing shelter for many, are often vulnerable to forced evictions, lack of infrastructure, and inadequate legal protection. In some cases, entire communities can be displaced when corrupts actors, including developers and local officials, decided to redeveloped land for commercial purposes, leaving the poor with few, if any, options for recourse.

The findings of this research suggest that corruption in the informal land market, particularly in urban land management, manifests in a variety of forms. These include the payment of bribes for essential processes such as property registration, the alteration of land titles, the acquisition of privileged information, the processing of cadastral surveys, and the creation of land use plans that favor certain individuals or groups. The complex and costly procedures involved in urban land transactions, combined with a lack of transparency and access to information, only serve to exacerbate the prevalence of bribery in land-related services.

As a result, individuals who are unable to afford these bribes are effectively excluded from the formal land market, further entrenching inequality. This bribery culture also undermines the enforcement of land laws, leaving citizens vulnerable to exploitation, illegal encroachment, and other forms of abuse. In cities experiencing rapid urbanization, the demand for land increases, which, coupled with rising land values, intensifies competition for this increasingly scarce resource. In such environments, the potential for both public officials and private actors to profit through corrupt practices becomes significant.

Moreover, weak and inconsistent land laws, alongside poor governance in urban land management, create an environment where corruption thrives. As urban populations grow and the pressure on land resources intensifies, corruption risks become more prominent. The competition for land, the opportunities for revenue generation, and the potential for private enrichment create fertile ground for corrupt activities. These dynamics present specific challenges to urban land markets, where both the public sector and private interests are often involved in corrupt practices that perpetuate inequality and undermine the integrity of land management systems.

In this context, corruption risks are most prevalent in the urban land markets themselves and within the broader framework of urban land management. Addressing these risks requires a multifaceted approach that not only strengthens legal and regulatory frameworks but also promotes transparency, accountability, and public participation in land-related processes. It is essential to ensure that land management practices are fair and inclusive, protecting vulnerable populations from exploitation while fostering a more equitable urban environment.

### 5.13 The effect of supply land of on land access ability

### 5.13.1 Implementation of urban land lease law in study area

Regarding the question of whether the urban land lease law is effectively implemented in the study area, the majority of respondents (41.4%) agreed that it is, while no respondents strongly agreed. This suggests that the implementation of the Urban Land Lease Proclamation No. 721/2011 is recognized and has been carried out in the City, albeit with some initial challenges. Initially, there was a general lack of awareness and a negative perception of the land lease law among landowners and the community, particularly regarding its impact on their ability to access land. Many individuals, especially public servants, faced difficulties, as they required personal housing to support their regular work duties.

However, over time, local authorities, in collaboration with urban land departments, took proactive measures to increase awareness and educate the public about the urban land lease law and its practical implications. These efforts gradually shifted attitudes, and the law has become more widely accepted and understood in the study area. The law, which is a national policy directive, serves as the primary framework for land allocation and lease agreements within urban areas. It now provides clear guidelines for acquiring land, benefiting both individuals and institutions, and is increasingly viewed as a legitimate and necessary tool for urban land management.

This shift in perception and the successful implementation of the law highlights the importance of public awareness campaigns and the role of local administrative bodies in facilitating understanding and ensuring the law's effective application. As a result of these efforts, the urban land lease law has now been successfully integrated into the City's land management practices, providing a more structured and regulated approach to urban land acquisition and use (as depicted in Figure 5.6).

According to the information obtained from this study, if the efficient and effect management of urban land is realized, various urban land-related problems can be solved properly. However, according to the data of the participants, municipal experts were tricked by various land-related benefits and instead of managing it effectively; they were made to illegally occupy the land of the urban people. The respondents said that urban land is effectively managed by the large number of participants in this question. However, based on the information obtained through verbal questioning and group discussions, they show that there are many deficiencies in terms of efficient management. They mention that urban lands in the city are being invaded illegally if only effective management of urban land is possible. Therefore, in this research area, instead of efficiently managing the urban land, it was found that there are gaps.

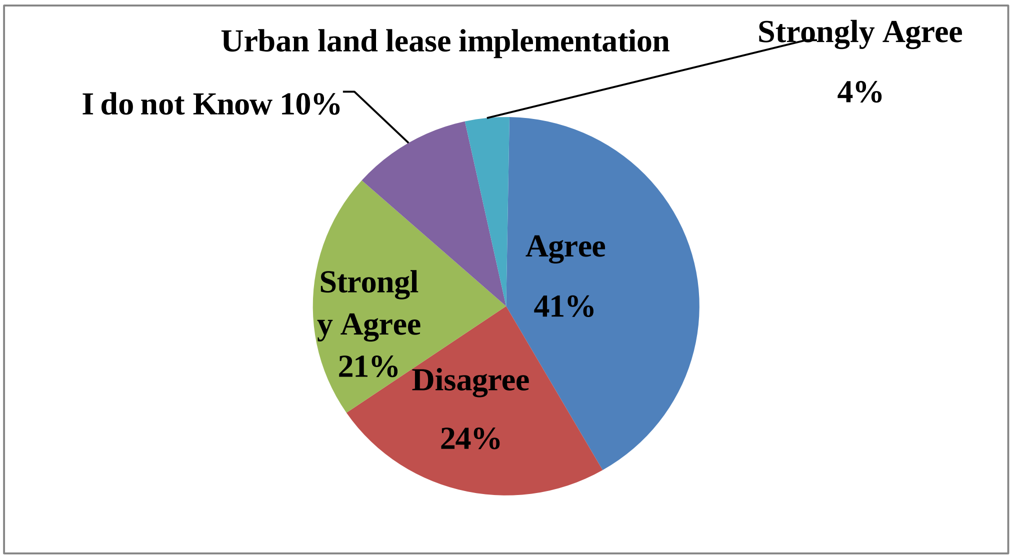



Figure 5.6 Implementation of land lease law

**5.13.2 Times in which urban land provided to lease competition**

Regarding the frequency of land leases available for competition each year, all respondents (100%) indicated that land is only offered for lease once per year. This reflects a significant limitation in the municipality's capacity to effectively manage and provide land for lease, particularly due to financial constraints. According to the urban land management coordinators interviewed, the local government faces a shortage of funds to compensate landowners adequately, which further restricts the number of available lease parcels.

As a result, the municipality can only offer a limited amount of land for lease competition annually, meaning that only a small portion of urban land is made available for leasing. This situation hampers the potential for broader access to land, particularly for public servants, who may rely on such leases for housing. To address this issue and increase the availability of land for leasing, the municipality would need to significantly improve its financial resources, as well as streamline compensation mechanisms to ensure that landowners are compensated fairly and promptly.

In order to meet the growing demand for urban land and improve the accessibility of land for public servants and other residents, the study suggests that at least two or more lease competitions per year would be necessary. However, achieving this goal would require substantial financial investment. It is crucial for the local government, along with other responsible bodies, to collaborate and find sustainable solutions to increase the availability of land for leasing and support the compensation process.

Ultimately, the limited availability of land for lease, coupled with the financial challenges faced by the municipality, has a direct impact on the land lease competition and the ability of public servants to participate and benefit from the system. This issue needs urgent attention to ensure equitable access to land for all citizens, particularly those in need of affordable housing (as seen in Table 5.4).

Table 5.4 The amount of urban land provided for lease competition

| **Variable name** | **Questions N= 385** | **Respondent Answers** | **Frequency** | **Percent** | **Remark** |
|---|---|---|---|---|---|
| Land supply | Amounts urban land provided for lease competition per year | One time per year | | 100.0 | |

### 5.13.3 Areas in which urban land is open to lease competition

The majority of respondents (88.5%) indicated that urban land available for lease is primarily located in the interior areas of the City. This suggests that the municipality faces significant challenges in paying compensation for land in more central or prime locations. Consequently, the municipal authorities tend to offer land for lease in the less developed, interior sections of the City, where compensation costs are lower.

However, the limited amount of land provided for lease near major streets or in more accessible parts of the City tends to be quickly claimed by more privileged groups. These are often individuals or entities with greater financial resources, which are able to outbid others and secure the land for various uses, including commercial development or private housing. As a result, public servants, along with other less privileged groups, have fewer opportunities to access land in these more desirable areas.

Moreover, during interviews, municipal land administrators emphasized that land located near main infrastructure, such as asphalt roads, is considered more valuable for higher-end developments, including multi-story buildings (G+1 and above). These prime locations are typically prioritized for commercial, residential, or mixed-use developments, further marginalizing those who are unable to afford such properties. In contrast, land in more remote interior areas is allocated for less expensive housing or other lower-density uses, which is typically where the municipal land leasing tends to occur.

Despite the availability of land in the interior parts of the City, public servants, like other members of society, have found it difficult to benefit from the leasing system. The combination of financial constraints and the location of available land have created significant barriers to their participation. Furthermore, the value of land closer to main roads is considerably higher than land located farther away, making it even less accessible to public servants and other low- to middle-income groups.

In conclusion, the location of land available for lease whether in more central or interior parts of the City has a profound impact on who benefits from the urban land lease system. Land near main roads and in more desirable areas is typically out of reach for most residents, especially public servants, due to its higher value and the competition from wealthier groups. Therefore, the current system of land allocation, particularly in relation to location, significantly influences who can access and benefit from urban land, perpetuating inequality in the City.

## 5.14 Current existing condition of accessing urban housing land problems

Although no compiled data was available as regards the demand for and supply of housing land at any office of the municipality of Hawassa City, efforts have been made on the part of the writer to tabulate the existing data from the registers of applicants and of those supplied with residential housing land.

The relatively complete registers listing persons demanding and supplied with housing land in the City are, in fact, available only for the period between 2006 and 2013. The data are presented in Figure 5.7 as it was clearly seen a total of 7418 applicants were registered between 2015 and 2022. Of these applicants, only 3168 persons accounting for 42.7 percent of the total were supplied with residential plots. Unfortunately, 4250 (57.3 percent) of the total applicants could not acquire the plots that they are in need of, It was also clearly seen that there is no consistency between the supplies of land corresponding to the demand for it. Therefore, it is possible to conclude that the supply system of housing land in Hawassa City does not meet significantly the demand posed by the needy or interested individuals to construct their own shelters.

As shown in Figure 5.7 though erratic, the demand for housing land in Hawassa City between 2015 and 2022 was far ahead of the supply for it. The erratic nature of the demand appearedto be associated with events caused by institutional performances. For instance, the supply of land in 2015 was almost null, and thus the demand for it was relatively lesser. However as the provision of land increased in 2010 and 2011, the demand increased drastically. On the other hand, a steep drop in the demand for housing land was seen to occur in 2012, while the increase in the supply of land was constant. This could be the result of the issuance of the new urban lease regulation in the preceding year by the government of the Sidama region. That means those residents who are in need of housing land might not accept immediately the new regulation and not believe that it would be applicable. This condition therefore might deter them from applying for land. The demand between 2018 and 2019 appeared to correspond to the condition of the supply of land. Another event that could be recognized from Figure 5.7 was that both the demand and supply of housing land in Hawassa were drastically decreasing between 2015 and 2022.

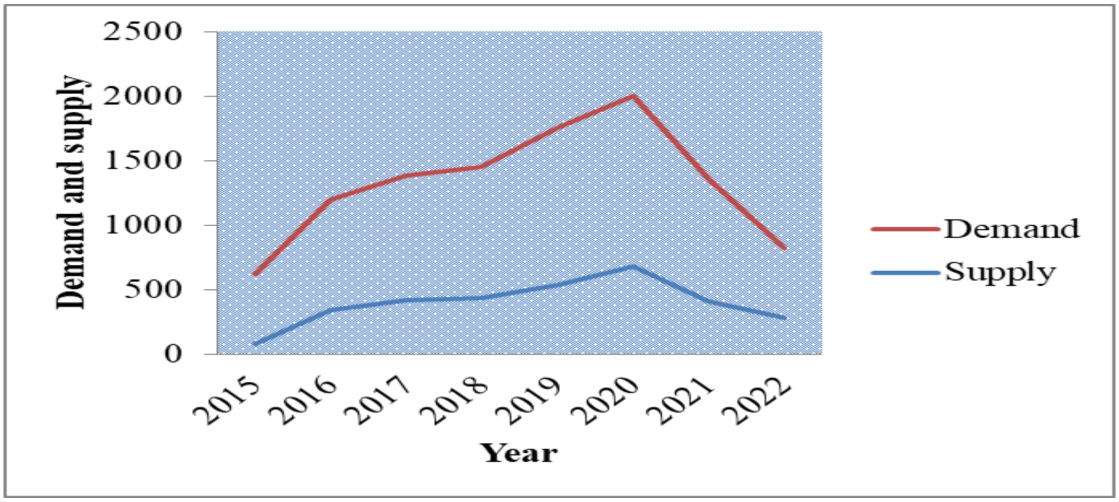



Figure 5.7 Demand and supply of housing land in Hawassa City

### 5.15 The challenges related to cost of land transaction

There was no readily available compiled data regarding the demand for and supply of housing land from the municipality of Hawassa City. However, efforts were made by the researcher to gather and organize available data from various municipal registers that track the applicants for, and allocation of, residential plots. The most complete records available span the period from 2006 to 2013, although data from more recent years, between 2015 and 2022, was also analyzed.

As presented in Figure 5.7, a total of 7,418 individuals registered as applicants for residential housing land between 2015 and 2022. However, only 3,168 of these applicants about 42.7% of the total—were successfully allocated land. The remaining 4,250 applicants, or 57.3% of the total, were unable to acquire the plots they sought. This discrepancy highlights a significant gap between the demand for housing land and the actual supply, suggesting that the current land allocation system in Hawassa does not meet the needs of the population seeking to build their own homes.

Further analysis of Figure 5.7 reveals that the demand for housing land in Hawassa City consistently outstripped the supply over the study period, although the trend was erratic. The fluctuations in demand seem to be closely linked to variations in the performance of municipal institutions and changes in land management policies. For example, the demand for land in 2015 was relatively low, largely because the supply of land during that year was almost nonexistent.

However, as the supply of land increased in 2010 and 2011, the demand for housing land surged sharply, reflecting the growing need for residential plots.

In contrast, there was a significant decline in demand for housing land in 2012, despite a steady increase in supply during that period. This drop in demand could be attributed to the introduction of a new urban lease regulation by the government of the Sidama region, which may have created uncertainty among potential applicants. Many residents were likely hesitant to embrace the new regulations, unsure of their applicability or potential impact, which could have led to a decline in the number of people applying for land that year.

Interestingly, between 2018 and 2019, the demand for housing land seemed to align more closely with the supply, indicating that the supply mechanisms and regulatory conditions were more stable during this period. However, overall, both the demand and supply of housing land in Hawassa showed a marked decline over the course of the study period (2015–2022), which further underlines the inconsistency and inefficiency in the City's land delivery system.

The data underscores the challenge of matching the demand for housing land with the available supply in Hawassa. The fluctuations in both demand and supply, along with the evident mismatch between the two, suggest systemic inefficiencies in land management, which have hindered the ability of many individuals to access the land they need to build homes. This inconsistency highlights not only weaknesses in administrative and regulatory practices but also underscores more fundamental challenges within the urban land management system. These issues suggest that there are systemic inefficiencies that prevent the City from effectively responding to the growing demand for housing land. Such challenges may stem from a variety of factors, including inadequate policy frameworks, insufficient institutional capa City, and poor coordination between the various stakeholders involved in land administration.

Furthermore, this mismatch between land demand and supply points to structural issues within the City's land delivery mechanisms. For instance, if the processes for land allocation are slow, inconsistent, or poorly managed, it can lead to delays and frustrations among applicants, ultimately making housing more difficult to access for many residents. The failure to align supply with demand not only limits opportunities for individuals to secure land for residential development but also exacerbates social and economic disparities, particularly among lower-income groups who are already disadvantaged in the competitive land market.

To address these challenges, it is essential to develop more efficient, transparent, and equitable land management practices. This could involve revising land policies to ensure they are responsive to the needs of the population, improving administrative processes to reduce delays, and investing in the capacity of local authorities to handle land transactions more effectively. Additionally, strengthening public awareness and participation in the land allocation process would help to ensure that land resources are distributed more fairly, particularly to those who need it most.

In conclusion, resolving these deep-seated issues in urban land management is crucial not only to improve the efficiency and fairness of land distribution in Hawassa but also to promote sustainable urban growth and development. By addressing these fundamental challenges, the City can create a more inclusive land management system that better meets the needs of its growing population and supports the development of affordable housing for all residents

Table 5.5 Respondents purchasing land through informal transactions

| No_ | Reasons for informal Land transactions | Response | |
|---|---|---|---|
| | | Frequency | Percentage |
| 1 | Delay of the municipality to provide land | 101 | 26.23 |
| 2 | Fear of losing the possibility of obtaining plots | 36 | 9.35 |
| 3 | Uncertainty about the municipality to give the land to People | 225 | 58.44 |
| 4 | Other reasons | 23 | 5.97 |
| | **Total** | **385** | **100** |

### 5.16 Factors affecting compliance with land use planning guidelines

Before estimating the model, a multi-collinearity test was conducted to check for correlation among the explanatory variables using the Variance Inflation Factor (VIF). In binary logit regression analysis, it is common to expect some degree of correlation between explanatory variables, particularly when dealing with categorical variables related to participation. Such correlations can lead to multi-collinearity, a well-known issue in regression analysis. While some scholars suggest that multi-collinearity is only problematic when its levels are very high (Gujarati, 1995), the results of the VIF test indicated that all variables entered into the model had low VIF values, all below 10. This suggests that there was no severe multi-collinearity problem among the explanatory variables in the model.

Additionally, the Breusch-Pagan test was used to assess the presence of heteroskedasti City, which refers to the situation where the variability of errors is not constant across observations. The test results indicated that there was no significant issue with heteroskedasti City (P-value = 0.145), meaning the error terms were homoscedastic and the assumption of constant variance was not violated.

To test for omitted variables, the Ramsey RESET test was employed. The test results showed no evidence of omitted variables in the model (P-value = 0.21), suggesting that all relevant factors had been accounted for in the model specification.

The binary logistic regression model was employed to identify and assess the key challenges affecting compliance with urban land use management in the study area. The analysis revealed that six out of the ten independent variables had a significant impact on compliance with land use planning guidelines. These variables played a crucial role in determining the outcomes of land use compliance in the study area.

The goodness-of-fit of the model was assessed using the coefficient of determination ($R^2$) and the adjusted $R^2$ values. The $R^2$ value of 0.8511 indicates that approximately 85.11% of the variation in the dependent variable (land use compliance) is explained by the independent variables, which points to a relatively high level of explanatory power. The adjusted $R^2$ value of 0.8370 takes into account the number of explanatory variables and adjusts for the potential overfitting of the model, further reinforcing the model's validity.

To identify the key factors influencing compliance, the Chi-square test of independence was used. This test identified several significant variables that are associated with land use compliance in the study area. These include income, ethnicity, having a developed site plan, and occupation. The results of the Chi-square test, presented in Table 5.6, include the Pearson Chi-square values, degrees of freedom (df), and the significance P-values, which show the strength of association between these variables and compliance with land use regulations.

Overall, the analysis highlights that demographic and economic factors, such as income, ethnic-city, and occupation, as well as practical considerations like the development of a site plan, significantly affect compliance with urban land use planning guidelines in the study area.

The urban planning process is designed by various concerned bodies, which is true in theory. However, in practice, increasing stakeholder participation and incorporating their feedback is crucial for the success of these plans. Often, the urban planning efforts of a city fall short of facilitating real development, leading to ineffective land management. These results in municipalities struggling to achieve the objectives outlined in their urban plans. A significant reason for this failure is the gap between the community's understanding of the urban planning goals and the strategic plans related to land management. Moreover, the community is frequently excluded from land related meetings, preventing them from raising concerns or contributing their input, which further hinders the effectiveness of the plans.

This observation was reinforced by a field survey conducted with households across six selected kebeles in the study area. The survey highlighted that the lack of community involvement in the planning and decision-making processes is a major factor behind the ineffective implementation of urban plans. This disconnection between the intended objectives of the urban plans and their actual outcomes creates challenges in realizing the goals of urban development.

A key issue identified through both the field survey and direct observation in Hawassa city, particularly in the six selected kebeles, is the growing environmental impact and the increasing demand for land, which significantly affects land management practices. Respondents noted that the rapid increase in land demand has led to illegal land occupations, as many individuals seeking to engage in trade or investment are resorting to unlawful means due to the escalating price of land. As land prices continue to rise in these areas, individuals with financial resources often engage in illegal land acquisition practices, exacerbating the challenges faced by land management authorities in Hawassa city. This illegal land occupation has a detrimental impact on the environment and contributes to urban instability.

The situation in this Hawassa city reveals the urgent need for improvements in land management practices, particularly in the context of urban growth. The increasing demand for land and the illegal ways in which some individuals are acquiring it are contributing to environmental degradation and social instability. Therefore, there is a pressing need for better regulation, more transparent land allocation systems, and greater community involvement in urban planning processes to ensure that development remains sustainable and inclusive. Addressing these challenges will be crucial for achieving effective urban growth and ensuring that the city's land management system can keep pace with the demands of a growing population.

Table 5.6 Correlation for factors affecting compliance with land use planning guidelines

| **Model** | **Unstandardized Coefficients** | | **Standardize d Coefficients** | **95.0% intervalfor B** | | **Confidence** | |
|---|---|---|---|---|---|---|---|
| Variables | B | Std. Error | Beta | Chi$^2$ | Sig. | Lower Bound | Upper Bound |
| *(Constant) | 2.743 | .612 | 0.87 | 4.484 | .000 | 1.531 | 3.955 |
| *Age | -.005 | .142 | -.003 | 7.44 | .973 | -.285 | .276 |
| *Main Occupation | .094 | .186 | .045 | 8.45 | 0.05 | -.275 | .463 |
| *Educational Status | .201 | .113 | .159 | 1.77 | 0.08 | -.425 | .024 |
| *Gender | .469 | .211 | .199 | 2.220 | 0.028 | .050 | .887 |
| *Have a site | .225 | .131 | -.157 | 15.75 | 0.01 | -.485 | .035 |
| plan | -0.25 | 0.13 | 0.58 | 3 | 0.06 | 0.234 | 0.569 |
| *problem urban mgt | -0.35 | 0.76 | 0.32 | 0.39 | 0.05 | 0.54 | 0.23 |
| *Instit. | 0.56 | 0.34 | 0.67 | 4.87 | 0.01 | 0.87 | 0.87 |
| Capa | 0.55 | 5 | 0.7 | 4.17 | 0.04 | 0.85 | 2.44 |
| City | -0.65 | 0.55 | 0.125 | 1.54 | 0.002 | 0.043 | 0.98 |
| *Income category | | | | | | | |
| *Ethni City | | | | | | | |
| *Mode of land acquisition | | | | | | | |

The independent variables included in the analysis are presented along with their respective levels of statistical significance. The significance levels are indicated as follows: ** denotes significance at the 1% level, * indicates significance at the 5% level, and a single asterisk (*) represents significance at the 10% level. These significance levels reflect the strength of the relationship between the independent variables and the dependent variable (compliance with urban land use management), based on the results of the statistical tests conducted.

A 1% significance level (**), which is the most stringent threshold, indicates a very strong association between the variable and the outcome, meaning the probability that this relationship is due to random chance is less than 1%. Similarly, a 5% significance level suggests that there is a strong probability that the relationship is not due to chance, though with a slightly higher likelihood of error compared to the 1% level. A 10% significance level represents a weaker, but still noteworthy, association where the probability of the observed relationship being random is less than 10%.

These indicators help assess the relevance of each independent variable in explaining variations in land use compliance, and they provide insight into the relative importance of each factor in influencing the urban land management system in the study area. The source of the data for these analyses is drawn from the results of the study.

The results in Table 5.6 revealed that the income of the respondent and obtaining of building permit have a strong influence on each other. This is due to the fact that the Pearson Chi- square value (4.87) was found to be significant at 10% (P-value $<0.1$). The high-income earners were found to have complied with land use regulations and were given permits to develop their lands. Hence there is enough evidence to reject the independence of income and obtaining of building permit to develop one land. The results further indicate that ethnicity plays a significant role in complying with the physical development and planning guidelines. From the chi-square value of 4.17 was reported which is significant at 5% (P-value $< 0.05$). This means that there is enough evidence that respondent ethnicity is independent of compliance with land use regulations. From the results, respondents who are non-indigenes were found to have complied more than those that are indigenous.

The results also indicate that people who developed site plans for their lands were found to have permits to further develop their land than those who did not acquire site plans at all. The Chi-square test value is 15.75 and was found to be significant at 1% (P-value $< 0.01$). This means that there is enough evidence to reject the independence of acquisition of site plan and obtaining of permit to develop one land. Since many of those who have acquired site plans have also obtained permits, it can be concluded that the development of site plans has a positive influence on obtaining of building permit.

Finally, the respondents were found to have been engaged in different occupations. The findings suggest that there are variations in the number of people from different occupations who have obtained building permits. The chi-square analysis provides a test value of 8.44 which is significant at 5% (P-value $<0.05$). This provides enough evidence to reject the independence of occupation and obtaining of building permits. The frequencies suggest that people who are in public service often comply more than those in other occupations.

**5.17 Effects of independent variables on urban land access ability**

To assess the influence of various predictors on urban land access, the researcher employed regression analysis, focusing on key factors such as the supply of land, the affordability of bidding prices, the accessibility of leased land to infrastructure, and the fairness of competition. These factors were analyzed as independent variables, while the dependent variable in the study was urban land access for civil servants.

The correlation coefficient (R) between the independent variables and the dependent variable was found to be 0.789, indicating a strong positive relationship between the predictors and the ability of civil servants to access urban land. This suggests that as the key predictors (land supply, bidding price affordability, infrastructure accessibility, and competition fairness) vary, the access to land for civil servants also changes in a significant manner.

The coefficient of determination, commonly referred to as $R^2$, measures how well the independent variables collectively explain the variation in the dependent variable. In this study, the $R^2$ value was 0.623, which means that approximately 62.3% of the variation in civil servants' land access can be explained by the four independent variables. The remaining 37.7% of the variation in land access is influenced by other factors not captured by this model. This indicates that while the four predictors have a notable influence on land access, there are other variables that also contribute to the variability in urban land access for civil servants.

Furthermore, the adjusted $R^2$ value, which accounts for the number of independent variables in the model and adjusts for potential overfitting, was calculated to be 0.616. This value is slightly lower than the $R^2$, as expected, but still very close, which suggests that the model generalizes well and does not overestimate the explained variation in land access.

The standard error of the estimate for the regression model, reported as 41,179, provides a measure of the average distance between the observed values and the predicted values based on the model. A smaller standard error indicates more accurate predictions, and in this case, the standard error reflects a reasonable level of prediction accuracy, considering the complexity of urban land access issues.

Overall, the statistical results indicate that the model is robust and significant in explaining the factors affecting urban land access for civil servants in the study area. The high $R^2$ values and the positive significance of the model suggest that the selected predictors land supply, bidding price, infrastructure access, and competition fairness are crucial factors influencing land access, although there are other variables that could further explain the remaining variation.

Table 5.7 Result of regression analysis

| **Model Summary** [b] | | | | | |
|---|---|---|---|---|---|
| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate | Durbin-Watson |
| 1 | .789[a] | .623 | .616 | .13985 | 1.838 |
| a. Predictors: (Constant), Competition Fairness, land supply , Price of afforded lands , Access ability of infrastructure | | | | | |
| b. Dependent Variable: access of land to resident | | | | | |

**5.18 Analysis of variance**

Table 5.8 presents the analysis of variance, which is a crucial statistical test used to determine whether the independent variables, when considered together, significantly impact the dependent variable. In this context, the dependent variable is the accessibility of urban land for residential purposes, and the independent variables include land supply, bidding price affordability, accessibility of leased land to infrastructure, and competition fairness.

The "F" statistic, displayed in the table, helps assess whether the regression model as a whole is statistically significant. Specifically, it tests the null hypothesis that the independent variables, collectively, do not explain any of the variation in the dependent variable. If the F-statistic is large and the p-value is small, we reject the null hypothesis, indicating that the independent variables jointly have a significant effect on the dependent variable.

Looking at the results in Table 5.8, the sum of squares column shows how the total variability in the dependent variable is partitioned between the regression model and the residuals (or errors). The total sum of squares represents the total variation in the dependent variable (urban land access), and in this case, it is 11.512. The regression sum of squares is the portion of the total variance explained by the independent variables, calculated as the difference between the total sum of squares and the residual sum of squares (11.512 - 4.342 = 7.170). This means that 7.170 of the total variation in urban land access can be explained by the independent variables in the model.

Each sum of squares has a corresponding degree of freedom (DF), which refers to the number of independent values that can vary in the analysis. The total degrees of freedom is calculated as n−1n−1, where n is the number of observations. In this case, with 227 respondents, the total degrees of freedom is 227−1=226227−1=226. The regression degrees of freedom is 4, corresponding to the four independent variables (land supply, bidding price affordability, infrastructure accessibility, and competition fairness) included in the model. The residual degrees of freedom, representing the errors after fitting the model, is therefore 226−4=222226−4=222.

The F-statistic value of 91.656 in Table 5.8 represents the ratio of the variance explained by the regression model to the unexplained variance (residuals). This F-ratio tests whether the independent variables collectively explain a significant portion of the variance in the dependent variable. In this case, the F-statistic of 91.656 is quite large, and the corresponding significance value (p-value) is reported as 0.000, which is less than 0.01. This p-value indicates that the regression model is highly significant, meaning that the independent variables together have a statistically significant effect on urban land access.

In summary, the results from the a nova analysis confirm that there is a strong and significant relationship between the independent variables (land supply, bidding price affordability, accessibility of leased land to infrastructure, and competition fairness) and the dependent variable (urban land access). The high F-statistic value and the very low p-value (p = 0.000) suggest that the regression model is a good fit and that the predictors included in the model play a critical role in explaining urban land access in the study area.

Table 5.8 Result shows the result of analysis of variance of a nova

| **ANOVA[a]** | | | | | | |
|---|---|---|---|---|---|---|
| Model | | Sum of Squares | Df | Mean Square | F | Sig. |
| 1 | Regression | 7.170 | 4 | 1.793 | 91.656 | .000[b] |
| | Residual | 4.342 | 222 | .020 | | |
| | Total | 11.512 | 226 | | | |
| a. Dependent Variable: access of land to civil servant | | | | | | |
| b. Predictors: (Constant), Competition Fairness, land supply, Price of afforded lands ,Access ability of infrastructure | | | | | | |

## 5. 19 Conclusion

The primary objective of this study was to examine the challenges and prospects related to urban land management and the implementation of land use laws in Hawassa City, with a particular focus on issues surrounding land acquisition, compliance with land use planning guidelines, and the capacity of urban land management institutions. The study highlights the critical role that effective land management, supported by strong legal and institutional frameworks, plays in shaping the current and future land utilization practices in urban areas. In particular, the study identifies several key challenges that need to be addressed in order to improve land management in Hawassa City.

Hawassa, like many rapidly urbanizing cities in Ethiopia, faces significant pressure on its infrastructure and housing due to the fast-paced growth in population and economic activities, especially the expansion of large-scale projects such as the Hawassa Industrial Park. This rapid urbanization has led to a major shortage of affordable housing, the proliferation of informal settlements, and an increasingly speculative land market. These factors have contributed to the City's uncontrolled physical growth and the rising demand for urban land, particularly among low- and middle-income residents, who often find themselves excluded from the formal land market.

The study reveals that the land management system in Hawassa is currently inadequate to meet the needs of its growing population. The municipality is unable to provide developed land for the majority of its residents, and instead, most people acquire land through informal transactions with private landowners. This informal land market, while filling a gap in the City's land supply, exacerbates the imbalance between supply and demand. Additionally, the City's low financial capacity, combined with weak institutional structures and an inefficient urban planning system, hinders the municipality's ability to adequately respond to the demand for land.

Land prices in Hawassa are notably high, particularly for low- and middle-income groups. The study found that the average lease price of land in the City ranges from 1,843 to 3,242 Birr per square meter, a significant difference that further alienates lower-income residents from accessing formal land. This price disparity is a direct result of the insufficient supply of land and the speculative nature of the urban land market. The municipality's failure to provide sufficient affordable land to residents has consequently driven up the price of land and exacerbated social inequalities.

One of the main factors contributing to the inefficiencies in land management in Hawassa is the growing presence of informal settlements. These settlements have not only led to overcrowding and inadequate infrastructure but also highlight the gaps in formal land management practices. The study found that over half of the respondents (51.5%) considered informal settlements to be a key challenge influencing land management in the City. The rapid urban expansion and the spread of informal settlements are further complicated by institutional challenges, such as a lack of skilled urban planning professionals, insufficient financial resources, and inefficient bureaucratic processes. These factors create a significant barrier to implementing effective land management practices and regulations.

Additionally, the study shows that urbanization in Hawassa has led to the encroachment of productive agricultural land and the destruction of essential ecosystems, including forests and wetlands. From 2005 to 2017, the City's built-up area and cultivated land increased by approximately 33 $km^2$ and 15 $km^2$, respectively, while the natural areas, including forests and healthy vegetation, decreased by around 50 $km^2$. This shift in land use, driven by both urban expansion and agricultural intensification, has resulted in the loss of valuable ecosystem services that are critical to the City's sustainability and the well-being of its residents.

Looking to the future, Hawassa faces the dual challenge of accommodating a rapidly growing population while ensuring that the City's natural resources and ecosystems are protected. The current urban growth model is unsustainable, as it places increasing pressure on limited resources such as water, energy, food, and land. Without effective urban planning and land management policies, this trend will continue, potentially leading to environmental degradation, inadequate housing, and growing social inequalities.

To address these challenges, the study suggests several key actions:

Improvement of Institutional Capacity: Strengthening the institutional framework for urban land management is essential. This includes enhancing the capacity of the municipality and relevant stakeholders to manage land more effectively, providing adequate training for urban planning professionals, and ensuring sufficient financial resources for land management projects.

Implementation of More Effective Land Supply Mechanisms: There is a need to create a more efficient and transparent land delivery system that can respond to the high demand for land, especially from low- and middle-income groups. The municipality must consider alternative mechanisms for land allocation, such as expanding the land lease system and providing more affordable land options for residents.

Urban Planning and Land Use Regulations: Developing and implementing more robust urban planning frameworks is necessary to guide the City's growth in a sustainable way. This should include land use zoning that balances the need for urban development with the preservation of natural resources and the provision of green spaces. The City must also address the growing problem of informal settlements by integrating them into the formal urban planning framework, ensuring access to basic infrastructure and services.

Environmental Protection and Resource Management: The study highlights the urgent need for environmental sustainability in urban planning. Protecting valuable ecosystems and ensuring the sustainable use of land resources should be a priority for the City's planning authorities. This includes safeguarding forests, wetlands, and agricultural land, while promoting green infrastructure solutions that can enhance the City's resilience to climate change and urbanization pressures.

Addressing Socio-Economic Inequalities: To ensure that all residents, particularly low and middle-income groups, have access to affordable land, the municipality should introduce policies that promote equitable land distribution. This may include subsidized land lease programs, targeted land allocation for public servants and low-income residents, and mechanisms to prevent land speculation that drives up prices.

In conclusion, Hawassa's urban land management system faces a complex set of challenges, including inadequate land supply, poor institutional capacity, high land prices, and the proliferation of informal settlements. Addressing these issues will require coordinated efforts at the local and national levels, focusing on strengthening institutional capacity, improving land delivery mechanisms, implementing effective urban planning strategies, and ensuring environmental sustainability. Only by addressing these challenges can the City manage its urbanization in a way that ensures equitable access to land for all its residents, while also safeguarding its natural resources for future generations.

The provision of residential land in Hawassa City is a critical issue that requires comprehensive and coordinated solutions. By adopting a multi-dimensional approach that includes vertical development, land regularization, improved financial management, and stronger institutional capacity, the City can address the challenges of housing provision and urban land management. Ensuring affordable land access for all residents, promoting citizen participation, and protecting the City's natural resources will be key to creating a sustainable urban environment that meets the needs of its growing population while maintaining environmental balance. With the right policies and strategies in place, Hawassa can overcome its current urban land challenges and build a more equitable and livable City for its residents.

### 5.20 Recommendations

Recommendations for Improving Urban Land Management and Housing Provision in Hawassa City. The issue of residential land provision in Hawassa City is a pressing concern for the majority of its residents. The shortage of available land for housing, driven by rapid urban growth, high demand, and economic challenges, has made it difficult for many citizens, especially low- and middle-income groups, to access affordable housing. Addressing these challenges requires a multi-faceted approach that considers both short-term solutions and long-term strategies to meet the housing needs of the City's growing population. Below are key recommendations for improving urban land management and housing provision in Hawassa City

#### 1. Expansion of Vertical Development

Given the limited availability of land and the high demand for residential plots, the City should prioritize vertical development over horizontal expansion. Vertical housing, such as condominiums or multi-story apartment buildings, can increase the supply of housing within a limited footprint. The government should encourage the construction of high-rise residential buildings by cooperatives, which would allow for the provision of affordable housing and the efficient use of available land. Vertical development also makes it easier to provide essential infrastructure, such as water, electricity, and roads, since these services are more efficiently distributed in high-density areas.

**2. Promote Public-Private Partnerships and Affordable Housing Cooperatives**

To ensure that low- and middle-income residents have access to affordable housing, the municipality should facilitate public-private partnerships (PPP) and support cooperative housing schemes. These initiatives could help reduce the cost of land acquisition and development, while also promoting inclusive housing models that accommodate various socio-economic groups. Special attention should be given to reducing the cost of land for self-help cooperative housing projects, ensuring that the low-income population can participate in the housing market.

**3. Urban Redevelopment and Informal Settlement Regularization**

In the short term, the City should focus on urban redevelopment and land readjustment strategies, particularly in low-density, overcrowded, and informal settlements. A key strategy would be the regularization of informal settlements, which would provide legal recognition to residents, while ensuring they have access to basic infrastructure and services. Land pooling and readjustment mechanisms should be applied in areas where informal settlements are prevalent to ensure the equitable distribution of resources and to enhance the use of land. In particular, areas that are currently underdeveloped or congested can be redeveloped into medium-density settlements that are more efficient and better equipped with services.

**4. Adopt Compact City Principles for Urban Expansion**

For long-term land management, urban expansion within the City's administrative boundaries should adhere to the principles of a compact City model. This approach focuses on developing areas with higher densities and mixed-use development, which not only helps in managing the limited land resources more effectively but also reduces urban sprawl. High-density development should be complemented by the creation of well-planned public spaces, green areas, and facilities to maintain a high quality of life for residents. The City should invest in proper infrastructure and services to support these higher-density developments.

**5. Integrate Rural and Urban Areas for Sustainable Growth**

There is also a need for a well-designed rural-urban transformation strategy to manage the urban periphery and integrate rural communities into the urban fabric. The peri-urban areas should be planned and developed to ensure a smooth transition between rural and urban areas, allowing for the sustainable integration of agricultural land into urban planning. Compensation for farmers affected by urban expansion should be linked to sustainable livelihood support, ensuring that rural populations are not negatively impacted by urbanization.

**6. Digitization and Modernization of Urban Land Management**

The City's urban land management system should be modernized through the digitization of land records and the development of a Geographic Information System (GIS) or Urban Land Information System (ULIS). By digitizing land registration, certification, and cadastral information, the municipality can enhance transparency, reduce land disputes, and increase the efficiency of land management processes. Furthermore, the use of digital tools would help in making more informed decisions regarding land use, zoning, and the provision of services.

**7. Enhancing Institutional Capacity and Training**

Strengthening the institutional capacity for urban land management is critical for effective urban planning. This includes investing in training programs for urban planners, land surveyors, GIS technicians, land administration officers, and legal experts. The municipality should ensure that its staff possesses advanced skills in urban land planning, land development, land protection, and mapping to improve land management practices. Additionally, there should be a focus on improving coordination among various stakeholders, including the government, private sector, and civil society, to ensure the effective implementation of urban policies.

**8. Financial Diversification for Sustainable Urban Development**

One of the key findings of this study is that Hawassa’s municipality heavily relies on land lease revenues to finance its operations. While land leases provide significant income, this revenue model is unsustainable in the long run, given the limited availability of land. Therefore, the City should diversify its revenue sources by exploring alternative financing models for urban development. This could include the introduction of new taxes, such as property taxes, and the development of local bonds or investment funds to finance infrastructure projects. In addition, the City could explore partnerships with private developers to fund large-scale infrastructure projects and urban developments.

**9. Addressing High Land Lease Prices and Ensuring Affordability**

The current land lease prices in Hawassa are prohibitively high, particularly for low- and middle-income groups. To improve accessibility to land, the municipality should consider introducing land lease pricing mechanisms that account for the financial capacity of different social groups. This could include offering subsidies for low-income residents, reducing the initial lease price for cooperative housing projects, and introducing tiered pricing for land leases based on income levels. Moreover, the City should develop policies that prevent land speculation and ensure that land prices remain affordable for ordinary residents.

**10. Citizen Participation and Transparency in Land Use Planning**

Effective land management requires the active participation of the community. The municipality should involve residents in urban land planning through consultations, public hearings, and participatory planning processes. This will ensure that the land use plans reflect the needs and aspirations of the community while also promoting social equity. Transparency in the land lease process and land use regulations is also crucial to avoid corruption and ensure that land resources are allocated fairly.

**11. Promote Sustainable Urban Design and Environmental Protection**

In addition to addressing housing needs, urban planning in Hawassa City must prioritize environmental sustainability. The City should ensure that open spaces and green areas are preserved and protected, particularly in peri-urban areas. Planning and development should incorporate green infrastructure solutions, such as parks, water management systems, and sustainable transport networks. Environmental preservation and sustainable resource management must be integrated into all aspects of urban planning to maintain the ecological health of the City and provide a high quality of life for residents.

# CHAPTER SIX

## 6. General Discussions, Conclusions, and Recommendations

### 6.1. Introduction

Cities are vital hubs that support a broad array of physical, economic, social, political, and cultural assets (Aerni, 2016). Given their importance, it is essential to consider the design, function, and structure of cities with a strong focus on sustainability. However, cities today face significant challenges stemming from uncontrolled urbanization and climate change. These challenges manifest in various forms, including the loss of biodiversity and natural habitats, air pollution levels exceeding health standards, and urban flooding (Raven et al., 2014).

One of the key drivers of these challenges is the changing dynamics of land use and land cover (LULCC), which are influenced by various meteorological and environmental factors. This study aims to quantify the land use/land cover changes in Hawassa City, Ethiopia, over the span of three decades. To do this, multispectral satellite imagery from 1990 to 2020 was analyzed. The study area was categorized into six land use/land cover types: farmland, barren land, built-up areas, bushland, woodland, and water bodies. The data for this analysis was derived from satellite images taken by Landsat 5TM in 1990, 2000, and 2010, as well as Landsat 8 OLI and SWIR for 2020. Image classification and analysis were carried out using software packages like QGIS 3.2, ArcGIS 10.3, ENVI 4.2, and ERDAS Imagine 2013.

The findings of this study indicate that the region is undergoing substantial land use changes, particularly in the transition from bare land to built-up areas and from bushland to agricultural land. The overall LULCC between 1990 and 2020 reveals that built-up land increased from 12.76% to 16.85% of the total area, while the proportions of bare land and bushland decreased from 4.77% to 2.48% and from 14.29% to 10.16%, respectively.

Hawassa’s urban expansion follows a similar trajectory to other cities in Ethiopia but is also marked by specific patterns and complexities due to its unique geographical and socio-economic context. Much like other Ethiopian cities, Hawassa faces many of the challenges associated with rapid urban growth. However, its urbanization process is distinguished by certain characteristics and underlying factors, such as its population growth and economic transformation.

Understanding the patterns of urban sprawl and examining changes over time will significantly aid in the planning and development of urban infrastructure and services. The current rate of growth, combined with projected figures, underscores the critical role of the City's planning department in preparing for future development that is not only economically and socially inclusive but also sustainable in terms of culture, environment, and resource management (Marshall et al., 2009).

In terms of land use change, the conversion of bare land to agricultural land has increased significantly over the past three decades, with a growth rate of 26.5%, 28%, and 30.11% in different periods. However, from 2010 to 2020, agricultural land area decreased slightly, from 78.5 km² (30.11%) to 74.97 km² (28.76%), reflecting a 1.35% decline in the last decade. This decrease is largely attributed to the rise of mega-projects and increased urban development, which have converted agricultural areas into built-up land.

The land use changes, particularly the increase in built-up areas, are linked to broader urban growth dynamics, including population increases and the implementation of national economic policies that drive urban transformation. While certain areas are designated as protected by the City's building codes, there has been inadequate enforcement of these policies. This lack of enforcement is primarily due to the fact that many buildings and activities within the designated buffer zones were established before these policies were enacted, or they arose informally after the policies were put in place. This highlights the challenges in managing urban expansion and enforcing land use regulations in rapidly growing cities like Hawassa.

### 6.2. General Discussions of the Study

Land use and land cover changes (LULCC) represent complex processes that result from the conversion of one type of land cover to another. These changes are driven by the interaction of both human and environmental factors, but the precise dynamics between these elements and their influence on land use patterns remain poorly understood (US-EPA, 2009). According to Lambin et al. (2005), LULCC is shaped by the interplay of biophysical and human factors across time and space, with potential consequences for both the physical environment and the social fabric of regions. Over human history, intensive exploitation of natural resources has led to profound changes in land use, particularly since the onset of industrialization and rapid urban expansion. In many regions, the demand for land has led to significant alterations in land cover, with agriculture expanding into previously forested, savanna, and steppe areas to meet the needs of growing populations (FAO, 2000). These changes, in turn, have had wide-ranging impacts on ecosystems, hydrological systems, and the environment at large (Akotsi et al., 2006).

In this study, land use and land cover changes in Hawassa City, Ethiopia, were analyzed using Landsat satellite imagery from 1990, 2000, 2010, and 2020. The study area was categorized into six main land use/land cover types: agriculture, bare land, built-up areas, and bushland, woodland, and water bodies. The findings reveal that water bodies and agricultural land were the dominant land cover types throughout the study period. However, between 2010 and 2020, agricultural land declined by 1.35% due to a 1.91% increase in built-up areas over the same period. The results of supervised classification indicated consistent land use types, though the extent of coverage varied depending on the land cover class.

The rapid expansion of built-up areas in Hawassa, especially in the northeastern and southeastern directions, reflects the significant spatiotemporal dynamics of urban growth in the City. This expansion was largely driven by population growth and economic transformation policies, which led to an increased demand for housing and infrastructure. The study also shows that agricultural land, which had increased by 26.5%, 28%, and 30.11% respectively between 1990 and 2000, experienced a decline of 1.35% between 2010 and 2020, due to the increasing conversion of agricultural land into urban areas for housing, services, and infrastructure development.

Between 1990 and 2020, the largest changes in land use were attributed to the expansion of built-up areas. The study found that the conversion of land from barren land and bushland to agriculture and built-up spaces accelerated during this period. This rapid urbanization, particularly in the form of residential developments, commercial spaces, and infrastructure projects, has led to significant environmental changes, including soil degradation and the loss of productive agricultural land. These trends underscore the importance of understanding the drivers of urban growth and their consequences for the environment and local communities.

In 2000, agriculture occupied the largest share of land in the study area, covering 73 km² (28% of the total area), while bare land accounted for just 9.68 km² (3.71%). By 2010, the proportion of agricultural land increased to 78.5 km² (30.11%), while bare land shrank to 8.17 km² (3.13%).

The conversion of barren land to agricultural use grew significantly during this period, with agriculture increasing by 26.5% to 30.11%. However, by 2020, agricultural land began to shrink again, primarily due to the urbanization of surrounding areas, with built-up land growing by 1.91% from 2010 to 2020.

The expansion of built-up areas in the City is directly linked to population growth, economic development, and government policies aimed at transforming the economy and urban landscape. However, this growth has come at a significant cost to both agricultural and natural land. As more land is converted to urban use, the demand for space for housing, commercial development, and infrastructure continues to rise, putting pressure on the remaining agricultural and natural spaces. The need for land to accommodate housing, roads, and other urban functions has led to the encroachment on protected areas, productive agricultural land, and even marginal lands that are unsuitable for development.

This shift in land use highlights the ongoing struggle between urban growth and environmental sustainability. The study demonstrates how rapid population growth and economic expansion can create a chain reaction of environmental issues, including soil degradation, deforestation, and the loss of arable land. As more people move into urban areas and the demand for housing increases, pressure mounts on surrounding rural and natural lands, resulting in the displacement of agricultural activities and the loss of key ecosystems.

Given these challenges, it is crucial to prioritize sustainable land use practices and develop comprehensive urban planning strategies that balance the need for growth with the protection of natural resources. Addressing these issues requires careful consideration of both the social and environmental consequences of land use changes, as well as the development of policies that promote sustainable urbanization. As Hawassa continues to grow, it will be essential to implement strategies that minimize the negative impacts of urbanization on the environment and local communities, while also accommodating the growing demand for housing and infrastructure.

### 6.3. General Conclusions

This study aimed to explore the dynamics of land use and land cover changes (LULCC) in Hawassa City over the past three decades (1990–2020) and to investigate the driving factors behind these changes. The research utilized various GIS and remote sensing tools, including ERDAS Imagine for satellite image processing and ArcGIS for vectorization and map preparation. Through the interpretation of Landsat images from three different decades (1990, 2000, 2010, and 2020), and field observations, the study classified the land cover types and analyzed their changes over time.

The results demonstrated significant LULCC in Hawassa, highlighting a steady expansion of built-up areas and agricultural land, along with a reduction in natural land covers such as bushland, bare land, and forests. Notably, between 2010 and 2020, agricultural land decreased by 30.11%, while built-up areas increased by 1.91%. This rapid urban expansion has been driven by a combination of population growth, economic development, and infrastructure projects, particularly linked to the establishment of the Hawassa Industrial Park. These factors have significantly altered the City's landscape and put immense pressure on surrounding agricultural and natural lands.

The City's population has grown substantially over the years, from 36,200 in 1984 to 455,658 by 2020. This growth has led to increased demand for housing and urban infrastructure, creating challenges for land management. The study found that Hawassa's urbanization has been largely unplanned, with a significant portion of the population living in informal settlements and facing inadequate housing conditions. These issues have been exacerbated by inefficient policies, a lack of financial resources, and insufficient land within the City's planning boundaries.

In addition to urban expansion, the study also highlighted the role of protected areas in Hawassa. The City is home to important ecological assets, such as Hawassa Lake and surrounding areas, which have been designated as protected zones due to their environmental, aesthetic, and recreational value. However, the implementation of policies to protect these areas has been inadequate, and many of these protected zones have been encroached upon by urban development.

The study also examined the impact of LULCC on ecosystem services (ES), noting a decline in regulatory ES such as climate regulation, water flow regulation, and nutrient cycling. While provisioning services, like agriculture, have increased, recreational services have been adversely affected by the expansion of built-up areas. This shift indicates a decrease in the City's overall resilience and its ability to support human well-being, emphasizing the need for sustainable land management practices.

The study's findings underscore the urgent need for more effective urban planning and land management strategies in Hawassa. The rapid urban expansion, particularly the conversion of agricultural and natural lands to urban uses, has resulted in land degradation and environmental stress. A key challenge identified in the study is the lack of proper compensation mechanisms for displaced residents due to urban growth. Many farmers and local communities were not adequately informed or consulted about the land acquisition process, leading to dissatisfaction and grievances over compensation levels.

To address these issues, the study recommends strengthening legal and institutional frameworks for urban land management, improving public participation in urban planning decisions, and ensuring fair compensation for displaced populations. In addition, more comprehensive policies and planning approaches are needed to balance urban growth with environmental sustainability, to protect natural resources, and to ensure that all residents benefit from the City's development.

In conclusion, while Hawassa City has experienced significant socio-economic and infrastructural growth, its rapid and often uncoordinated urban expansion has created several challenges in land management. Effective urban planning, coupled with stronger governance and sustainable land use policies, is critical to ensuring that the City can accommodate its growing population while preserving its environmental assets and improving the quality of life for all residents.

### 6.4. Contributions of the Study

Because the study examined Analysis of land use /land covers dynamics in relation to urban expansion the case of Hawassa City, empirical evidence that guides policymakers and implementers toward the right choices and decisions is documented at all levels. The current study's conceptual, empirical, theoretical, and methodological contributions are also discussed.

**Conceptual contributions:** The study helps to explain, develop, and contextualize LULC principles in connection to urban growth. Furthermore, the study tried to provide light on comprehending LULC in the context of evolving urbanization which is commonly viewed from just two viewpoints in the study region. It also presented a previously unexplored idea in livelihood vulnerability research: cluster analysis-based urban growth. The study has helped to clarify, on land use and land cover changes in Hawassa City from 1990 to 2020 using GIS and remote sensing tools. The analysis showed an increase in built-up and agricultural land, while bare land, bushland, and forest decreased. Urban expansion led to a decrease in natural vegetation. The study emphasized the importance of sustainable urban development practices and proper urban planning to mitigate environmental degradation. Future research could explore the socio-economic factors driving land use changes and monitor the implementation of proposed scenarios for City expansion. The findings can guide decision-makers and City planners towards sustainable development and improving the quality of life in the region.

**Empirical contributions:** This analysis is a reliable guide for decision-makers and urban planners towards the improvement of the quality of life in Hawassa. Integrating LULC change, urban expansion, and livelihood. Each of the thematic studies presents a diagnosis of the situation with regard to the factor under study; this is based on surveys of the existing situation in Hawassa. The diagnosis, in turn, leads to an analysis of the present situation. Adaptive capacity of farmers can be considered a significant empirical contribution of this study.

**Theoretical contributions:** The study used the of land use management of Cities and urban centres are very important contributors to the national economy; Hawassa's booming economic activities has been a potential contributing factor to its increasing internal revenue. The growing importance of the City as an economic hub; Projects on lake protection; development policies; International support (intellectual and financial); Federal Government's support to land use initiatives. The research made a further theoretical contribution by combining different theories to achieve a common goal.

### 6.5. Recommendations

Based on the findings of this Ph.D. research, the following recommendations are proposed for future policy and strategic interventions to guide sustainable urban development and address the pressing challenges faced by Hawassa City:

Implement Comprehensive Urban Planning for Sustainable Landscape and Natural Resource Management: There is an urgent need to adopt a well-structured urban planning framework that incorporates environmental sustainability into the City's growth. This should include clear guidelines for the management of natural resources, such as forests, water bodies, and agricultural lands, alongside urban development. Sustainable urban development requires an integrated approach that balances urbanization with ecological preservation. This could involve zoning regulations, land use management strategies, and the promotion of green infrastructure to reduce environmental degradation while fostering economic growth.

Conduct Detailed Land Use and Land Cover Studies: A more detailed and systematic study of land use and land cover (LULC) changes in the region is critical for identifying areas where development pressures are highest and where conflicts between economic and environmental goals are emerging. These studies should aim to map desired land use categories, considering the need to protect critical ecosystems while accommodating urban expansion. By understanding the trends and drivers of LULCC, policymakers can ensure that the development process aligns with both environmental sustainability and the social needs of the population, helping to avoid resource depletion and ecological degradation.

Engage Kebele Administrations in Mitigation Efforts: The Kebele administrations, both in the areas that are already part of the City and those still outside its boundaries, must be more actively involved in mitigating the adverse effects of rapid urbanization and LULC changes. This can be achieved by designing and implementing targeted programs to counter the detrimental effects of land use changes, particularly through urban safety net programs. These programs should focus on poverty reduction, providing local communities with the tools and resources to adapt to the urban transformation while preserving their livelihoods. Mitigation measures should also involve training community leaders and strengthening local governance to better address these challenges at the grassroots level.

Address Compensation Concerns and Ensure Fair Implementation: The study highlighted widespread dissatisfaction among households regarding the compensation they received when their land was expropriated for urban development. In many cases, the compensation was insufficient to support the livelihoods of displaced families, particularly those who relied on agricultural land for their income. To resolve this, the local government should periodically review and improve the compensation policies, ensuring that they are fair, transparent, and aligned with the needs of displaced residents. Compensation should not only replace lost income but also offer long-term solutions for resettlement, job training, and access to new livelihoods. Furthermore, efforts should be made to raise awareness among the public on how to manage compensation funds effectively, through integrated education and financial management programs.

Foster Public Participation in Green Infrastructure Development: The design and development of green infrastructure such as parks, green spaces, and urban forests should be a collaborative process involving local communities. Public participation is essential to ensure that green spaces meet the needs of residents while also contributing to environmental sustainability. Local government authorities should organize forums, workshops, and meetings to engage the community in planning and decision-making processes. This should include outreach activities such as public consultations, town hall meetings, and the distribution of informative materials like posters and leaflets. Additionally, special training programs and orientation sessions should be developed for those who work in government, particularly in urban planning and development sectors, to foster a greater understanding of green infrastructure and its importance for the City's future.

Close Policy Gaps and Strengthen Governance in Urban Expansion: The study found that policy and strategy gaps in the urban expansion program have created challenges for effective City growth and governance. The lack of proper coordination, inadequate compensation schemes, and insufficient public participation have undermined the City's ability to plan for sustainable development. There is a need for a thorough review of existing urban expansion policies, with a focus on closing these gaps. Policymakers should adopt more inclusive and participatory approaches, ensuring that urban expansion strategies align with long-term sustainability goals and address the needs of all stakeholders, particularly marginalized groups. Regular evaluations of the policy implementation should be conducted to ensure transparency and accountability, with active feedback mechanisms in place for affected communities.

Promote Community Awareness and Capacity Building: Effective urban governance also requires raising awareness and building the capacity of both local government officials and residents. The study suggests that many individuals, particularly those in informal settlements, lack understanding of urban planning processes and their rights within these processes. This can be addressed through targeted educational campaigns, information dissemination, and training programs on urban development policies, land rights, and environmental sustainability. Efforts should also be made to foster a culture of participation and dialogue between local government authorities and community members to ensure that the urban expansion process is transparent, inclusive, and equitable.

Integrate Land Use Planning with Broader Socio-Economic Development Goals: Future urban development in Hawassa should be closely linked to broader socio-economic development goals, including job creation, poverty reduction, and the improvement of public services. Urbanization, when managed effectively, can drive economic growth and enhance the quality of life for City residents. However, without proper management, it can exacerbate inequalities and strain resources. Thus, urban planning should be integrated with policies aimed at improving education, healthcare, and infrastructure, and reducing poverty. Economic and social planning should go hand in hand with environmental protection efforts to create a more resilient and sustainable urban environment.

In summary, this research highlights the need for a more integrated, inclusive, and sustainable approach to urban planning and land management in Hawassa. To address the challenges of rapid urban expansion, the local government should focus on enhancing public participation, ensuring fair compensation for displaced communities, improving governance mechanisms, and aligning urban development with environmental and social goals. By implementing these recommendations, Hawassa can better navigate the complexities of urbanization and create a more sustainable, equitable, and resilient City for future generations.

## 6.6. Future Research Areas

Although this study focused on the dynamics of land use and land cover changes in relation to urban expansion in upper Hawassa City, it was limited to six Kebeles due to financial constraints that hindered the collection of comprehensive socio-economic survey data across the broader basin. Consequently, future research should aim to extend the scope of data collection to include a more comprehensive analysis of urban-urban and urban-rural linkages. This would allow for a more nuanced understanding of how Hawassa City influences, and is influenced by, its surrounding hinterlands. Future studies should also consider the role of neighboring towns and rural areas in both Sidama Region and Oromiya Regional State, as these were not incorporated into the current analysis.

Additionally, this study primarily focused on the spatial delineation of urban expansion based on proximity and neighborhood catchment areas, without exploring the full range of socio-economic, environmental, and political interactions between Hawassa City and its surrounding regions. Future research could benefit from examining the degree of interaction and interdependence between urban and rural areas in terms of infrastructure development, administrative boundaries, and socio-economic linkages. Investigating the pull factors of urban growth (e.g., employment opportunities, infrastructure development) and the push factors from rural hinterlands (e.g., agricultural pressures, migration) would provide a deeper understanding of the forces driving land use change in the region.

Future studies should also address the challenges of urban land management in greater detail, particularly the inefficiencies in land supply mechanisms for housing and urban development. Enhancing compliance with land use planning regulations, and identifying strategies to reduce informal land markets, should be a key area of focus to improve urban land management efficiency in Hawassa City. Research could explore the potential for strengthening urban governance structures and mitigating the impact of informal settlements, which continue to pose significant challenges to urban planning and development.

Further investigations into the socio-economic drivers of land use changes would provide valuable insights into the factors shaping the urban landscape. This could include exploring how population dynamics, economic activities, and social trends contribute to shifts in land use patterns. Incorporating more recent remote sensing data for a temporal analysis would improve the accuracy and relevance of findings, allowing for a better understanding of land use change over time.

Moreover, future research could focus on the long-term effects of vertical urban expansion as a strategy to accommodate growing populations, particularly in terms of its impacts on housing affordability, infrastructure, and community well-being. Additionally, studies exploring the impact of land use changes on ecosystem processes and services would provide critical information on how urbanization affects the environment. This could include analyzing changes in biodiversity, water cycles, and carbon sequestration as a result of urban growth.

Future work should also monitor the implementation of proposed urban expansion scenarios and assess their effectiveness in promoting sustainable urban development. This includes evaluating the potential of different planning models, such as mixed-use zoning and sustainable transportation networks, to minimize the environmental and social costs of urban growth. Furthermore, long-term monitoring of urban growth and land use changes will be essential to inform future planning and policy decisions, ensuring that Hawassa's expansion remains sustainable and resilient to future challenges.

Finally, future research should explore the socio-economic impacts of urban growth and land use changes on local communities, particularly vulnerable groups living in informal settlements, and assess how these changes are affecting community well-being, access to services, and overall quality of life. Understanding these impacts is crucial for developing inclusive urban policies that prioritize equitable development and ensure that all residents benefit from the City's growth.

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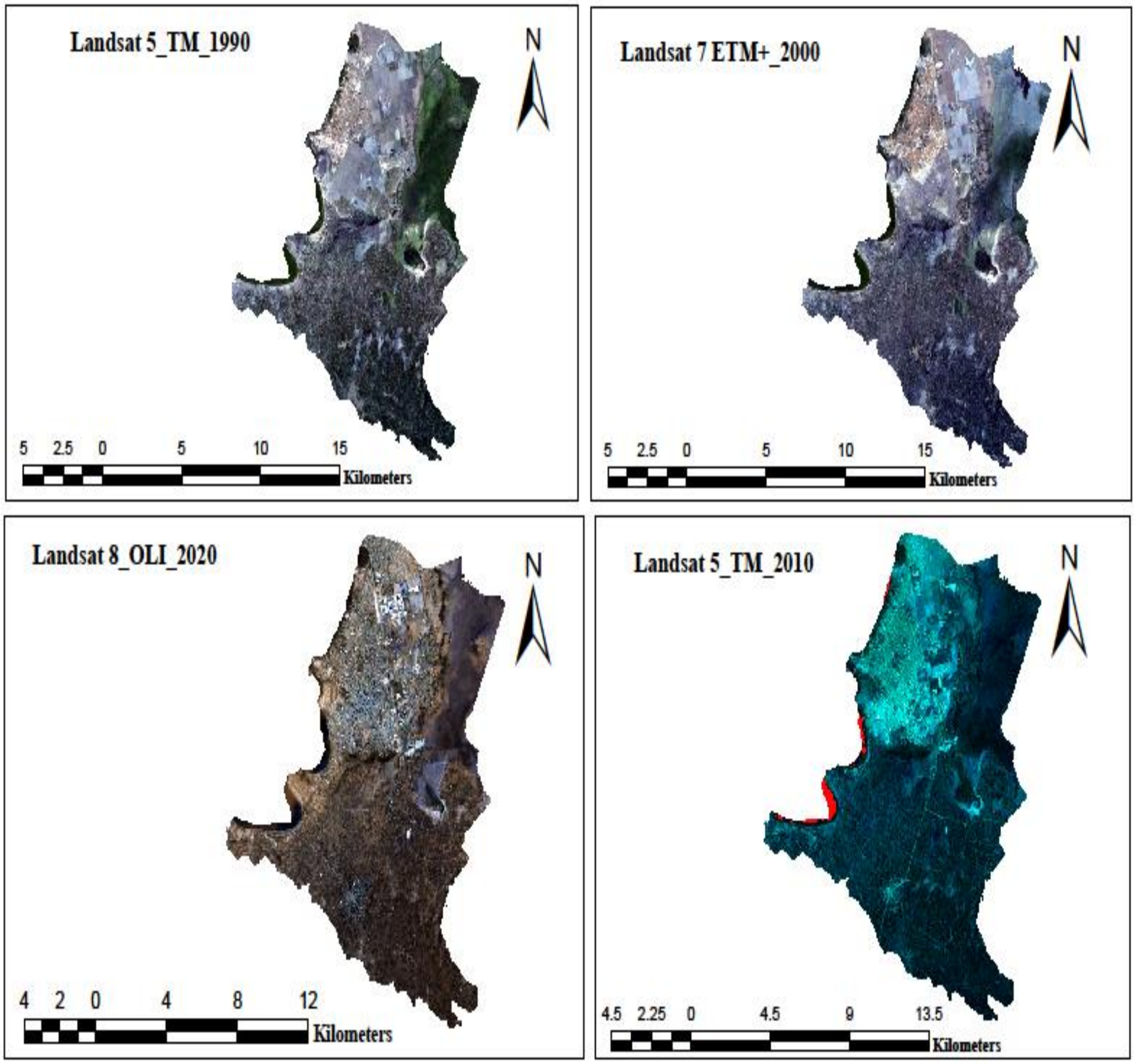
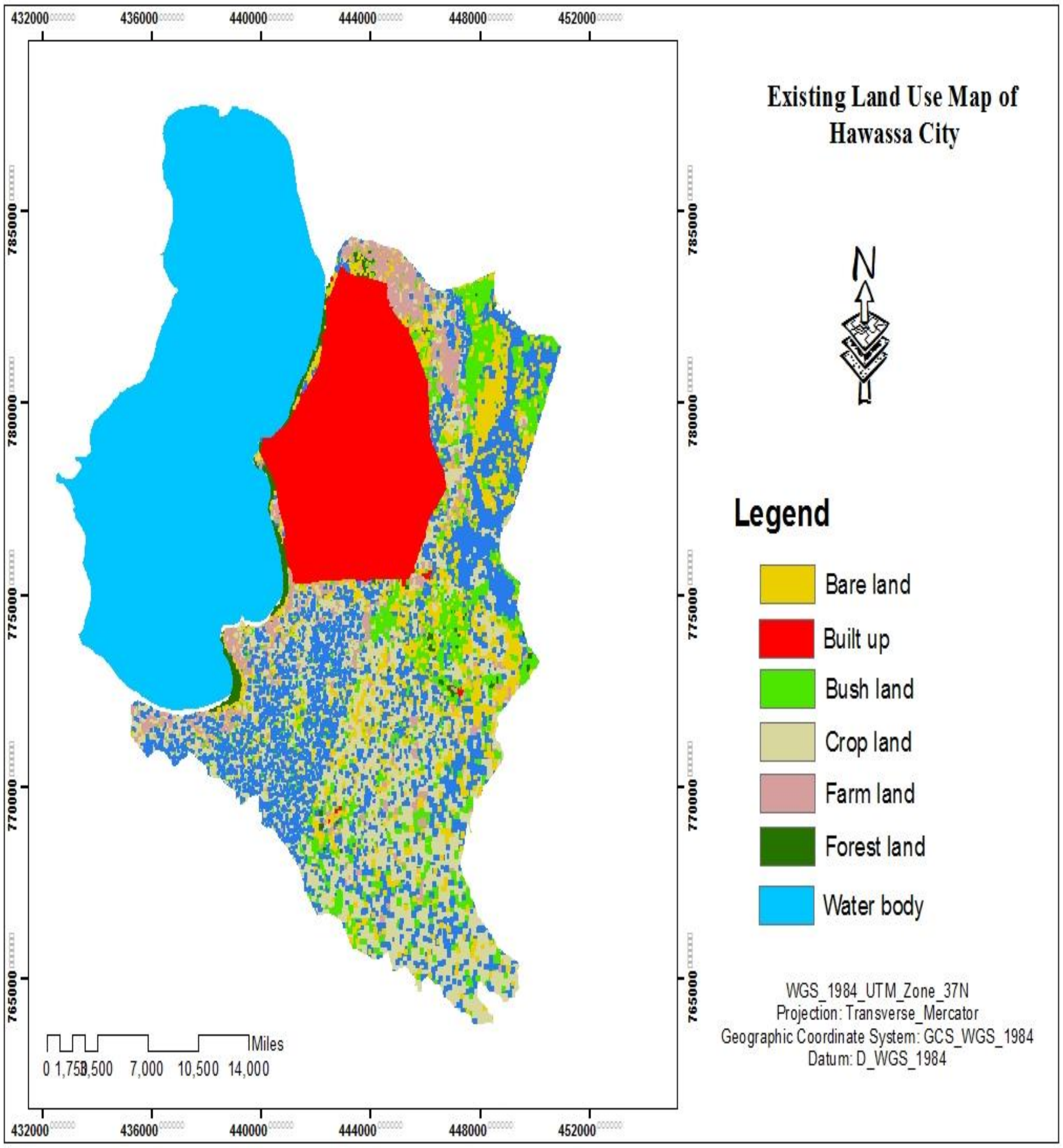
## APPENDICES I

## Appendix A

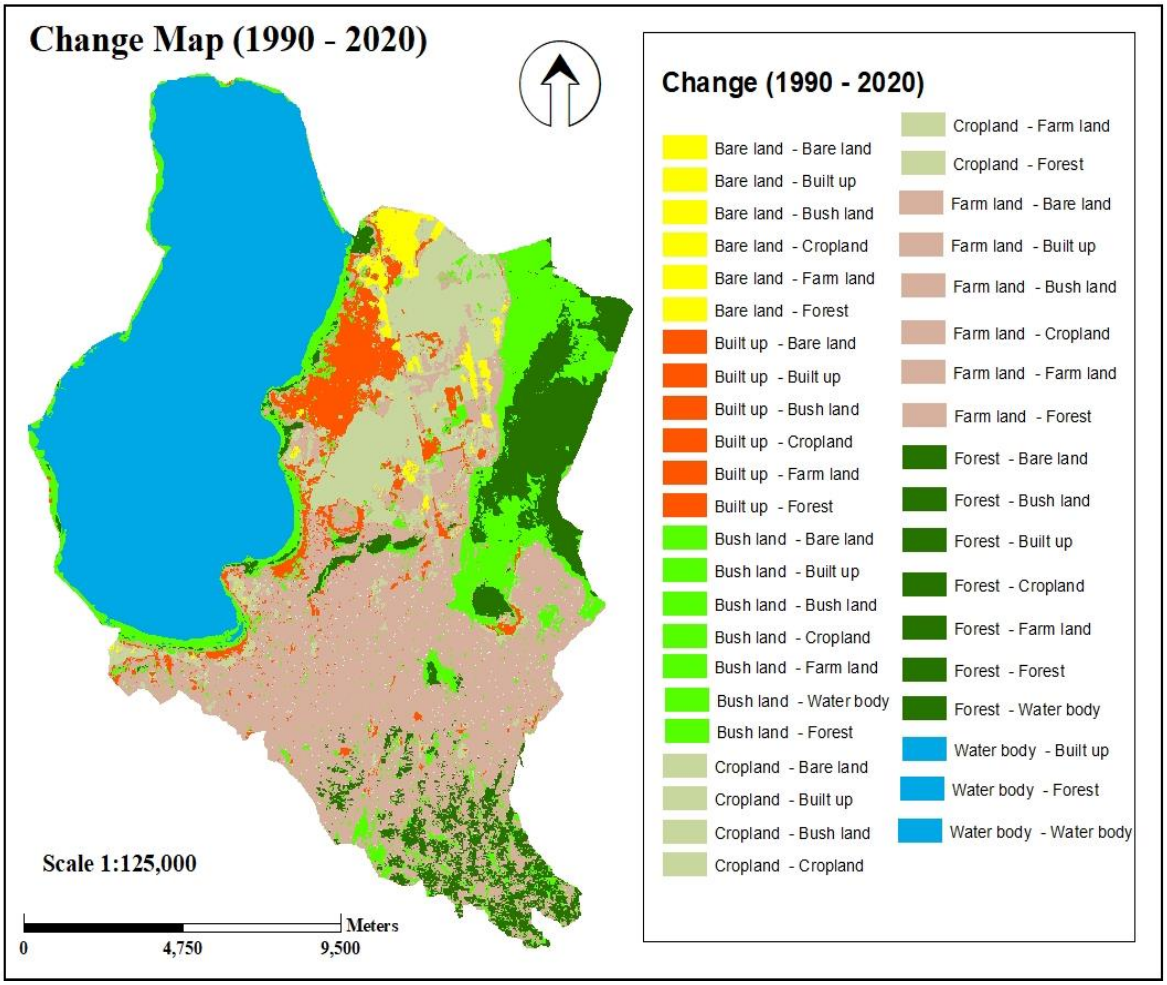
### Figures

Cross tabulation maps of gains and losses, transition of land cover classes, transition potential maps and trends of maps


Landsat 5_TM_1990
N
5 2.5 0 5 10 15
Kilometers
Landsat 7 ETM+_2000
N
5 2.5 0 5 10 15
Kilometers
Landsat 8_OLI_2020
N
4 2 0 4 8 12
Kilometers
Landsat 5_TM_2010
N
4.5 2.25 0 4.5 9 13.5
Kilometers



Existing Land Use Map of Hawassa City
Legend
Bare land
Built up
Bush land
Crop land
Farm land
Forest land
Water body
WGS_1984_UTM_Zone_37N
Projection: Transverse_Mercator
Geographic Coordinate System: GCS_WGS_1984
Datum: D_WGS_1984
Miles
0 1,750 3,500 7,000 10,500 14,000
432000
436000
440000
444000
448000
452000
785000
780000
775000
770000
765000
N


Change Map (1990 - 2020)
Change (1990 - 2020)
Bare land - Bare land
Bare land - Built up
Bare land - Bush land
Bare land - Cropland
Bare land - Farm land
Bare land - Forest
Built up - Bare land
Built up - Built up
Built up - Bush land
Built up - Cropland
Built up - Farm land
Built up - Forest
Bush land - Bare land
Bush land - Built up
Bush land - Bush land
Bush land - Cropland
Bush land - Farm land
Bush land - Water body
Bush land - Forest
Cropland - Bare land
Cropland - Built up
Cropland - Bush land
Cropland - Cropland
Cropland - Farm land
Cropland - Forest
Farm land - Bare land
Farm land - Built up
Farm land - Bush land
Farm land - Cropland
Farm land - Farm land
Farm land - Forest
Forest - Bare land
Forest - Bush land
Forest - Built up
Forest - Cropland
Forest - Farm land
Forest - Forest
Forest - Water body
Water body - Built up
Water body - Forest
Water body - Water body
Scale 1:125,000
Meters
0
4,750
9,500

## Appendix B

### Tables

**Cross tabulation performs a cross-tabulation analysis that compares images containing categorical variables. The table below was computed from actual land cover map of 1990 and simulate map of 2020**

Table

lulc_1990_Intersect

| FID * | Shape * | FID_lulc_1990 | gridcode | lulc_90 | Area_90 | FID_lulc_2020 | OBJECTID | gridcode | LULC_2020 | Area_ha | Shape_Length | Shape_Area | Change | Ar |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Polygon | 0 | 1 | Bare land | 396.136494 | 0 | 1 | 1 | Bare land | 218.249941 | 6955.484251 | 75721.434394 | Bare land - Bare land | |
| 2 | Polygon | 0 | 1 | Bare land | 396.136494 | 1 | 2 | 2 | Built up | 4744.305133 | 90132.482878 | 3147270.806311 | Bare land - Built up | |
| 3 | Polygon | 0 | 1 | Bare land | 396.136494 | 2 | 3 | 3 | Bush land | 1133.181684 | 1780.400895 | 14774.654884 | Bare land - Bush land | |
| 4 | Polygon | 0 | 1 | Bare land | 396.136494 | 3 | 4 | 4 | Cropland | 2134.158267 | 48126.117515 | 615040.230397 | Bare land - Cropland | |
| 5 | Polygon | 0 | 1 | Bare land | 396.136494 | 4 | 5 | 5 | Farm land | 6803.639532 | 12724.418701 | 100526.966364 | Bare land - Farm land | |
| 6 | Polygon | 0 | 1 | Bare land | 396.136494 | 5 | 6 | 6 | Forest | 1762.485276 | 807.035242 | 5052.26275 | Bare land - Forest | |
| 7 | Polygon | 1 | 2 | Built up | 1240.961142 | 0 | 1 | 1 | Bare land | 218.249941 | 15567.568794 | 119050.538355 | Built up - Bare land | |
| 8 | Polygon | 1 | 2 | Built up | 1240.961142 | 1 | 2 | 2 | Built up | 4744.305133 | 293982.742828 | 9650614.025595 | Built up - Built up | |
| 9 | Polygon | 1 | 2 | Built up | 1240.961142 | 2 | 3 | 3 | Bush land | 1133.181684 | 4451.079994 | 31658.296562 | Built up - Bush land | |
| 10 | Polygon | 1 | 2 | Built up | 1240.961142 | 3 | 4 | 4 | Cropland | 2134.158267 | 144282.567503 | 1335952.516082 | Built up - Cropland | |
| 11 | Polygon | 1 | 2 | Built up | 1240.961142 | 4 | 5 | 5 | Farm land | 6803.639532 | 138708.827558 | 1068725.644977 | Built up - Farm land | |
| 12 | Polygon | 1 | 2 | Built up | 1240.961142 | 5 | 6 | 6 | Forest | 1762.485276 | 25056.75905 | 198474.578405 | Built up - Forest | |
| 13 | Polygon | 2 | 3 | Bush land | 2757.332024 | 0 | 1 | 1 | Bare land | 218.249941 | 41028.004516 | 673371.204808 | Bush land - Bare land | |
| 14 | Polygon | 2 | 3 | Bush land | 2757.332024 | 1 | 2 | 2 | Built up | 4744.305133 | 309030.644791 | 7057196.032362 | Bush land - Built up | |
| 15 | Polygon | 2 | 3 | Bush land | 2757.332024 | 2 | 3 | 3 | Bush land | 1133.181684 | 152944.497238 | 5646814.874543 | Bush land - Bush land | |
| 16 | Polygon | 2 | 3 | Bush land | 2757.332024 | 3 | 4 | 4 | Cropland | 2134.158267 | 297710.591074 | 3843138.490813 | Bush land - Cropland | |
| 17 | Polygon | 2 | 3 | Bush land | 2757.332024 | 4 | 5 | 5 | Farm land | 6803.639532 | 492639.296256 | 5524526.03265 | Bush land - Farm land | |
| 18 | Polygon | 2 | 3 | Bush land | 2757.332024 | 5 | 6 | 6 | Forest | 1762.485276 | 250942.127533 | 4334112.37372 | Bush land - Forest | |
| 19 | Polygon | 2 | 3 | Bush land | 2757.332024 | 6 | 7 | 7 | Water body | 8337.98435 | 31026.510361 | 434875.720486 | Bush land - Water body | |
| 20 | Polygon | 3 | 4 | Cropland | 2439.003239 | 0 | 1 | 1 | Bare land | 218.249941 | 68605.479828 | 920552.005098 | Cropland - Bare land | |
| 21 | Polygon | 3 | 4 | Cropland | 2439.003239 | 1 | 2 | 2 | Built up | 4744.305133 | 451621.562308 | 15244192.179695 | Cropland - Built up | |
| 22 | Polygon | 3 | 4 | Cropland | 2439.003239 | 2 | 3 | 3 | Bush land | 1133.181684 | 15981.262149 | 201216.432882 | Cropland - Bush land | |
| 23 | Polygon | 3 | 4 | Cropland | 2439.003239 | 3 | 4 | 4 | Cropland | 2134.158267 | 374898.668268 | 5488630.958811 | Cropland - Cropland | |
| 24 | Polygon | 3 | 4 | Cropland | 2439.003239 | 4 | 5 | 5 | Farm land | 6803.639532 | 215095.927209 | 2397196.718786 | Cropland - Farm land | |
| 25 | Polygon | 3 | 4 | Cropland | 2439.003239 | 5 | 6 | 6 | Forest | 1762.485276 | 15753.126959 | 127065.177067 | Cropland - Forest | |
| 26 | Polygon | 4 | 5 | Farm land | 7233.753388 | 0 | 1 | 1 | Bare land | 218.249941 | 40155.737546 | 374630.295239 | Farm land - Bare land | |
| 27 | Polygon | 4 | 5 | Farm land | 7233.753388 | 1 | 2 | 2 | Built up | 4744.305133 | 535622.825835 | 8499703.005026 | Farm land - Built up | |
| 28 | Polygon | 4 | 5 | Farm land | 7233.753388 | 2 | 3 | 3 | Bush land | 1133.181684 | 51769.33716 | 430641.212062 | Farm land - Bush land | |
| 29 | Polygon | 4 | 5 | Farm land | 7233.753388 | 3 | 4 | 4 | Cropland | 2134.158267 | 828204.409829 | 9086790.721881 | Farm land - Cropland | |
| 30 | Polygon | 4 | 5 | Farm land | 7233.753388 | 4 | 5 | 5 | Farm land | 6803.639532 | 1520180.604551 | 49794591.995177 | Farm land - Farm land | |

Search

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Table

lulc_1990_Intersect

| FID * | Shape * | FID_lulc_1990 | gridcode | lulc_90 | Area_90 | FID_lulc_2020 | OBJECTID | gridcode | LULC_2020 | Area_ha | Shape_Length | Shape_Area | Change | Ar |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Polygon | 0 | 1 | Bare land | 396.136494 | 0 | 1 | 1 | Bare land | 218.249941 | 6955.484251 | 75721.434394 | Bare land - Bare land | |
| 2 | Polygon | 0 | 1 | Bare land | 396.136494 | 1 | 2 | 2 | Built up | 4744.305133 | 90132.482878 | 3147270.806311 | Bare land - Built up | |
| 3 | Polygon | 0 | 1 | Bare land | 396.136494 | 2 | 3 | 3 | Bush land | 1133.181684 | 1780.400895 | 14774.654884 | Bare land - Bush land | |
| 4 | Polygon | 0 | 1 | Bare land | 396.136494 | 3 | 4 | 4 | Cropland | 2134.158267 | 48126.117515 | 615040.230397 | Bare land - Cropland | |
| 5 | Polygon | 0 | 1 | Bare land | 396.136494 | 4 | 5 | 5 | Farm land | 6803.639532 | 12724.418701 | 100526.966364 | Bare land - Farm land | |
| 6 | Polygon | 0 | 1 | Bare land | 396.136494 | 5 | 6 | 6 | Forest | 1762.485276 | 807.035242 | 5052.26275 | Bare land - Forest | |
| 7 | Polygon | 1 | 2 | Built up | 1240.961142 | 0 | 1 | 1 | Bare land | 218.249941 | 15567.568794 | 119050.538355 | Built up - Bare land | |
| 8 | Polygon | 1 | 2 | Built up | 1240.961142 | 1 | 2 | 2 | Built up | 4744.305133 | 293982.742828 | 9650614.025595 | Built up - Built up | |
| 9 | Polygon | 1 | 2 | Built up | 1240.961142 | 2 | 3 | 3 | Bush land | 1133.181684 | 4451.079994 | 31658.296562 | Built up - Bush land | |
| 10 | Polygon | 1 | 2 | Built up | 1240.961142 | 3 | 4 | 4 | Cropland | 2134.158267 | 144282.567503 | 1335952.516082 | Built up - Cropland | |
| 11 | Polygon | 1 | 2 | Built up | 1240.961142 | 4 | 5 | 5 | Farm land | 6803.639532 | 138708.827558 | 1068725.644977 | Built up - Farm land | |
| 12 | Polygon | 1 | 2 | Built up | 1240.961142 | 5 | 6 | 6 | Forest | 1762.485276 | 25056.75905 | 198474.578405 | Built up - Forest | |
| 13 | Polygon | 2 | 3 | Bush land | 2757.332024 | 0 | 1 | 1 | Bare land | 218.249941 | 41028.004516 | 673371.204808 | Bush land - Bare land | |
| 14 | Polygon | 2 | 3 | Bush land | 2757.332024 | 1 | 2 | 2 | Built up | 4744.305133 | 309030.644791 | 7057196.032362 | Bush land - Built up | |
| 15 | Polygon | 2 | 3 | Bush land | 2757.332024 | 2 | 3 | 3 | Bush land | 1133.181684 | 152944.497238 | 5646814.874543 | Bush land - Bush land | |
| 16 | Polygon | 2 | 3 | Bush land | 2757.332024 | 3 | 4 | 4 | Cropland | 2134.158267 | 297710.591074 | 3843138.490813 | Bush land - Cropland | |
| 17 | Polygon | 2 | 3 | Bush land | 2757.332024 | 4 | 5 | 5 | Farm land | 6803.639532 | 492639.296256 | 5524526.03265 | Bush land - Farm land | |
| 18 | Polygon | 2 | 3 | Bush land | 2757.332024 | 5 | 6 | 6 | Forest | 1762.485276 | 250942.127533 | 4334112.37372 | Bush land - Forest | |
| 19 | Polygon | 2 | 3 | Bush land | 2757.332024 | 6 | 7 | 7 | Water body | 8337.98435 | 31026.510361 | 434875.720486 | Bush land - Water body | |
| 20 | Polygon | 3 | 4 | Cropland | 2439.003239 | 0 | 1 | 1 | Bare land | 218.249941 | 68605.479828 | 920552.005098 | Cropland - Bare land | |
| 21 | Polygon | 3 | 4 | Cropland | 2439.003239 | 1 | 2 | 2 | Built up | 4744.305133 | 451621.562308 | 15244192.179695 | Cropland - Built up | |
| 22 | Polygon | 3 | 4 | Cropland | 2439.003239 | 2 | 3 | 3 | Bush land | 1133.181684 | 15981.262149 | 201216.432882 | Cropland - Bush land | |
| 23 | Polygon | 3 | 4 | Cropland | 2439.003239 | 3 | 4 | 4 | Cropland | 2134.158267 | 374898.668268 | 5488630.958811 | Cropland - Cropland | |
| 24 | Polygon | 3 | 4 | Cropland | 2439.003239 | 4 | 5 | 5 | Farm land | 6803.639532 | 215095.927209 | 2397196.718786 | Cropland - Farm land | |
| 25 | Polygon | 3 | 4 | Cropland | 2439.003239 | 5 | 6 | 6 | Forest | 1762.485276 | 15753.126959 | 127065.177067 | Cropland - Forest | |
| 26 | Polygon | 4 | 5 | Farm land | 7233.753388 | 0 | 1 | 1 | Bare land | 218.249941 | 40155.737546 | 374630.295239 | Farm land - Bare land | |
| 27 | Polygon | 4 | 5 | Farm land | 7233.753388 | 1 | 2 | 2 | Built up | 4744.305133 | 535622.825835 | 8499703.005026 | Farm land - Built up | |
| 28 | Polygon | 4 | 5 | Farm land | 7233.753388 | 2 | 3 | 3 | Bush land | 1133.181684 | 51769.33716 | 430641.212062 | Farm land - Bush land | |
| 29 | Polygon | 4 | 5 | Farm land | 7233.753388 | 3 | 4 | 4 | Cropland | 2134.158267 | 828204.409829 | 9086790.721881 | Farm land - Cropland | |
| 30 | Polygon | 4 | 5 | Farm land | 7233.753388 | 4 | 5 | 5 | Farm land | 6803.639532 | 1520180.604551 | 49794591.995177 | Farm land - Farm land | |

Search

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Table

lulc_1990_Intersect

| Area_90 | FID_lulc_2020 | OBJECTID | gridcode | LULC_2020 | Area_ha | Shape_Length | Shape_Area | Change | Area_change |
|---|---|---|---|---|---|---|---|---|---|
| 396.136494 | 0 | 1 | 1 | Bare land | 218.249941 | 6955.484251 | 75721.434394 | Bare land - Bare land | 7.57 |
| 396.136494 | 1 | 2 | 2 | Built up | 4744.305133 | 90132.482878 | 3147270.806311 | Bare land - Built up | 314.73 |
| 396.136494 | 2 | 3 | 3 | Bush land | 1133.181684 | 1780.400895 | 14774.654884 | Bare land - Bush land | 1.48 |
| 396.136494 | 3 | 4 | 4 | Cropland | 2134.158267 | 48126.117515 | 615040.230397 | Bare land - Cropland | 61.5 |
| 396.136494 | 4 | 5 | 5 | Farm land | 6803.639532 | 12724.418701 | 100526.966364 | Bare land - Farm land | 10.05 |
| 396.136494 | 5 | 6 | 6 | Forest | 1762.485276 | 807.035242 | 5052.26275 | Bare land - Forest | 0.51 |
| 1240.961142 | 0 | 1 | 1 | Bare land | 218.249941 | 15567.568794 | 119050.538355 | Built up - Bare land | 11.91 |
| 1240.961142 | 1 | 2 | 2 | Built up | 4744.305133 | 293982.742828 | 9650614.025595 | Built up - Built up | 965.06 |
| 1240.961142 | 2 | 3 | 3 | Bush land | 1133.181684 | 4451.079994 | 31658.296562 | Built up - Bush land | 3.17 |
| 1240.961142 | 3 | 4 | 4 | Cropland | 2134.158267 | 144282.567503 | 1335952.516082 | Built up - Cropland | 133.6 |
| 1240.961142 | 4 | 5 | 5 | Farm land | 6803.639532 | 138708.827558 | 1068725.644977 | Built up - Farm land | 106.87 |
| 1240.961142 | 5 | 6 | 6 | Forest | 1762.485276 | 25056.75905 | 198474.578405 | Built up - Forest | 19.85 |
| 2757.332024 | 0 | 1 | 1 | Bare land | 218.249941 | 41028.004516 | 673371.204808 | Bush land - Bare land | 67.34 |
| 2757.332024 | 1 | 2 | 2 | Built up | 4744.305133 | 309030.644791 | 7057196.032362 | Bush land - Built up | 705.72 |
| 2757.332024 | 2 | 3 | 3 | Bush land | 1133.181684 | 152944.497238 | 5646814.874543 | Bush land - Bush land | 564.68 |
| 2757.332024 | 3 | 4 | 4 | Cropland | 2134.158267 | 297710.591074 | 3843138.490813 | Bush land - Cropland | 384.31 |
| 2757.332024 | 4 | 5 | 5 | Farm land | 6803.639532 | 492639.296256 | 5524526.03265 | Bush land - Farm land | 552.45 |
| 2757.332024 | 5 | 6 | 6 | Forest | 1762.485276 | 250942.127533 | 4334112.37372 | Bush land - Forest | 433.41 |
| 2757.332024 | 6 | 7 | 7 | Water body | 8337.98435 | 31026.510361 | 434875.720486 | Bush land - Water body | 43.49 |
| 2439.003239 | 0 | 1 | 1 | Bare land | 218.249941 | 68605.479828 | 920552.005098 | Cropland - Bare land | 92.06 |
| 2439.003239 | 1 | 2 | 2 | Built up | 4744.305133 | 451621.562308 | 15244192.179695 | Cropland - Built up | 1524.42 |
| 2439.003239 | 2 | 3 | 3 | Bush land | 1133.181684 | 15981.262149 | 201216.432882 | Cropland - Bush land | 20.12 |
| 2439.003239 | 3 | 4 | 4 | Cropland | 2134.158267 | 374898.668268 | 5488630.958811 | Cropland - Cropland | 548.86 |
| 2439.003239 | 4 | 5 | 5 | Farm land | 6803.639532 | 215095.927209 | 2397196.718786 | Cropland - Farm land | 239.72 |
| 2439.003239 | 5 | 6 | 6 | Forest | 1762.485276 | 15753.126959 | 127065.177067 | Cropland - Forest | 12.71 |
| 7233.753388 | 0 | 1 | 1 | Bare land | 218.249941 | 40155.737546 | 374630.295239 | Farm land - Bare land | 37.46 |
| 7233.753388 | 1 | 2 | 2 | Built up | 4744.305133 | 535622.825835 | 8499703.005026 | Farm land - Built up | 849.97 |
| 7233.753388 | 2 | 3 | 3 | Bush land | 1133.181684 | 51769.33716 | 430641.212062 | Farm land - Bush land | 43.06 |
| 7233.753388 | 3 | 4 | 4 | Cropland | 2134.158267 | 828204.409829 | 9086790.721881 | Farm land - Cropland | 908.68 |
| 7233.753388 | 4 | 5 | 5 | Farm land | 6803.639532 | 1520180.604551 | 49794591.995177 | Farm land - Farm land | 4979.46 |

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## APPENDIX II Household Survey Questionnaire

**ADDIS ABABA UNIVERSITY**

**College of Technology and Built Environment**

**Ph.D. Program in Urban and Regional Planning**

**A HOUSEHOLD SURVEY QUESTIONNAIRE**

**Introduction and consent**

**Dear respondent!** Good morning/afternoon! My name is Mefekir Woldegebriel and I am working as part of the data collection team of the PhD study entitled "**Analysis of Land Use /Land cover dynamic in relation to urban expansion: The case of Hawassa City."** This is being conducted as a main data sources to be supported by secondary data to be collected using Remote Sensing and GIS techniques between 1990 and 2020, which this study is lacking. You are selected for this survey randomly as a resident of the Hawassa City and your important role as a City dweller. Your participation is based on your willingness to take part.

I will ask you a series of questions that would take about 45-60 minutes. Therefore, your kind cooperation with honest responses to the household survey questionnaire will be vital for the overall success of the study. It is purely for academic purpose (PhD study); results and any other details will not be used for un-intended purpose. To this end, anonymity and confidentiality of our respondents are highly guaranteed unless and otherwise under mutual agreement between the concerned parties. If you don't choose to participate, it will in no way impact you in any aspect. Before we begin, do you want to ask me any questions about the survey? [***Listen questions and provide appropriate responses***].

**General instruction for the interviewer/enumerator**

- ⇒ Please put the code chosen by the respondent in the space provided for some of the close-ended questions and encircle the chosen reposes for those which do not have space to put the codes;
- ⇒ The respondent can choose more than one response for some questions (multiple response items);
- ⇒ Skip the code to which it does not require the response;
- ⇒ Write down the response for open-ended questions whenever the respondent provides and necessary;

**Module 2. Public Perception on the Role of Urban Green Infrastructure Development and Land Use Management in Rapidly Urbanized Countries: The Case of Hawassa City, Ethiopia**

**MODULE 1: HOUSEHOLD IDENTIFICATION**

| ***SN*** | **Questions** | **Code Description** |
|---|---|---|
| M1.1 | Household identification No. | |
| M1.2 | Sub- City of the study | 1=<br>2=<br>3=<br>4=<br>5= |
| M1.3 | *Kebele* | |
| M1.4 | Agro-ecology type | 1= Midland<br>2= Lowland |
| M1.5 | Respondent sex | 1= Male<br>2= Female |
| M1.6 | Date of interview | |
| M1.7 | Enumerator name | |

**MODULE 2: DEMOGRAPHIC INFORMATION**

| **SN** | **Question(s)** | **Code Description** |
|---|---|---|
| M2.1 | Sex of the household head | 1=Male<br>2=Female |
| M2.2 | Age of the household head **[write in years]** | |
| M2.3 | Level of education of the household head | 1=Illiterate<br>2=Informal education (religious, adult education)<br>3= Primary school (1-8) |

| SN | Question(s) | Code Description |
|---|---|---|
| | | 4= Secondary school (9-10)<br>5= Preparatory (11-12)<br>6= Above preparatory<br>7=Certificate<br>8=Diploma certificate<br>9=Degree<br>10=Masters<br>11=PhD and above |
| M2.4 | Years of schooling **[write in years]** | |
| M2.5 | Marital status of the household head<br><br>[**If age is above 18 years**] | 1= Never married<br>2= Married<br>3= Divorced<br>4= Separated<br>5= Widowed |
| M2.6 | What is/was your house head's main industry of occupation? | 1= Urban Agriculture<br>2= Mining<br>3= Manufacturing<br>4= Electri City<br>5= Construction<br>6= Transportation<br>7= Buying and Selling any commodity<br>8= Financial Services<br>9= Personal Services/own business<br>10= Education<br>11= Health<br>12= Public Administration<br>13=Own business<br>14= Other (Specify) |

| SN | Question(s) | Code Description | |
|---|---|---|---|
| M2.7 | Religious affiliation of the household head | 1= Orthodox<br>2= Protestant<br>3= Catholic<br>4= Muslim<br>5=Indigenous religion<br>6= Other (specify) | |
| M2.8 | The house head responsibility in the community | 1= Member of the community<br>2= Religious leader<br>3= Development group leader<br>4= Kebele administrator<br>5= Council or cabinet member<br>6=Trade/Cooperative/ Union leader<br>7= Other (specify) | |
| M2.9 | Length of years in the current residence **[write in years]**<br><br>Probe as *[how long have you been living in this current residence?]* | ☐ | |
| M2.10 | House head farming experience **[write in years]** | ☐ | |
| M2.11 | Household size (**write in number**)<br><br>*[Please let the respondent to give the number of household members categorized by sex and age groups]* | No of male HH members ≤ 14 | ☐ |
| | | No of female HH members ≤ 14 | ☐ |
| | | No of male HH members [15-64] | ☐ |
| | | No of female HH members [15-64] | ☐ |
| | | No of male HH members ≥65 | ☐ |
| | | No of female HH members ≥ 65 | ☐ |

| SN | Question(s) | Code Description | |
|---|---|---|---|
| M2.12 | Is this your village of origin? | 1=Yes 2=No | |
| M2.13 | If your place of birth is different from the current place, what is the reason for coming here? (**Multiple response is possible)** | 1=Marriage<br>2=Join relative<br>3=Divorce<br>4=Search for better jobs;<br>5=Business/service provision;<br>6=Education/employment<br>7=others specify______ | |
| M2.14 | The total size of land in square meter | | |

**MODULE 3: Existing condition, visiting trends and frequency of visits to green infrastructure,**

1. Are there any green infrastructure in your locality? **Yes** ☐ **No** ☐

2. If yes**,** how many green infrastructures do you know in your locality?

   1. One 2. Two 3. Three 4. Others specify_____

3. Have you ever visit green infrastructure? **Yes** ☐ **No** ☐

4. How frequently you visited green infrastructure? **1=daily** 2=**several time a week 3=once a week 4=once a month 5=several times a year 6 . Others specify**…………………………………………………………………………………..

5. How many times you spend by visiting green infrastructure? **1= <10 minutes**. **2 =10-20 minutes. 3 = 21-30 minutes. 4 =1-2 hours.5 =>2 hours**

6. What is the importance of visiting green infrastructure? **1=to relax and reduce stress 2=to be closer to nature 3=to meet friends 4=for sporting activities 5=to play with children 6=others specify………………………………………………………………………………**

7. What are the factors that hinder the development of green infrastructures in your locality?

…………………………………………………………………………………………………

8. Are you willing to participate in green infrastructure development? Yes ☐ No ☐

If your answer is no, why?………………………………………………………………………

9. What is your responsibility in management of infrastructure?

1. Financial support 2. In kind support 3. Participating in community discussion 4. Other specify……………………………………………………………………………………….

10. Do you ever participate in planting campaign in your village? Yes ☐ No ☐

If No, why? 1. Lack information 2. No interest 3. It is others responsibilities 4. Negligence 5. If any other specify……………………………………………………………………………..

11. What are the main challenges facing Hawassa City in developing and managing green infrastructures in general?.

……………………………………………………………………………………………………

12. What should be done for Q#11?.........................................................................................

**MODULE 4: General perceptions of green infrastructure by local communities**

1. What is the attitude of the urban dwellers towards green infrastructure? **1=positive 0=negative**

2. If **yes,** to what extent are you satisfied by green infrastructure? 1= Strongly satisfied. 2= Satisfied. 3 =Neutral 4= Not satisfied 5= strongly not satisfied.

3. Perception toward capa City building being developed by town administration. **1=** Strongly satisfied**. 2=** Satisfied. **3=**Neutral 4= Not satisfied **5=** strongly not satisfied.

**Interview schedule for dependent variable**

| S. No | * Positive and ** Negative Statements | Strongly Agree(5) | Agree(4) | Neutral(3) | Disagree(2) | Strongly Disagree(1) |
|---|---|---|---|---|---|---|
| 1 | Green areas have benefit for the wellbeing of the community. | | | | | |
| 2 | Informal settlement has been taking big part for the reduction of green areas. | | | | | |
| 3 | In your understanding is the spatial urban expansion has been decreasing the available green areas? | | | | | |
| 4 | There is annual decline in green areas coverage. | | | | | |
| 5 | Participation is concerned with the involvement of users in the maintenance and future planning of green infrastructure. | | | | | |
| 6 | Play fields should be replaced by industrial construction. | | | | | |
| 7 | Parks were dangerous because it reproduces wild animals. | | | | | |
| 8 | Wetlands have no more benefit in community. | | | | | |
| 9 | In the City good attention given to green infrastructure development and management. | | | | | |
| 10 | You have no responsibility for managing keeping safe the green areas. | | | | | |
| **Total** | | | | | | |

**MODULE 5: Economic effects of displacement**

Items inside the following box were prepared to measure economic effect of the displacement on the community. The numbers correspondence to items in the right side of the Table represents

1=Strongly Disagree 2=Disagree 3= Undecided 4= Agree, 5= Strongly Agree

Due to this, you are kindly requested to put the ' (√) mark under the number of your choice, after carefully reading each item.

| No. | Items | Responses | | | | |
|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 |
| 1 | I have incurred huge economic loss due to displaced people | | | | | |
| 2 | Much of our properties have been shared for the displaced | | | | | |
| 3 | There has been problems with managing monthly and daily incomes due to the displaced people | | | | | |
| 4 | The community is in a great pressure of sharing their foods to the displaced | | | | | |
| 5 | I am unable to recover from material loss shared to displaced unless there is support from stakeholders | | | | | |
| 6 | Wage works in the City has been threatened due to huge labor force from displaced community | | | | | |
| 7 | Market places were ceased are functioning better since the arrival of the displaced | | | | | |
| 8 | Repetitive salary cut for the displaced has been severely harmed me | | | | | |
| 9 | We need support from the government to compensate what we have lost due to the displaced | | | | | |
| 10 | I was personally pushed to give the money for displaced beyond my own will | | | | | |
| 11 | All members of the community are nagging about high inflation in recent times | | | | | |
| 12 | Regularly, beggars come from the City center to ask clothes and food | | | | | |

**MODULE 6: Psychosocial effects**

Items inside the following box are measuring the psychological effects of the arrival of displaced people on the community. The numbers correspondence to items in the right side of the Table represents 1=strongly disagree, 2=disagree 3=undecided, 4= agree, and 5= strongly agree. Hence, after carefully reading each item, put the 'tick' (√) Mark under the number of your choice.

| No. | Items<br><br>**Since the arrival of the displaced** | Responses | | | | |
|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 |
| 1 | Individuals' motivation to run their regular tasks is decreased since the arrival of the displaced | | | | | |
| 2 | Interpersonal relationships among the members of community is decreased | | | | | |
| 3 | Sociability is increased among people | | | | | |
| 4 | I have testified that feeling of victimhood due to displaced is high in our locality | | | | | |
| 5 | The community developed negative attitude towards the displaced people | | | | | |
| 6 | Anti-social behavior among youngsters has been increased. | | | | | |
| 7 | I witnessed that the feeling of hopelessness intensely increased among the people. | | | | | |
| 8 | Feeling of helplessness is intensified among the community in the City | | | | | |
| 9 | Trustworthiness increased among the members of community | | | | | |
| 10 | People are worshiping and attending religious institutional programs less than previous times | | | | | |
| 11 | Overall, trauma and anxiety is increasing within the community following their interaction with the displaced people | | | | | |
| 12 | Religious festivals are kept to be well celebrated among the community as it was | | | | | |

**MODULE 7: Health problems**

Items inside the following box were prepared to measure health effects of the displaced people on the community. The numbers correspondence to items in the right side of the table represents 1=Strongly Disagree 2=Disagree 3= Undecided. 4= Agree, and 5= Strongly Agree

Due to this, you are kindly requested to put the '(√) mark under the number of your choice, after carefully reading each item.

| No. | Items | Responses | | | | |
|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 |
| 1 | Environmental pollution is significantly increased since increased recent times | | | | | |
| 2 | Since recent time, many communicable diseases are stemming from the displaced areas | | | | | |
| 3 | The ratio of health center-to person is highly decreased since the arrival of the displaced | | | | | |
| 4 | The ratio of health professional-to person is highly decreased since the arrival of the displaced | | | | | |
| 5 | Our community is increasingly subject to communicable diseases | | | | | |
| 6 | Due to large number of displaced, controlling pandemic diseases is increasingly high. | | | | | |
| 7 | The price of essential drugs is being escalating because of high demands in the refugee areas. | | | | | |
| 8 | There is visible lack of keeping personal hygiene in the displaced areas | | | | | |
| 9 | Obviously, there is lack of keeping environmental sanitation in the displaced areas | | | | | |
| 10 | Lack of proper waste disposal has been critical problem since the arrival of the displaced | | | | | |

**MODULE 8: Community's wellbeing**

Items inside the following box were prepared to measure the condition of wellbeing of the community after the arrival of the displaced. The numbers correspondence to items in the right side of the table represents 1=Strongly Disagree 2=Disagree 3=Undecided 4=Agree and 5= Strongly Agree

Due to this, you are kindly requested to put the ‘ (√) mark under the number of your choice, after carefully reading each item.

| No. | Items | Responses | | | | |
|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 |
| 1 | The provisions of electricity and potable water has been hampered since the arrival of displaced people | | | | | |
| 2 | Our community has been in great economic shock | | | | | |
| 3 | The ratio of health center-to person is highly decreased since the arrival of the displaced | | | | | |
| 4 | The ratio of health professional-to person is highly decreased since the arrival of the displaced | | | | | |
| 5 | Our community is increasingly subject to communicable diseases | | | | | |
| 6 | Due to large number of displaced, controlling pandemic diseases is increasingly high. | | | | | |
| 7 | The price of essential drugs is being escalating because of high demands in the refugee areas. | | | | | |
| 8 | There is visible lack of keeping personal hygiene in the displaced areas | | | | | |
| 9 | Obviously, there is lack of keeping environmental sanitation in the displaced areas | | | | | |
| 10 | Extension workers and health professionals in our community are not providing sufficient help for people due to additional workload from the displaced people | | | | | |

**MODULE 8: Environmental effect of internal displacement**

Items inside the following box were prepared to measure the environmental impacts of the arrival of the displaced on the host community. The numbers correspondence to items in the right side of the table represents

1=Strongly Disagree 2=Disagree 3= Undecided 4= Agree, and 5= Strongly Agree

Due to this, you are kindly requested to put the ' (√) mark under the number of your choice, after carefully reading each item.

| No. | Items | Responses | | | | |
|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 |
| 1 | Deforestation is increasingly common since the arrival of the displaced | | | | | |
| 2 | The carrying capacity of the environment is being decreased since the arrival of the displaced | | | | | |
| 3 | Since the arrival of the displaced, environmental pollution is significantly increased | | | | | |
| 4 | Due to limited carrying capacity, floods are becoming common | | | | | |
| 5 | The ratio of potable water to person is highly decreased since the arrival of the displaced | | | | | |
| 6 | The demand for fire wood and construction wood increased | | | | | |
| 7 | Our community is becoming increasingly noisy since recent time | | | | | |
| 8 | Environmental protection mechanisms are facing great challenge | | | | | |
| 9 | The community's peace and security issue is jeopardized | | | | | |
| 10 | Management of wastes is becoming the critical problem since the arrival of the displaced | | | | | |

**Table 1. Health related effect**

| **Reliability Statistics** | |
|---|---|
| Cronbach's Alpha | N of Items |
| .857 | 10 |

| **Item-Total Statistics** | | | | |
|---|---|---|---|---|
| | Scale Mean if Item Deleted | Scale Variance if Item Deleted | Corrected Item-Total Correlation | Cronbach's Alpha if Item Deleted |
| Health1 | 26.64 | 64.224 | .325 | .865 |
| Health2 | 26.53 | 57.383 | .700 | .831 |
| Health3 | 27.11 | 61.007 | .494 | .850 |
| Health4 | 26.58 | 60.034 | .604 | .840 |
| Health5 | 26.44 | 61.506 | .491 | .850 |
| Health6 | 26.84 | 58.072 | .646 | .836 |
| Health7 | 26.60 | 57.084 | .733 | .828 |
| Health8 | 27.42 | 62.971 | .535 | .846 |
| Health9 | 26.93 | 63.241 | .430 | .854 |
| Health10 | 26.39 | 58.511 | .718 | .831 |

**Table 2.Wellbeing**

| Reliability Statistics | |
|---|---|
| Cronbach's Alpha | N of Items |
| .882 | 10 |

| Item-Total Statistics | | | | |
|---|---|---|---|---|
| | Scale Mean if Item Deleted | Scale Variance if Item Deleted | Corrected Item-Total Correlation | Cronbach's Alpha if Item Deleted |
| Wellbeing1 | 25.74 | 65.545 | .565 | .874 |
| Wellbeing2 | 25.59 | 63.414 | .654 | .867 |
| Wellbeing3 | 25.82 | 64.658 | .530 | .877 |
| Wellbeing4 | 25.29 | 63.403 | .652 | .868 |
| Wellbeing5 | 25.19 | 64.397 | .556 | .875 |
| Wellbeing6 | 25.58 | 61.737 | .685 | .865 |
| Wellbeing7 | 25.35 | 61.572 | .727 | .862 |
| Wellbeing8 | 26.16 | 67.403 | .559 | .874 |
| Wellbeing9 | 25.68 | 67.384 | .459 | .881 |
| Wellbeing10 | 25.14 | 62.277 | .739 | .861 |

**Table 3. Environmental Effect**

| Reliability Statistics | |
|---|---|
| Cronbach's Alpha | N of Items |
| .856 | 10 |

| Item-Total Statistics | | | | |
|---|---|---|---|---|
| | Scale Mean if Item Deleted | Scale Variance if Item Deleted | Corrected Item-Total Correlation | Cronbach's Alpha if Item Deleted |
| EvtalEffect1 | 24.47 | 56.032 | .646 | .835 |
| EvtalEffect2 | 24.39 | 56.544 | .550 | .843 |
| EvtalEffect3 | 24.55 | 56.006 | .558 | .842 |
| EvtalEffect4 | 24.03 | 57.300 | .542 | .844 |
| EvtalEffect5 | 23.92 | 57.333 | .506 | .847 |
| EvtalEffect6 | 24.31 | 54.246 | .662 | .833 |
| EvtalEffect7 | 24.90 | 58.315 | .612 | .839 |
| EvtalEffect8 | 24.41 | 58.517 | .492 | .848 |
| EvtalEffect9 | 24.83 | 59.077 | .466 | .850 |
| EvtalEffect10 | 24.37 | 56.928 | .588 | .840 |

**MODULE 9: The extent to which urban plan implementation that attend the objective of town on land administration experts in Hawassa City**

1. Hawassa City urban plan implementation is sufficient for the town development? Yes ☐ ☐ No If, no, what do you think the reasons------------------------------------------------------------------

2. A urban plan implementation of a town is cause for land management challenges? Yes ☐ No ☐

If, no, what do you think the reasons---------------------------------------------------------------------

3. Is the Municipality achieving its objectives based on the intended plan? Yes ☐ No ☐

if no, what are the reason and the measures for the town its development?

……………………………………………………………………………………………

4. Do the procedures, guidelines, proclamations, and other land related issues disclosed to stakeholders? Yes ☐ No ☐ If no, what are the reasons that make the system not to do effectively?

5. What are the major challenges and prospects in the Municipality?

…………………………………………………………………………………………

**MODULE 10: Impact of urban planning implementation on land management activity individual that got the land in Hawassa City**

1. With what method you had taken the land? 1. Permit ☐ 2. Lease ☐ 3. Buying from ☐ peripheral ☐ 4. Farmers' land holding ☐ 5. Contractual ☐

2. Do you think that the filing system of the Municipality is satisfactory to manage the owner of the land and building? Yes ☐ No ☐ If not what would you think about the consequence on the development of the City.........................................................................................?

3. Is the Municipality quick to respond to enough for your complains? Yes ☐ No ☐ If no, what are the reasons? 1. Lack of community participation 2. Lack of information 3. Lack of awareness community & experts 4. undecided responsibility 5. Lack of capacity of experts

4. Is the Municipality taking measures against the un-ethical staff members? Yes No
If no, what are the reasons? -------------------------------------------------------------------

5.Is there environmental impact related to land management? Yes ☐ No ☐

Section IV. Institutional arrangements on land management's practices (kebele to Mayor) in Hawassa City.

1. How often do you go to the Municipality with other institutional collaboration?

1. Excellent 2. Very good 3. Good 4. Poor 5. Very poor

3. How often do you go to the Municipality? 1. Frequently 2. Sometimes 3. Rarely

4. In Municipality inappropriate access houses the land market? Yes ☐ No ☐ . If yes, what are the reasons? -------------------------------------------------------------------------------

5. Have you ever participated in meetings called by the Municipality? Yes ☐ No ☐.

If no, what are the reasons?.........................................................................................

5. How do see the supervision of municipality to land administration office and expert?

1. High 2. Medium 3. Low

6. Does municipal form committee and land administration office to handle the question of community? Yes ☐ No ☐ If not what is the reason? -------------------------------------

7. Lease method of Land delivery system increases the revenue of Hawassa City? 1= Strongly 2=Agree 3=Agree 4= Undecided 4=Disagree 5= strongly disagree

**MODULE 11. The community perception practicing on urban plan implementation and Land management challenges in Hawassa City Municipality.**

1= Strongly 2=Agree 3=Agree 4= Undecided 4=Disagree 5= Strongly disagree

**Table 4 . Community perception practicing on urban planning implementation and Land management challenges.**

| | **Challenge** | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 1 | Ineffective use of land resource | | | | | |
| 2 | Absence of accountability& transparency | | | | | |
| 3 | Ineffective recoding system | | | | | |
| 4 | Absence of skilled man power | | | | | |
| 5 | Lack of perception both(expert and community) | | | | | |

## Appendix III: Key Informant Interview Guide

**Addis Ababa University**

**College of Technology and Built Environment**

**Ph.D. Program in Urban and Regional Planning**

**Interview Guide for selected individuals**

1. What are the factors that affect the development and management of green infrastructure in your locality?

2. In what ways are you involving as stakeholder to plan, develop and manage green infrastructure in your locality?

3. What is the importance of green infrastructure for the community in your locality?

4. In your perception and observation there any defined use for urban green infrastructure for sustainable development.

5. According to your opinion what are major triggering factor for green infrastructure development.

Does the Municipality have adequate stuff for effective land management in the town?
6. All are accountable and effective perform on land and environmental issue?
7. How do you cross-check accountability issue in land administration experts?

8. Is there urban plan implementation for the City that can guide the current development of a City?

9. Is there clear commitment of Municipal to take measurement to improve good governance issue in land administration office?

10. All stuff members are skilled and qualified on land management related issue?

11. Does Hawassa City municipal land administration office mass (group) regular meeting with stakeholders?

**Stakeholders in Hawassa City**

1. How do you promise community involvement in issue like urban planning and land management in relation to office?

2. How regularly see ethical issue with Municipal land administration expert?
3. What is impact on development of the town?

4. Is there environmental challenges on land related issue?

**Interview Schedule for data collection from Focus Group discussion**

1. What are the factors that affect the development and management of green infrastructure in your locality?

2. In what ways are you involving as stakeholder to plan, develop and manage green infrastructure in your locality?

3. What is the importance of green infrastructure for the community in your locality?

4. In your perception and observation there any defined use for urban green infrastructure for sustainable development.

5. Do land management experts are accountable and transparent for the mission they Performed?

6. How do you participate in meeting, plan, and conserve environment and land management issue?

7. According to your Municipality sufficient land use planning?

8. Is there illegal land occupation and informal settlement in your locality?

9. How do you see municipality office in terms of awareness creation for community on land related issue?

10. What are the appropriate actions that taken for development of the town?

**Observation Checklist**

This instrument was designed to investigating the availability of certain goal setting actions in relation to the urban planning and land management challenge improvement case study in Hawassa City Municipality.

**Table 5. Observation Checklist**

| Nº | Items | High | Medium | Low |
|---|---|---|---|---|
| 1 | Urban plan implementation achieve based on a City objective. | | | |
| 2 | Accountable and effective experts on land related issue | | | |
| 3 | Manager of the Municipality giving support and immediate feedbacks for experts and stakeholder (kebele land administrative committee). | | | |
| 4 | Institutional collaboration on land related issue (kebele to Mayor) | | | |
| 5 | Community and experts perception on land related issue | | | |

**Table 6. Urban Planning implementation indicators and Land management indicator Check list**

| Urban Planning implementation indicators | Land management indicators |
|---|---|
| 1. Is there natural resource depletion in your area? 1.yes 2 No<br>2. Is there illegal land market in your area? 1. Yes 2. No<br>3. Is there urban poverty and inequity?1.yes 2.No<br>4. Urban efficiency/Natural resources protection | 1. Is there institution actors arrangement? 1. Yes 2. No<br>2 .Is there poverty and food insecurity? 1. Yes 2. No<br>3. Is there land broker action in your area? 1. Yes 2. No<br>4. Equitable and inclusive society |