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Development of Cadastral Information System by using Geographic Information System in Addis Ababa City: a Case Study in Akaki Kality Sub-City, Ethiopia

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A THESISSUBMITTED TO THE SCHOOL OF CIVIL AND ENVIRONMENTAL ENGINEERING INPARTIAL FULFILLMENT OF THE REQUIREMENT FORTHE DEGREES OF THEMASTERS IN GEODESY AND GEOMATICS PROGRAM

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Approval Sheet

We are members of the thesis examination board; hereby approved the originality of this thesis entitled "Development of Cadastral Information System by using Geographic Information System in Addis Ababa City a Case Study in Akaki Kality Sub-City, Ethiopia" thereby critically examining it and evaluating the final open defense by the undersigned researcher. Therefore, we certify that this paper meets the required standards with respect to quality and originality.

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Declaration

I am, Atisaw Chale, proclaim the originality of this MSc. Thesis in entitled "Development of Cadastral Information System by using Geographic Information System in Addis Ababa City a Case Study in Akaki Kality Sub-City, Ethiopia" has been carried out by me under my Advisor of **Dr. Hamere Yohannes**. I also confirm that, this research thesis belongs to me and was my original work which hasn't been submitted for any other institutions or university for the award of any academic qualification or any other events.

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Abstract

Every developmental effort and human activity depends on land. Therefore, systematic recording of land ownership is essential to ensure the rights of landowners. This paper focuses on the developing a Cadastral Information System (CIS) using Geographic Information System (GIS). Parcel corner data were collected. Sampling data was gathered through key informant interviews, and existing analog (paper-based) attribute data, high-resolution aerial imagery, and Ground Control Point (GCP) data were also utilized. The collected parcel data and aerial imagery were digitized using ArcGIS software. The digitization yielded 126 parcels and 14 roads totally of 140 parcels. Subsequently, topology rule violations were addressed: "Must have no Gaps" and "Must not have overlaps" were fixed for parcels, and "Must not have dangles" was fixed for roads. Finally, the existing analog (paper-based) attribute data was converted to digital format using MS Excel and linked (joined) to the digitized spatial data via a unique id. Parcels were initially identified by using attribute data and existing land use, resulting in 95 registered residential parcels, 18 residential undocumented parcels, 1 sports field, 3 open spaces, 9 cutoff places from parcels, and 14 roads. Secondly, identification by adjudication right showed 71 lease hold, 36 free hold, and 33 unidentified parcels. Further identification by adjudication result revealed 50 parcels with eligible and 90 ineligible parcels. Lastly, ownership type identification categorized the parcels as 21 governments, 118 private, and 1 religious place. Additionally, an attribute data query was applied to quickly access the attribute data.The CIS map of ground data was compared with the CIS map of aerial imagery to assess the accuracy discrepancies between the two. The analysis revealed that the CIS map based on ground data exhibited higher accuracy compared to the map from aerial imagery.Five participants were selected based on their work experience and academic qualifications. They responded to questions based on their perceptions of the CIS in Ethiopia. Notably, more than half of the participants rated the current level of the CIS as low. Finally, these findings verified that the applied cadastral system effectively and efficiently manage land parcels in the study area and we recommend government sector to address concerns regarding CIS not applied area.

Keywords: Attribute data, Cadastral Information System, Data query, GIS, Topology rule

List of Abbreviations

AU	African Union
CIS	Cadastral Information System
DBMS	Database Management System
DGPS	Differential Global Position System
DXF	Drawing Interchange Format
ESRI	Environmental System Research Institute
FAO	Food and Agriculture Organization
FDRE	Federal Democratic Republic of Ethiopia
FIG	International Federation of Surveyors
GCP	Ground Control Point
GIS	Geographic Information System
GNSS	Global Navigation Satellite System
GPS	Global Position System
ISO	International Organization for Standard
LAS	Land Administration System
LHRIA	Land Holding Registration and Information Agency
PMGC	Provisional Military Government Council
QGIS	Quantum GIS
RTK	Real Time Kinematic
SQL	Structural Query Language
UAV	Unmanned Aerial Vehicle
UNECA	United Nations Economic Commission for Africa
UNECE	United Nations Economic Commission for Europe
UPIC	Unique Parcel Identification Code
UTM	Universal Transverse Mercator

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Chapter One

1. Introduction

1.1 Background of the Study

Every developmental effort and human activities are based on land (Orisakwe & Bakari, 2013; Zegeye, 2019). Therefore, to ensure the rights of the owner of the land, the systematic recording of land is essential; because land demand in urban areas increases daily and people also struggle to acquire land by all means. A systematic record is very important for planning, public administration, and private, and government sectors. To perform this work, accurate and up-to-date data is important. In developed countries, legal systems have developed, and they use cadastres to define the administrative boundary and to identify the location of the parcels (Daba, 2022). Cadastre is the main source of data for the legal system, which is a crucial source of data for conflict resolution and legal actions involving landowners (Daba, 2022). According to the International Federation of Surveyors (FIG) definition, cadastre means an often parcel-based, current information system that contains a record of land ownership interests (i.e. rights, responsibilities, and restrictions). It contains a geometric description of land parcels that are connected to other documents defining the type of interests, who owns or controls those interests, and frequently the cost of the piece and its upgrades (FIG, 1998). Cadastre aids in improving the effectiveness of land transactions and security of tenure in general by giving people associated with their pertinent information. The information is geographically referenced and attributes data embedded with them. Due to the scarce community resources, cadastres have to be integrated into land administration systems around the 1980s (Yomralioglu et al., 2017).

United Nations Economic Commission for Europe (UNECE) defines the term ‘Land Administration System (LAS)’ as the process of determining, documenting, and communicating information on the tenure, value, and usage of land when implementing land management policies. It indicates that a LAS supervises not only land ownership and tenure but also land value and usage (UNECE, 1996).Today's advancements in computer technology provide significant potential for automating cadastres and developing land information systems (FIG, 1998). Computer systems are often more cost-effective in the long term and may be built to offer greater information access, quality, and legal and physical security than traditional systems.

To computerize cadastres and land information systems, Geographic Information System (GIS) technology gives way for cadastres to easily access and creates maps, use database information, and automate internal business procedures. GIS integrates hardware, software, and data for capturing, managing, analyzing, and displaying all forms of geographically referenced information. It allows users to view, understand, question, interpret, and visualize data in many ways that reveal relationships, patterns, and trends in the form of maps, globes, reports, and charts. Also, it helps users answer questions and solve problems by looking at data in a way that is quickly understood and easily shared, and GIS technology can be integrated into any enterprise information system framework. So, the importance of developing a Cadastral Information System using GIS is improving accuracy and efficiency, enhancing accessibility, increasing transparency, improving land management, etc.

In most African countries, the existing cadastral system had been established by the colonial power; their primary goal was satisfying their interests rather than paying much attention to the customary land tenure laws. Due to insufficient funds, lack of skilled manpower, lack of political will, and others, the prevalence of the cadastral system is unsuccessful (Geospatial World, 2011).

In Ethiopia, the first cadastral survey and land registration were started in 1909 (Pokhrel & Sharma, 2021), the foundation of the Ethiopian Mapping and Geography Institute in 1954 (later, Ethiopia Space Science and Geospatial Institute) gave vital force for the cadastral system. According to United Nations Economic Commission for Africa (UNECA), cadastral Survey and Registration in Ethiopia seminar paper (UNECA, 1970), Ethiopia was covered by aerial photographs at 1:50,000 scales around 1970. This proves that; Ethiopia gives great attention to modern cadastral systems. Federal Democratic Republic of Ethiopia (FDRE) Ministry of Urban Development, Housing, and Construction prepared guidelines for the urban legal cadastre in 2015. This provides a consistent and reliable framework for the organization and management of land-related information. This guide line defines the rules and procedures that must be followed when creating, maintaining, and using cadastral data. It helps to ensure the data's accuracy, completeness, and consistency.

The aim of this study is the Development of a Cadastral Information System by using a Geographic Information System in Addis Ababa city: a Case Study in Akaki Kality sub-city. As mentioned above, the cadastral information system (CIS) is an engine for land administration; the functions of land tenure, land value, land usage, and land development are aided by cadastral information (Chekole et al., 2020). It is a system that stores, manages, and displays detailed information associated with land parcels. This includes ownership, boundary, and land use information, as well as legal documents, historical data, and, maps. Therefore, CIS plays an essential role in managing and electronics recording land ownership rights within the geographic regions.

1.2 Statement of the Problem

The traditional cadastral system is inefficient and time-consuming to update and maintain. Because it often relies on paper records and manual processes. Which can make it difficult to quickly and easily update information or search for specific land parcels (Mondal et al., 2016; Navratil & Frank., 2004). Moreover, it may not be able to accurately capture or display more complex information about the land. This leads to inefficiency and delays in property transactions, increased risk of disputes and conflicts over property ownership and boundaries, difficulty in (assessing property values and determining property taxes, planning, and development, providing public services, managing and conserving natural resources, providing evidence of land ownership for legal matters) and others too many. However, every landowner wants their land to be protected, secure, and private. To fix this issue different researcher uses different approaches to fix the problems, (Orisakwe & Bakari, 2013) they use analog topographic maps to develop digital cadastral maps. While, (Mondal et al., 2016) used analog cadastral village maps to develop a digital land information system and the other researcher (Mondal et al., 2015) used Ortho images to generate cadastral maps of the study area. And other different researchers also used different methods and data to generate cadastral maps (Jennifer E. Kennedy, 2011; Khakimova et al., 2022; Murat & Laarakker, 2011). In Ethiopia, researchers developed cadastral maps at different methods and study areas. Abera Abdeta Daba (Daba, 2022) developed a cadastral map of Assosa town; Zegeye, (2019) also developed a cadastral map of Tepi town, south Western Ethiopia. Different evaluators evaluate the developed cadastral map in Ethiopia, Solomon Dargie Chekole (Chekole et al., 2020; Pokhrel & Sharma, 2021; Solomon, 2021), they are tried to conclude that, attempts to develop a reliable urban cadastral system have failed many times. During my observation, In Addis Ababa city, Akaki kality sub-city traditional way of land registration and organizing spatial and non-spatial data is more applicable rather than modern cadastral information systems. This does not imply that this sub-city has no cadastral system at all. As mentioned above, in paper records and manual processes, fragmented lands are created during registration time. This does not imply that this sub-city has no cadastral system at all. This study aims to develop a Cadastral Information System in Addis Ababa City Using a Geographic Information System: A Case Study in Akaki Kality sub-City by using primary and secondary data. This improves data organizing, efficiency, and all other difficulties mentioned above.

1.3 Objectives of the Study

1.3.1 General objective

The primary goal of this study is to create a Cadastral Information System in Addis Ababa city, Akaki Kality sub-city using a Geographic Information System.

1.3.2 Specific objectives

This study specifically tries to address the following objectives:

- ✓ To transform analog (paper-based)attribute data to digital
- ✓ To compare the ground survey line map and aerial photo line map
- ✓ To incorporate of attribute data

1.4 Research Questions

The questionnaires designed for this research are as follows;

- ❖ What is the most effective method for transforming paper-based attribute data into a digital format?
- ❖ To what extent do ground survey line maps and aerial photo line maps differ?
- ❖ At which development level an existing CIS is found?

1.5 Scope of the Study

This study is focused on the ‘Development of Cadastral Information System by using Geographic Information System in Addis Ababa city: a Case Study in Akaki Kality sub-city’. ArcGIS is used to analyze and create geodatabase to store spatial and attribute data, and Leica GPS GS14 instrument is also used to collect the parcel data. The scope of this study will be developing the cadastral information system using primary and secondary data in Addis Ababa city, Akaki kality sub-city.

1.6 Significance of the Study

Modern land development and management are practical and efficient land administration, improved accuracy and precision, better accessibility, better data management, and better collaboration and coordination. This is so because, when the implementation and administration of the cadastral information system are effective, the urban development and the rural development that helps to fulfill the socioeconomic needs of the society will be amplified. Hence this study can indicate the ways that the agency's officials have to do in the future base on the views of the landowners (landholders) and can serve as an additional source of reference material for those who want to conduct full-time research.

1.7 Limitations of the study

Adequate and reliable information is important to undertake any kind of survey precautions. However, the unwillingness and carelessness of some respondents while filling out the questionnaires during data collection are considered constraints to the study. In addition, since the cadastral information system is still on trial in the Addis Ababa city administration LHRIA, the absence of enough reference materials regarding the cadastral information system implementation and related problems in the agency is also have constraint. It isn't easy to cover the whole registered landholders. The study is delimited to some Akaki Kality sub-city legal cadastre registered landholders, some employees of LHRIA, and some Office heads, including headquarters staff.

However, selecting one sub-city is delimited. The researcher strongly believes that the above mention represents most of the legal cadastre registered landholders throughout Addis Ababa City and employees of the LHRIA as far as the concept of legal cadastre is considered the same everywhere in the city.

The study is delimited to Akaki Kality Sub-City with a cadastral information system using GIS implementation has been practiced in this sub-city.

1.8 Structure of the study

This study has divided in to five chapters. The first chapter deals with background of the study, statement of problem, objectives of the study, research questions, scope of the study, significance of the study and limitation of the study. Chapter two incorporates a literature review. Chapter three presents the description of the study area and research methodology applied in the analysis. Chapter four presents the results and discussions of the study. The last chapter concludes the major findings of the study and recommended some potential measures that should be undertaken by the different concerned bodies in the future.

Chapter Two:

2. Literature Review

2.1 Introduction

The single most crucial property on which human existence is depends on land. The land is described as a region of the earth's surface, including the water, soil, rocks, minerals, and hydrocarbons beneath or on it, as well as the air above it. It includes everything relating to a fixed place or point on the earth's surface, including areas covered by water, including the sea. Land plays a significant role in terms of social, economic, and social aspects. In terms of economics, it provides a means of subsistence; in terms of social aspect it is base for social interaction, in terms of politics it is a source of power and also in terms of culture, it is a symbol of collective identity (Chekole et al., 2020). Therefore, effectively managing land is very important for those mentioned activities. Developing a modern cadastre system is a big solution for managing land effectively and efficiently way. The term cadastre word comes from Roman, it means a method of preserving records on land parcels (property) in terms of their geographic breadth of historical, existing, and future rights and land interests in property (Daba, 2022).

A cadastre is an important economic and planning system. It is a database that contains information about the land. It serves as the foundation for legal aspects such as ownership as well as economic aspects such as land taxation. It also supplies information for planning tasks (Navratil & Frank., 2004). The level of understanding and operation of cadastral systems varies across countries due to different interpretations of the concept as a result of cultural, legal, social, and institutional differences (Silva & Stubkjær, 2002). Williamson explains the cadastral system as a foundation and the main integral part of the parcel-based information system containing basic recorded information of land (Williamson, 1985). Bogaerts et al. define the cadastral system as a combination of cadastre and land registration other researcher Silva et al. describes the cadastral system as a combination of cadastre and other spatial focus and land registration describes the legal focus (Silva & Stubkjær, 2002). To common understanding, this study considers the cadastral system as a system where land is recorded and tracked in terms of its ownership, boundaries, and other characteristics. Hence, Cadastral systems should be seen as a core component of more comprehensive land administration systems or infrastructures concerned with the processes of determining, recording, and disseminating, information about tenure value and use of land when implementing land policies.

Appropriate land administration systems then provide the basis for sound land management towards economic, social, and environmental sustainability.

One fundamental part of the cadastral system is the cadastral survey; it creates and maintains a record of land ownership, including physical characteristics and boundaries, in a geographic area. The survey provides spatial information used to establish legal rights and responsibilities relating to the land by property owners, governments, and other stakeholders. Cadastral surveys are conducted by mapping professionals who specialize in measuring areas to produce binding documents such as maps, plats, diagrams, and subdivision plans. However, the cadastral system consists of all components related to land holding or ownership, such as legislation, agencies or organizations responsible for administering the system (e.g., registry offices), registration procedures (e.g., titles), and management tools (e.g., tax assessment). In this way, the cadastral survey is an essential part of the larger whole that makes up the cadastral systems.

2.2 Historical background of cadastral system

In cadastre: Geo-Information Innovations in Land Administration book (Yomralioglu et al., 2017) the development of the cadastral system is classified into four waves after second world war (WWII). It began (unsurprisingly) with the postwar reforms, particularly in South Asia, principally Japan, Taiwan, and South Korea. Indeed, Asian examples have figured prominently in the main narrative about the importance of comprehensive land reform to the economic development agenda over the years. These early success stories were generally repeated elsewhere, with the Swynnerton Plan in Kenya frequently mentioned as a cautionary tale, and the first wave of reform eventually came to an end. The second wave of land reform, which dominated the 1960s and 1970s, had a major Latin American component and was ideologically oriented. As one might expect, this chapter has proven to be quite complicated and contentious. Russell King's Land Reform: A History is a superb introduction to that period for anyone interested, despite its age.

Whatever successes this era may have had, the overall effect was to cast doubt on the motivations and concerns of property reform as part of the development agenda, and there was a general withdrawal from the field by financing agencies.

The third wave which is a recent chapter in the property reform narrative has many strands, ranging from major World Bank investments in property projects such as Thailand to post-Soviet East European reforms, to Latin American jurisdictions such as Peru (with its language of formalization), to South Africa, and elsewhere. Increasing land rights for the poor is the key to alleviating poverty and encouraging economic growth, as the World Bank said in its 2003 Annual Report, among other arguments that significantly shaped this agenda. The recent revival of land administration as a prominent topic of study was a key component of this third wave. The introduction of contemporary systems engineering concepts and the development of new models for the integration of the various land administration components (such as surveying, registration, valuation, and so on) came after early attempts at automation, particularly in the field of land registration. Above and beyond all of this, is the idea of the land parcel as a basic portal into the world of knowledge. Formal registration of individual land rights increases investment, productivity, and household consumption, according to a more recent systematic review of the quantitative literature on the effects of tenure formalization in developing countries funded by the U.K. Department for International Development(Sheet& Rutten, 2013). However, this review included the important caveat that productivity had not increased as much in Africa as in Asia and Latin America. In the latest fourth wave the property reform story, and the crucial contributions being made by the land administration community, continue to evolve and feature prominently in the international development agenda. While much of the professional practice literature continues to be based on paradigms developed in the West, there is a significant and growing contribution by academics and practitioners based elsewhere (the recent paper by (Demir et al., 2015) being a good example). But at a deeper level, we are also witnessing the evolution of a new narrative: about the nature and importance of property, the institutional and administrative underpinnings required, and the role of citizens and civic society for the successful and sustainable implementation of reform.

2.2.1 Historical background of the cadastral system in Ethiopia

Ethiopia's urban cadastral system has been trialed by several administrations and regimes. In 1909, for the first time, Emperor Menilik-II approved legislation to establish Ethiopia's first cadastral system in Addis Ababa (Pokhrel & Sharma, 2021; Solomon, 2021). Throughout the whole Imperial period, the land tenure systems were extremely complex (Wibke Crewett et al., 2008). Crewett et al. found that tenure regimes varied across Ethiopia's empire, particularly in rural areas. Urban property registration began with the passage of the first land law. The initial urban cadastre was created by a French company. The 1907 decree in Article 1 states one of the aims of the law was 'to buy land in the town of Addis Ababa'(Alemie et al., 2015). This considered the beginning of the development of cadastre in Ethiopia. A certificate known as 'yerist woreqet' provides a title deed and ensures ownership security. Emperor Haile Selassie succeeded Emperor Menelik II in 1928.

Land tenure regimes remained mostly unchanged. However, the 1931 and 1955 constitutions included measures to protect landowners from arbitrary deprivation without compensation (Alemie et al., 2015). Urban cadastral plans were created by surveys conducted by town administrations and maintained by municipalities. The foundation of the Ethiopian Mapping and Geography Institute in 1954 (later, Ethiopia Space Science and Geospatial Institute) give vital force to the cadastral system which was established by Emperor Haile Selassie. During the Imperial rule, feudal landlords had a privileged relationship with their land and people (Cohen & Koehn, 1977). Cohen and Koehn (1978) found that 5% of land in Addis Ababa was owned by landlords, accounting for 95% of the total. In 1974, an uprising under the slogan land for the tiller' resulted in the fall of the Imperial government. The Provisional Military Government Council (PMGC), supported by a socialist ideology, gained control. Land tenure policies have undergone a paradigm shift. However, the current Federal Democratic Republic of Ethiopia (FDRE) the country's political system transitioned from socialist to federalist ideology. The constitution preserved state ownership of land and made no significant changes to the military landholding structure. However, the Transitional Government of Ethiopia implemented the first urban land leasehold scheme. Federal Democratic Republic of Ethiopia (FDRE) Ministry of Urban Development, Housing, and Construction prepared guidelines for the urban legal cadastre in 2015. This provides a consistent and reliable framework for the organization and management of land-related information. This guideline defines the rules and procedures that must be followed when creating, maintaining, and using cadastral data.

2.3 Cadastral system

It is a parcel-based and up-to-date land information system containing a record of interests in land (e.g. rights, restrictions, and responsibilities). It usually includes a geometric description of land parcels linked to other records describing the nature of the interests, the ownership or control of those interests, and often the value of the parcel and its improvements. Cadastral mapping, on the other hand, involves the preparation of a map showing the boundaries of the subdivisions of land for purposes of describing and recording ownership of the property. Basically, there are two techniques for preparing the map: aerial photography and ground surveying. Data obtained from these techniques pass through various stages for preparing the final cadastral map. These include feature extraction, attribution, maintaining topological integrity, cartographic processing, etc.

2.4 Type of cadastral system

Basically, there are three fundamental cadastral systems,

i. Legal cadastre
ii. Fiscal cadastre
iii. Multipurpose cadastre

i. Legal cadastre

Legal cadastre is the determination of legal ownership and the registration of legal transactions (Daba, 2022).

A legal cadastre is the public register of real property, kept and maintained by a government entity (e.g., local or state governments). This information typically includes the name of the property owner, address, acreage, and zoning of each property. It typically records mortgages, liens, easements, encumbrances, covenants, and restrictions that affect the title to each parcel of land.

ii. Fiscal cadastre

The fiscal cadastre is where taxation values for land parcels are determined and assessed. This information is used by tax assessors to calculate taxes based on an individual's ability to pay or on properties deemed beneficial to society at large.

iii. Multipurpose cadastre

A multipurpose cadastre is a comprehensive information system for registering and monitoring land-related issues regarding a specific country, municipality, or region. It usually includes information related to property boundaries, ownership history, and socio-economic data on land use and zoning regulations. It can serve both government and private sector interests by supporting a wide range of activities related to taxation, urban planning, land registry services and, and other issues.

2.5 Techniques of data collection for cadastre

The precision of data is very important in a cadastral survey, when cadastral survey data is used in cadastral work, ensuring the accuracy of the data is important. In the cadastral mapping method, terrestrial methods are mostly employed, but photogrammetric and remote sensing approaches are also used. These methods require necessary equipment, cost, requiring accuracy, and staff (Yomralioglu et al., 2017). Due to technological advancement, using photogrammetry, and remote sensing methods is increasing the speed of preparation of cadastral maps (Yomralıoğlu, 2000).

Two types of cadastral measuring procedures are now in use: direct and indirect. Direct procedures are processes that determine locations on land by measuring angles, and distances with traditional measurement instruments. Mathematical procedures are used to compute the coordinates and area of each parcel in the field. Using GPS, remote sensing, and photogrammetry techniques, indirect procedures gather item position information. The terrestrial technique is considered direct and the other one is the indirect technique. Currently, the indirect method is more applied instead of the direct method (Yomralioglu et al., 2017).

2.6 Cadastral information system (CIS)

A Cadastral Information System is a computerized system that provides access to cadastral (or property) records for land management purposes. Emengini et al. explain CIS in their study, it is capturing, managing, and processing land information on a computer system in a legalized, sophisticated, effective, and efficient way (Emengini et al., 2017). This includes details about the ownership, boundaries, dimensions, and, value of properties. The system identifies the parcel information by using X and Y coordinates and attributes information. The benefit of CIS is essential for the government and private sector. CIS provides organizing and storing spatial information about land parcels. This system is used for taxation, legislative planning, development oversight, and real estate transactions. The key advantage of CIS is the ability to quickly capture accurate property information from official sources and analyze it in the context of specific land uses and geographic features. This makes it easier for governments and other stakeholders to effectively manage land use decisions.

2.7 A Geographic Information System (GIS)

A GIS (Geographic Information System) is a powerful tool used for computerized mapping and spatial analysis. It provides functionality to capture, store, query, analyze, display, and output geographic information. GIS is a computer-based system that stores geographically referenced data and links it with non-graphic attributes (data in tables) allowing for a wide range of information processing including manipulation, analysis, and modeling. GIS contains five main components

i. Hardware: The physical components of a GIS system, such as computers, scanners, printers, and plotters.
ii. Software: Programs used to capture, store, analyze, and display geographically referenced information. This includes proprietary GIS software such as ESRI ArcGIS and Quantum

GIS (QGIS), as well as open-source software tools like GRASS. This study used ArcGIS to perform the tasks.

iii. Data: Information that is attached to a geographic location or area and which can be mapped or analyzed, including spatial databases containing points, lines, and polygons as well as aerial imagery and satellite images.

iv. People: Operators who have the necessary skills to use the hardware and software components of the GIS and understand how to interpret its outputs for decision-making purposes.

v. Method: is an approach for performing tasks or steps to achieve a specific goal. It often combines various GIS data and tools to complete a complex task more easily.

One of the input data for GIS is spatial data, which is any information that has a geographic component. Which means it describes the physical locations and shapes of geographic features (natural or man-made). Common types of spatial data include vector data (points, lines, and polygons) and raster data (satellite imagery, aerial photos, and digital elevation models). Geospatial information is used in mapping applications (i.e., cadastral maps), navigation apps, urban planning, environmental monitoring, logistics, and many other fields. A cadastral map uses parcel data to prepare the map. Parcel data is a form of cadastral GIS data showing the boundaries and attribute information about properties in a given area. The attribute information typically includes land parcel numbers, owner information, descriptions of the area, size of the land, land use, and other relevant data.

2.8 Cadastral Map

A cadastral Map is a map showing the position and boundaries of parcels for purposes of describing and recording ownership of the property and prepared by the registering institution. It shall be prepared once the parcel is adjudicated and the boundary is marked as articulated on the registration of urban landholding Registration Proclamation no. 818/2014, article 7 shall include administrative boundaries, parcels, roads, unique parcel identification codes, and block partition-based parcel addresses and parcel size. The cadastral map which shall be prepared based on an urban administrative boundary shall contain respective administrative boundaries, cadastre index maps, parcel boundaries, and coordinates. A cadastral map showing verified parcels within a cadastral block shall be prepared according to the national standard in such a manner that it covers the urban administrative boundary and contains leaves assigned with serial names and numbers. A cadastral map to be prepared this Article shall be prepared on paper or paper and in digital form only after the legal boundary of a parcel is surveyed and demarcated.

2.9 Data in the cadastral system

Both primary and secondary data is used in this study. Primary data in cadastral map purposes refers to information that are collected or gathered directly from the land, such as boundary measurements (coordinate of the boundary). This type of data is collected by surveyors by ground surveying, aerial photography, and other professionals who need an accurate representation of a certain property or area. However, non-spatial data is collected by question and answer, existing legal documents, and field observation. Non-spatial data include parcel owners, parcel status, parcel size, and other related information. Secondary data means the existing geographical and land-use information about a certain area, often in the form of public records such as tax assessor documents or archived maps and surveys. This type of data is used to supplement primary mapping data, typically collected during recent surveying activities. Parcel corner data and socioeconomic data are collected in this study by (primary data) and the existing cadastral maps data and aerial imagery data are obtained from Addis Ababa city administration, Akaki Kality sub-city, Land Holding Registration and Information agency bureau collected by (secondary data). In this study, the primary spatial data is collected by Leica GPS GS14, which is a dual-frequency correlation positioning system (GPS) module aimed at professional applications. It has been designed and manufactured by Leica Geosystems in Switzerland. The GPS GS14 combines both laser technology and leading-edge satellite navigation capabilities for the highest accuracy in positioning tasks. It features an integrated antenna, which supports receiving signals from up to 15 satellites simultaneously over two frequency bands (L1/E5 1575) and (L2C/E6 1218). Combining these technologies ensures quick and precise positioning in the worst environments with an autonomous accuracy of 10 cm or better. The GPS GS14 can be connected to many other systems such as Total Stations, Automatic Vehicle Location (AVL) systems, Differential GNSS Receiver, etc. making it ideal for surveying and mapping applications or any application that requires high-accuracy positioning data. While the secondary uses aerial images to digitize the corner of each parcel. From georeferenced aerial imagery data parcels, roads, rivers, and other features are digitized manually. Finally, each parcel must also generate relevant attributes and records to complete the cadastral map.

2.10 Geodatabase for cadastre system

A geodatabase is a special type of database used to store spatial data and the relationships between them. Geodatabases can store data such as points, lines, polygons, and raster images that represent features of the Earth such as roads, land use, elevation, soils, and hydrology. They are commonly used for geographical information systems (GIS). There are three basic types of geodatabase; personal, file, and enterprise geodatabase

i. Personal geodatabase

ArcGIS geodatabases were originally stored and maintained as Microsoft Access data files. And it is limited to 2GB per Microsoft database access. The file (data) format is Microsoft database (.mdb) (ESRI, 2021c).

Benefits of Personal Geodatabases:

- ✓ Easy to use and manage data
- ✓ The File size is small
- ✓ Compatible with all older versions of the ArcGIS software

Drawbacks of personal Geodatabase

- ✓ Data storage is limited to size 2GB
- ✓ It is not scalable as file a geodatabase
- ✓ Topology data types, feature classes and raster data are not fully supported

ii. File Geodatabase

A file system folder containing a collection of several sorts of GIS datasets that store spatial data in folders, tables, and features. It is a native of the ESRI ArcGIS software and is used to store geographic information such as point features, lines, polygons, raster images, attributes, relationships, and topology. File geodatabases provide storage capabilities that exceed those of the traditional personal geodatabase (ESRI, 2021c).The data format is geodatabase (.gdb)(ESRI, 2021c).

Benefits of File Geodatabases:

- ✓ It is compatible with window and Linux operating systems
- ✓ It can contain larger file sizes up to 1TB
- ✓ It supports a wide range of data types; topology, feature classes, raster data
- ✓ It is friendly with web service publishing, enabling the sharing of GIS data and services through web applications

Drawbacks of File Geodatabase

- ✓ File geodatabases may not be entirely compatible with previous ArcGIS program versions.

iii. File geodatabases include more advanced functionality and data structures, and it may be going to the complexity Enterprise geodatabase

An enterprise geodatabase is a set of specialized databases used to manage geographic data within a GIS. It is a central storage repository for all types of geospatial data, allowing for improved accuracy, better control over data updates, and better access to information. Enterprise geodatabases also offer advanced features such as versioning, reliability, and secure access. It is provided by a database management system (DBMS) and the storage format is Oracle, PostgreSQL, Microsoft SQL Server, IBM db2, and, others (ESRI, 2021c). Many readers and many writers can access it at the same time.

Benefits of Enterprise Geodatabases:

- ✓ It is built on relational database management systems (RDBMS) such as Postgre SQL, Microsoft SQL Server, and Oracle.
- ✓ To protect sensitive data and maintain data integrity, enterprise geodatabases include extensive security capabilities such as user authentication, access control, and data auditing.
- ✓ It allows several users to edit at the same time, allowing for efficient collaboration and data sharing while protecting data integrity via granular version control techniques.
- ✓ Enterprise geodatabases are built for long-term data management, ensuring that data is preserved and accessible for future generations.

Drawbacks of Enterprise Geodatabase

- ✓ Enterprise geodatabases are more difficult than personal or file geodatabases because they require specific expertise and IT infrastructure to set up and manage.
- ✓ When compared to simpler geodatabase solutions, enterprise geodatabases may necessitate more training and user uptake, particularly for firms with limited GIS knowledge.
- ✓ Enterprise geodatabases may not be entirely compatible with previous ArcGIS software versions.

2.11 Definitions of terms

Aerial photograph: a photograph of the earth's surface taken with a camera mounted in an airplane or balloon. It is used in mapping to provide geographical information for base maps.

Boundary mark: means a survey mark which demarcates a parcel of land.

cadastre base map: a map prepared using land surveying or air photography that shows administrative boundaries, fences, roads, building or house footprint, river, lake, land features, distribution of permanent survey points, and similar objects.

Cadastral survey control points: means a survey mark established by land boundary surveyor for future use and reference. It serves to provide primary evidence for boundary definition when other more vulnerable stations have been disturbed or destroyed.

Cadastral survey: means a method of measuring landholding boundary on the field using a land surveying instruments or through photogrammetric means**.**

Coordinate system: a reference system consisting of a set of points, lines, and/or surfaces, and a set of rules, used to define the positions of points in space in either two or three dimensions.

Digital orthophoto: a georeferenced image prepared from a perspective photograph, or other remotely-sensed data in which the displacement within the image due to sensor orientation and terrain relief has been removed. Orthophotos combine the characteristics of photography with the geometric qualities of a map.

Ground surveying: The measurement of dimensional relationships, as of horizontal distances, elevations, directions, and angles, on the earth's surface.

Parcel: an area of land, whose boundary extent is clearly defined and demarcated on the ground and drawn upon a map with rights having a unique parcel identification code.

Unique Parcel Identification Code: this is a unique code or number by which a parcel located in an urban centre is uniquely identified.

2.12 Documents in a cadastre

Cadastral data changes imply a representation. Because documents are actual items that describe cadastral data, they offer this representation. For instance, a bill of sale represents the change in ownership by listing the previous and current owners. The contents of the document must be stored in a computer form. Cadastral documents usually have two signatures: the beneficiary and the landowner. In addition, the agreement of the owners of the neighboring land is also important. The computer representation must show these aspects and also the signature of all stakeholders. Gerhard Navratil and Andrew U. Frank in their study (Navratil & Frank., 2004) classified documents into three main categories.

i. **Legal changes**

Legal changes itself classified into three classes

a) Transfer of rights: Ownership rights are transferred from one person to another through sales or inheritances.
b) Establishment of rights: If the parcel's owner gives someone else a portion of his ownership rights. Eg. walks across the parcel
c) Deletion of rights: If rights established in the manner previously mentioned are no longer required, they may be removed.

ii. **Changes in technical data:** If a landowner wishes to sell a certain portion of his land, he must divide the rest of his holdings. The number of the area stored in the cadastre database was changed at this time.

iii. **Changes of additional data:** Additional which recorded in the cadastre database can also change with or without a request of land owners. For instance, if the street name changes, that might change in a document.

2.13 Checking topology error in parcel data

A topology error in ArcGIS is an issue with data layers that affects a dataset's integrity. It occurs when features within the layers do not adhere to predefined rules, such as overlapping or having gaps between them. It can lead to inaccurate analysis and results if the data is not correctly maintained.

Topology error occurs in point, line, and polygon data.

1. Topology error in point data

Topology error in point data can arise when points are outside or touch the boundary of a polygon, or when lines do not encompass the points ((ESRI, 2021)). Topology errors in point vector data can take many forms. Common topology errors include overlapping points with identical coordinates, points that fall outside the boundaries of the feature they are supposed to represent, and points that do not connect correctly to form a continuous line or surface. In some cases, the geographic features themselves may be incorrect or have been incorrectly digitized. According to (ESRI, 2021) the following are some topology rules in point, line, and polygon.

Point topology rules

i. **Must Coincide With**

Points in one feature class (or subtype) must match points in another feature class (or subtype). This is important in situations when points must be covered by other points, such as when transformers must coincide with power poles in electric distribution networks or observation sites must coincide with stations.

ii. Must Be Disjoint

Points must be geographically separated from others in the same feature class (or subtype). Any points that overlap are incorrect. This is useful for ensuring that points do not overlap or duplicate within the same feature class, such as in city layers, parcel lot ID points, wells, or streetlamp poles.

iii. Must Be Covered By Boundary Of parcel

Points must fall within the bounds of area features. This is important when the point characteristics contribute to the boundary system, such as boundary markers, which must be identified on the margins of specific areas.

iv. Must Be Properly Inside

It requires that points fall within area features. This is beneficial when the point features correspond to polygons, such as wells and well pads, or address points and parcels. We can fix it by deleting the feature or moving the point out of the boundary.

v. Must Be Covered By Endpoint Of line

Points in one feature class must be covered by line endpoints from another feature class. This rule is similar to the line rule Endpoint Must Be Covered By, except that when the rule is broken, the point feature is flagged as an error rather than the line. Boundary corner markers may be confined to be covered by boundary line ends. This is also fixed by deleting features or moving points out of the boundary.

vi. Point Must Be Covered By Line

Points in one feature class must be covered by lines from another feature class. It does not require the covered portion of the line to have an endpoint. This rule is beneficial for points that are located along a series of lines, such as highway signage.

2. Topology error in Line data

In-line data topology errors most of the time occurred, such as when features do not share boundaries or nodes, or multiple features exist at the same location. Most of the time topology errors in vector line data generally manifest as gaps, overlaps, and dangles in the line geometry.

Eg. Topology rules inline data in ArcGIS are lines that must not overlap, must not have dangles, must not self-overlap, must not self-intersect, and others.

Line topology rules

i. **Must Not Overlap**

Lines must not overlap with those in the same feature class (or subtype). This rule is applied in situations where line segments should not be duplicated, such as in a stream feature class. Lines can cross and intersect, but not share segments.

ii. **Must Not Intersect**

Line features of the same feature class (or subtype) must not cross or overlap with one another. Lines may share endpoints. This rule applies to contour lines that should never cross each other, as well as circumstances where lines should connect only at endpoints, such as street segments and crossings. We can fix this by subtracting the intersected line from the features or splitting the line features.

iii. **Must Not Intersect With**

Line features from one feature class (or subtype) must not cross or overlap with those from another feature class (or subtype). Lines may share endpoints. This rule is applied when there are lines from two levels that should never cross each other, or when the intersection of lines should only occur at ends, such as streets and railroad's. We can also fix it by subtracting and splitting the features.

iv. **Must Not Have Dangles**

A line feature must touchlines of the same feature class (or subtype) at both endpoints. A dangle is an endpoint that is not connected to any other line. This rule applies when line features must form closed loops, such as when establishing the bounds of polygon features. It can also be utilized in situations where lines frequently join other lines, such as streets. In this scenario, exceptions can be made if the norm is occasionally broken, such as in cul-de-sacs or dead-end roadway segments. It can fixed by extending, trim, or snap the line features.

v. **Must Not Overlap With**

Line features in one feature class (or subtype) must not overlap with those in another. This rule applies when line features cannot share the same place. Roads, for example, cannot overlap with railroads, nor can depression subtypes of contour lines overlap with other contour lines. We can also fix it by subtracting and splitting the features.

vi. **Must Be Inside**

A line must be contained inside the boundaries of an area feature. This is useful in situations when lines partially or completely overlap with area boundaries but cannot extend beyond polygons, such as state highways that must be within state borders and rivers that must be within watersheds.

3. Topology error in Polygon data

Topology errors in vector polygon data can manifest in several different ways. Two common problems are overlapping polygons, where two or more polygons share the same space, and gaps or slivers between adjacent polygons. Both of these types of issues can be fixed by editing the polygons to ensure they align properly and do not overlap. Other topology errors might include incorrectly connected points along shared boundaries or unexpected self-intersections where the boundary of a single polygon intersects itself. These issues can also be corrected with careful editing. Some topology rules in ArcGIS for polygon data are, that polygon must not overlap, must not have gaps, contains points, must cover each other, the boundary must be covered by, and many others rules.

Polygon topology rules

i. Must Not Overlap

It requires that polygon interiors not overlap. The polygons may share edges or vertices. This rule applies when a given region cannot be divided into two or more polygons. It can be used to simulate administrative boundaries such as ZIP codes or voting districts, as well as mutually exclusive geographical classifications like land cover or landform type. It can be fixed by merging, subtracting, or creating the features.

ii. Must Not Have Gaps

This rule requires no voids within or between polygons. Every polygon must form a continuous surface. There will always be an inaccuracy throughout the surface's perimeter. This error can either be ignored or marked as an exception. Apply this criterion to data that must cover a whole area. Soil polygons, for example, cannot have gaps or holes; instead, they must encompass the entire area.

iii. Must Not Overlap With

The interiors of polygons in one feature class (or subtype) must not overlap with those in another feature class (or subtype). Polygons from the two feature classes may share edges or vertices or be wholly disconnected. This rule applies when an area cannot be assigned to two different feature classes. It is useful for integrating two mutually exclusive area classification systems, such as zoning and water body type, when areas described in one class cannot be classified in the other, and vice versa.

iv. Must Be Covered By Feature Class Of other feature

A polygon in one feature class (or subtype) must share all of its area with polygons in another feature class (or subtype). An area in the first feature class that is not covered by polygons from the other feature class is considered an error. This rule applies when an area of one type, such as a state, must be completely covered by another type, such as counties.

v. Must Cover Each Other

Requires that the polygons of one feature class (or subtype) share their entire area with the polygons of another. Polygons can share edges or vertices. Any region declared in one feature class but not shared with the other is an error. This rule applies when two classification systems are used for the same geographic area, and each point identified in one must also be defined in the other. It can fixed by subtracting or creating features of polygon.

vi. Must Be Covered By

Polygons of one feature class (or subtype) must be enclosed by polygons of another feature class (or subtype). Polygons can share edges or vertices. Any area described in the contained feature class must be covered by a feature from the covering class. This rule applies when area features of one kind must be contained within features of another type.

2.14 Topological structure in cadastral map

Topology is frequently used to alter geometric data, assess the precision of registered data, and display the relationships between objects. It is possible to gather the topological information of cadastral objects in matrix form by using the graph theory [0]. Planar graphs are used to represent such data Sets of boundary points, lines, and parcels should be understood as sets of nodes (N), edges (E), and faces (F), respectively, when attempting to view cadastral data with a graph (ISO 19107). (Lewandowicz, 2012). International organization for standard (ISO 19152) also approved model for Land Administration Domain Model (ISO, 2012). The standard describes the unification of cadastral data models. The standard basically provides spatial unit, a generic conceptual model, terminology for land administration, basic administrative units, rights, responsibilities and restrictions (RRRs) and etc. The current GIS based topology rule is applied for vector based (point, line and polygon based) (Martinez-Llario et al., 2017).

Chapter Three

3. Research Methodology

3.1 Description of the Study Area

Addis Ababa is the capital city of the Federal Democratic Republic of Ethiopia and one of the largest cities on the African continent. It is located in the very central part of the country and is a key center of transportation, logistics, and commerce. The city has international significance for being the seat of the African Union (AU) and the United Nations Economic Commission for Africa (UNECA). The geographic coordinate of the city is located latitude of 9° 1' 48" N and a longitude of 38° 44' 24" E. The city lies at the foot of Mount Entoto and forms part of the watershed for the Awash. From its lowest point, around Bole International Airport, at 2,326 meters above sea level in the southern periphery, Addis Ababa raises to over 3,000 meters in the Entoto mountains to the north. The total area of the city is about 527 km^2. The city is a subtropical highland climate with precipitation varying considerably by the month. It has a complex mix of alpine climate zones, with temperature differences of up to 10 °C, depending on elevation and prevailing wind patterns. The high elevation moderates temperatures year-round, and the city's position near the equator means that temperatures are constant monthly. As such the climate would be Mari time if its elevation was not taken into account, as no month is above 22 °C in mean temperatures. (Socio-economic profile of Addis Ababa, 2012)

The city has eleven sub-cities called “kifile-ketemas”, the largest one is the Bole sub-city and the smallest is Addis Ketema in its geographical area coverage and Kolfe keranio has the highest population and Akaki Kality has the smallest one. This sub cites also classified into one hundred sixteen Weredas, which are the lowest administrative units (Berhe et al., 2017).

Akaki Kality is one of the sub-city of Addis Ababa covers latitude of8° 51' 05''- 8° 57' 30''N and longitude of 38° 44' 45''- 38° 49' 20''E, with a total area of 68.30 $km^2$and a total population of 335,740.It is located in the southwestern suburb of the city. It borders the sub-city of Bole, Nifas Silk lafto, and, Oromiya Regional State.

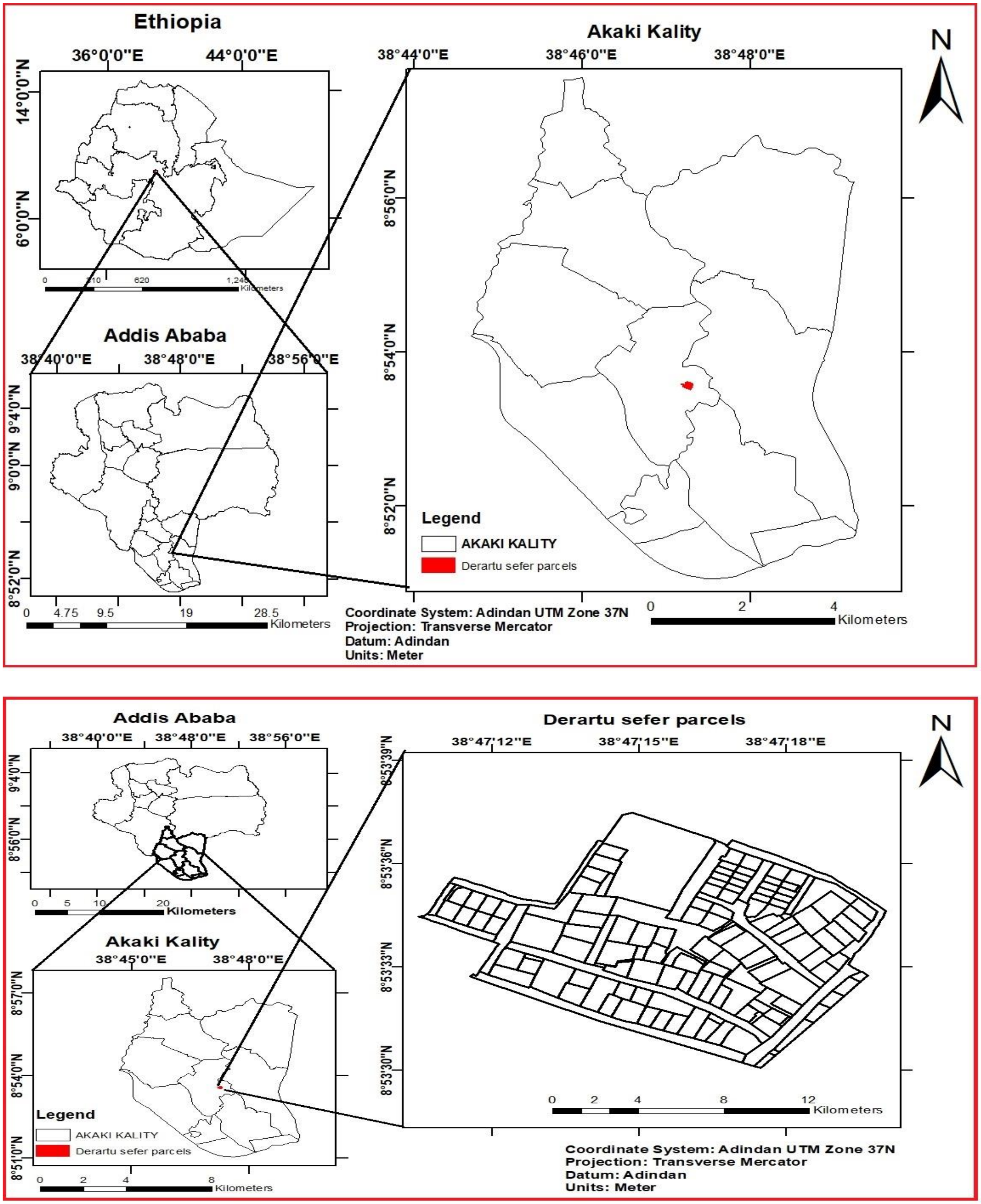


Figure 3.1 The location of the study area

3.2 Used instruments and software

The following (Table 3.1) presents using software for this study and its specifications

Table 3.1 List of software, instruments, and specifications

Software	Version	Production Company	Function
ArcGIS	10.2.2	Environmental system research institute (ESRI)	✓ It uses to create a cadastral map from the existing land ownership and survey data ✓ Modify or update the existing cadastral map ✓ It uses to display the output of the cadastral map
Microsoft Office	2007	Microsoft	✓ To organize the document (Word) ✓ To prepare key points in clear, concise and visually appealing way (power point) ✓ To compute statistical measurement(Excel)
Instrument			
Leica GPS	GS14	Leica	✓ To collect the spatial data
Sokkia total station cx 105	Cx 105	Sokkia	✓ To collect the spatial data

3.3 Data Sources, and descriptions

A. Existing attribute data (spatial and Non-Spatial Data)

The existing map attribute data provide valuable information, such as the owner of the parcel, adjudicated right, responsibility, adjudication results, and other important data about the parcel. This information can be used to help create a more detailed map with new features, such as additional information and other features that are pertinent to the cadastral map. Once this information is made, it is easy to create a map using GIS software. The existing cadastral map data includes both spatial and non-spatial data. The existing attributes data was obtained from the Addis Ababa City Administration, Akaki Kality sub-city, Land Holding Registration, and Information Agency. Spatial data in the cadastral maps are georeferenced physical feature data found in the study area. Physical features include buildings, roads, parcel corners, and other infrastructures. Whereas, attribute data or non-spatial data is data associated with spatial attributes. It includes the size and shape of the parcels, land cover, legal restriction, type of land use, and rights and responsibilities associated with ownership of the parcels according to urban landholding registration proclamation no. 818/2014, article 30. The analog format is paper-based data; it uses traditional cartography techniques and analog recording methods. This data contains information about the boundaries, land ownership, geography of an area, and, other important data. It was used to visualize and compare to collected data.

B. Ground control point (GCP) data (Reference data)

GCP is used as a base point to collect the physical features data which is used for cadastral map preparation. It includes roads, buildings, parcel corners, and other features. The GCP data is used to examine the error of the existing cadastral map coordinate by sample coordinate data and it also be used to recover destroyed coordinate point data and acquire new feature coordinates that were not collected previously. The Leica GPS GS14 instrument is used to collect destroyed coordinate data and new physical feature coordinate point data that any surveyor has not collected before. In this study real-time kinematic (RTK) GPS technique was applied to collect the data. In RTK, an additional reference station (located at a known position), is used to help determine the accuracies needed for various specialized tasks. The relative Positioning between the Rover (unknown position) and Base (known position) is determined by measuring the distance between them using radio signals over long distances, allowing them to establish a connection between unknown coordinates and those known after the completion of adjustments.

C. Attribute data

Attribute data is associated with geographic features in a map; it includes parcel ownership, income, family size, land use type (education, residential, religious, etc.), legal restriction, rights and responsibilities related to the land ownership, and others. Attribute data also include general information about the whole region or country and it contains details about each property represented on the map. Generally, socio-economic data including in attribute data(demographic, income, housing characteristics, employment information, and much more).

3.4 Data processing, methods and analysis

The main objective of this study is the Development of a Cadastral Information System by using Geographic Information System (GIS) in Addis Ababa city: a Case Study in Akaki Kality sub-city. The field survey method, collecting socio-economic data, and converting the existing analog recorded data to digital are the main data sources in this study. To apply the cadastral information system; converting the collected and existing data to a suitable GIS file format, creating a geodatabase, analyzing data and finally preparing digital cadastral information system data are the main methods in this study.

3.4.1 Field survey

i. Ensuring GCP point data

Cadastral survey data requires high precision, consistency, and reliability. To ensure the accuracy of the cadastral survey data, GCP point data has a high role in orienting and calibrating geospatial data. It was established by triangulation network, GPS, and inertia navigation methods. In this study the GCP data was obtained from Addis Ababa city, Akaki kality sub-city Land Holding Registration and Information Agency (LHRIA). Two first-order GCP data were used as an initial point for this study (A208 and A206) code GCP data. It contains X, Y, Z, and a description of the point. However, elevation data (Z) is rarely used for cadastral purpose tasks. Adindan datum was used in this study; it is local relevance, accurate, more suitable, better representation of Earth surface in Ethiopia region (Abubeker, 2020).

The following figure 3.2 describe the location of GCP point one (A206), point two (A208) and its triangulation.

Table 3.2 GCP Reference data

GCP	Easting (mE)	Northing (mN)
A206	476493.999	983097.757
A208	476679.264	982991.656

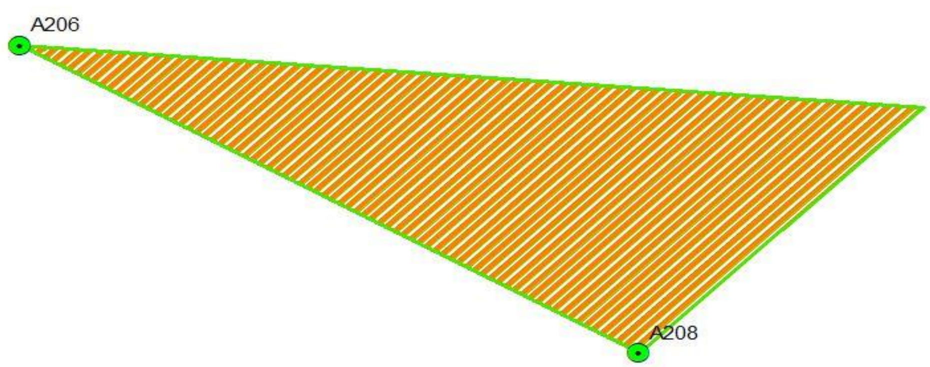


Figure 3.2 GCP reference data in the study area

ii. Traverse data

It is one method of surveying to measure angles and distance between a series of connected points with a line. It is used to determine the coordinate point data, length, and direction of the line between them. In this study, the Leica GPS GS14 instrument and Sokkia CX 105 total station instruments are used for data collection. Sokkia's CX 105 is one of the Sokkia's CX instruments and it is reliable, accurate, and easy to use as it also has a long duration of battery life and is waterproof. It is described in the next part.

iii. Collecting Cadastral survey data

In the cadastral survey, a lot of data are collected related to parcel and their boundaries. This is used for several purposes. Secure cadastral data, sustainable land management, taxation, for planning, economic development, conflict resolution, and other several purposes. Most of the time cadastral survey collects the boundary of the property, property ownership, property value (for tax purposes), and Land use. In this study spatial data collected for these purposes are corner points of parcel data (Government and private sector), road data, and space. The recorded data is a sub-part of Derartu sefer which includes five blocks' data (126 parcels corner data) and road data. 1126-point data are collected during the field survey using Sokkia's CX 105 total station and Leica GPS GS14 instruments. Most of the data are collected by the Leica GPSGS14 instrument and a point which not convenient to collect in the Leica GPS GS14 instrument is collected by Sokkia's CX 105 total station instrument.

The following steps describe how to collect spatial data using Leica GPS GS14 instrument in RTK methods

1. Choose a safe location for the base station that is free from any obstructions like buildings, power lines, and trees.
2. Mount the Leica DGPS GS14 instrument on a tripod
3. Connect the antenna to the instrument and turn on the power
4. Connect the base receiver to the DGPS controller via Bluetooth
5. Configure the basic setting of the instrument like coordinate system, datum, projection, and GPS mode (RTK)
6. Start recording data from the base station
7. Repeat steps 3-5 for the rover receiver also

8. Start recording data from the rover receiver

9. After collecting data, stop recording data using the GPS controller and power of the instrument

3.4.2 Transferring coordinate point data from GPS to ArcGIS

GPS row data collected by the GPS GS14 instrument was transferred to a computer via a USB disk; the data includes point number, point location (X, Y), Elevation (Z), and description of the point number. It is separated by Microsoft Excel.

The following procedures describe how to load GPS collected row data to ArcGIS

i. Arrange a row of data in Excel and save it in CSV format
ii. Open ArcMap software and select the Add x,y data option under the file subfolder
iii. Browse row GPS data and Select X for x data and Y for y
iv. Specify the coordinate system and load it to the ArcMap interface

3.4.3 Areal imagery

Aerial imagery is taking photographs of interested area by aircraft, UAV, or helicopter from an elevated position. It covers a wide area as compared with the conventional (ground method); it has high accuracy, easy to record a feature that is difficult to record in-ground methods. However, Aerial image has some limitations. Processing after data collection consumes a lot of time, the accuracy of steep terrain areas is low, and the equipment cost is also challenging. Sometimes the features are hidden by trees, buildings, and other structures; like the corner of the parcel, road, and other important features. To compare the collected row data by GPS with aerial photo data, aerial photo is applied in this study. It was obtained from the Addis Ababa City Land Holding Registration and Information Agency (LHRIA). Parcel data is also created by using aerial photo data, and it is used to compare ground data collected in field surveys.

3.4.4 Create a geodatabase to store spatial data in ArcMap

A geodatabase is a structured collection of spatial data that is used to store, manage, and analyze geographic data. It is also used to maintain the integrity of the data sets by using versioning or archiving. They contain feature classes, tables, raster data, etc. It provides an organized repository for data, facilitates data sharing, and integration, increases speed and accuracy when working with large datasets, facilitates analysis of spatial relationships between features, and supports a variety of feature types. The main features of Geodatabase are spatial data storage, attribute data management, scalability, and performance. File geodatabase is applied in this study, which is easy to use, and high performance. A file geodatabase includes a projection system, feature data set, feature classes, and others. After a geodatabase creation corner parcel point data and road data are connected by line using the Editor Tool.

3.4.5 Join Attribute data to spatial data

Attribute data is non-spatial information which linked to geographic features and characterizes them. Usually, it is kept in tabular form and connected with the matching spatial features via a unique identification. It gives us additional context and information about the spatial location; in other words, it defines the spatial data and makes it meaningful. In this study, several attribute data are included which are related to parcel information. Shape length, shape area, Parcel ID, Owner name, sex, nationality, city, sub-city, wereda, ketene, sefer, block, house number, application status, title deed number, document area, surveyed area, tenure type, permitted land use, existing land use, ownership land use adjudicated (right, restriction and responsibility), adjudication (result, registration number, registration date, remark) are included in this study. Analog information of all attribute data was obtained from the Addis Ababa City Administration Land Holding Registration and Information Agency (LHRIA). All existing analog attributes are transferred to digital in table format and joined to the ArcMap attribute table. The following steps are used to join the attribute data with spatial data.

i. Arrange data in Excel CSV format
ii. Open ArcGIS software and add spatial data from the directory
iii. Add the socioeconomic data to the Table of Contents as an additional layer
iv. Right-click on the socioeconomic layer and select Joins and Relates > Join
v. Select a common field from the spatial layer that can be used for joining the new layer with it, it may be point ID, parcel owner name, or others
vi. Select a field in the socioeconomic layer that contains the same information but corresponds to its geographic area
vii. Click ok to complete the join between socioeconomic data and spatial data

3.4.6 Data querying

Data querying is the technique of identifying records from the attribute table based on certain criteria. This enables one to concentrate on a portion of the data that is pertinent to an interesting task or research. Two main data queries in ArcMap are selected by attribute and selected by location.

i. **Select by location**: this data querying is based an intersection and proximity of the features to filter the data. Most of the time this data querying is used for analyzing spatial patterns and identifying features that share specific spatial relationships.

ii. **Select by Attribute**: This data querying type focuses on non-spatial information associated with features. Users can identify features that meet specific criteria from attribute table. It can select by parcel owner name, parcel ID, sex, city, sub-city, wereda, ketene, sefer, block, house number, application status, title deed number, document area, surveyed area, tenure type, permitted land use, existing land use, ownership land use adjudicated (right, restriction and responsibility), adjudication (result, registration number, registration date, remark) from the attribute table. In this study select by parcel owner name and Parcel ID number are applied to obtain data from the attribute table.

3.4.7 Topology error

Topology error means a violation of one or more topology rules that control how features are arranged spatially in a geodatabase (ESRI, 2021). It is a mistake related to the spatial relationship between different features, such as property boundaries, road segments, and others. These errors occur when two adjacent parcels are not connected by a shared line, or when there is an unintended gap between two parcels that should be seamlessly joined. It arises from different sources; making mistakes when (collecting data, data entry), editing errors, data conversion process, and others. This can lead to inconsistency and inaccuracies of data. Therefore, it is important to check for and fix topology errors before using the map in any analysis or publishing it as it could lead to incorrect results. Topology errors that commonly occur in parcel maps include duplicate lines, misplaced points, and nodes, incorrect information about the features, and other errors are occurred. ArcMap provides topology rules for polygons such as (Must Not Overlap, Must Not Have Gaps, Must Not Overlap With, Must Be Covered by Feature Class Of, Must Cover Each Other, Must Be Covered By, Boundary Must Be Covered By, Area Boundary Must Be Covered by Boundary Of, Contains Point, Contains One Point). However, in cadastral applications extensively using the topology rule is Must

Not Overlap. Because to preserve the legal and spatial integrity of land ownership records Must Not Overlap makes sure that the borders of neighboring cadastral parcels do not overlap or share the same area. Also Must Be Covered By topology rule is important for cadastral survey; it ensures that the Parcel boundary is covered by a block or another administrative boundary. In this study "Must Not Overlap", "Must Be Covered By", and "Must Not Have Gaps" topology rules are applied to ensure the accuracy of parcel data. More of this part is described in literature review part.

3.4.8 Sampling technique

Sampling data collection is a science that requires careful planning (Yanmei & Zhang, 2022). Two main approaches of sampling techniques are probability sampling technique and non-probability sampling technique. Probability sampling approaches are strongly advised if representativeness is crucial and if the sample data will be used to generalize the features of the population. Nonprobability sampling procedures, however, may be employed to gather data if the researcher is just interested in examining the sample's features and is not concerned with inferential statistics. Probability sampling methods itself classified into four; simple random sampling method, systematic sampling, stratified sampling, and clustered sampling. On the other hand, non-probability sampling is classified into five classes; Convenience sampling, Snowball sampling, Purposive sampling, Quota sampling, and Key informants sampling (Yanmei & Zhang, 2022).

i. Methods of data collection

In this study, Key informant sampling is applied from non-probability sampling. Key informant sampling is a more focused kind of purposive sampling, it involves the researcher choosing an individual group of people who are thought to be experts on the topic of interest. Because these experts have a deep understanding of the topic, have access to relevant information, and have an interest to share their knowledge. The method of data collection for this study is an interview, which is used to obtain detailed information and provide a more in-depth understanding of the topic. It is face-to-face communication with the interviewer. The selected interviewers were selected according to their academic qualifications and work experiences. In this study Addis Ababa city administration Land Holding Registration and Information Agency (LHRIA) experts and officers participated to share their knowledge and experience.

The following flow chart shows whole structure of the methodology

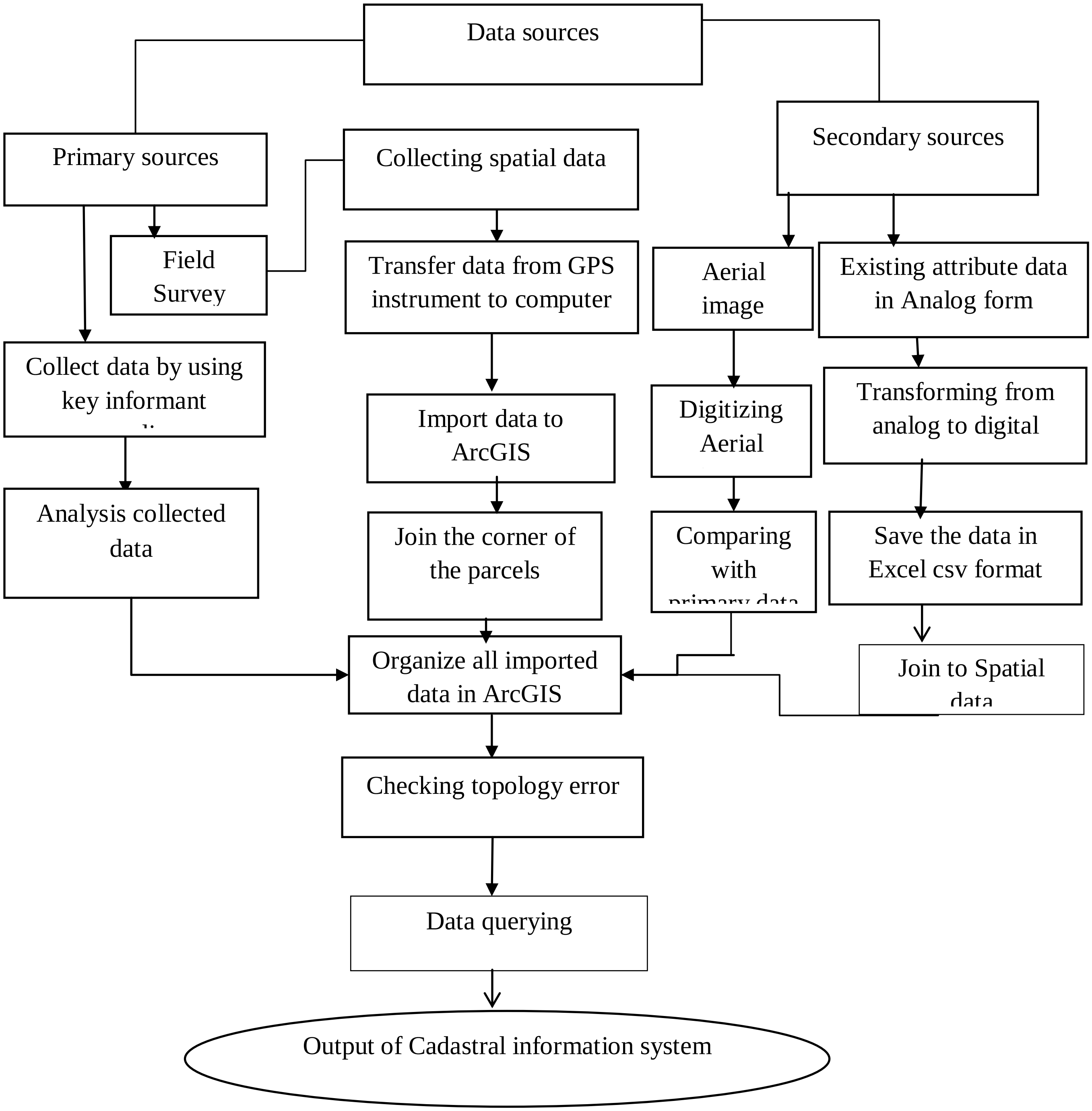


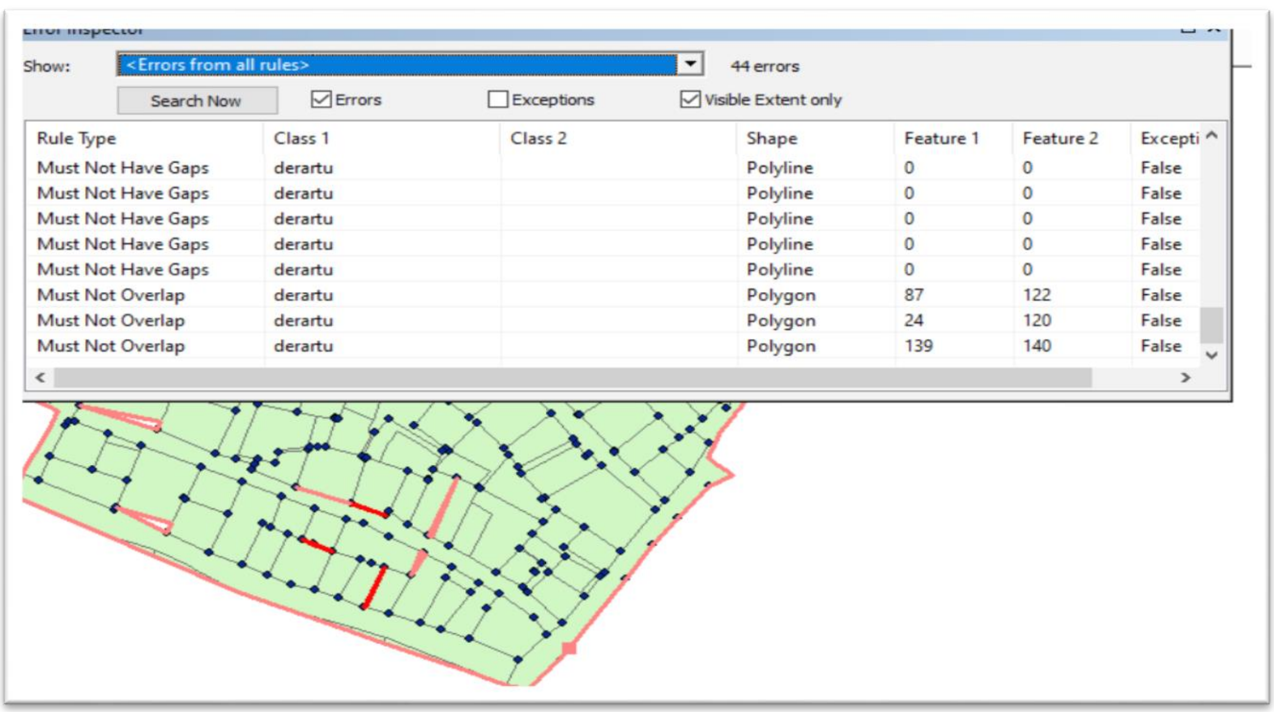
Figure 3.3 The flow chart of general methodology

Chapter Four

4 Results and Discussion

4.1 Detecting topology errors from the cadastral map

Topology errors are violations of the rules that govern the spatial relationships between features in a geodatabase (ESRI, 2021).These errors are discrepancies or flaws in spatial data that can influence the dependability and accuracy of analysis and decision-making. It is more described in 3.4 part, the errors can be fixed using the Error Inspector or by clicking them on the map and selecting the Fix Topology Error tool. The below figure 4.1 shows that there is one topology rule violation in the parcel, which is the Must Not Have Gaps rule violation and it should be fixed by some methods. It can fix either Mark an Exception or edit the features. In this study, Must Not Have Gaps and Must Not Overlap topology rules are applied for parcels and 'Must Not Have Dangles' for road data. Based on the topology rule, one 'Must Not Gaps' and four 'Must Not Have Dangles' rules have been fixed.



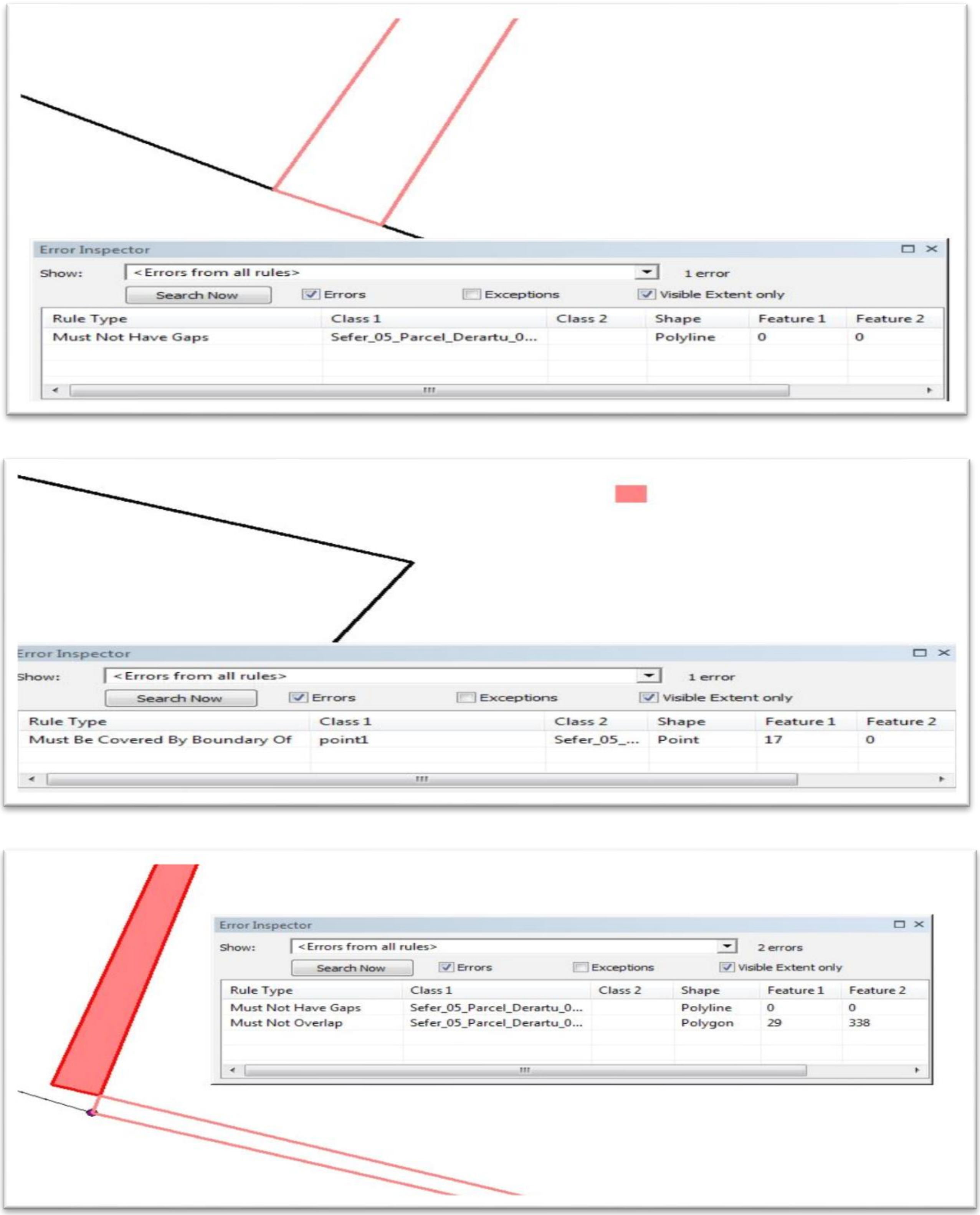


Figure 4.1 Fixing Topology rule violation for study area

4.2 Cadastral survey data

4.2.1 Existing land use

Cadastral survey data is used for land management, recording land ownership, and defining property boundaries. It includes essential information to identify the owner of the land, the area of the land, legal descriptions, and others (Atazadeh et al., 2021). Spatial data in cadastral maps includes parcel boundaries, roads, and other important features. The following figure 4.2 the cadastral map of the study area.

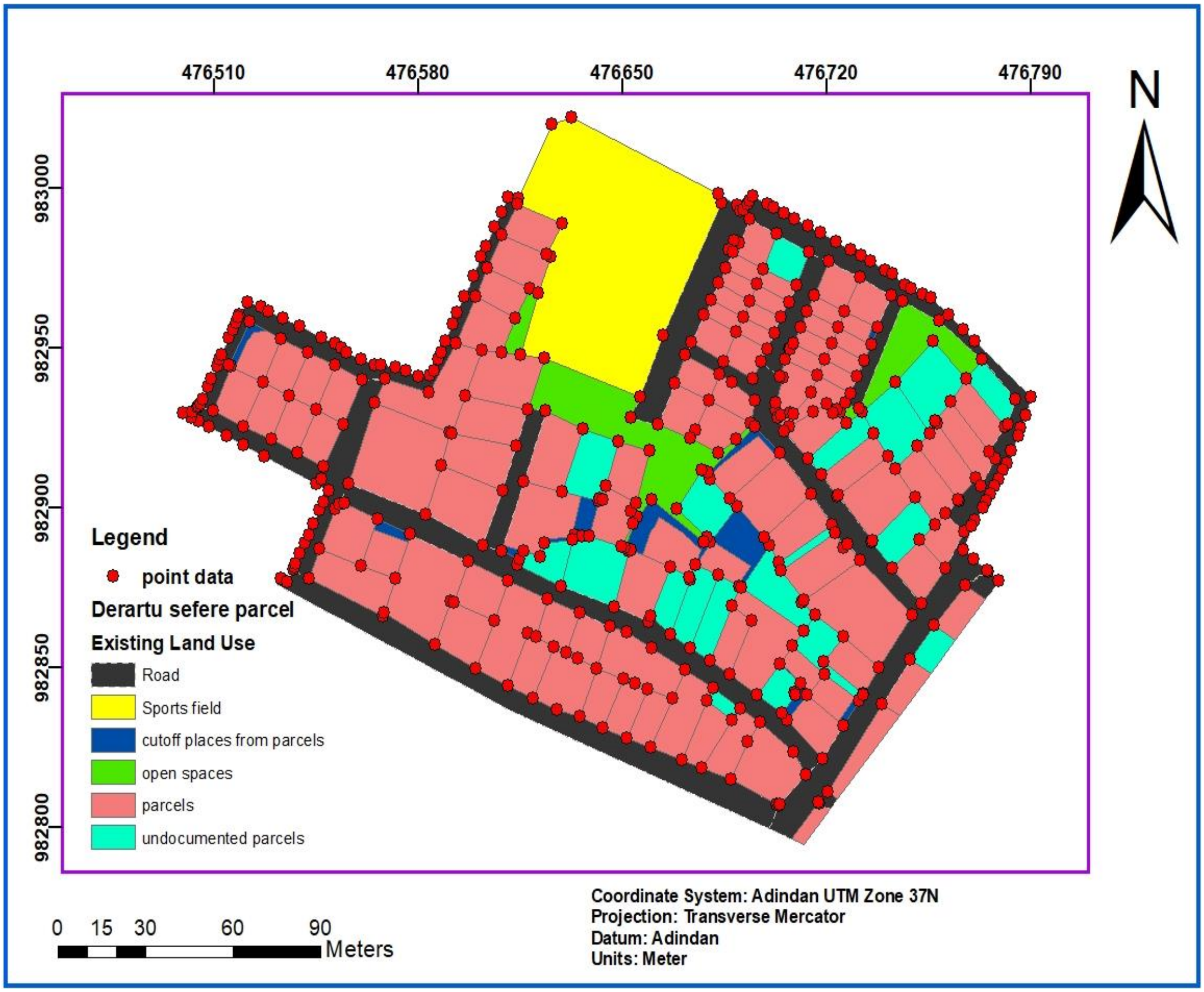


Figure 4.2 Cadastral Map of Derartu sefer wereda 8 Ketena 3

The above figure 4.2 describes that, totally the study area was classified into six main classes; a road, sports field, open space, parcel, parcel (not fully documented), and a place cut off from the parcel. A parcel class describes a fully documented parcel, which has the full right to use, transfer to others, change additional data, and others. In total, 95 parcels (not including open space, road, sports field, cutoff from parcel place) are recorded in parcel classification, which covers a 1.87 ha area. However, 18 parcels are recorded as undocumented parcels. They do not have enough evidence of the owner of the parcel. In total, 0.371 ha are covered by undocumented parcels in the study area. The third classification is road; it also covers 0.87ha area of the study area. The other one is the sports field; it is an outdoor playground created and meant to be used for particular sports activities and it covers a 0.37 ha area. The fifth one is open space; it describes a space that has not undergone extensive development for institutional, commercial, industrial, or residential purposes and it covers 0.177ha area. The last one is open space which cutoff from parcel; it describes a section of land that is divided from a larger one, usually by a survey line or other official borders and it covers 0.065ha.

4.2.2 Adjudicated rights, responsibility, and restriction

Adjudication is the process of final and authoritative determination of the existing rights and claims of people to land (FAO, 2001). It includes Adjudicated right, Adjudicated responsibility, Adjudicated restriction, and others; Adjudicated right refers to a legal ruling or judgment that has been made in a dispute or case, usually final, that determines who is right or wrong in a specific parcel of land. Whereas, adjudicated responsibility refers to the legal procedure that establishes and allocates particular rights and responsibilities to the individuals involved in the ownership, use, or administration of the property parcel. Decisions about land usage, property rights, and other related obligations may fall under this category. An adjudicated restriction in a parcel could refer to a court-imposed or other authority-imposed legal restriction on the use or development of a plot of property. In this study, Adjudicated right is recorded in two types; Freehold and leasehold. Freehold is the one legally held before the City began to be governed by the Lease System occupied or leased after the execution of a lease, substituted for an existing possession, or occupied before the lease is executed, to be continued by the appropriate party outside the lease. Whereas leasehold is the right to use urban land is transferred by a time-limited contract. The following figure 4.3 describes the adjudication right of study area land.

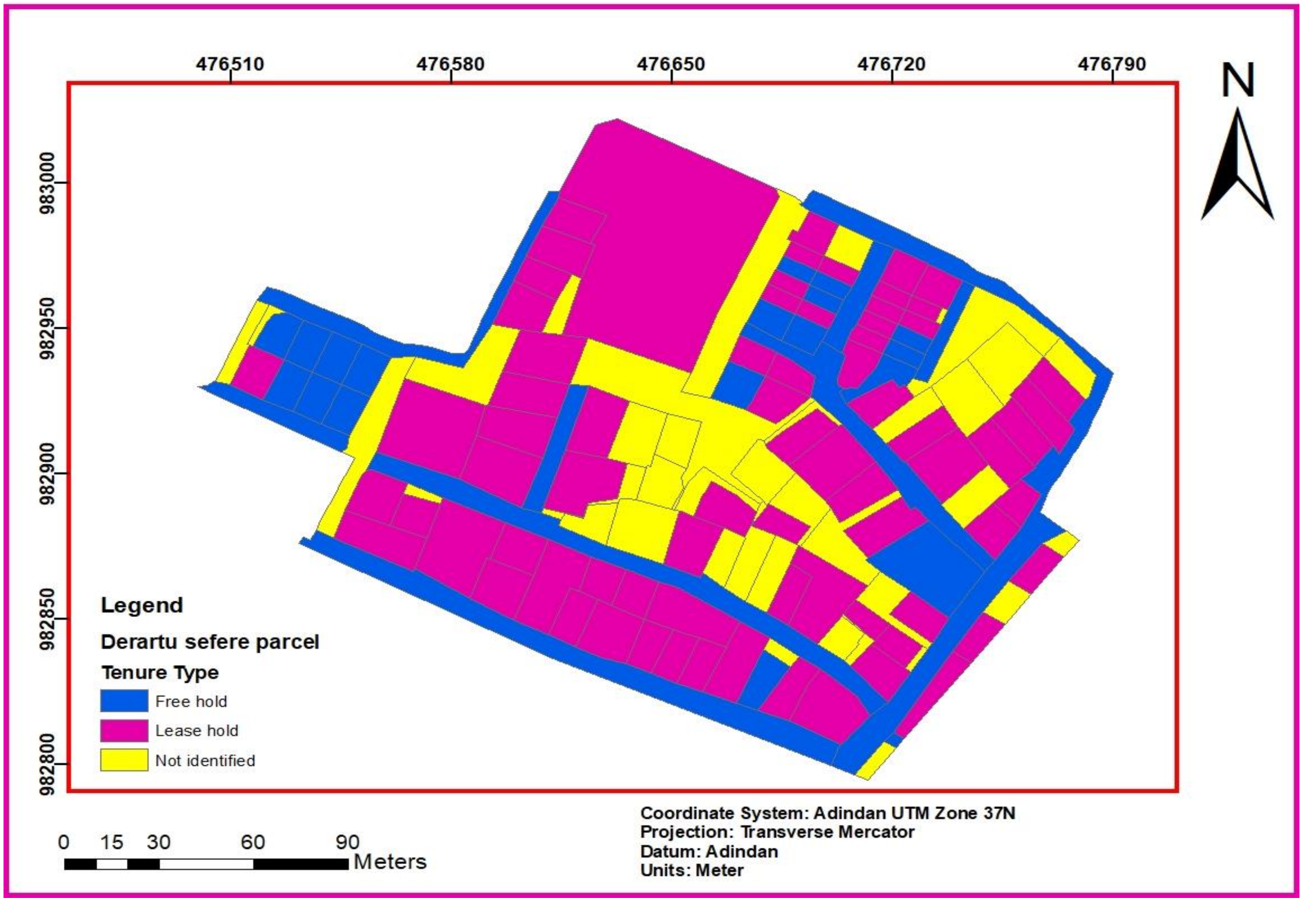


Figure 4.3 Adjudication right of study area parcel

Out of 95 fully documented or deed-registered parcels 70 parcel owners have the right to use their land in leasehold, however, 22 parcel owners have the right to use their land freehold and 3 parcels are unidentified. All road classifications were considered as freehold and the other open space, undocumented parcel, and a space cut off from the parcel are recorded as unidentified space. As mentioned Freehold means that the owner can do what he or she likes with the land, it is unlimited right over a property for example in the way of disposal, subject to any restrictive covenants and the various planning regulations that are imposed by statute concerning the use of the land. Freehold is not absolute since the State retains the right to acquire land in the public interest, for instance for building new housing or motorways.

4.2.3 Adjudicated result

A claim is considered eligible if it fits the land ownership criteria outlined in the appropriate legislative framework and survey procedures. Whereas a claim is considered ineligible if it does not satisfy the requirements for some right. In this study area, adjudicated result is classified in two main classes (figure 4.4).

Figure 4.4 Adjudication result of study area parcel

The above figure 4.4 depicts that the eligible parcel in adjudication result are 50 out of 140 parcels and 90 parcels are ineligible in selected study area based on adjudication result.

4.2.4 Ownership type

The legal designation of a parcel of land's ownership status is known as ownership type. It specifies who has ownership over the land and what rights they have regarding its usage and development. The particular categories of ownership differ depending on the legal framework of the country or region where the poll is conducted. In this study, ownership was categorized into three main groups; private, governmental, and religious place. Private Ownership is owned by either individuals or companies, utilized for any legal purpose, and subject to taxes and development regulations. Whereas, Governmental ownership is owned by a governmental authority for public benefit (parks, highways), exempt from taxes, and subject to certain rules and religious place is owned by religious institutions primarily for religious purposes, frequently tax-exempt, and subject to religious regulations and restrictions. According to this ownership type identification categorized the parcels as 21 governments, 118 private, and 1 religious parcel in this study area. The following figure 4.5 depicts the ownership type of study area parcels.

Figure 4.5 Ownership type in study area parcel

4.3 Comparison of ground-collected data and digitized aerial photo map

A digitized aerial photo map is also a digital map that depicts the borders of real property parcels developed by digitizing aerial photographs. The output of the map delineates all real property parcels and should be linked to a geodetic control network and a base map. In this study, a 20cm spatial resolution aerial image was applied to digitize the features of the study area. According to Addis Ababa city, Land Holding Registration and Information Agency (LHRIA) data, the obtained aerial image of the study area was captured in 2011 and the expected accuracy of the image is 0.2m for horizontal and 0.4m for vertical. The following figure 4.6 depicts the digitized line map of the cadastral map and an aerial image of the study area.

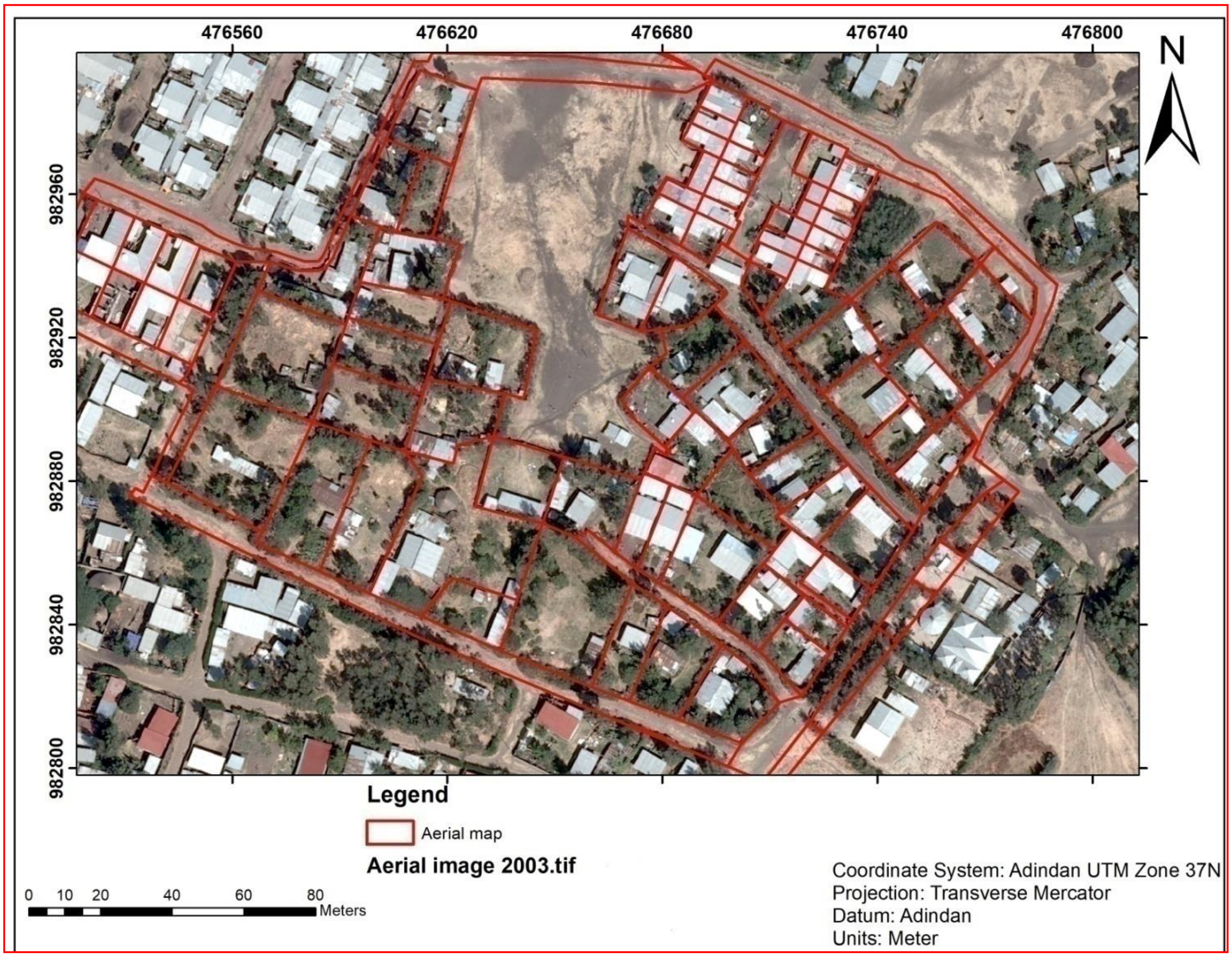
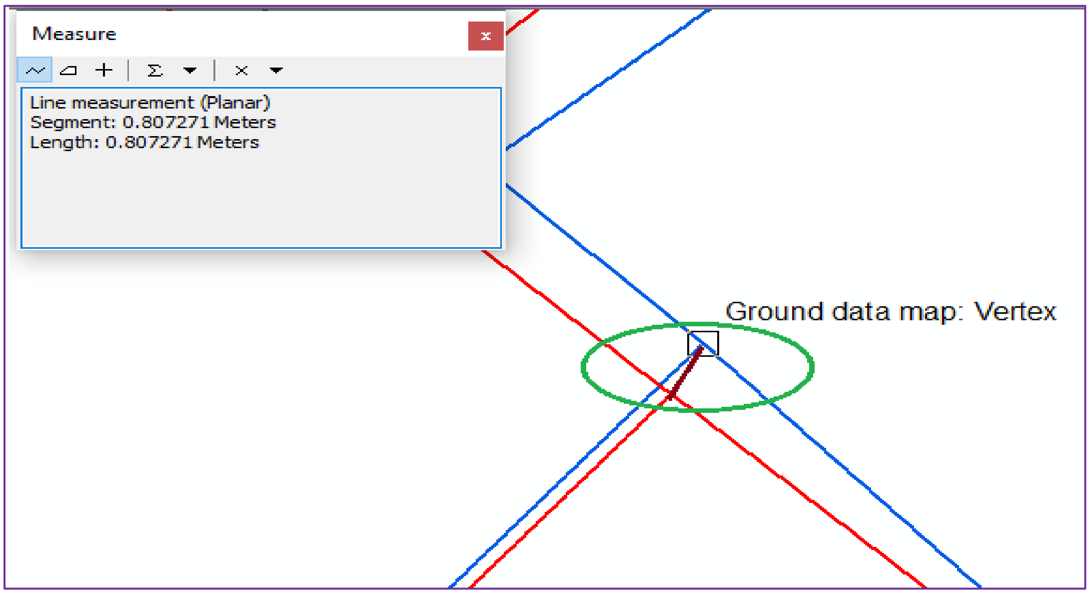
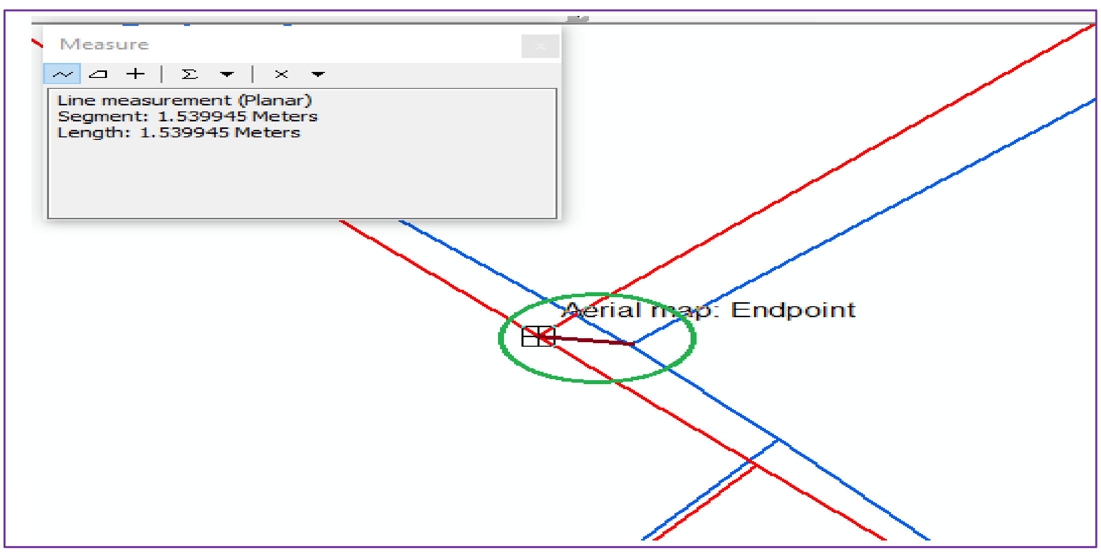


Figure 4.6 Aerial image of study area and digitized aerial map

Most of studies can employ ground truthing to compare ground-collected data maps and digitized aerial maps. This entails comparing physical measurements gathered at the ground level with remote sensing data (GIS Geography, 2022). This technique can detect errors in existing maps. Most studies verify that ground-collected data maps are more accurate and precise, making the perfect for assessing specific features and locations that require precision. This study compares ground data to a cadastral map and an aerial map to detect geometric errors. Deviations can reach up to 2m and, in some situations, exceed this limit. These discrepancies could be related to digitization problems, limitations in aerial image accuracy, or the period when the photographs were taken. The below figure 4.7 (a) and (b) show the deviation between ground-collected data and digitized aerial maps. It shows some deviation between both ground data and aerial maps.

A)





B)

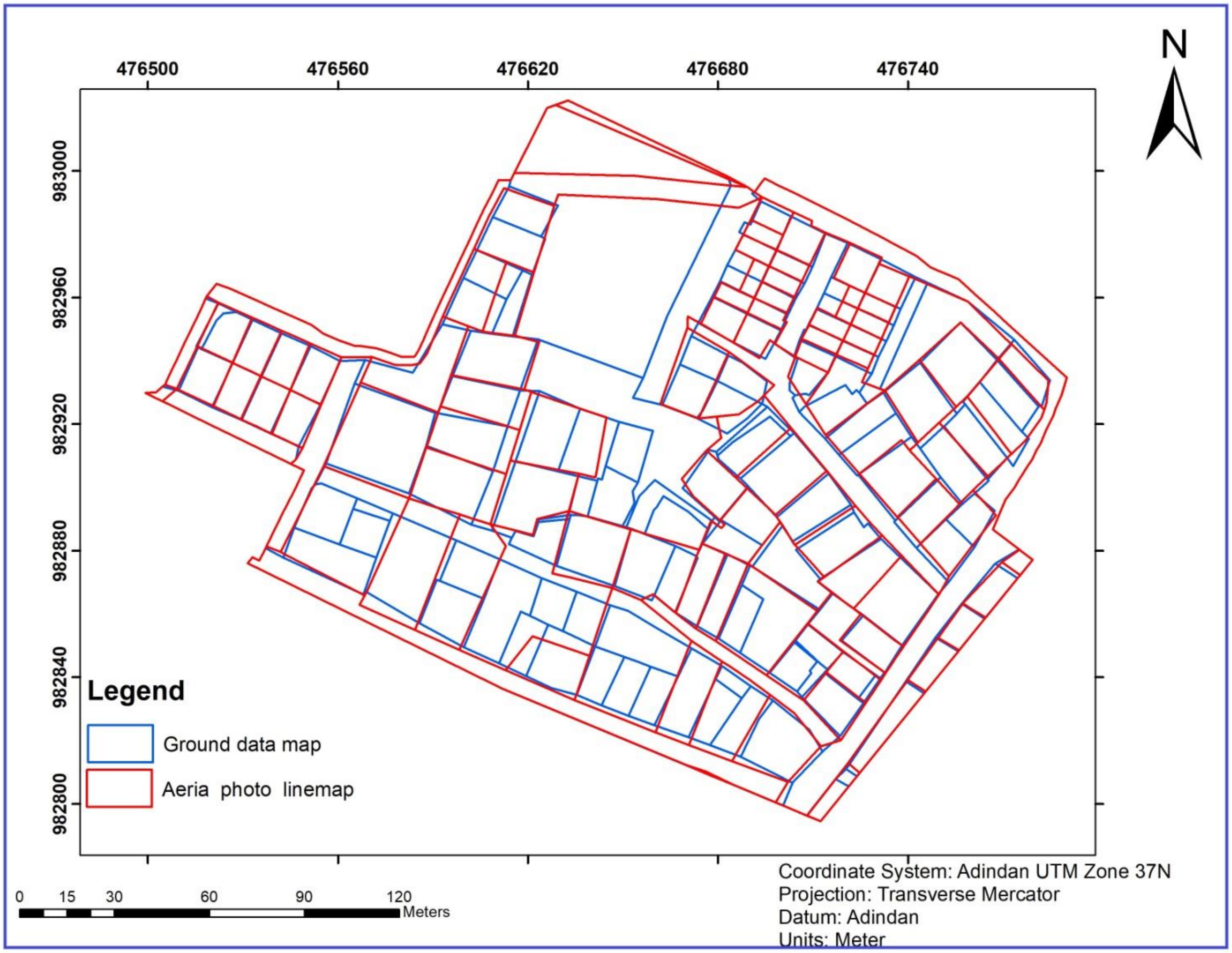


Figure 4.7 Discrepancies between map b) Cadastral map prepared by ground data and aerial photo

4.4 Spatial query analysis

Spatial inquiries are always done using spatial data. Geographic data is essential for establishing geodatabases and answering geographic queries fast, which might be difficult or time-consuming otherwise (Wunderlich, 2012). Spatial query is applied by using the 'Selection by Location' tool in ArcMap. It identifies the features conditions from other feature by some preconditions. In this study attribute query is more applied rather than spatial query.

4.5 Attribute query Analysis

Attribute query analysis refers to the process of searching and retrieving feature records from a database using desired attribute values. This is an essential component in managing and analyzing GIS data. The value can be numeric, text, Boolean, or dates. The selected records' features are highlighted on both the map and the table, similar to a database query (Zegeye, 2019). ArcMap Select by Attributes dialog box generates queries based on database values and SQL operators.

4.5.1 Attribute query analysis based on ownership type

As described above, the ownership types were classified into three main classes; private, government and religious place. Based on the data, 21 government, 118 private, and 1 religious place parcels data were identified in figure 4.5. To identify the number of parcel for ownership type we can easily use by attribute table. The following figure 4.8 shows the attribute query analysis for private parcel data from the ownership column.

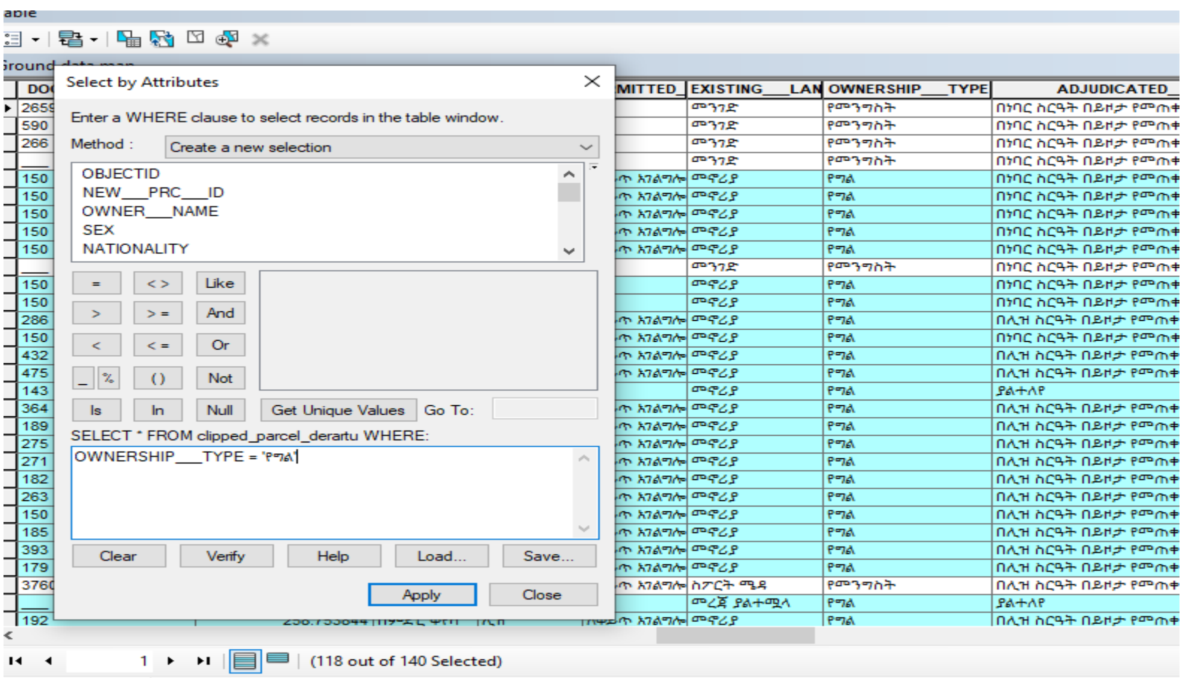


Figure 4.8 Query result having ownership type

4.5.2 Attribute query analysis based on parcel area

Based on the data, in the study area, around 38% of the area of the parcel was covered by greater than 200 square meters and the remaining 86 (62%) parcels were covered by less than 200 square meter parcel of the study area. The following Figure 4.9 shows the parcel area of the study area which covered more than or equal to 200 square meters, which it retrieved by using select by attribute query language.

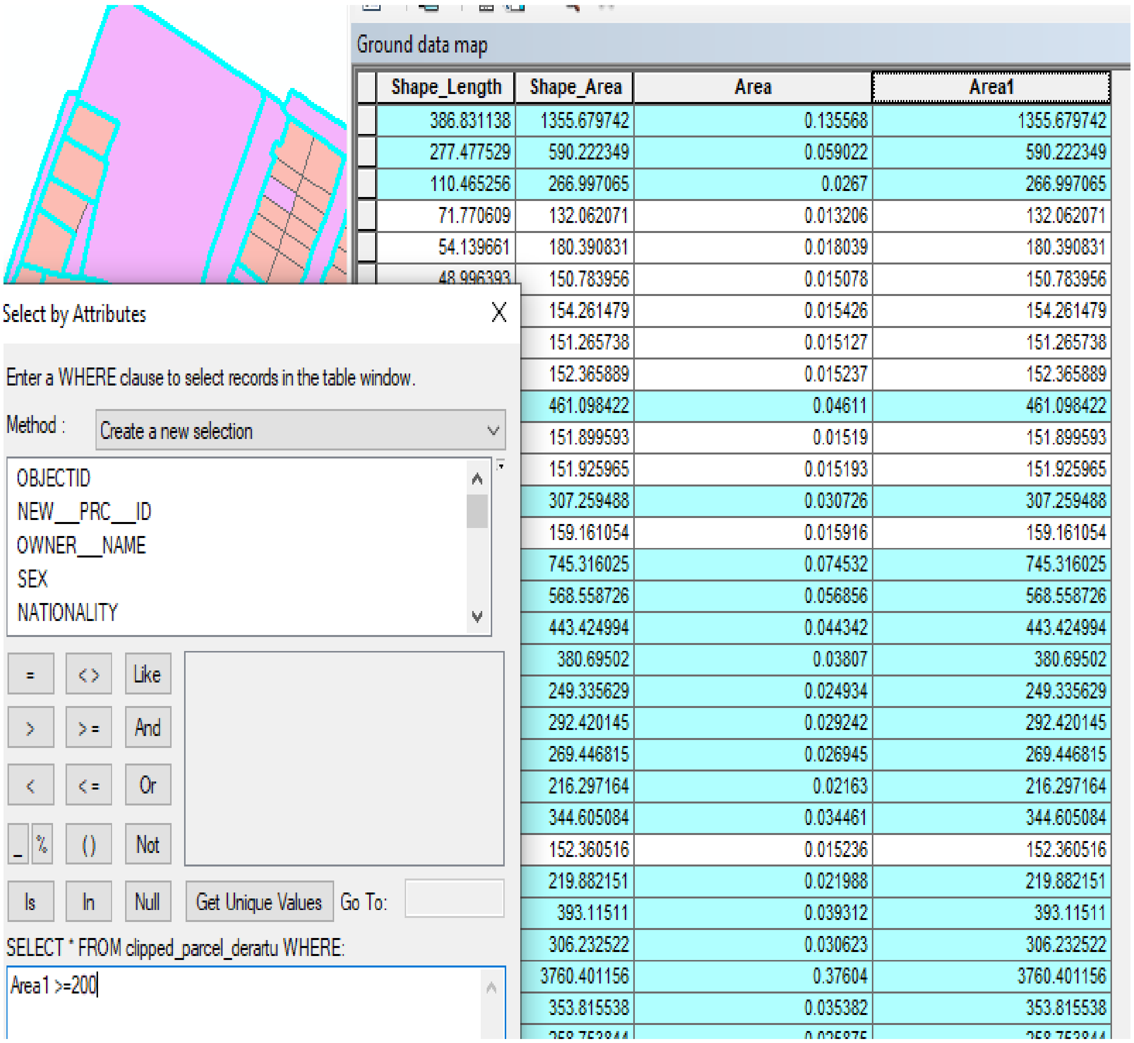


Figure 4.9 Query results having parcel area

4.5.3 Attribute query analysis based on parcel owner

Select by attribute by owner searches and retrieves records of features in a database using the owner's name. In this study randomly one parcel owner was selected and the attribute query selected the owner parcel only (figure 4.10). This is used to extract specific records of features in a GIS database that are related to certain parcel owners as well as it saves time to obtain the specific data about the individual owner of the parcel. To extract data from the attribute table, you'll need three crucial components: the name of the desired column (for example, "Parcel Owner"), a comparison operator (such as "="), and the precise value you're looking for (for example, "John"). In this study, Value was stored in the Amharic alphabet.

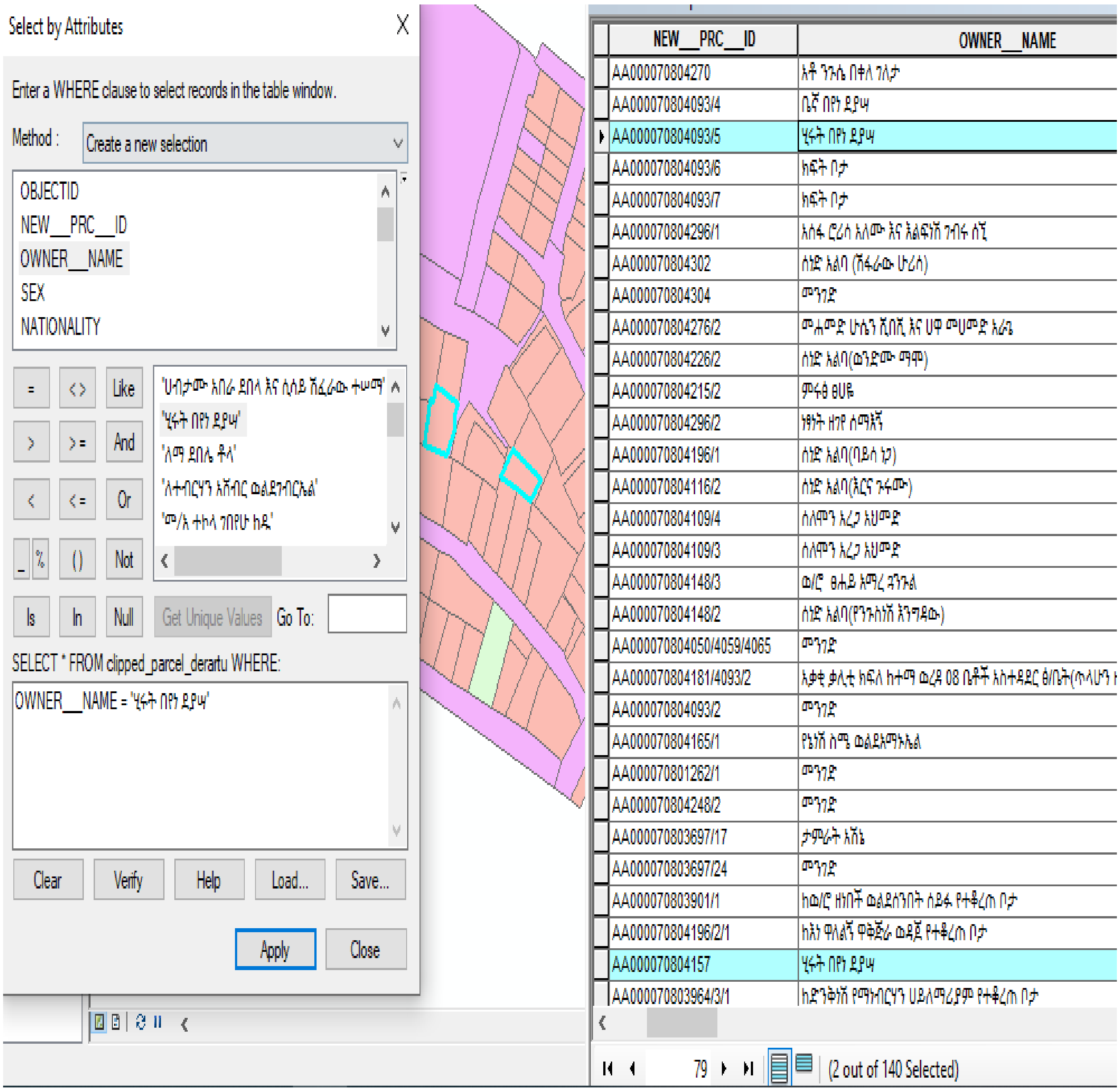


Figure 4.10 Query results having parcel owner

The figure above depicts one owner with two parcels listed. This makes it straightforward to determine how many parcels are linked to a particular owner.

4.5.4 Attribute query analysis based on Unique Parcel Identification Code (UPID)

Unique Parcel Identification Code (UPID) is the unique code or number by which a parcel located in an urban center is uniquely identified. Select by attribute by UPID searches and retrieves records of features in a database using the UPID. In this study randomly selected one UPID and opening attribute query was shown the following Figure 4.11. This is used to extract specific records of features in a GIS database that are related to certain UPIDs as well as it saves time to obtain the specific data about the individual UPID of the parcel.

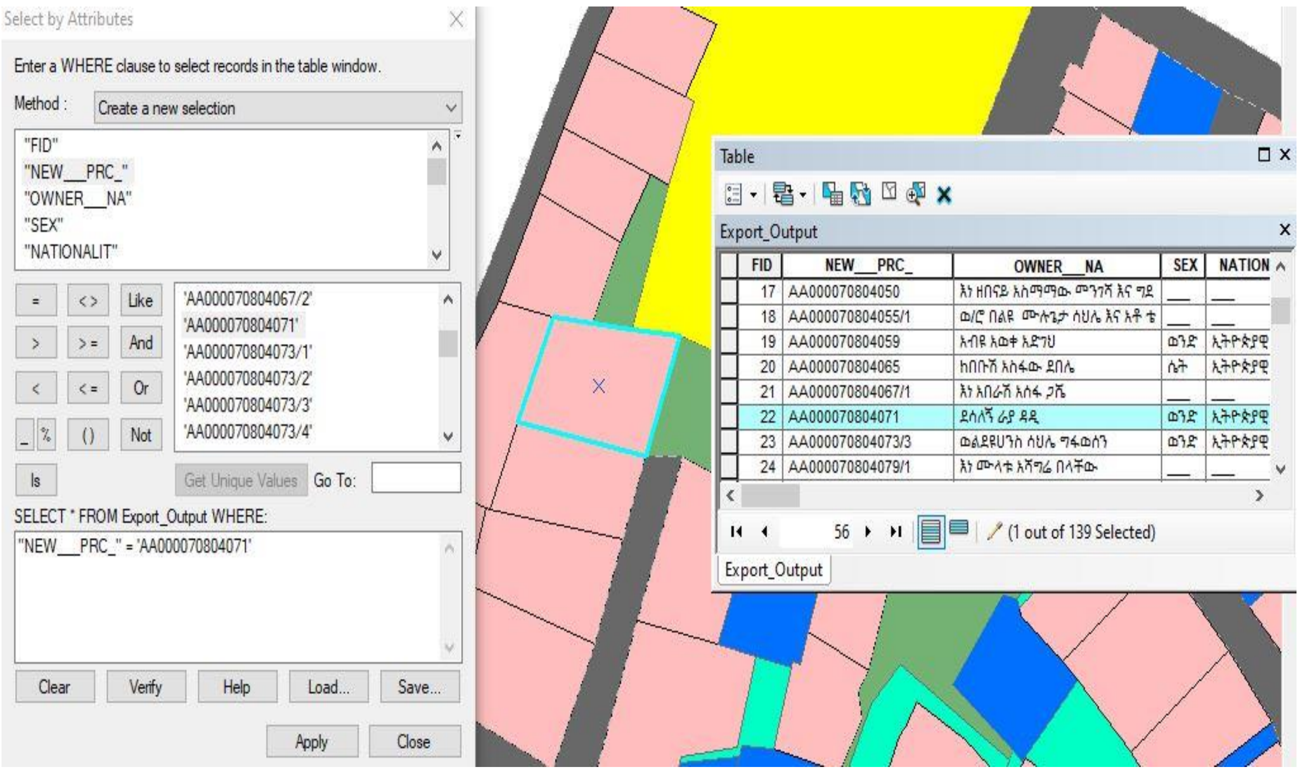


Figure 4.11 Query results having UPID

4.6 Key informant responses for digital cadastral information

Key informant sampling is a research data-collecting technique that involves selecting persons with extensive knowledge of a given issue or group. This technique is a focused kind of purposive sampling. It involves the researcher choosing an individual group of people who are thought to be experts on the topic of interest. These experts have a deep understanding of the topic, have access to relevant information, and have an interest in sharing their knowledge.

In this study, Addis Ababa city administration Land Holding Registration and Information Agency (LHRIA) experts, chief surveyors, and officers are invited to share their knowledge and experience based on their qualifications and work experiences.

The interview was focused on basic ideas about cadastral information systems, the current level of the cadastral system in Ethiopia and Addis Ababa, the basic advantages and drawbacks of modern CIS in comparison to traditional cadastral systems, the basic challenges of implementing the modern cadastral information system, and the participants' feelings about cadastral information.

Five participants were selected for the interview; almost all participants' concepts for the cadastral information system were approached similarly. For the second question (the advantages of modern CIS), the answers reflected by the two participants focused on improving accuracy, reliability, and efficiency. Whereas, the other two participants focused on improving accuracy and decision-making, while the remaining participants provided an in-depth description of the advantages of CIS, including accuracy, reliability, efficiency, and integration withother systems.

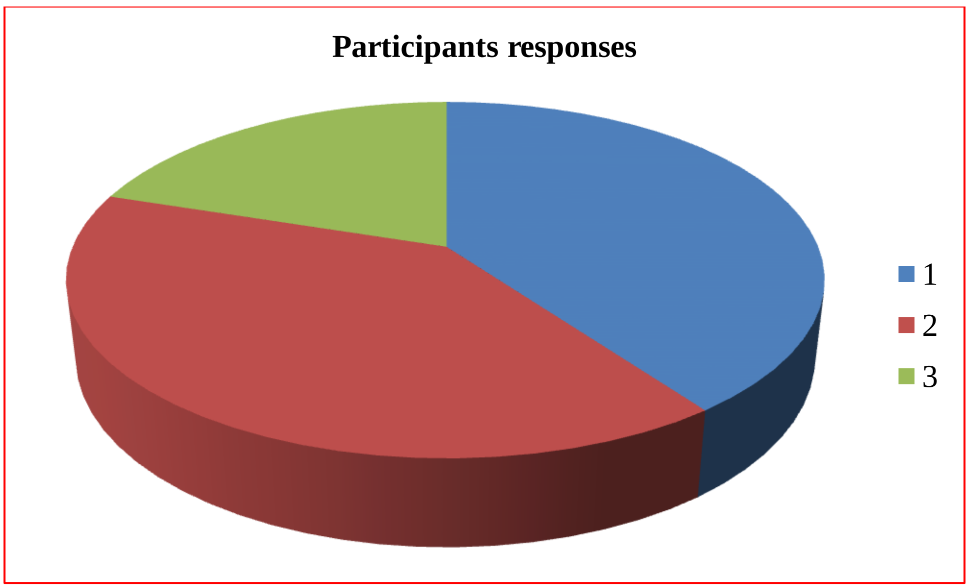


Figure 4.12 Participant responses on advantage of CIS

Note: 1= Improving accuracy, reliability and efficient, 2= improving accuracy, decision making, 3=improving accuracy, reliability, effective and efficient and Integration with Other Systems. And the participants continued to reflect their feelings on the drawbacks of the CIS, almost all briefly mentioning the lack of enough expertise and high initial investment. Another question asked about the current level of the cadastral information system. Half of the participants explained that more than 90 cities in Ethiopia have been covered by aerial photography, which they considered an achievement for the country. Regarding Addis Ababa specifically, the situation was similar, with some improvements noted compared to other cities. Generally, the participants assessed the level of the CIS in Ethiopia. Three participants put the level at low, while two rated it as medium.

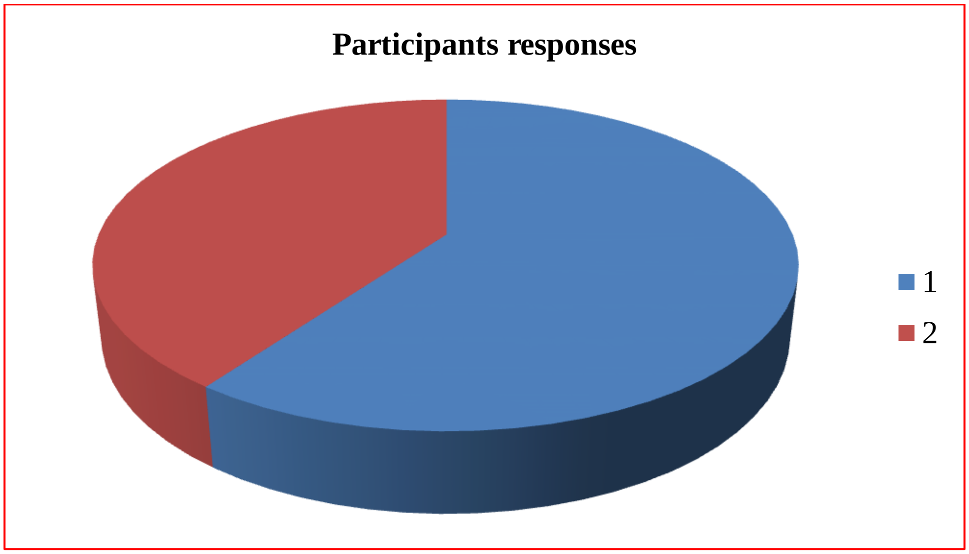


Figure 4.13 Participant responses on the level of CIS in Ethiopia

Note: 1=Medium level and 2 = Low level

The next question asked the participants about the basic challenges of implementing the modern cadastral information system. Respondents raised various issues, including lack of basic infrastructure, cyber security, data quality and inconsistency, the legal framework, public awareness, and others. However, all participants were highly focused on the issue of informal settlements in Addis Ababa city, highlighting its current and challenging nature for CIS implementation. The absence of a procedure and the complex issues surrounding integrating informal settlements into the formal system were emphasized. Finally, the participants responded with their feelings about CIS, stating that the government sector is paying high attention to the cadastral information system, focusing on areas like capacity building, improving basic infrastructure, and addressing cyber security concerns.

4.8 Discussion

Coordinate point of parcel corner data was collected using Leica GPS GS14 and Sokkia CX105 total station instruments. Sampling data was collected using the key informant sampling technique to acquire a deep understanding of the topic and have access to relevant information. And existing analog attribute data was transformed to digital using Microsoft Excel. An additional aerial image captured in 2011 was applied to digitize the study area (Derartu sefer). These all are considered essential data for this study. The related studies also used different data to prepare CIS; (Daba, 2022; Zegeye, 2019); in their study they used corner point data collected by ground survey. In (Mondal et al., 2016) used analog-based cadastral data from survey buildings, and topo sheets collected from a survey of India. (Mondal et al., 2015) uses analog cadastral village maps to prepare land information systems using cadastral techniques about mining areas. (Alwan et al., 2018) used high spatial resolution (10cm) aerial image to prepare a cadastre map of the study area. Multiple studies have found that cadastral maps created from ground data are more accurate than those created using topo sheets, aerial photos, or digital analog cadastral data (Dardanelli & Maltese, 2022; Pullar & Donaldson, 2022).

In this study, the collected coordinate points of parcel corners and the aerial image were digitized using ArcMap 10.2.2 to evaluate the deviation between the aerial line map and the ground-collected data line map. Next, the transformed digital attribute data from analog records was joined to the digitized map generated from ground data using a unique ID number. Following the attribute data join, topology errors in the digitized map, specifically line and polygon topology rule violations, were corrected using various techniques tailored to each violation type. Finally, the data query was checked by attribute data query and spatial data query. Attribute data query was applied in ownership type, parcel area, and parcel owner.

Different studies, such as (Mondal et al., 2015, 2016), implement distinct methods to develop cadastral information systems based on their available data. In their study, they digitized the analog village map to create a digital base layer, followed by separate layers for roads, parcels, ponds, and other features. Finally, they integrate attribute data and apply topological corrections, ensuring data integrity and spatial accuracy.

(Alwan et al.2018) georeferenced a high-resolution 10cm aerial image using high-accuracy ground control points from the study area. They then digitized the georeferenced image, extracting parcels, roads, and other relevant features for cadastral purposes. Finally, they produced a 1:500 cadastral map with a targeted precision of 0.115 meters. (Daba, 2022) employed their methods to prepare a cadastral information system (CIS) map. This involved digitizing parcel corner points collected by a ground survey technique and integrating attribute data collected through questionnaires, interviews, and observations. After data implementation and evaluation, the cadastral information system map was successfully prepared. And other different researcher uses their own methods to prepare CIS maps; (Jennifer E. Kennedy, 2011; Khakimova et al., 2022; Mondal et al., 2016; Orisakwe & Bakari, 2013;Zegeye,2019).

Chapter Five

5. Conclusions and Recommendations

5.1 Conclusions

Implementing a digital cadastral information system is essential for ensuring effective and efficient land management. This study focuses on the development of a Cadastral Information System (CIS) using Geographic Information Systems (GIS) in Addis Ababa City, with a case study in Akaki Kality Sub City. A total of 1123 corner point data for parcels and roads were collected using ground survey techniques. Additionally, sampling data was collected through key informant interviews and an aerial image of the study area captured in 2011 was utilized. Existing analog (paper-based) attribute data was integrated to achieve the study's objectives. The collected ground data was then digitized using ArcGIS 10.2.2 followed by the application of topological rules. Based on above result they can be concluded that the collected data by RTK technique precisely locate the place of the parcel corner and fixing topology rule violation ensured the integrity and consistency of the spatial data.

To digitize analog data, paper-based attribute data was transformed to digital using Microsoft Excel and joined to the digital spatial data via unique identifiers. Based on this combined data, the existing land use was classified into six categories: undocumented, road, parcel, sports field, parcel cutoff, and open space. This leads us to the conclusion that existing analog data is the main source for attribute data, which defines each parcel in the study area. Next, the analysis focused on Adjudication Rights, classifying the study area into three groups: leasehold, freehold, and unidentified. The analysis identified the presence of unidentified adjudication rights for some parcels. Again, the study area was classified in adjudication results, it was verified for each parcel; eligible and ineligible parcel were identified based on comparing document area and ground survey area and existing data, the majority lacked sufficient information for a definitive classification.

As compare document area and ground survey area for eligible or ineligible based on area use tolerance limit. Tolerance limit means the document area is not greater or less by 10 percent from ground survey area it is eligible.

The document area is greater or less by more than 10 percent from ground survey area it is ineligible or above or below tolerance limit. The ineligible parcels will be processed based on the response received after the reason has been sent to the copyright holder's office. This result leads us to the conclusion that the parcel (document) area is different form ground survey area. And also the result leads us to the conclusion that the existing attribute data is well not organized and not enough data to full access of the parcel.

Secondly, the ground-based CIS map was compared to the aerial-based CIS map to assess their discrepancies. Notably, the aerial map exhibited slightly lower accuracy compared to the ground-based one.

Next, data queries were conducted based on parcel area, ownership type, and parcel owner. These queries demonstrated the CIS map's efficiency and effectiveness in retrieving both individual and group data from its repository.

Lastly, the analysis of sampling data acquired through key informant interviews led to the conclusion that CIS development in the study area currently lags behind its full potential.

5.2 Recommendations

This study revealed the development of CIS map by using different data.

Thus, the following recommendations are hereby made:

- The analysis of Adjudication Rights and results revealed undocumented parcels in existing land use, unidentified adjudication rights for some parcels, and ineligible parcels within the adjudication results. This necessitates prioritizing and swiftly resolving these issues.
- There is a lack of infrastructure and related instruments to CIS, therefore local government sector should give great attention for CIS and related infrastructure.
- Develop an Enterprise Geo-Database
- The creation of an extensive corporate geo-database ought to be the top priority for future research in order to enable effective data management and utilization.

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Appendix

Appendix I:-Interview Questions based on Cadastral Information System (CIS) Focus:

1. Basic idea about CIS

- Would you explain the basic idea of a Cadastral Information System (CIS) is and its advantage?
- Could you please share your experience interaction with CIS?

2. Current CIS Level in Ethiopia & Addis Ababa:

- In your perspective, how would you rank the current level of development and effectiveness of the CIS in Ethiopia, particularly in Addis Ababa?
- Could you mention some of strengths and limitations in the present CIS implementation in these areas?

3. Comparing Traditional vs. Modern CIS:

- What are the main benefits of current cadastral information systems over conventional paper-based systems?
- Are there any disadvantages or obstacles in implementing current CIS compared to traditional systems?

4. Implementing Modern CIS Challenges:

- What are the main challenges of adopting a contemporary CIS in Ethiopia?
- Are there any special technological, social, or economic challenges that need to be addressed?

5. Perceptions and Feelings on CIS:

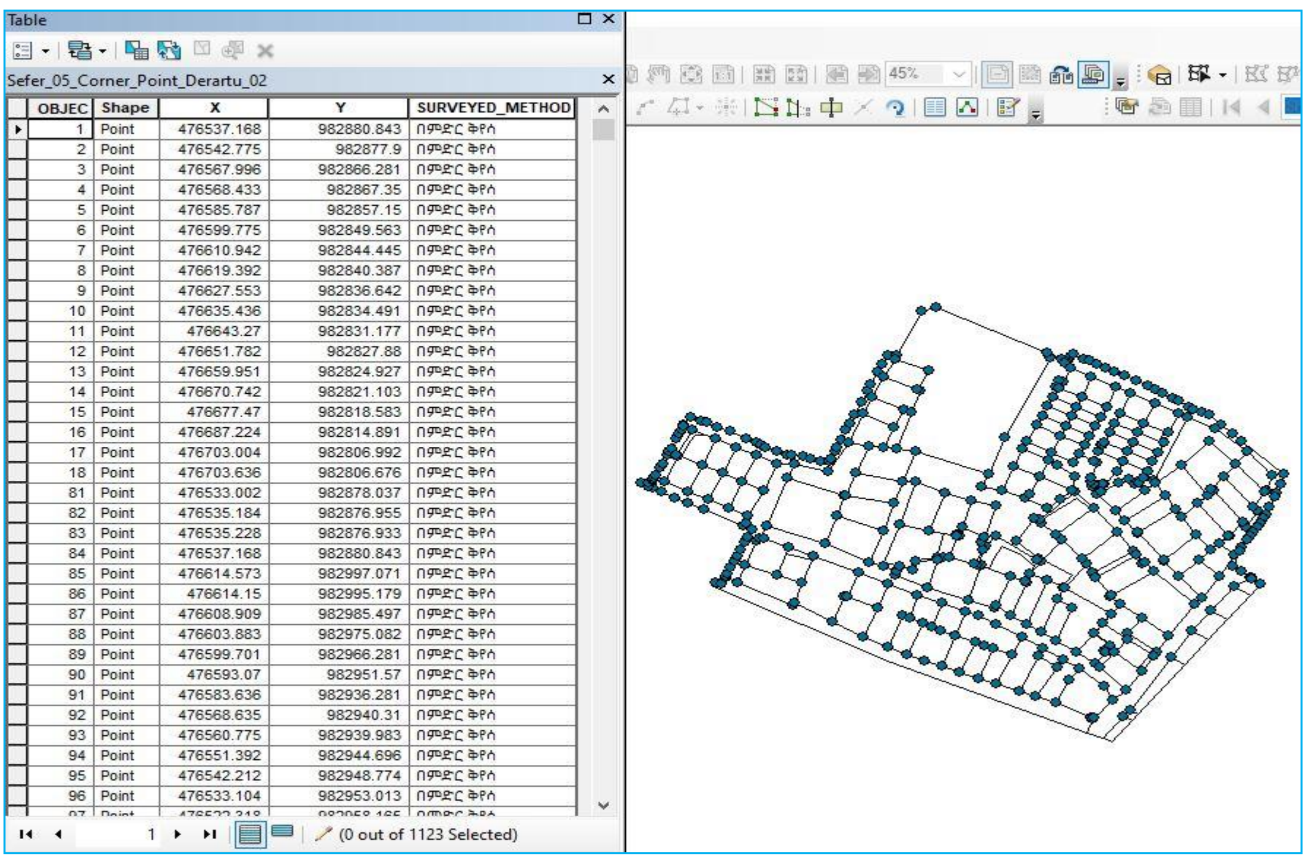
- What is your opinion on the importance of creating and implementing a strong CIS in Ethiopia?
- Do you think contemporary CIS can improve land management and ownership transparency?

6. Additional Thoughts:

Do you have any more thoughts on CIS, its current state, or its prospective impact in Ethiopia and Addis Ababa?

Appendix II:-Instruments used to collect data on the ground

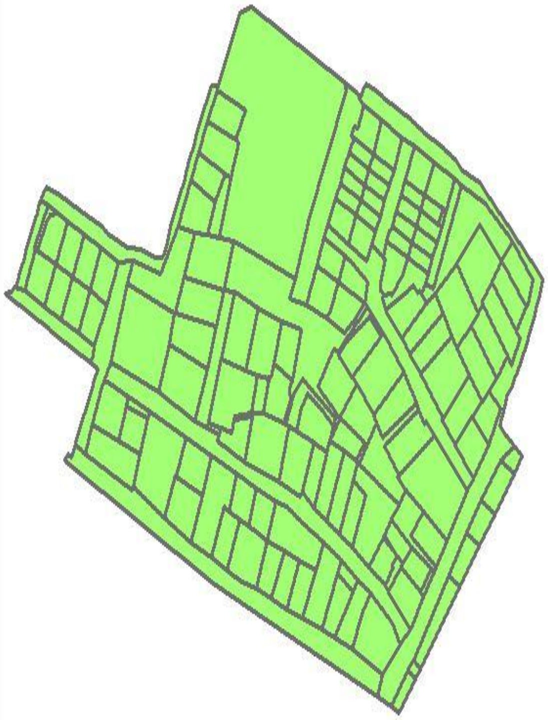
Appendix III:- The Point data collected by ground survey



OBJEC	Shape	X	Y	SURVEYED_METHOD
1	Point	476537.168	982880.843	በምድር ቅየሳ
2	Point	476542.775	982877.9	በምድር ቅየሳ
3	Point	476567.996	982866.281	በምድር ቅየሳ
4	Point	476568.433	982867.35	በምድር ቅየሳ
5	Point	476585.787	982857.15	በምድር ቅየሳ
6	Point	476599.775	982849.563	በምድር ቅየሳ
7	Point	476610.942	982844.445	በምድር ቅየሳ
8	Point	476619.392	982840.387	በምድር ቅየሳ
9	Point	476627.553	982836.642	በምድር ቅየሳ
10	Point	476635.436	982834.491	በምድር ቅየሳ
11	Point	476643.27	982831.177	በምድር ቅየሳ
12	Point	476651.782	982827.88	በምድር ቅየሳ
13	Point	476659.951	982824.927	በምድር ቅየሳ
14	Point	476670.742	982821.103	በምድር ቅየሳ
15	Point	476677.47	982818.583	በምድር ቅየሳ
16	Point	476687.224	982814.891	በምድር ቅየሳ
17	Point	476703.004	982806.992	በምድር ቅየሳ
18	Point	476703.636	982806.676	በምድር ቅየሳ
81	Point	476533.002	982878.037	በምድር ቅየሳ
82	Point	476535.184	982876.955	በምድር ቅየሳ
83	Point	476535.228	982876.933	በምድር ቅየሳ
84	Point	476537.168	982880.843	በምድር ቅየሳ
85	Point	476614.573	982997.071	በምድር ቅየሳ
86	Point	476614.15	982995.179	በምድር ቅየሳ
87	Point	476608.909	982985.497	በምድር ቅየሳ
88	Point	476603.883	982975.082	በምድር ቅየሳ
89	Point	476599.701	982966.281	በምድር ቅየሳ
90	Point	476593.07	982951.57	በምድር ቅየሳ
91	Point	476583.636	982936.281	በምድር ቅየሳ
92	Point	476568.635	982940.31	በምድር ቅየሳ
93	Point	476560.775	982939.983	በምድር ቅየሳ
94	Point	476551.392	982944.696	በምድር ቅየሳ
95	Point	476542.212	982948.774	በምድር ቅየሳ
96	Point	476533.104	982953.013	በምድር ቅየሳ

Appendix IV: The parcel data of the study area

UPID	OWNER_NAME	DOCUM	SURVEYED	SURVEYED	TENURE_Type	EXISTING_Land_	OWNERSHIP_	ADJUDICA
AA000070803630/	መንገድ	2659	1355.68	በምድር ቅየሰ	Free hold	Road	governments	eligible
AA000070803632	መንገድ	590	590.222	በምድር ቅየሰ	Free hold	Road	governments	eligible
AA000070803758/	መንገድ	266	266.997	በምድር ቅየሰ	Free hold	Road	governments	eligible
AA000070803866	መንገድ	__	132.062	በምድር ቅየሰ	Not identified	Road	governments	ineligible
AA000070803885	ምስጋናች ሁሴን ሀሰን	150	180.391	በምድር ቅየሰ	Lease hold	parcels	private	ineligible
AA000070803901	ወ/ሮ ዘነበች ወልደሰንበት	150	150.784	በምድር ቅየሰ	Free hold	parcels	private	eligible
AA000070803917	አቶ ተገኜ ኃ/ሚካኤል ያሚ	150	154.261	በምድር ቅየሰ	Free hold	parcels	private	eligible
AA000070803930	ወ/ሮ ንግስቲ በርሄ ደበሣይ እ	150	151.266	በምድር ቅየሰ	Free hold	parcels	private	eligible
AA000070803936	ባጫ ቤኛ ከፈኒ	150	152.366	በምድር ቅየሰ	Free hold	parcels	private	eligible
AA000070803944	መንገድ	__	461.098	በምድር ቅየሰ	Not identified	Road	governments	ineligible
AA000070803952	ዘነበች አበበ ገላሸ	150	151.9	በምድር ቅየሰ	Free hold	parcels	private	eligible
AA000070803959	አማኑኤል ተክለ	150	151.926	በምድር ቅየሰ	Free hold	parcels	private	ineligible
AA000070803964/	አቶ አንጋሱ በረና ጅሎ	286	307.259	በምድር ቅየሰ	Lease hold	parcels	private	eligible
AA000070803972	አመዘነች መኮንን ዳምጤ	150	159.161	በምድር ቅየሰ	Free hold	parcels	private	eligible
AA000070803994	ሰህሌ ሃይሌ ጨመነ	432	745.316	በምድር ቅየሰ	Lease hold	parcels	private	ineligible
AA000070804021	ሠላማዊት ይግለጡ ወልደጊዮ	475	568.559	በምድር ቅየሰ	Lease hold	parcels	private	ineligible
AA000070804023	ዳባ ሁንዴ አረዳ	143	443.425	በምድር ቅየሰ	Not identified	parcels	private	ineligible
AA000070804050	እነ ዘበናይ አስማማው መንገሻ	364	380.695	በምድር ቅየሰ	Lease hold	parcels	private	ineligible
AA000070804055/	ወ/ሮ በልዩ ሙሉጌታ ሰህሌ እ	189	249.336	በምድር ቅየሰ	Lease hold	parcels	private	ineligible
AA000070804059	አብዩ እውቀ አደገህ	275	292.42	በምድር ቅየሰ	Lease hold	parcels	private	eligible
AA000070804065	ከበቡሽ አሰፋው ደበሌ	271	269.447	በምድር ቅየሰ	Lease hold	parcels	private	eligible
AA000070804067/	እነ አበራሽ አሰፋ ጋሼ	182	216.297	በምድር ቅየሰ	Lease hold	parcels	private	ineligible
AA000070804071	ደሰለኝ ራያ ዳዲ	263	344.605	በምድር ቅየሰ	Lease hold	parcels	private	ineligible
AA000070804073/	ወልደዩሀንስ ሰህሌ ግፋወሰን	150	152.361	በምድር ቅየሰ	Lease hold	parcels	private	ineligible
AA000070804079/	እነ ሙላቱ አሻግሬ በላቸው	185	219.882	በምድር ቅየሰ	Lease hold	parcels	private	ineligible
AA000070804086	አሸናፊ ድረስ ታምር	393	393.115	በምድር ቅየሰ	Lease hold	parcels	private	eligible
AA000070804092/	ጋሻው ጓዴ ወንድሜነህ እና	179	306.233	በምድር ቅየሰ	Lease hold	parcels	private	ineligible
AA000070804093/	በአቃቂ ቃሊቲ ክፍለ ከተማ ወ	3760.33	3760.401	በምድር ቅየሰ	Lease hold	Sports field	governments	eligible
AA000070804100	ሰነድ አልባ(ፋሲካ አሰፋው)	__	353.816	በምድር ቅየሰ	Not identified	undocumented pa	private	ineligible
AA000070804116/	እነ ሲ/ር እታለማሁ ገብሬ ወዬ	192	258.754	በምድር ቅየሰ	Lease hold	parcels	private	ineligible
AA000070804127	መንገድ	1223	1223.628	በምድር ቅየሰ	Free hold	Road	governments	eligible
AA000070804132	ሰባተኛው ቀን አድቬንቲስት አ	233	289.727	በምድር ቅየሰ	Lease hold	parcels	religious	ineligible
AA000070804137/	አቃቂ ቃሊቲ ክፍለ ከተማ ወረ	189	172.064	በምድር ቅየሰ	Free hold	parcels	governments	ineligible
AA000070804142	ሰነድ አልባ(ዘነበች ወጨፎ)	__	200.125	በምድር ቅየሰ	Not identified	undocumented pa	private	ineligible
AA000070804144	ሰነድ አልባ(አበበ ሽፈራው)	__	236.94	በምድር ቅየሰ	Not identified	undocumented pa	private	ineligible
AA000070804146	መንገድ	780	780.503	በምድር ቅየሰ	Free hold	Road	governments	eligible
AA000070804148/	አለማየሁ ተሰፋዬ ጉለማ	156	165.406	በምድር ቅየሰ	Free hold	parcels	private	ineligible



Appendix V:- Total Cadastral survey data attributes

Table

Derartu_sefere_parcel

No	UPID	OWNER_Name	SEX	NATIONA	CITY	SUB_CITY	WORED	KETENA	SEFER	DOCUMENT_	SURVEYED_Area	SURVEYED_By	TENURE_Type	EXISTING_land_use	OWNERSHIP_type	Adjudicated_result
1	AA000070803630/36	መንገድ	__	__	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	2659	1355.68	በምድር ቅየሳ	Fee hold	Road	governments	eligible
2	AA000070803632	መንገድ	__	__	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	590	590.222	በምድር ቅየሳ	Fee hold	Road	governments	eligible
3	AA000070803758/6	መንገድ	__	__	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	266	266.997	በምድር ቅየሳ	Fee hold	Road	governments	eligible
4	AA000070803866	መንገድ	__	__	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	__	132.062	በምድር ቅየሳ	Not identified	Road	governments	ineligible
5	AA000070803885	ምስጋነች ሁሴን ሀሰን	ሴት	ኢትዮጵያዊ	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	150	180.391	በምድር ቅየሳ	Lease hold	parcels	private	ineligible
6	AA000070803901	ወ/ሮ ዘነበች ወልደሰንበ	ሴት	ኢትዮጵያዊ	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	150	150.784	በምድር ቅየሳ	Fee hold	parcels	private	eligible
7	AA000070803917	አቶ ተገኜ ኃ/ሚካኤል ያ	ወንድ	ኢትዮጵያዊ	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	150	154.261	በምድር ቅየሳ	Fee hold	parcels	private	eligible
8	AA000070803930	ወ/ሮ ንግስቲ በርሄ ደበ	__	__	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	150	151.266	በምድር ቅየሳ	Fee hold	parcels	private	eligible
9	AA000070803936	ባጫ ቤኛ ከፈኒ	ወንድ	ኢትዮጵያዊ	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	150	152.366	በምድር ቅየሳ	Fee hold	parcels	private	eligible
10	AA000070803944	መንገድ	__	__	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	__	461.098	በምድር ቅየሳ	Not identified	Road	governments	ineligible
11	AA000070803952	ዘነበች አበበ ገላሽ	ሴት	ኢትዮጵያዊ	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	150	151.9	በምድር ቅየሳ	Fee hold	parcels	private	eligible
12	AA000070803959	አማኑኤል ተክለ	ወንድ	ኢትዮጵያዊ	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	150	151.926	በምድር ቅየሳ	Fee hold	parcels	private	ineligible
13	AA000070803964/1	አቶ እንጋሱ ቦረና ጅሎ	ወንድ	ኢትዮጵያዊ	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	286	307.259	በምድር ቅየሳ	Lease hold	parcels	private	eligible
14	AA000070803972	አመዘነች መኮንን ዳም	ሴት	ኢትዮጵያዊ	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	150	159.161	በምድር ቅየሳ	Fee hold	parcels	private	eligible
15	AA000070803994	ሰህሌ ሃይሌ ጨመነ	ወንድ	ኢትዮጵያዊ	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	432	745.316	በምድር ቅየሳ	Lease hold	parcels	private	ineligible
16	AA000070804021	ሠላማዊት ይግለጡ ወል	ሴት	ኢትዮጵያዊ	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	475	568.559	በምድር ቅየሳ	Lease hold	parcels	private	ineligible
17	AA000070804023	ዳባ ሁንዴ አረዳ	ወንድ	ኢትዮጵያዊ	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	143	443.425	በምድር ቅየሳ	Not identified	parcels	private	ineligible
18	AA000070804050	እነ ዘበናይ አስማማው	__	__	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	364	380.695	በምድር ቅየሳ	Lease hold	parcels	private	ineligible
19	AA000070804055/1	ወ/ሮ በልዩ ሙሉጌታ ሰ	__	__	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	189	249.336	በምድር ቅየሳ	Lease hold	parcels	private	ineligible
20	AA000070804059	አብዩ አወቀ አድገህ	ወንድ	ኢትዮጵያዊ	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	275	292.42	በምድር ቅየሳ	Lease hold	parcels	private	eligible
21	AA000070804065	ከበቡሽ አስፋው ደበሌ	ሴት	ኢትዮጵያዊ	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	271	269.447	በምድር ቅየሳ	Lease hold	parcels	private	eligible
22	AA000070804067/1	እነ አበራሽ አሰፋ ጋሼ	__	__	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	182	216.297	በምድር ቅየሳ	Lease hold	parcels	private	ineligible
23	AA000070804071	ደሰለኝ ራያ ዳዲ	ወንድ	ኢትዮጵያዊ	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	263	344.605	በምድር ቅየሳ	Lease hold	parcels	private	ineligible
24	AA000070804073/3	ወልደዩሀንስ ሰህሌ ግፋ	ወንድ	ኢትዮጵያዊ	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	150	152.361	በምድር ቅየሳ	Lease hold	parcels	private	ineligible
25	AA000070804079/1	እነ ሙላቱ አሻግሬ በላቸ	__	__	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	185	219.882	በምድር ቅየሳ	Lease hold	parcels	private	ineligible
26	AA000070804086	አሸናፊ ድረስ ታምር	ወንድ	ኢትዮጵያዊ	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	393	393.115	በምድር ቅየሳ	Lease hold	parcels	private	eligible
27	AA000070804092/1	ጋሻው ጓዴ ወንድሜነህ	__	__	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	179	306.233	በምድር ቅየሳ	Lease hold	parcels	private	ineligible
28	AA000070804093/3	በአቃቂ ቃሊቲ ክፍለ ከተ	__	__	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	3760.33	3760.401	በምድር ቅየሳ	Lease hold	Sports field	governments	eligible
29	AA000070804100	ሰነድ አልባ(ፋሲካ አሰፋ	__	__	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	__	353.816	በምድር ቅየሳ	Not identified	undocumented parcel	private	ineligible
30	AA000070804116/1	እነ ሲ/ር እታለማሁ ገብሬ	ሴት	ኢትዮጵያዊ	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	192	258.754	በምድር ቅየሳ	Lease hold	parcels	private	ineligible
31	AA000070804127	መንገድ	__	__	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	1223	1223.628	በምድር ቅየሳ	Fee hold	Road	governments	eligible
32	AA000070804132	ሰባተኛው ቀን አድቬንቲ	__	__	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	233	289.727	በምድር ቅየሳ	Lease hold	parcels	religious	ineligible
33	AA000070804137/1	አቃቂ ቃሊቲ ክፍለ ከተ	__	__	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	189	172.064	በምድር ቅየሳ	Fee hold	parcels	governments	ineligible
34	AA000070804142	ሰነድ አልባ(ዘነበች ወጨ	__	__	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	__	200.125	በምድር ቅየሳ	Not identified	undocumented parcel	private	ineligible
35	AA000070804144	ሰነድ አልባ(አበበ ሽፈራ	__	__	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	__	236.94	በምድር ቅየሳ	Not identified	undocumented parcel	private	ineligible
36	AA000070804146	መንገድ	__	__	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	780	780.503	በምድር ቅየሳ	Fee hold	Road	governments	eligible
37	AA000070804148/1	አለማየሁ ተስፋዬ ጉለማ	ወንድ	ኢትዮጵያዊ	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	156	165.406	በምድር ቅየሳ	Fee hold	parcels	private	ineligible
38	AA000070804152	ሰነድ አልባ(ሔለን ታዬ)			አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2		196.268	በምድር ቅየሳ	Not identified	undocumented parcel	private	ineligible

1 (0 out of 140 Selected)

No	UPID	OWNER_Name	SEX	NATIONA	CITY	SUB_CITY	WORED	KETENA	SEFER	DOCUMENT_	SURVEYED_Area	SURVEYED_By	TENURE_Type	EXISTING_land_use	OWNERSHIP_type	Adjudicated_result
39	AA000070804154/1	ዘውዱ ደምሴ ጨፍቼ	ወንድ	ኢትዮጵያዊ	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	126	179.605	በምድር ቅየሳ	Lease hold	parcels	private	ineligible
40	AA000070804155	የሱፍ አሰን መኮንን	ወንድ	ኢትዮጵያዊ	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	63	121.268	በምድር ቅየሳ	Fee hold	parcels	private	ineligible
41	AA000070804157/1	ከሂሩት በየነ ደያሣ እና ወ	___	___	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	___	213.431	በምድር ቅየሳ	Not identified	cutoff places from pa	private	ineligible
42	AA000070804160	ሀብታሙ አበራ ደበላ እ	___	___	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	202	205.057	በምድር ቅየሳ	Lease hold	parcels	private	eligible
43	AA000070804163	ዘቢባ ሰኢድ አዳሙ	ሴት	ኢትዮጵያዊ	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	63	67.43	በምድር ቅየሳ	Lease hold	parcels	private	eligible
44	AA000070804165/2	ዘውዱ በየነ ዴያሣ	ወንድ	ኢትዮጵያዊ	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	182	424.398	በምድር ቅየሳ	Lease hold	parcels	private	ineligible
45	AA000070804173	ይትባርክ ወረደ ጎባቸው	___	___	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	303	371.968	በምድር ቅየሳ	Lease hold	parcels	private	ineligible
46	AA000070804175	ደምላሽ ብዙነህ ሀብተወ	ወንድ	ኢትዮጵያዊ	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	60.5	118.053	በምድር ቅየሳ	Fee hold	parcels	private	ineligible
47	AA000070804178	ጽጌ ባዩ ማንደፍሮ	ሴት	ኢትዮጵያዊ	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	63	64.784	በምድር ቅየሳ	Lease hold	parcels	private	eligible
48	AA000070804179	ወ/ሮ አረጋሽ ሆርጄ ደበሌ	ሴት	ኢትዮጵያዊ	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	365	362.616	በምድር ቅየሳ	Lease hold	parcels	private	eligible
49	AA000070804181/40	ለማ ደበሌ ቶላ	ወንድ	ኢትዮጵያዊ	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	63	67.372	በምድር ቅየሳ	Lease hold	parcels	private	eligible
50	AA000070804185	ሙሴ ናርዶስ ፀጋዬ	ወንድ	ኢትዮጵያዊ	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	63	65.545	በምድር ቅየሳ	Lease hold	parcels	private	eligible
51	AA000070804186	ሰነድ አልባ(መክብብ ሙ	___	___	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	___	328.082	በምድር ቅየሳ	Not identified	undocumented parcel	private	ineligible
52	AA000070804184/41	መ/አ ተኮላ ገበየሁ ከዱ	ወንድ	ኢትዮጵያዊ	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	63	134.543	በምድር ቅየሳ	Lease hold	parcels	private	ineligible
53	AA000070804191	ፀደይ አበበ አሰኑ	ሴት	ኢትዮጵያዊ	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	63	65.357	በምድር ቅየሳ	Fee hold	parcels	private	eligible
54	AA000070804193	ፀጋዬ አበራ	___	___	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	63	66.865	በምድር ቅየሳ	Fee hold	parcels	private	eligible
55	AA000070804196/2	እነ ዋለልኝ ዋቅጅራ ወዳጀ	___	___	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	96	96.11	በምድር ቅየሳ	Lease hold	parcels	private	eligible
56	AA000070804198	ፈንታሁን ደለለ ሽፈራው	ወንድ	ኢትዮጵያዊ	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	63	70.487	በምድር ቅየሳ	Lease hold	parcels	private	eligible
57	AA000070804200	መንገድ	___	___	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	275	275.809	በምድር ቅየሳ	Fee hold	Road	governments	eligible
58	AA000070804201	በይሳ ኢፋ በየነ እና አሸቴ	___	___	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	202	226.544	በምድር ቅየሳ	Lease hold	parcels	private	eligible
59	AA000070804202	ሰነድ አልባ (አለማየሁ ዘ	___	___	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	63	142.043	በምድር ቅየሳ	Not identified	undocumented parcel	private	ineligible
60	AA000070804207/42	ደምሴ አበበ አብተው	ወንድ	ኢትዮጵያዊ	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	63	152.761	በምድር ቅየሳ	Lease hold	parcels	private	ineligible
61	AA000070804209	ሽመልስ ቦጋለ ተካ	ወንድ	ኢትዮጵያዊ	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	256	264.102	በምድር ቅየሳ	Lease hold	parcels	private	ineligible
62	AA000070804213	ፍቃዱ ስዩም ቢያድግልኝ	ወንድ	ኢትዮጵያዊ	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	63	68.522	በምድር ቅየሳ	Lease hold	parcels	private	eligible
63	AA000070804214	ተፈራ ሀይሌ ወልደጊዮርገ	___	___	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	123	189.877	በምድር ቅየሳ	Lease hold	parcels	private	ineligible
64	AA000070804215/1	አቶ ደጀኔ እንጌቻ ሲርና እ	___	___	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	165	181.768	በምድር ቅየሳ	Lease hold	parcels	private	ineligible
65	AA000070804217	ሰነድ አልባ(አበራ ድባለ)	___	___	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	___	190.695	በምድር ቅየሳ	Not identified	undocumented parcel	private	ineligible
66	AA000070804220	አቶ ጥዑም አብዲ ኢብራ	ወንድ	ኢትዮጵያዊ	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	63	66.127	በምድር ቅየሳ	Lease hold	parcels	private	eligible
67	AA000070804226/1	የሺ ለገሰ በሬዶ	ሴት	ኢትዮጵያዊ	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	184	189.908	በምድር ቅየሳ	Lease hold	parcels	private	eligible
68	AA000070804227	አስናቀች ወልደፃድቅ ወል	ሴት	ኢትዮጵያዊ	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	118	118.265	በምድር ቅየሳ	Lease hold	parcels	private	eligible
69	AA000070804229	ሲሳይ ጋደሬ ወልደተንሳ	ወንድ	ኢትዮጵያዊ	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	60.5	141.017	በምድር ቅየሳ	Lease hold	parcels	private	ineligible
70	AA000070804230/42	ጎበዜ ግርማ መኮንን	ወንድ	ኢትዮጵያዊ	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	63	65.191	በምድር ቅየሳ	Lease hold	parcels	private	eligible
71	AA000070804232	ማሞ ፀጋዬ	ወንድ	ኢትዮጵያዊ	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	64	70.273	በምድር ቅየሳ	Fee hold	parcels	private	ineligible
72	AA000070804248/1	ክፍት ቦታ	___	___	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	___	515.689	በምድር ቅየሳ	Not identified	open spaces	governments	ineligible
73	AA000070804250	ወ/ሮ እምቤት ቱሉ ጌና	ሴት	ኢትዮጵያዊ	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	58	140.424	በምድር ቅየሳ	Lease hold	parcels	private	ineligible
74	AA000070804256	ሰነድ አልባ(ብርሃኔ ዘርጋ	___	___	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	___	319.736	በምድር ቅየሳ	Not identified	undocumented parcel	private	ineligible
75	AA000070804263	ሰነድ አልባ(ሰይድ ኢብራ	___	___	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	___	217.946	በምድር ቅየሳ	Not identified	undocumented parcel	private	ineligible
76	AA000070804268	ሞቱማ አጀማ ደቻሳ	ወንድ	ኢትዮጵያዊ	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	506.84	129.34	በምድር ቅየሳ	Lease hold	parcels	private	ineligible

1 (0 out of 140 Selected)

No	UPID	OWNER_Name	SEX	NATIONA	CITY	SUB_CITY	WORED	KETENA	SEFER	DOCUMENT_	SURVEYED_Area	SURVEYED_By	TENURE_Type	EXISTING_land_use	OWNERSHIP_type	Adjudicated_result
77	AA000070804270	አቶ ንጉሴ በቀለ ገለታ	ወንድ	ኢትዮጵያዊ	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	165	239.943	በምድር ቅየሳ	Lease hold	parcels	private	ineligible
78	AA000070804093/4	ቤኛ በየነ ደያሣ	ሴት	ኢትዮጵያዊ	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	___	176.556	በምድር ቅየሳ	Not identified	parcels	private	ineligible
79	AA000070804093/5	ሄሩት በየነ ደያሣ	ሴት	ኢትዮጵያዊ	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	___	188.812	በምድር ቅየሳ	Not identified	parcels	private	ineligible
80	AA000070804093/6	ክፍት ቦታ	___	___	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	___	1143.572	በምድር ቅየሳ	Not identified	open spaces	governments	ineligible
81	AA000070804093/7	ክፍት ቦታ	___	___	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	___	109.048	በምድር ቅየሳ	Not identified	open spaces	governments	ineligible
82	AA000070804296/1	አስፋ ርርሳ አለሙ እና እ	___	___	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	147	210.891	በምድር ቅየሳ	Lease hold	parcels	private	ineligible
83	AA000070804302	ሰነድ አልባ (ሽፋራው ሁ	___	___	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	___	153.862	በምድር ቅየሳ	Not identified	undocumented parcel	private	ineligible
84	AA000070804304	መንገድ	___	___	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	___	53.321	በምድር ቅየሳ	Not identified	Road	governments	ineligible
85	AA000070804276/2	መሐመድ ሁሴን ሺበሺ	___	___	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	103	130.41	በምድር ቅየሳ	Lease hold	parcels	private	ineligible
86	AA000070804226/2	ሰነድ አልባ(ወንድሙ ማ	___	___	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	___	168.838	በምድር ቅየሳ	Not identified	undocumented parcel	governments	ineligible
87	AA000070804215/2	ምፋፅ ፀሀዬ	ወንድ	ኢትዮጵያዊ	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	63	148.862	በምድር ቅየሳ	Fee hold	parcels	private	ineligible
88	AA000070804296/2	ነፃነት ዘገየ ሰማኸኝ	ሴት	ኢትዮጵያዊ	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	195	180.577	በምድር ቅየሳ	Lease hold	parcels	private	eligible
89	AA000070804196/1	ሰነድ አልባ(ባይለ ነጋ)	___	___	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	___	119.536	በምድር ቅየሳ	Not identified	undocumented parcel	private	ineligible
90	AA000070804116/2	ሰነድ አልባ(እርና ጉፋሙ)	___	___	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	___	143.359	በምድር ቅየሳ	Not identified	undocumented parcel	private	ineligible
91	AA000070804109/4	ሰለሞን አረጋ አህመድ	ወንድ	ኢትዮጵያዊ	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	334	351.019	በምድር ቅየሳ	Lease hold	parcels	private	ineligible
92	AA000070804109/3	ሰለሞን አረጋ አህመድ	ወንድ	ኢትዮጵያዊ	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	167	151.786	በምድር ቅየሳ	Lease hold	parcels	private	eligible
93	AA000070804148/3	ወ/ሮ ፀሐይ አማረ ደንን	ሴት	ኢትዮጵያዊ	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	200	192.469	በምድር ቅየሳ	Lease hold	parcels	private	eligible
94	AA000070804148/2	ሰነድ አልባ(የንጉሥስንሽ እን	___	___	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	___	49.586	በምድር ቅየሳ	Not identified	undocumented parcel	private	ineligible
95	AA000070804050/40	መንገድ	___	___	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	274	274.334	በምድር ቅየሳ	Fee hold	Road	governments	eligible
96	AA000070804181/40	አቃቂ ቃሊቲ ክፍለ ከተ	___	___	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	65	66.495	በምድር ቅየሳ	Fee hold	parcels	governments	eligible
97	AA000070804093/2	መንገድ	___	___	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	___	730.312	በምድር ቅየሳ	Not identified	Road	governments	ineligible
98	AA000070804165/1	የኔነሽ ስሜ ወልደአማኑኤ	ሴት	ኢትዮጵያዊ	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	79	148.039	በምድር ቅየሳ	Lease hold	parcels	private	ineligible
99	AA000070801262/1	መንገድ	___	___	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	1767	1748.387	በምድር ቅየሳ	Fee hold	Road	governments	eligible
100	AA000070804248/2	መንገድ	___	___	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	159	159.704	በምድር ቅየሳ	Fee hold	Road	governments	eligible
101	AA000070803697/17	ታምራት አሸኔ	___	___	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	___	65.738	በምድር ቅየሳ	Not identified	parcels	private	ineligible
102	AA000070803697/24	መንገድ	___	___	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	251	18.952	በምድር ቅየሳ	Fee hold	Road	governments	eligible
103	AA000070803901/1	ከወ/ሮ ዘነቡች ወልደሰንበ	___	___	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	___	36.175	በምድር ቅየሳ	Not identified	cutoff places from pa	private	ineligible
104	AA000070804196/2/1	ከእነ ዋለልኝ ዋቅጅራ ወዳ	___	___	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	___	39.864	በምድር ቅየሳ	Not identified	cutoff places from pa	private	ineligible
105	AA000070804157	ሄሩት በየነ ደያሣ	ሴት	ኢትዮጵያዊ	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	127	127.016	በምድር ቅየሳ	Lease hold	parcels	private	eligible
106	AA000070803964/3/1	ከደንቅነሽ የማነብርሃን	___	___	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	___	36.713	በምድር ቅየሳ	Not identified	cutoff places from pa	private	ineligible
107	AA000070804093/1/1	ከአልማዝ ሰይፋ ቦርዱ የ	___	___	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	___	140.134	በምድር ቅየሳ	Not identified	cutoff places from pa	private	ineligible
108	AA000070804227/1	ከአስናቀች ወልደፃድቅ ወ	___	___	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	___	18.972	በምድር ቅየሳ	Not identified	cutoff places from pa	private	ineligible
109	AA000070804160/1	ከሀብታሙ አበራ ደበላ	___	___	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	___	51.693	በምድር ቅየሳ	Not identified	cutoff places from pa	private	ineligible
110	AA000070804245/1	ከአቶ ሰሎሞን ግደይ ሰህ	___	___	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	___	9.918	በምድር ቅየሳ	Not identified	cutoff places from pa	private	ineligible
111	AA000070804086/1	ከአሸናፊ ደረስ ታምር የ	___	___	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	___	100.807	በምድር ቅየሳ	Not identified	cutoff places from pa	private	ineligible
112	AA000070804233	ዘሀራ እንድሪስ ሙሄ	ሴት	ኢትዮጵያዊ	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	142	167.908	በምድር ቅየሳ	Lease hold	parcels	private	ineligible
113	AA000070804236/42	ደረጄ ከበበው ሀይሌ እና	___	___	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	63	64.924	በምድር ቅየሳ	Lease hold	parcels	private	ineligible
114	AA000070804237	አከርስ አንጀ ጋዜ	ወንድ	ኢትዮጵያዊ	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	63	69.278	በምድር ቅየሳ	Fee hold	parcels	private	ineligible

1 (0 out of 140 Selected)

115	AA000070804239	ተድላ ቆርቾ ብሩ	ወንድ	ኢትዮጵያዊ	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	1190		185.038	በምድር ቅየሳ	Lease hold	parcels	private	ineligible
116	AA000070804241	መንግስቱ ተሻገር ወርቄ	ወንድ	ኢትዮጵያዊ	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	63		69.586	በምድር ቅየሳ	Lease hold	parcels	private	eligible
117	AA000070804243/42	ሞቱማ አጀማ ደቻሳ	ወንድ	ኢትዮጵያዊ	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	397		630.165	በምድር ቅየሳ	Fee hold	parcels	private	ineligible
118	AA000070804245	አቶ ሰሎሞን ግደይ ሰህለ	ወንድ	ኢትዮጵያዊ	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	57		58.627	በምድር ቅየሳ	Lease hold	parcels	private	eligible
119	AA000070804246	ለተብርሃን አሸብር ወልደ	ሴት	ኢትዮጵያዊ	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	251		347.441	በምድር ቅየሳ	Lease hold	parcels	private	ineligible
120	AA000070804275	ሰነድ አልባ (ቄስ ሺበሺ	__	__	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	__		347.302	በምድር ቅየሳ	Not identified	undocumented parcel	private	ineligible
121	AA000070804276/1	ዘገየ በቀለ ቶልዩ	ወንድ	ኢትዮጵያዊ	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	162		181.571	በምድር ቅየሳ	Lease hold	parcels	private	eligible
122	AA000070804283	ሰነድ አልባ(ግርማ ሞቱ	__	__	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	__		113.358	በምድር ቅየሳ	Not identified	undocumented parcel	private	ineligible
123	AA000070804285	ወሰኔ መንግስቴ ብርሌ	ሴት	ኢትዮጵያዊ	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	229		200.872	በምድር ቅየሳ	Lease hold	parcels	private	ineligible
124	AA000070804294/1	እነ አስቴር ለማ ጋረደው	__	__	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	280		140.157	በምድር ቅየሳ	Lease hold	parcels	private	ineligible
125	AA000070804093/1	አልማዝ ሰይፉ ቦርዴ	ሴት	ኢትዮጵያዊ	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	207		207.88	በምድር ቅየሳ	Lease hold	parcels	private	eligible
126	AA000070804137/2	ታደሰ እንዳይላሉ ላቀው	ወንድ	ኢትዮጵያዊ	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	144		120.413	በምድር ቅየሳ	Lease hold	parcels	private	ineligible
127	AA000070804154/2	አረጋ መኮንን መሸሻ	ወንድ	ኢትዮጵያዊ	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	90		122.186	በምድር ቅየሳ	Lease hold	parcels	private	ineligible
128	AA000070804092/2	ሰነድ አልባ(ሰለሞን ማ	__	__	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	__		272.874	በምድር ቅየሳ	Not identified	undocumented parcel	private	ineligible
129	AA000070804073/4	ሰነድ አልባ(አሰሉ ለማ)	__	__	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	__		153.525	በምድር ቅየሳ	Not identified	undocumented parcel	private	ineligible
130	AA000070804067/2	አቶ አሰፋ ደንድር ሰራረ	ወንድ	ኢትዮጵያዊ	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	150		156.296	በምድር ቅየሳ	Lease hold	parcels	private	eligible
131	AA000070804079/2	ወ/ሮ መሰረት ሲሳይ አባ	ሴት	ኢትዮጵያዊ	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	150		181.553	በምድር ቅየሳ	Lease hold	parcels	private	ineligible
132	AA000070803964/3	ድንቅነሽ የማነብርሃን ሀ	ሴት	ኢትዮጵያዊ	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	150		150.256	በምድር ቅየሳ	Lease hold	parcels	private	eligible
133	AA000070803964/2	አቶ ፍርድአወቅ አንጋሱ	__	__	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	165		235.497	በምድር ቅየሳ	Lease hold	parcels	private	ineligible
134	AA000070804055/2	ዋዘቴ ኢንደስትሪያል ሰር	__	__	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	189		204.322	በምድር ቅየሳ	Lease hold	parcels	private	eligible
135	AA000070804073/1	ወልደዩሀንስ ሰህሌ ግፋ	ወንድ	ኢትዮጵያዊ	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	350		403.481	በምድር ቅየሳ	Lease hold	parcels	private	ineligible
136	AA000070804073/40	ወልደዩሀንስ ሰህሌ ግፋ	ወንድ	ኢትዮጵያዊ	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	150		168.805	በምድር ቅየሳ	Lease hold	parcels	private	ineligible
137	AA000070804073/2	ተስፋው ያለው ወንድ	ወንድ	ኢትዮጵያዊ	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	150		150.07	በምድር ቅየሳ	Lease hold	parcels	private	eligible
138	AA000070804089	ዘለቀሽ አሰበ መኮንን እና	__	__	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	346		290.884	በምድር ቅየሳ	Lease hold	parcels	private	ineligible
139	AA000070804109/1	ብሩ ቲቾ ፊዳ	ወንድ	ኢትዮጵያዊ	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	165		152.651	በምድር ቅየሳ	Lease hold	parcels	private	ineligible
140	AA000070804109/2	ሰለሞን አረጋ አህመድ	ወንድ	ኢትዮጵያዊ	አዲስ አበባ	አቃቂ ቃሊቲ	8	3	ደራርቱ 2	168		151.882	በምድር ቅየሳ	Lease hold	parcels	private	ineligible

1 (0 out of 140 Selected)