ADDIS ABABA UNIVERSITY

INSTITUTE OF TECHNOLOGY

SCHOOL OF CIVIL AND ENVIRONMENTAL ENGINEERING

GIS-Based Urban Land Property Valuation for Taxation Purpose: The Case of Akaki Kality sub city, Addis Ababa, Ethiopia

BY: Tadilo Alemu Achenef

Adviser: Hamere Yohannes (PhD)

A thesis submitted to the School of Civil and Environmental Engineering Graduate Studies of Addis Ababa Institute of Technology in Partial Fulfillment of the Requirement for the Degree Masters of Science in **Geodesy and Geomatics (specialization in Geomatics)**

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SCHOOL OF GRADUATE STUDIES DEPARTMENT OF

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Approved by board of examiners:

Advisor	Signature	Date
Internal Examiner	Signature	Date
External Examiner	Signature	Date
Chairman	Signature	Date

DECLARATION

I, the undersigned, declare that this thesis work is my original work carried out under the supervision of Dr. Hamere Yohannes (PhD). It has not been presented for a degree in any universities and all sources of materials used for the thesis work have been properly acknowledged.

Name	Signature	Date

Place: Addis Ababa

This thesis has been submitted for examination with my approval as a university advisor.

Name	Signature	Date

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Tadilo Alemu
January, 2024

Acronyms

ARCGIS	Aeronautical Reconnaissance Coverage Geographic Information System
CBD	Central Business District
DEM	Digital Elevation Model
GIS	Geographic Information System
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
MCE	Multi-Criteria Evaluation
MS	Micro Soft
SRTM	Shuttle Radar Topography Mission
USGS	United States Geological Survey

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Abstract

Land valuation is the process of assessing the characteristics of a given piece of land grounded on experience and judgment, for different purposes like for transaction, mortgage, taxation, insurance, and so on. In this case the study concentrated on land property valuation for taxation purpose. It is considered that an owner should be able to pay taxes to the government in connection with his ownership, in terms of the government services he receives and the infrastructure provided to him. That is, a property owner who lives in an area with better infrastructure and government services will be taxed higher or vice versa. In the current situation, the land ownership registration and information agency of Addis Ababa city administration and land development management institutions in connection with land property valuation, especially the land property valuation service used for tax rate purposes follows the calculation method based on income capitalization and based on the current land property transaction value which, might not indicate whether the land property right holder is situated on well-developed infrastructures or not. That makes the system unfair, which does not follow the multiple requirements or parameters that affect a land property value. Therefore, this study will address and show the direction of the land and land-related valuation system especially for laving taxes, observed in the city administration specifically Akaki Kality sub city, for the study using multi-faceted criteria's to develop land property valuation model and parcel data were integrated using ArcGIS to developed property valuation attribute table. The result indicated that the majority (35.16% and 28.88% respectively) of the total land area falls under the categories of very high land value and high land value. This indicated that these areas have high potential for development, so that should rate high tax. Whereas 15.37% of the study area are moderately offers some potential for development. The low value (12%) has limited development opportunities or undesirable locations, following to this property owner on this category should pay lower rate of tax. The remaining 8.59% of the area has the lowest development opportunity and infrastructures. In conclusion, the significant proportion of land falling under the very high and high categories have nice development opportunities for various purposes such as residential, commercial, or industrial projects. Developers and investors can focus their efforts on acquiring and utilizing these lands to capitalize on the high development opportunities associated with these areas. Additionally, the distribution of land across different categories provides valuable understanding for urban planners and policymakers relating to taxation. Following to this study concerned parties may elongate it throughout the city and gives coefficients to each categories' of land values. This knowledge also allows decision-makers to prioritize areas with higher potential for growth and allocate resources accordingly.

Key Words: Land Value, Property Valuation, GIS, Weighted Overlay Analysis

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CHAPTER ONE: INTRODUCTION

1.1. Background of the study

Land valuation is the process of assessing the characteristics of a given piece of land grounded on experience and judgment. To make an acceptable value estimation for land, numerous palpable and impalpable land valuation factors should be taken into account during the valuation process (Li, Prussella, et al., 2015). Land or property valuation is the process of relating and quantifying the property value factors. Land property value is a function of positional, physical, legal, and profitable factors. Property functional rates may include position influences (availability to the request place, road stations, etc.). The lesser the reliance on client access, the lesser the need to detect at the position of maximum availability. The high land values at the places of maximum availability ("The Development of a GIS-Based Property Information System for Real Estate Valuation," 1997).

Land value means the price of a land at a given point of time grounded on its position. Land value varies from position to position. Land values are high in the center of a megacity whereas low in its fringe or periphery. Within a position, availability impacts the land value and values are high for the land parcels near the road (Santosh et al., 2018a). Property valuation is done for different purposes, including taxation, deals, and insurance. Valuation is a process of estimating the value for which a property will be changed or the duty rate that should be paid for it on a particular date (Koeva et al., 2021). The large number of environmental, economic, and social factors, similar as ecological, health, and profitable development can impact urban land- use felicity (Yan et al., 2021).

For land evaluation, the top criteria that are used for spatial analysis are pitch, road propinquity, land use/ land cover, land values, and geological conformation (Santosh et al., 2018). According to (Koeva et al., 2021), land valuation factors for taxation purposes are classified in to two categories, internal and external factors. Internal factors include parcel size, constructed- up area; improvement; shape, and type of subject property, whereas external factors include vacuity, neighborhood, land use, terrain, and service availability (Yang et al., 2008). As external factors, the introductory structure installations similar as the presence of electricity, telephone installation, and water will be considered in the process. In addition, the distances to other installations similar as seminaries, main and minor roads, and fiscal institutions in the girding area play a vital part (Li, Prussella, et al., 2015). Thus, external factors were employed to conduct the current study. Availability to the Central Business District (CBD) as a position trait, other position attributes including availability to major roads, distance to road, and the town area significantly impact land evaluation. Generally, the town area is eased with introductory communal facilitates further than other areas. The transportation system has a significant impact on the land value of an urban area (Islam et al., 2022).

The use of GIS technology in property valuation has gained popularity due to its capability to handle spatial data and analyze complex land attributes. GIS allows for the integration and analysis of various datasets such infrastructure, accessibility, and socio-economic factors, which are crucial in determining the value of urban land. With the availability of advanced GIS software and spatial databases (Hasnine & Rukhsana, 2023). A spatial database is a type of database that is designed to store and process spatial data. It is specifically built to handle GIS data, which consists of spatially referenced data points, lines, and polygons. This type of database provides advanced spatial indexing and query processing capabilities, allowing for efficient storage and retrieval of spatial data. This data is typically stored in a spatial database alongside non-spatial attributes. Attributes in GIS refer to the descriptive information or characteristics associated with a spatial object (Longley, 2005). To accomplish this research, the involved factors were slope, drainage network, electric power lines, roads, round-about (squares), railway stations, bus terminals, educational centers, health centers, financial institutions, Shopping centers, police and justice institutions, and governmental administrative offices of the study area.

In the suitability evaluation process, the selection and standardization of pointers, the determination of weight, and how to combine GIS with the decision- making process are always the crucial points (Jia & Zhessakov, 2021). Thus, this exploration was conducted in Akaki Kality sub-city of Addis Ababa, Ethiopia to assess the urban land value for Taxation purposes by using ArcGIS as a tool.

1.2. Statement of the Problem

Urban land administration requires integrating a wide range of data on ecological, environmental, urban planning and development process (Yan et al., 2021). As one of the main functions of land administration systems, property valuation is struck by positional, physical, legal, and profitable factors. Despite the significance of property valuation to profitable development, there are commonly no standardized rules or strict data conditions for property valuation for taxation in developing surrounds (Koeva et al., 2021). Sufficient estimation can be done by assaying a certain piece of land characteristics. Determination of a land parcel value depends on several physical and profitable characteristics, which must be taken into consideration precisely in a land valuation procedure (Li, Prussella, et al., 2015). Although land valuation and taxation have always been important rudiments of cadaster, the transnational land operation wisdom academic community has been fairly late in studying the information model for land valuation and taxation (Xu et al., 2019). Due to the complexity of land valuation process, land property possessors with a fluently understood explanation of how their properties have been valued, were a continual challenge for valuators and assessors.

To increase the effectiveness of land valuation process, a nominal asset value- grounded model has been developed using GIS (Li, Prussella, et al., 2015). The land value duty is a variant of the property tax that imposes an advanced tax rate on land than on advancements or levies only the land value. Land value taxation would enhance both the fairness and the effectiveness of the property duty (Dye & England, 2010). Numerous other types of changes in property duty policy, similar as assessment restrictions or limitations, have undesirable side goods, including unstable (unequal) treatment of similarly positioned taxpayers and deformation of profitable impulses.

It is considered that an owner should be able to pay taxes to the government in connection with his ownership, in terms of the government services he receives and the infrastructure provided to him. That is, a property owner who lives in an area with better infrastructure and government services will be taxed higher or vice versa. In the current situation, the land ownership registration and information agency of Addis Ababa city administration and land development management institutions in connection with land property valuation, especially the land property valuation service used for tax rate purposes follows the calculation method based on income capitalization and based on the current land property transaction value which, might not indicate whether the land property right holder is situated on well-developed infrastructures or not. That makes the system unfair, which does not follow the multiple requirements or parameters that affect a land property value.

Therefore, this study will address and show the direction of the land and land-related valuation system especially for laving taxes, observed in the city administration as well as Akaki Kality sub city, for the study using multi-faceted criteria.

Some studies were conducted related this research title in different locations but not in Addis Ababa specifically in the current study area Akaki Kality sub-city. Like (Li, Pussella, et al., 2015) in Matara Urban Council Area, Sri Lanka; (Mansouri Daneshvar, 2014) in urbanized region, NE Iran; and (Islam et al., 2022a) a case of Rajshahi City corporation area, conduct research related the current study. In this study title, no further research is completed and the issue is researchable since the problem is economically and politically sensitive.

Therefore, the specified problems above could be solved by identifying the parameters for urban land valuation, developing urban land value model using multi criteria evaluation method (MCE) method. Followed to this, the property attribute value model was linked to the parcels spatial data (retrieved from the system database of "Land Holding Registration and Information Agency Akaki Kality sub-city branch" together. In this study, ArcGIS 10.7 were employed to develop GIS based property valuation attribute table database.

1.3. Objective of the Study

1.3.1. General Objective

The general objective of the study is to determine the value of Urban Land for Taxation Purposes and making a property valuation model using GIS-Based approach.

1.3.2. Specific Objectives

- To make an analysis for identified parameters of urban land property valuation suitability in the study area
- To develop the urban land property valuation model of the study area for taxation purposes by using Multi-criteria evaluation method
- To generate property valuation attribute table to simplify the service delivery for the study area

1.4. Basic research questions

- What is the accessibility of identified parameters that considered for urban land property valuation suitability modeling in the study area?
- What looks the urban land property valuation model of the study area developed for taxation purposes using the Multi-criteria evaluation (MCE) method?
- How to generate GIS-based property valuation attribute table to simplify service delivery in the study area?

1.5. Significance of the study

This study will give scientific contributions to understanding the application of GIS to determining the value of urban land for taxation developing purposes. Inform to different stakeholders for their decision-making processes to avoid biased taxation. Therefore, the current study is expected to contribute to a sustainable taxation system by providing a scientifically investigated solution. Moreover, it will be the benchmark for other researchers conducting similar research titles for solving the problems. The study's outcome is expected to contribute highly to policy analysis and collaboration strategies. Researchers, policy-makers, government bodies, development agents, and humanitarian partners may learn lessons from this research regarding the effectiveness of urban land management practices.

1.6. Scope of the study

This study was conducted at Akaki Kality sub-City of Addis Ababa, Ethiopia and has been carried out identifying the parameters for urban land value suitability modeling; to develop an urban land value model of the study area for taxation purpose by using multi-criteria evaluation (MCE) method and to generate land property valuation attribute table by integrating/ joining the weighted overlay result with the attribute of each parcels on the study area. This encompasses that selecting factors that affect land property value taxation and analysis (propinquity analysis, slope analysis, and drainage network analysis) were made on the area.

CHAPTER TWO: LITERATURE REVIEW

2.1. The Concept of Urban Land Convenience Evaluation

Land is an area of earth and it's a natural resource to benefit citizens. As a factor of product, land has a profitable value, because of the high demand for space, and purposes, similar like sanctuary covering, education, public services, husbandry and husbandry, mining, business, transport, and recreation. thus, land is a scarce resource especially in civic areas, because further than half of the world population lives in civic areas and half of the world population in developing countries also live in civic areas. Value maps are important decision- making tools that illustrate the terrain of property values over space and time in a way that most property professionals find intuitive, videlicet, in map form. An evaluation index system for the evaluation of the suitability of municipal land can be done using Geographic Information System technology. (Yan et al., 2021). Complex evaluations of land parcels have been carried out by using of four criteria (technological, provident, ecological, and social) for two special tasks ecological criterion is the more provident, and criterion is more important and significant respectively (Arefiev et al., 2015).

Urban land convenience assessment is an important fundamental work in urban land development. Land convenience assessment, in the environment of land use planning, is a bridging phase linking land coffers assessment to any land use decision making process. This decision- making process considers not only the natural attributes of the land but also its socioeconomic and environmental features (Mamo G. M., 2019).

2.2. Factors Affecting Property Valuation for Taxation

Factors affecting property valuation for taxation are classified into two main orders internal and external factors. Internal factors include parcel size, built-up area; improvement; shape, and type of subject property, whereas external factors include accessibility, neighborhood, land use, terrain, and utility (Koeva et al., 2021). The large figures of environmental, profitability and social factors, similar as ecological, health, population growth, and profitability development, can impact urban land-use prefer-ability (Yang et al., 2008).

The parcel size is used to determine the land value of either the developed or uninhabited parcels. This serves as the duty (tax) base for both leaseholders and freeholders. Also, for the land lease fee to be paid by the taxpayer, the parcel size plays an essential part because the bigger the parcel, the more lease fee is paid if the positions of the parcels are in the same area whereby the rate is the same. Parcel area serves as a land parcel lease fee base as the system of determining the lease fee is the rate per square unit. The built-up area is one of the most applicable factors for the property tax system. Property duty is assessed grounded on the request value, and this includes the value of the land, structure, and any advancements. Thus, precise area computations are demanded. Also, the size of the perpendicular dimension also shouldn't be forgotten. In the built-up areas, enhancement refers to the position of external work done to increase the value of the property; this includes property conservation, concrete parking, gardening, sewage drainage systems, water tanks, and others. These features are also part of the request value of the property to be tested and need to be assessed and considered during data collection for property valuation for taxation purposes. Shape refers to the spatial form of a parcel, whether it's regular (vertical lines) or irregular (polygons with angles). The shape doesn't affect the value of the land and property directly, whereas it affects enhancement and design that can be put up in that parcel. The type refers to whether the parcel of land is built or unbuilt. Still, this goes hand in hand with land use and development conditions that can be filled by specifying the number of structures, requires a construction content rate, and allows for a number of bottoms on an individual parcel (Koeva et al., 2021).

Land location factors such as neighborhood, availability (roads) of the property, public installations, serviceability, and structure, all affect property value. The neighborhood is a pivotal factor in the specific surroundings that affect the value of the property. The buffer around that property in a particular area determines the girding features of the property. Availability is measured by how accessible the property is. Availability is more affiliated to the road structure and defines whether the property is accessible by primary roads or sections, roads, water pipes, fiber optical internet, and electricity. serviceability relate to services or features that are connected to parcels, similar as water pipes, electricity, gas, sewerage, drainage, and other installations (Koeva et al., 2021). The parameters videlicet, distance to seminaries, distance to roads, distance to police station, distance to road station, distance to health installations, land- use type and distance to government structures are used to determine the request value of a land (Li, Prussella, et al., 2015).

2.3. The Role of GIS for Land Valuation

The fast development of Geographic Information Systems (GIS) has dramatically changed the procedure for spatial data collecting, storing, assaying and displaying (Sui, n.d.,1992). ArcGIS provides a technological platform for an analysis and an original stage is the spatial representation of property information in the form of value maps. Due to the complexity of land valuation process, furnishing property owners with an easy, accessible explanation of how their property has been valued is a challenge for planners and assessors. For the moment, ArcGIS is suitable to execute all these complex tasks. ArcGIS capabilities not only facilitates the organizing and operating of geographic data, but also it enable investigators to take full advantage of the position information contained in these databases to support the operation of a spatial statistical and spatial econometric tool (Li, Prussella, et al., 2015). ArcGIS provides a technological platform on which to base such an analysis and an original stage is the spatial representation of property information in the form of value maps. ArcGIS is now suitable to address some of the problems essential in traditional maps by producing them efficiently and as part of a wider suite of data analysis ways (PETER J. WYATT, 1997).

2.4. GIS-Based Attribute table database

A GIS-based attribute table database is a collection of geospatial data that includes various attributes or characteristics associated with geographic features. These databases are used in geographic information systems (GIS) to store, manage, analyze, and visualize spatial data. The attributes in a GIS-based database can include information such as land use, population demographics, infrastructure details, environmental features, and much more. The integration of spatial and attribute data allows for comprehensive analysis and decision-making (Rigaux et al., 2002).

The integration of spatial and attribute data is essential for understanding complex relationships between location-based phenomena and their associated attributes. It enables informed decision-making in diverse fields ranging from urban planning to environmental management to business operations (Devogele et al., 1998).

Integrating spatial and attribute data in GIS is essential for a variety of reasons. Firstly, it allows users to analyze the relationships between geographical features and their attributes, which can help them make informed decisions based on these insights. Secondly, combining spatial and attribute data can help create more accurate and detailed maps, which are useful for various applications such as urban planning, and environmental management. Lastly, integrating spatial and attribute data can lead to improved data management and better decision-making. By organizing and analyzing data in a GIS, users can identify patterns, trends, and relationships that might not be apparent through traditional methods. This can help them make more informed decisions, save time and resources, and ultimately improve the quality of their work (Devogele et al., 1998).

2.5. Weighted Overlay MCE Method for Modeling Urban Land Value

Land convenience analysis is used for different types of operations identification of suitable locales of urban development. In setting the significance of the criteria used and calculating the weights of factors, ArcGIS tools must be integrated with other styles to meliorate the results of land convenience analysis. The integration of ArcGIS tools and multi-criteria decision analysis is an important approach for assessing land convenience. (Aburas et al., n.d., 2015).

Suitability map for urban land development can be uprooted using weighted overlay ways in ArcGIS. Weighted overlay analysis is the process of find the suitable area for urban land development and was effective way for the study. By combining all reclassified raster layers using Weighted Overlay tool and applying common dimension scale and weights each according to its significance, the land value model can be produced (Santosh et al., 2018). Once the weights established, the Weighted Overlay tool (for Multi-Criteria Evaluation) are used to combine the factors for bearing multicriteria evaluation (Hussien et al., n.d.,2019). Before performing multi-criteria evaluation (MCE) to produce suitability models of urban land value, each dataset were converted in to raster format and reclassified in to a common scale using ArcGIS10.7 spatial analysis tool. The raster data model is the more suitable fashion because the structure of raster data is grid cell grounded, which can fluently delineate suitable spots. According to (Li, Prussella, et al., 2015) the value of the land codified in to 5 which are very low, low, moderate, high, and very high values. Each class is represented by giving a separate integer value 1 up to 5 from very low to very high, independently. The primary issue in the evaluation is assigning weights to each factor independently (Dai et al., 2001).

CHAPTER THREE: MATERIALS AND METHODS

3.1. Study Area Description

This research was conducted in Akaki Kality sub-city, which is the southern part of Addis Ababa, the capital city of Ethiopia. Specifically, it is surrounded by Bole sub city in the northeast; Nefasilk Lafto sub city in the northwest and the other part is surrounded by Oromia regional state. The latitude ranges from 8°50'11" N to 8°58'30" N, and the longitude ranges from 38°44'45"E to 38° 52'40"E (Fig. 3.1). In addition, the elevation is between 2044 and 2354 meters above sea level. The area covers a total area of 123,957,250 m^2. Akaki Kality is a rapidly growing residential and industrial area and it is home to several educational institutions, including universities and technical colleges. Akaki Kality is also known for its vibrant marketplaces and commercial activities.

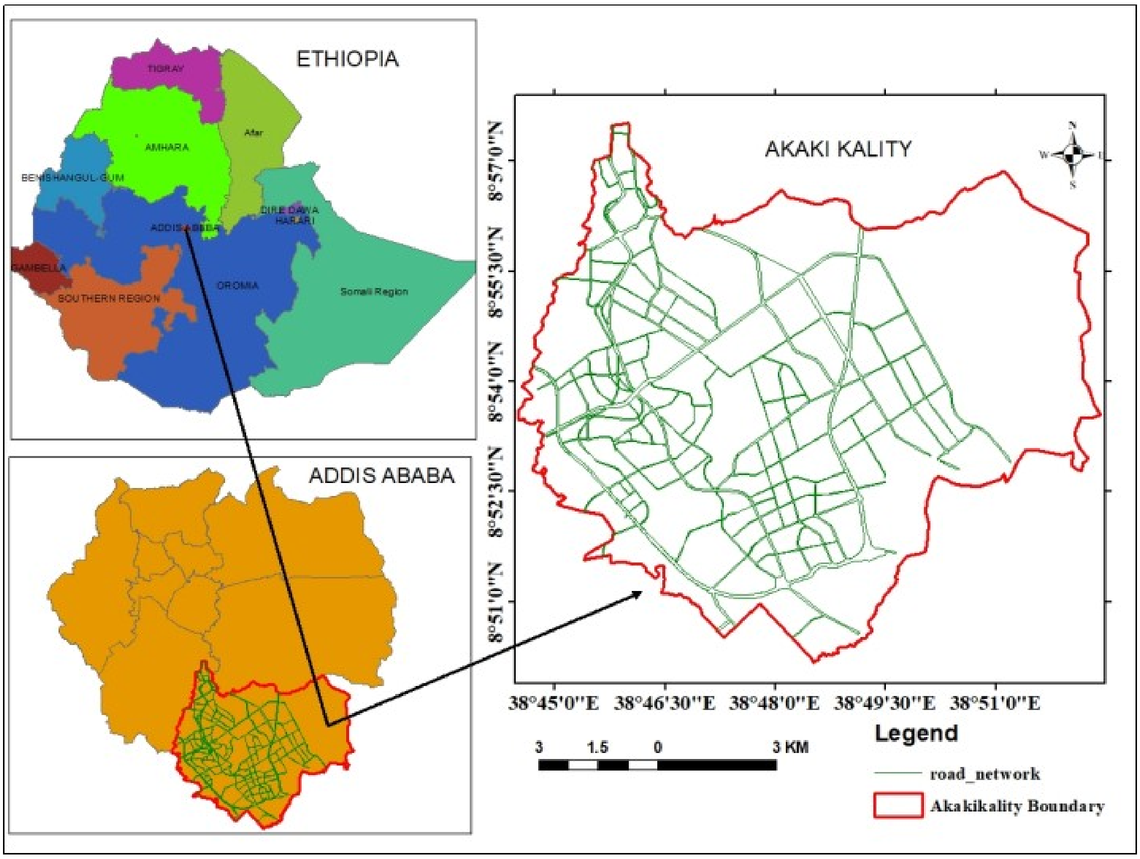

Fig3. 1: Location map of the study area

3.2. Data Types and Sources

Data were collected from different sources. DEM raster topographic data, Locational X, Y coordinates using ground survey, the existing land-use map, infrastructures shape file data, socio-economic data, parcel attribute data were collected and employed to conduct the current study. All data, which were applicable in this study, are presented below in the table (Table 3.1).

Table3.1: Data type and sources used in the study

No	Data	Format	Source
1	DEM (Digital Elevation Model)	Raster	https://earthexplorer.usgs.gov/
2	Roads, Educational centers, Health centers, Financial institutions, sub-city and Woreda Administrative offices, and Electric Power lines	Shape file	Akaki Kality sub-city plan and development commission
3	Round-about(squares), Railway stations, Bus terminals, and Market centers	Text file to Shape file	Ground Survey Using Handheld GPS
4	Land parcels information and study area boundary	Shape file	Akaki Kality land holding registration and information agency branch office
5	Previous studies, journals, published books	Texts, tables and figures	Secondary sources, internet, library...

3.3. Soft Wares Used to Analyze the Data

The following soft wares were used for data analyses that are vital for achieving the research objectives efficiently and effectively (Table 3.2).

Table3. 2: Software, tools and its functions

No	Software & tools	Purpose and description
1	Arc GIS 10.7	For proximity analysis, overlay analysis and to prepare maps
2	IDRISI SELVA 17.0	For pair wise comparison matrix and to give weight for selected parameters to avoid biases
3	Hand held GPS	For Collecting X, Y coordinate data

3.4. Data Acquisition and Material

The Digital Elevation Model (DEM) raster data was downloaded from the archive of the United States Geological Survey (USGS) for slope analysis and drainage network identification. This DEM data was a raster data which enables to make elevation related analysis. DEM from SRTM (30m×30m) resolution data of the study area was used for spatial surface analysis. Slope and drainage network of the study area was generated from DEM.

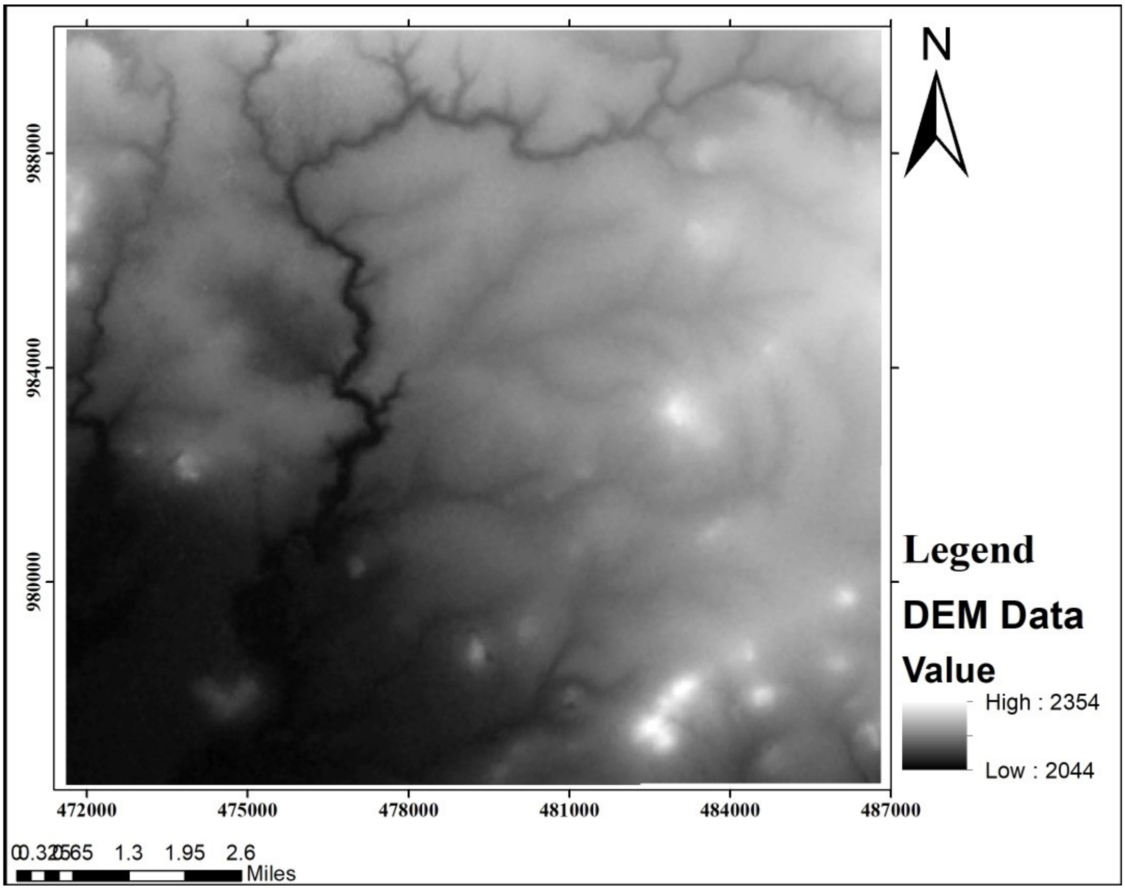

Figure3. 2 DEM Data of the study area

On the other hand some of the location X, Y coordinate data of identified parameters such as market centers, Railway stations, bus terminals, and roundabouts were collected from ground survey (physical presence) using handheld GPS. As these collected data were in form of text file type, were processed and digitized to point Shape-files using ArcGIS.

The remaining point and linear data were collected from concerned institution, plan commission of Akaki Kality sub-city. These data were two categories' ; first, point data X,Y coordinate in CSV (Comma delimited) excel file, processed and digitized into point Shape-file using ArcGIS. The parameters were health centers and hospitals, Educational centers (schools, Colleges), Governmental offices, police and justice institutions, and financial institutions. Secondly linear data (road network, electric power-lines, and boundary of the study area) were collected in the form of linear shape-files, from plan commission and land Holding registration and information agency of Akaki Kality sub-city.

Parcel data of the study area were collected and extracted from the archive of system database of land holding registration and information agency Akaki Kality branch office. Not only spatial data, but also materials such as handheld GPS from Land Holding Registration and Information Agency Akaki Kality branch office, and software's (IDRISI SELVA 17.0, and Zotero) from before use, were collected and installed.

3.5. Methodology

3.5.1. Parameters for Urban Land Value Modeling

Transportation facility, shopping facility, educational facility, topographic/ slope factors, and civic amenities are among the factors influencing urban land value (Bv et al., 2020a).

Road is an important factor in land value site suitability analysis because of the need to transport raw products and finished materials. (Santosh et al., 2018) and (Mamo G. M., 2019) Properties near major highways and important roads are valued high than the other road networks (Bv et al., 2020b). Therefore, in this research, to determine better accessibility to the existing road, buffer zones were created by taking distance from the road and land buffer zones could be created along the proximity analysis in ArcGIS.

Slope is an important criterion for suitable site selection in urban development. Steep slopes are inimical for construction. Steeper slopes increase construction costs, limit maximum bottom areas, and contribute to corrosion during construction and posterior use (Santosh et al., 2018a). In this thesis, the slope raster layer was generated from DEM 30m resolution and reclassified according to standards.

Based on various research articles, 13 parameters that were said to have an impact on land property value were identified to produce urban land value model. The principal factors that were used for land value spatial suitability analysis were slope, proximity to roads networks , distance to round about (squares), proximity to drainage network, proximity to electric power lines, railway station, bus terminal, police station, schools & colleges, hospitals & health centers, financial sectors, government offices, and market centers. These 13 parameters were used in the preparation of urban land value maps of the study area. Each of the parameters map were produced by using the proximity analysis in Arc GIS 10.7.

3.5.2. Data Processing and Analysis

3.5.2.1. Slope Analysis

Slope is an important factor to consider when valuing urban land. It involves examining the gradient or incline of the land, which can have significant impacts on its development potential, site functionality, and overall value. The slope of a piece of land can determine its suitability for various types of development. Flat or gently sloping land is typically easier and less expensive to build on, making it more attractive for residential, commercial, or industrial projects (Lee et al., n.d., 2001). Steeply sloping land, on the other hand, pose challenges in terms of construction costs, accessibility, and stability, which can limit its development potential and, consequently, its value (Sutejo & Gofar, 2015). Slope analysis also considers the impact of land inclination on water drainage and erosion. Steeper slopes can lead to faster water runoff, increasing the risk of flooding during heavy rainstorms. This may require additional measures, such as the construction of retention ponds or drainage systems, which can add to the development costs. The erosion potential on steep slopes can also affect the long-term stability and suitability of the land, influencing its value (Nabiollahy et al., 2018). Accordingly, the current research conducted by considering the above described idea.

After the tool made a slope analysis, reclassifying using intervals or ranges was done from the bench mark of different research papers. The suitability of the slope gradient of the land surface for valuation of a piece of land in case of taxation considers the cost to construction, venerability to flood, how much of it can be prevented by the concerned body.

3.5.2.2. Drainage Network Analysis

Drainage network analysis for urban suitability refers to the evaluation and assessment of the existing drainage infrastructure to determine its capacity and functionality in managing storm water run-off in urban areas. This analysis is important for urban planning and development to ensure that appropriate measures are taken to prevent flooding, waterlogging, and other drainage-related issues (Lindsay et al., 2019). In the current study, to perform Drainage network analysis, DEM data was used to generate flow direction and flow accumulation. After calculating flow direction and flow accumulation, the next step was to extract the drainage. This involves identifying and connecting cells with similar flow directions and accumulation values to form a network of stream channels. With the drainage network extracted, analyzing drainage density was the output by employing Arc GIS software.

3.5.2.3. Proximity analysis of Facilities

Proximity analysis of public facilities involves the assessment of the distance between public service facilities and the communities they serve. This analysis is crucial for understanding accessibility, equity, and efficiency in the delivery of public services. It helps in identifying areas with inadequate access to essential services and informs decision-making processes for resource allocation and infrastructure development (Solodev, 2016). Proximity analysis is used to assess the distribution of healthcare facilities such as hospitals, clinics, and pharmacies to ensure that communities have adequate access to medical care. In the context of education centers proximity analysis helps in determining the availability and accessibility of schools, colleges, and other educational institutions for different populations. Moreover, Social service agencies use proximity analysis to identify areas where there may be gaps in access to social support programs, welfare services, and community resources (Ardeshiri et al., 2018). Therefore, the current study is conducted by applying the proximity analysis.
Following to the analysis, the ranges or intervals were given for each requirement are based on the ranges set by many experts in the field and follow the range of intervals used in various research papers. Not only that, this research is based on the existing situation and various professional assumptions (Li, Prussella, et al., 2015).

3.5.3. Urban Land Value Modeling Using Weighted Overlay MCE Method

To produce suitability models of urban land value, each of the vector dataset are converted in to raster format and reclassified in to a common scale using ArcGIS 10.7 spatial analyst tool. Because, the structure of raster data is grid cell based, which can easily delineate suitable sites. According to (Li, Pussella, et al., 2015) the value of the land classed in to 5 which are very low, low, moderate, high, and very high values. Each class is represented by giving a discrete integer value 1 to 5 from very low to very high, respectively. The current study was conducted in a similar way of the mentioned above. The primary issue in the evaluation is assigning weights to each factor separately (Dai et al., 2001b). Weighting in suitability analysis refers to assigning a numeric value to each factor in order to recognize its relative importance, and usually express in percent format (Santosh et al., 2018b) and (Mamo, 2019). To resolve personal biased in assigning weight for each dataset, pair wise comparison matrix were computed using IDRISI SELVA 17.0 software by Analytic Hierarchy Process (AHP), which follows defining the problem, organized criteria's from 1 to 9 (standing from different scholars and literatures), pairwise comparison matrix, and calculate relative weight. Finally, each factor was multiplied by their respective weights obtained from the pair-wise comparison matrix. The land value for each factor were analyzed and overlaid in ArcGIS 10.7 to locate each land value class.

Therefore, in this study, the parameters such as Infrastructure (Main roads, Roundabout, rail way stations, Electric power lines, and Bus terminals), shopping facilities (shopping centers) are employed to produce the model. In addition, civic and amenities (Police station, financial sectors, government offices, hospitals & health stations, schools and colleges), drainage network, and slope were overlaid and produced urban land property value model.

Table3.3: pairwise comparison matrix and weights of Critical factors

	A	B	C	D	E	F	G	H	I	J	K	L	M	Weight
Slope (A)	1													0.2164
Road accessibility (B)	1/2	1												0.1797
Schools (C)	1/2	½	1											0.1427
Hospitals & Health centers(D)	1/3	½	1/2	1										0.1097
police stations (E)	1/4	1/3	1/3	1/2	1									0.0847
Financial centers (F)	1/5	¼	1/4	1/3	1/2	1								0.0659
Bus station Proximity (G)	1/5	¼	1/4	1/3	1/3	1/2	1							0.0504
Market Centers (H)	1/5	1/5	1/4	1/4	1/3	1/3	1/2	1						0.041
Rail Way Stations (I)	1/6	1/5	1/5	1/4	1/4	1/3	1/3	1/2	1					0.032
Drainage Density (J)	1/6	1/5	1/5	1/4	1/4	1/3	1/3	1/2	½	1				0.0279
Government office (K)	1/7	1/6	1/6	1/5	1/5	1/4	1/4	1/3	1/3	½	1			0.0217
Round About (L)	1/8	1/7	1/7	1/6	1/6	1/5	1/4	1/4	1/3	1/3	½	1		0.0158
Electric power line (M)	1/9	1/9	1/8	1/7	1/7	1/6	1/5	1/5	¼	¼	1/3	1/2	1	0.012

Table 3.3 provided represents a set of factors and their corresponding weights for evaluating the desirability or land value of a location. These factors are commonly considered when assessing the quality of a particular area or region. As calculated from pairwise comparison matrix of the above table the consistency ratio is equal to 0.03, which is Consistency is acceptable.

3.5.4. Developing GIS Based Property Valuation Attribute table database

GIS comprised of a spatially referenced database, simple data manipulation functions, and geographical display (Peter J. Wyatt, 1997). The attribute table database developed as part of this research contains comprehensive details for the study area. The land value factors and the weighted overplayed result of the current study were recorded in the property value attribute table database and were linked to the spatial data together. In this study, ArcGIS 10.7 were employed to develop GIS based property valuation attribute table database.

3.5.5. Methodological Flow Chart of the Study

To perform the intended objectives, different data such as infrastructure, data that are civic amenities, shopping facilities data, and Digital Elevation Model (DEM) data were collected from various sources and processed. To accomplish this study, the following flowchart were applicable (Fig.2)

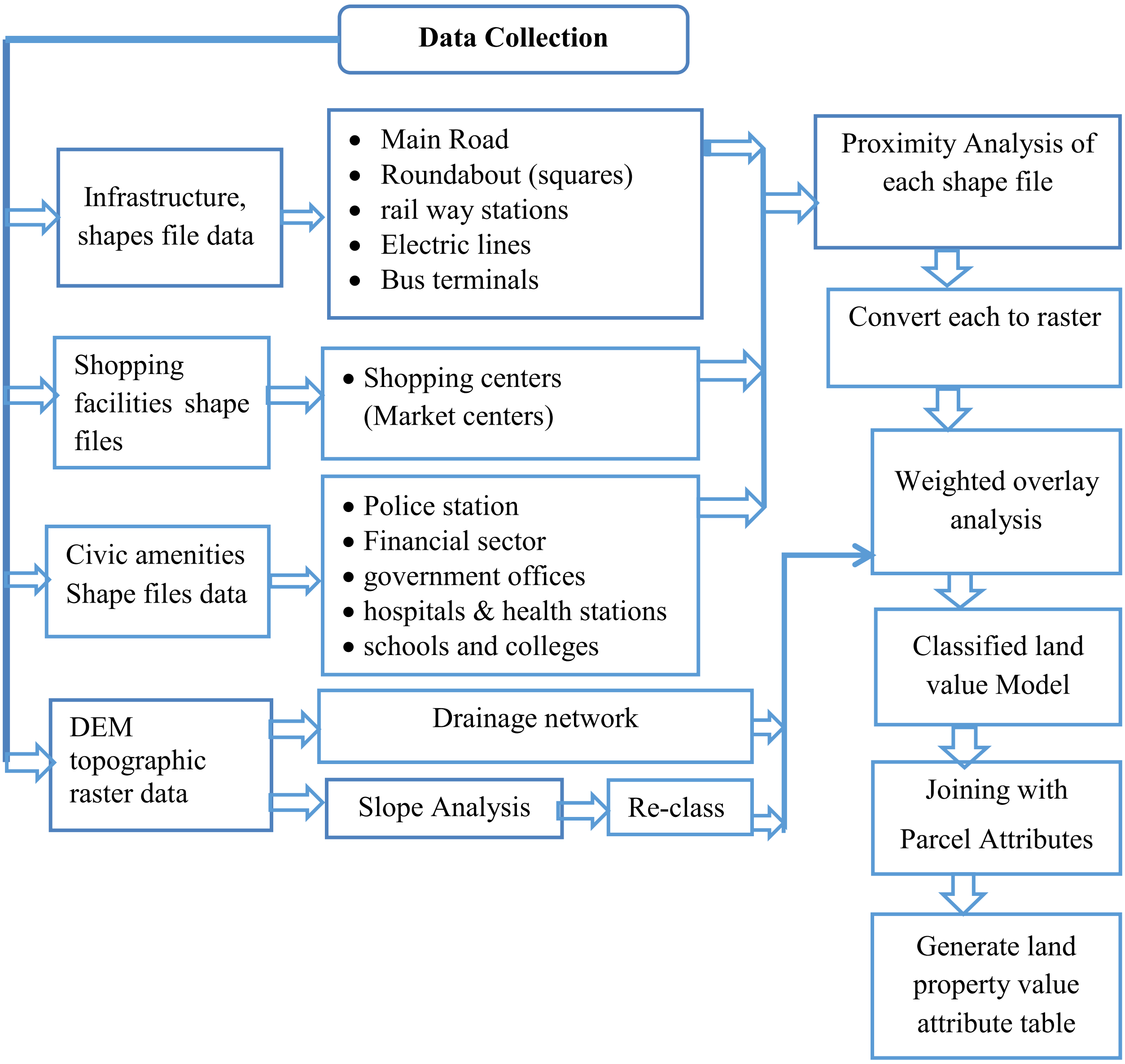

Fig3. 1: The overall methodological flow chart of the study

CHAPTER FOUR: RESULT

4.1. Parameters for Urban Land Property Valuation Suitability Modeling

4.1.1. School Proximity

The study analyzed the distance to schools in a particular area and assigned suitability values based on different distance ranges. The suitability value is a measure of how suitable an area is based on its proximity to schools. The study found that 20.5% of the area had a distance to schools between 0 and 500 meters, which was considered very high land value. In the distance range of 500 to 1000 meters, which accounted for 20.4% of the area, the suitability value was, indicating a high level. For distances between 1000 and 2000 meters, which covered 33.0% of the area, the value is indicating a moderate level of land value. In the distance range of 2000 to 5000 meters, this represented for 22.9% of the area, the suitability value indicating a low level of suitability. Lastly, areas located greater than 5000 meters away from schools covered only 3.1% of the total area but had a suitability value, indicating a very low level of suitability. These areas are significantly distant from schools and may not be suitable for residents who require easy access to educational institutions.

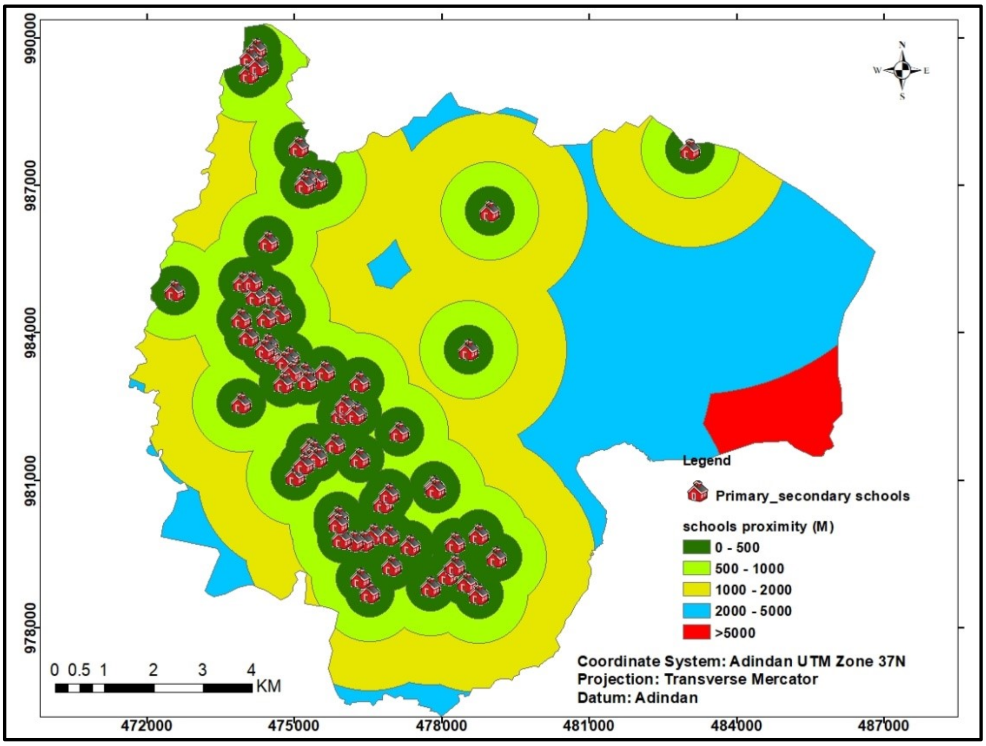

Fig4. 1: Schools and college proximity map of the study area

Table4.1: Land Value Classification by Distance from Schools and Area

NO	Distance from schools (m)	Land value	Area(m^2)	Area (%)
1	0 – 500	Very high	25,413,630	20.502
2	500 – 1000	High	25,327,770	20.432
3	1000 – 2000	moderate	40,964,830	33.048
4	2000 – 5000	Low	28,432,300	22.937
5	>5000	Very low	3,818,720	3.081
Sum			123,957,250	100

4.1.2. Distance Proximity to Police Stations

According to the study, the land value in the area can be categorized into five different levels: very high, high, moderate, low, and very low. Area located in the distance range of (0-1000m), the study found that 36.88% of the area has a very high land value. The next category is high land value, within the distance range of 1000-2000m, which accounts for 22.972% of the area. The moderate land value category, distance range (2000-3000) represents 11.830% of the area. The low value of land category, which is the distance range (3000-4000m), comprises 7.27% of the area. Lastly, the very low land value category, areas situated at a distance greater than 400m from police stations covers 21.050% of the area (Fig 4.2 and Table 4.2).

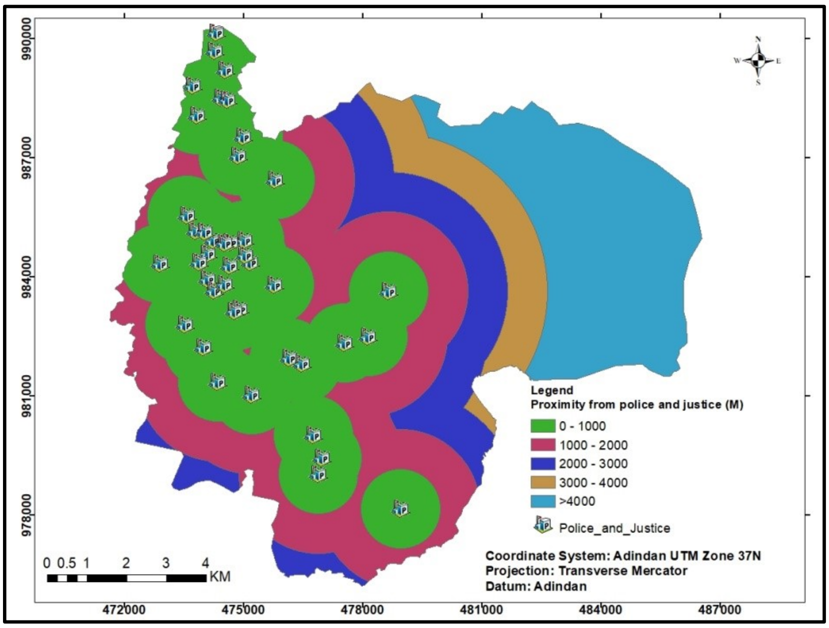

Fig4. 2: proximity map of police stations in the study area

Table4.2: Proximity from Police Stations and Land Value Analysis

No	Distance proximity from police stations	Land value	Area(m^2)	Area (%)
1	0 -1000	Very high	45,715,620	36.880
2	1000 – 2000	High	28,476,010	22.972
3	2000 – 3000	Moderate	14,663,710	11.830
4	3000 – 4000	Low	9,009,400	7.268
5	>4000	Very low	26,092,530	21.050
Sum			123,957,250	100.000

4.1.3. Distance Proximity to Health Centers

Based on the results of the study, it can be observed that there is a correlation between distance proximity from a health center and hospitals land value in different areas. The study categorized the land value area into five ranges: 0-1000m, 1000-2000m, 2000-3000m, 3000-5000m, and greater than 5000m. The study found that areas with distance proximity of 0-1000 meters from a health centers and hospitals had a very high land value covers of 33.734% of the study area. Areas with distance proximity of 1000-2000 meters from a health centers and hospitals had a high land value percentage of 32.325%. In the range of 2000-3000 meters, the land value percentage dropped to a moderate level of 11.453%. Areas with distance proximity of 3000-5000 meters from a health center had a low land value percentage of 11.235%. Lastly, areas located more than 5000 meters away from a health center had a very low land value which covers percentage of 11.254%.

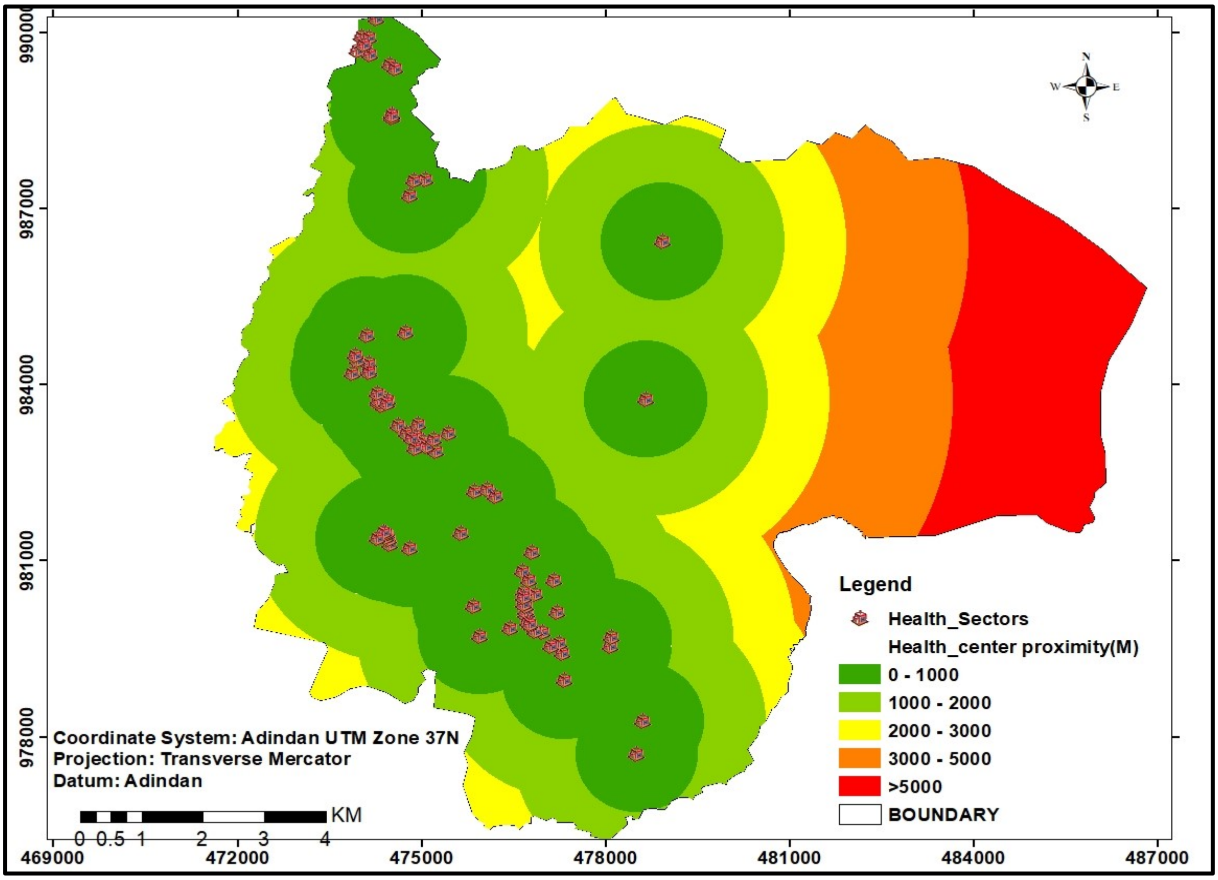

Fig4. 3: Proximity map of health centers in the study

Table4. 3: Health and Hospital Centers Proximity and Land Value Analysis Result

No	Distance proximity from health & hospitals centers(m)	Land value	Area(m^2)	Area (%)
1	0-1000	Very high	41,815,730	33.733
2	1000-2000	High	40,068,940	32.325
3	2000-3000	Moderate	14,197,020	11.453
4	3000-5000	Low	13,926,000	11.235
5	>5000	Very low	13,949,560	11.254
Sum			123,957,250	100

4.1.4. Distance Proximity from Financial Sectors

The study conducted on distance proximity from the financial sector and land value in different areas. The study categorizes the distance proximity into five ranges: 0-500 meters, 500-1000 meters, 1000-2000 meters, 2000-5000 meters, and greater than 5000 meters. Each range is associated with specific land value and area coverage in percentage. Areas within a distance of 0-500 meters from the financial sector have a very high land value represents of 8.55%. This indicates that properties located in close proximity to the financial sector tend to have higher land values. In the range of 500-1000 meters, the land value area percentage is classified as high covers 11.70%. Moving further away, the study shows that areas within a distance of 1000-2000 meters from the financial sector have a moderate land value area, which accounts percentage of 18.57%. As we move even further away, properties located within a distance of 2000-5000 meters from the financial sector experience a low land value area covers of 33.26% of the total area. Finally, areas located at a distance greater than 5000 meters from the financial sector have a very low land value area percentage of 27.90%. This indicates that properties in these areas are less influenced by the presence of the financial sector and therefore have lower land values compared to areas in closer proximity.

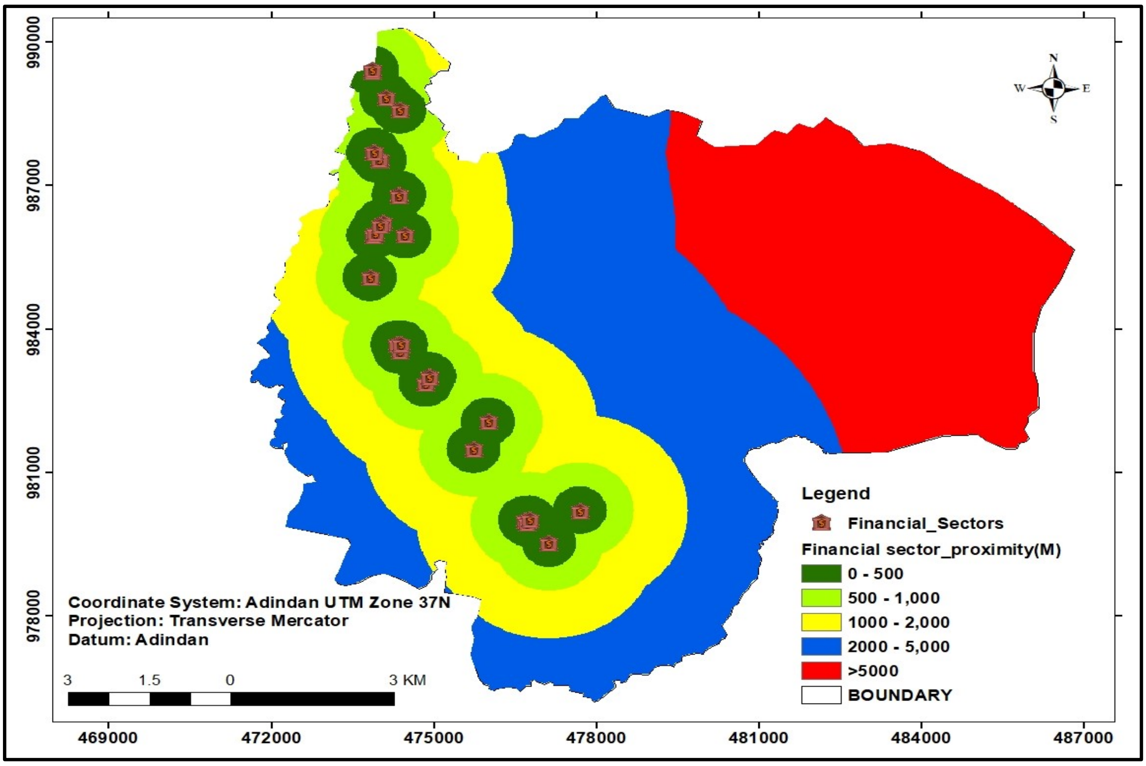

Fig4. 4: proximity map of financial sectors

Table4. 4: Land Value Classification based on Distance from Financial Sector and Area

No	Distance from financial sector	Land value	Area(m^2)	Area (%)
1	0 – 500	Very high	10,601,210	8.552
2	500 – 1000	High	14,507,560	11.704
3	1000 – 2000	Moderate	23,021,930	18.572
4	2000 – 5000	Low	41,236,090	33.266
5	>5000	Very low	34,590,460	27.906
SUM			123,957,250	100

4.1.5. Distance Proximity from Electric Line

Based on the study presented in (Table 4.5), it can be observed that there is a relationship between the distance to electric lines and land value. The study categorizes the land into different distance ranges from electric lines and assigns corresponding percentages to each category. The study shows that areas with a distance of 0-300 meters from electric lines have a very high land value, accounting for 21.79% of the total area studied. Moving further away, areas with a distance of 300-500 meters have a high land value, representing 9.25% of the total area. As the distance increases to 500-1000 meters, the land value decreases to a moderate level, accounting for 19.23% of the total area. For areas located at a distance of 1000-2000 meters from electric lines, the land value drops further to a low level, representing 26.12% of the total area. Lastly, areas situated at a distance greater than 2000 meters from electric lines have a very low land value, accounting for 23.59% of the total area studied. These areas experience the lowest land values due to their considerable distance from electric infrastructure.

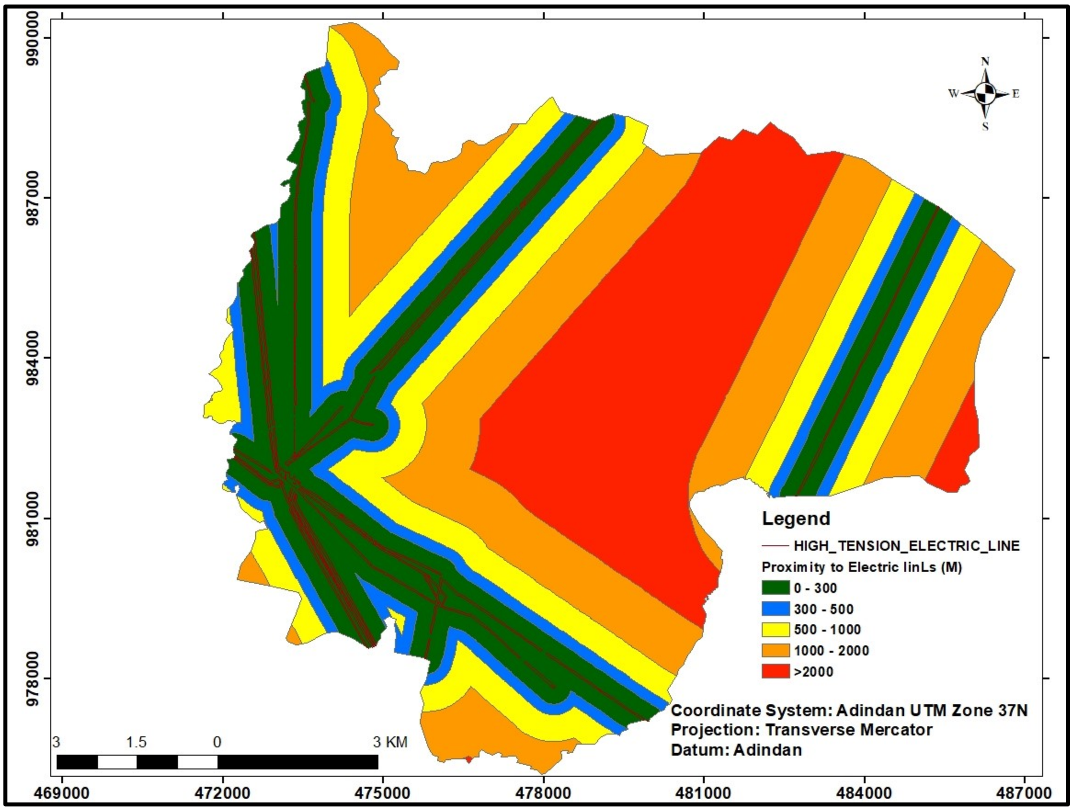

Fig4. 5: proximity map of electric power lines

Table4. 5 : Distance to Electric power Lines and Land Characteristics

No	**Distance to electric lines**	**Land value**	**Area(m^2)**	**Area (%)**
1	0-300	Very high	27,005,120	21.786
2	300-500	High	11,486,900	9.267
3	500-1000	Moderate	23,840,970	19.232
4	1000-2000	Low	32,378,270	26.121
5	>2000	Very low	29,245,990	23.594
Sum			123,957,250	100

4.1.6. Slope

Based on the study presented in the Table 4.6 and Fig. 4.6 below, the relationship between slope (in degrees) and the corresponding land value was presented. According to the table, slopes ranging from 0 to 2 degrees are classified as "Very high" land value and covers 45.52% of the study area. Slopes between 2 and 5 degrees are classified as "High" value of land and this class represents 44.99% of the area. Moving on, slopes ranging from 5 to 10 degrees fall under the "Moderate" land value category, with a coverage area of 7.01%. Slopes between 10 and 15 degrees are classified as "Low" value of land and have area coverage of 1.99%. Lastly, slopes greater than 15 degrees are categorized as "Very low" and have the lowest land value which accounts 0.46% of the total study area. The study demonstrates a clear inverse relationship between slope and land value. As the slope increases, the land value decreases significantly.

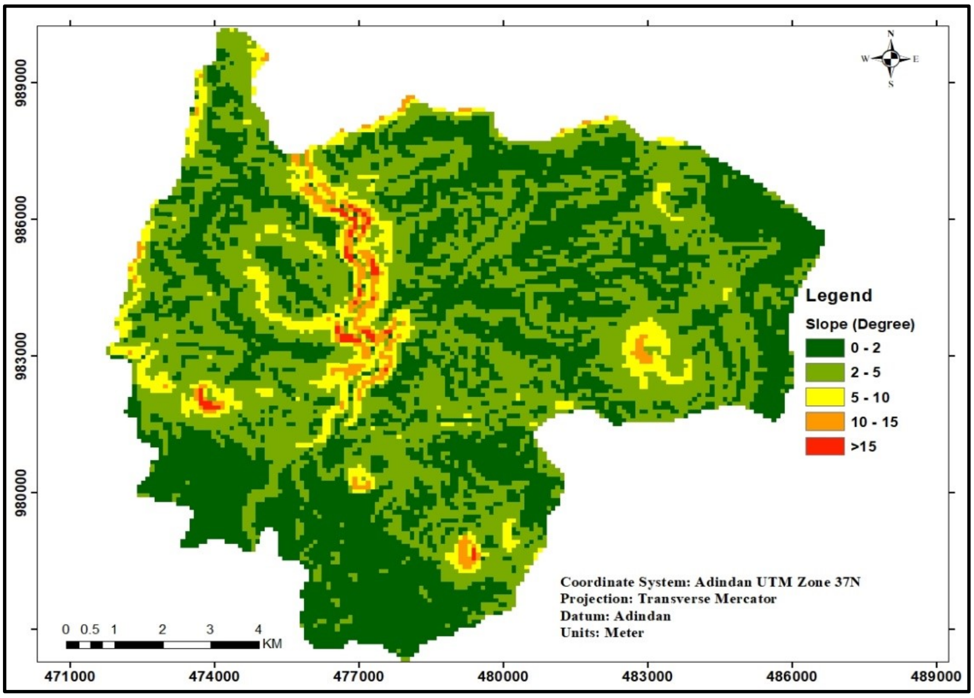

Fig4.6: Re-classed Slope map of the study area

Table4.6: Land Value Suitability based on Slope classification and Area

No	Slope (in degree)	Land Value suitability	Area(m^2)	Area (%)
1	0 – 2	Very high	56,434,670	45.528
2	2 – 5	High	55,778,800	44.998
3	5 – 10	Moderate	8,699,130	7.018
4	10 – 15	Low	2,471,450	1.994
5	>15	Very low	573,200	0.462
SUM			123,957,250	100

4.1.7. Drainage Density

According to the result of the study presented in Table 4.7, the Land Convenience value is divided into five categories based on drainage density: very high, high, moderate, low, and very low. The percentage values indicate the proportion of land in each category. Areas with drainage densities ranging from 0 to 80 categorized as very high. This class represents 58.31% of the total study area. A drainage density between 80 and 200, which is high land value, covers 10.65% of the area. Another suitability category is moderate: this category encompasses areas with drainage densities ranging from 200 to 400. It comprises 18.52% of the study area. The low category includes areas with drainage densities between 400 and 600. It accounts for 7.95% of the area. The last one is very low vale of land category. This category represents areas with drainage densities exceeding 600 and covers 4.56% of the study area. The majority of the land falls under the very high category, followed by high, moderate, low, and very low categories. Land Convenience based on drainage density shows that areas with higher drainage densities have lower suitability for urban land uses, while areas with lower drainage densities have higher suitability.

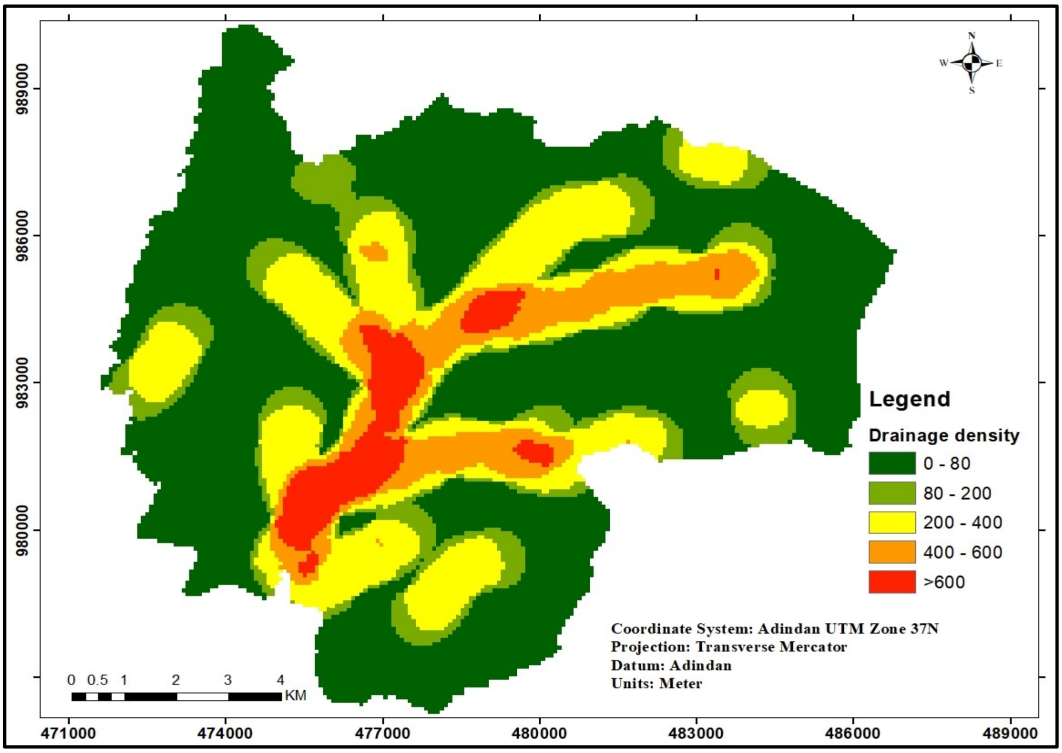

Fig4. 7:Re-classed drainage density map of the study area

Table4. 7: Drainage density categories and their corresponding land value areas

No	Drainage density	Land Value	Area(m^2)	Area (%)
1	0 -80	Very high	72,280,110	58.310
2	80 – 200	High	13,205,330	10.653
3	200 – 400	Moderate	22,959,010	18.522
4	400 – 600	Low	9,854,680	7.950
5	>600	Very low	5,658,120	4.565
Sum			123,957,250	100.000

4.1.8. Distance Proximity from Government Offices

The study conducted on proximity distance from government offices categorizes the proximity distance into four ranges: 0-1000 meters, 1000-2000 meters, 2000-5000 meters, and 5000-10000 meters. Each range is associated with specific land value and area coverage, indicating the level of influence government offices have on property values.

According to the study, areas within a proximity distance of 0-1000 meters from government offices show very high land value, with a percentage of 30.598. The presence of government offices in such areas contribute to increased demand due to convenience, accessibility to services. In the range of 1000-2000 meters, the land value area percentage decreases slightly to 20.762, indicating a high land value. Although properties in this range are not as close to government offices as those in the previous range; moving further away, the study finds that areas within a proximity distance of 2000-5000 meters from government offices have a moderate land value area percentage of 23.54. Lastly, areas within a proximity distance of 5000-10000 meters from government offices exhibit a low land value, which covers 25.11% of the study area. This indicates that the influence of government offices on property values is relatively weak in this range.

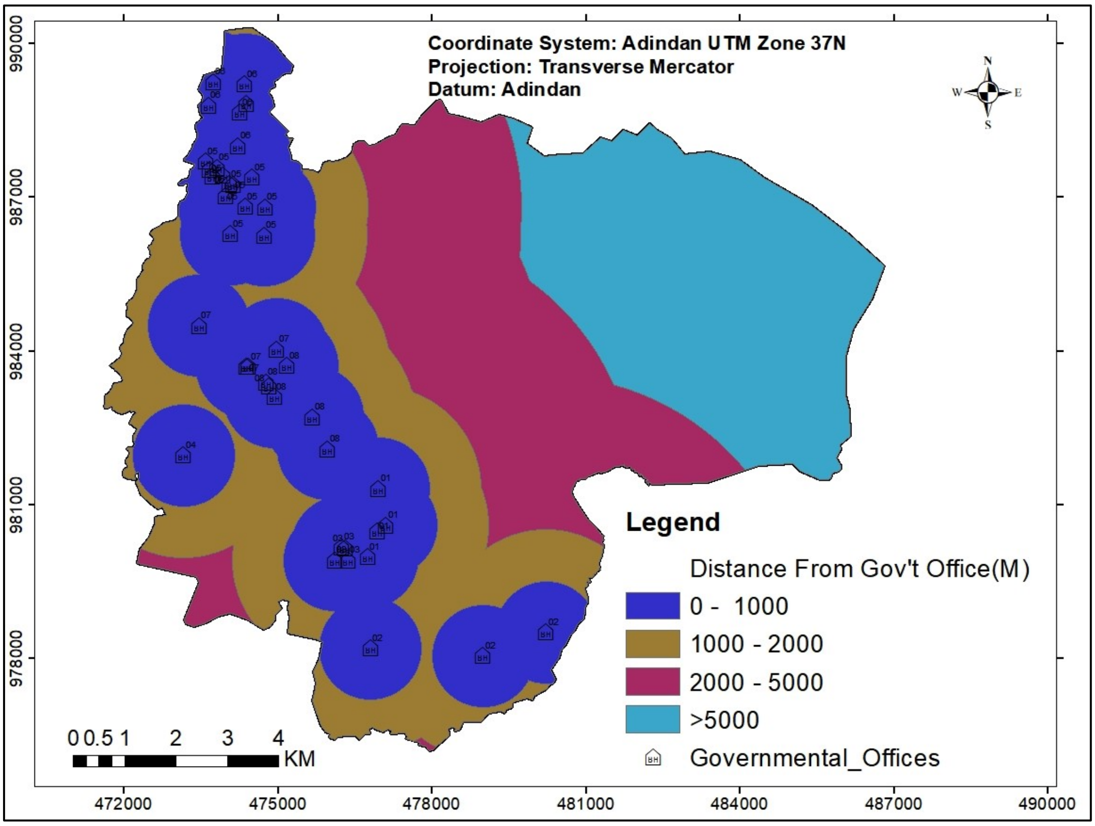

Fig4.8: Proximity map of government offices

Table4. 8: Land Convenience Based on Distance from Government Offices

No	Distance from government offices (m)	Land Convenience Value	Area(m^2)	Area (%)
1	0 – 1000	Very high	37,928,955	30.598
2	1000 – 2000	High	25,733,685	20.76
3	2000 – 5000	Moderate	29,171,917	23.53
4	5000 – 10000	Low	31,122,693	25.108
Sum			123,957,250	100.00

4.1.9. Distance Proximity from Railway Stations

According to the study, areas within 0-500 meters of a rail station were found to have very high land values, with coverage of 2.33%. The convenience and accessibility offered by rail transportation likely contribute to the increased desirability and subsequently higher land values in these areas. Moving further away from the rail station, the study found that areas within 500-1000 meters had high land values, with a percentage of 1.83. In the range of 1000-2000 meters, land values were categorized as moderate, which covers 3.13% of the study area. As we move further away from the rail station, the study reveals a significant drop in land values. Areas within 2000-5000 meters were classified as having low land values, represents 20.18% of the study area. Finally, areas located over 15,000 meters away from a rail station were found to have very low land values, with coverage of 72.53%.

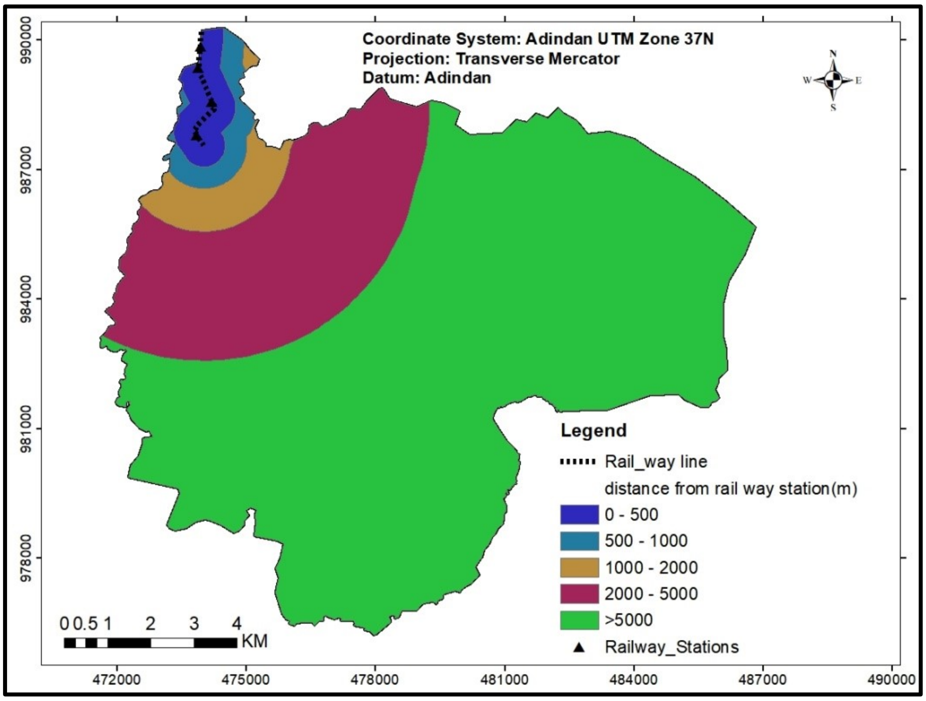

Fig4. 9: Proximity map of Railway Stations

No	Railway proximity (m)	Land value	Area(m^2)	Area (%)
1	0-500	Very high	2,892,631	2.33
2	500-1000	High	2,271,299	1.83
3	1000-2000	Moderate	3,874,190	3.13
4	2000-5000	Low	25,009,710	20.18
5	>5000	Very low	89,909,420	72.53
Sum			123,957,250	100

Table4. 9: Railway Proximity and Land Value Distribution

4.1.10. Distance Proximity from Bus Terminals

According to the study, areas within a proximity distance of 0-500 meters from a bus station have a very high land value, covering 8.13% of the total area. This indicates that properties located within this range are likely to have higher land values due to their close proximity to public transportation. Moving further away from the bus station, areas within a distance of 500-1000 meters are classified as having a high land value, covering 17.05% of the total area. As we move into the range of 1000-2000 meters from the bus station, the land value is categorized as moderate, covering 29.12% of the total area. Areas within a distance of 2000-3000 meters from the bus station are classified as having a low land value, covering 17.30% of the total area. Properties in this range may be less desirable due to their increased distance from public transportation. Finally, areas located greater than 3000 meters away from the bus station are considered to have a very low land value, covering 28.40% of the total area. These properties are likely to have lower land values compared to those in closer proximity to the bus station.

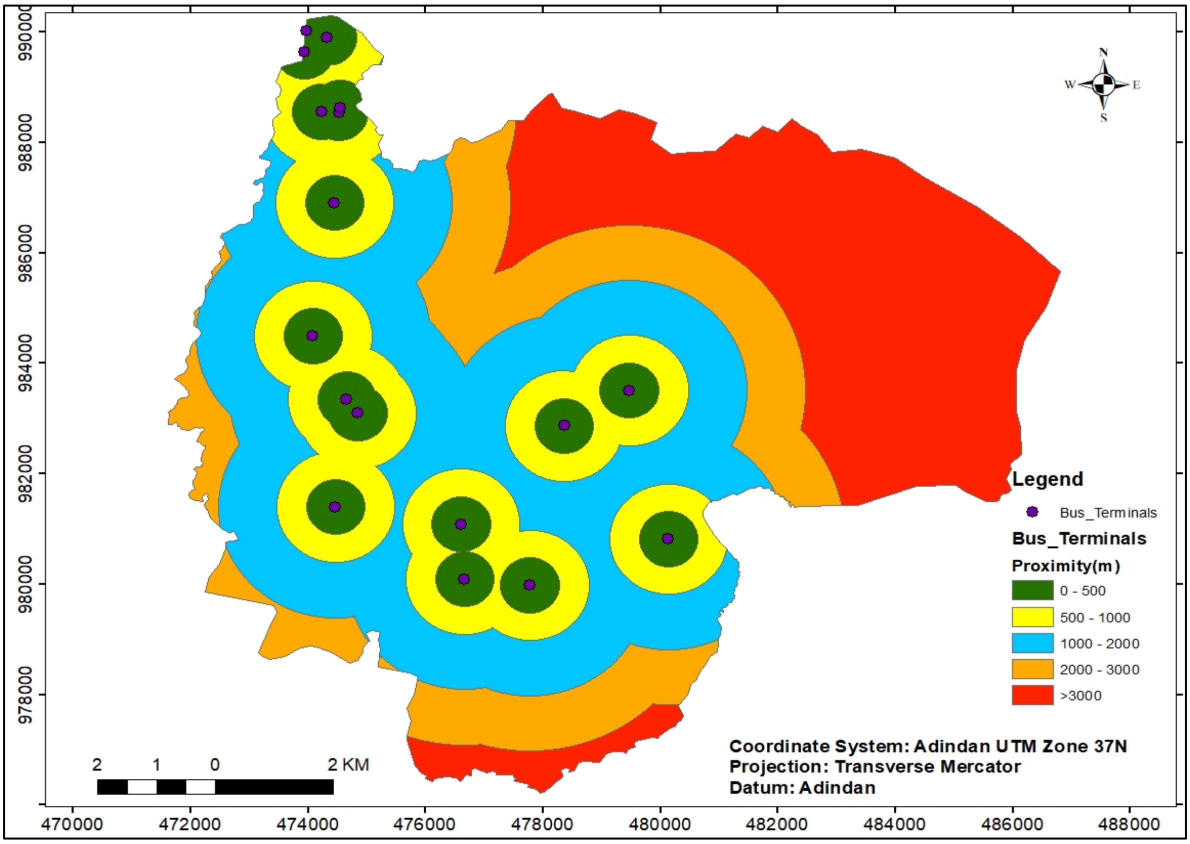

Fig4. 10: Proximity from Bus Terminals

Table4. 10: Proximity of from bus terminal and Land Value Distribution

No	Distance from bus station(m)	**Land value**	Area(m^2)	Area (%)
1	0-500	Very high	10,083,600	8.13
2	500-1000	High	21,131,200	17.05
3	1000-2000	Moderate	36,092,400	29.12
4	2000-3000	Low	21,449,400	17.30
5	>3000	Very low	35,200,600	28.40
Sum			123,957,250	100.00

4.1.11. Distance Proximity from Market Centers

According to the study, when the proximity distance is within the range of 0-500 meters from market centers, the land value area percentage is classified as very high at 1.24%. Properties located very close to market centers tend to have higher land values due to their convenient access to commercial activities and amenities. In the range of 500-1000 meters, the land value area percentage is classified as high covers 2.75% of the study area. For proximity distances falling within the range of 1000-2000 meters, the land value area is categorized as "moderate" that represents 8.91%. When the proximity distance extends to the range of 2000-3000 meters, the land value area percentage drops significantly to low at 13.27%. This suggests that properties situated further away from market centers experience a notable decline in land value. Finally, for proximity distances exceeding 3000 meters, the land value area percentage is classified as very low covers 73.82% of the study area (Table 4.11 and Fig4.11). This indicates that most of the study area is largely composed of low-value of land.

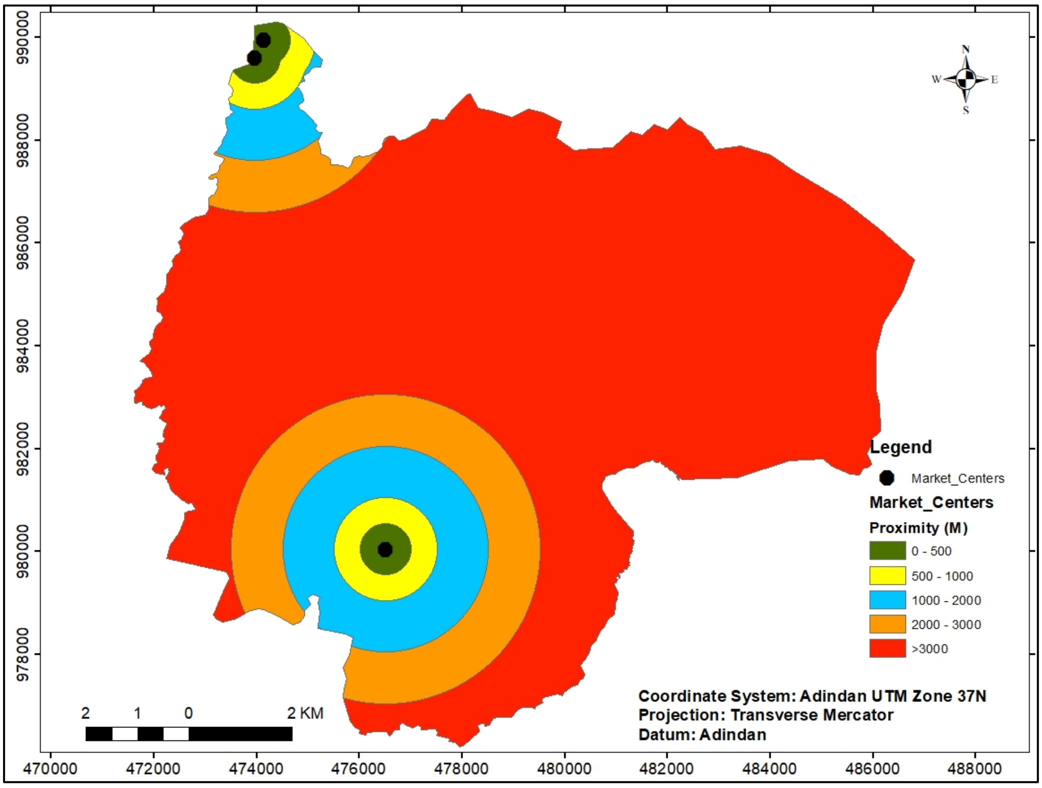

Fig4. 11: Proximity map of Market Centers

Table4. 11: Land Value and Area Distribution Based on Distance from Market Centers

No	**Distance from market centers (m)**	**Land value**	**Area (m^2)**	**Area (%)**
1	0-500	Very high	1,539,700	1.24
2	500-1000	High	3,414,500	2.75
3	1000-2000	Moderate	11,050,600	8.91
4	2000-3000	Low	16,446,000	13.27
5	>3000	Very low	91,506,500	73.82
Sum			123,957,250	100

4.1.12. Proximity from Round About

In areas where the proximity distance is 0-500 meters, the land value is classified as very high, covering 10.17% of the total area. This indicates that properties located within a close proximity to roundabouts tend to have higher values due to factors such as convenience and accessibility. Moving further away from the roundabout, in the range of 500-1000 meters, the land value remains high but covers a larger area of 22.73%. As the proximity distance increases to 1000-2000 meters, the land value is categorized as moderate and covers area of 39.41%. Moving even further away in the range of 2000-3000 meters, the land value drops to low levels and covering 11.59% of the area. Finally, for distances greater than 3000 meters, the land value is classified as very low, covering 16.10% of the area. In this range, properties are likely to be the furthest from the roundabout.

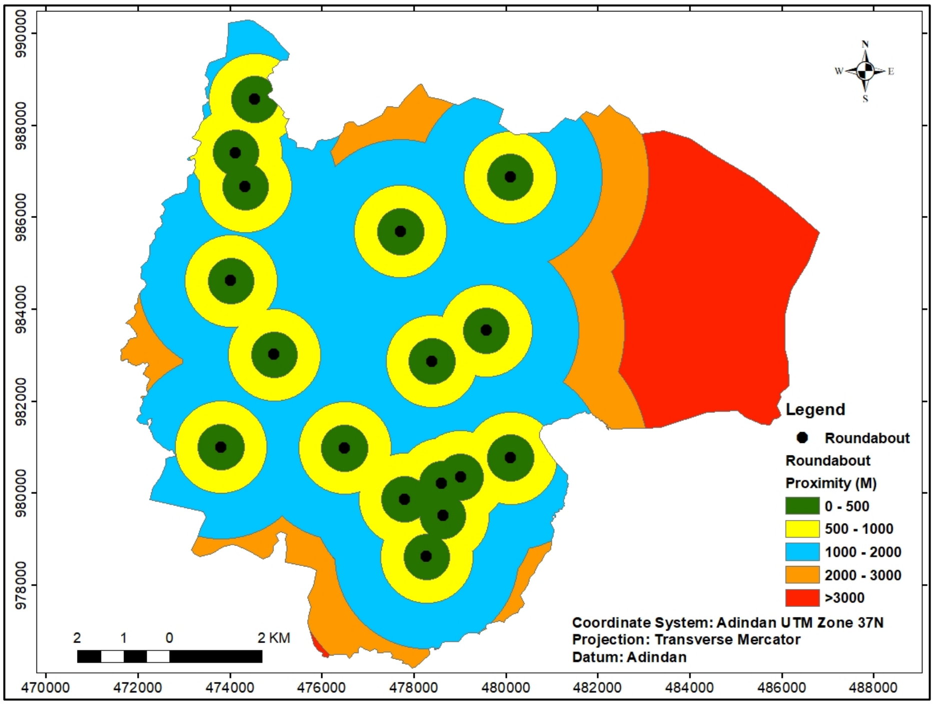

Fig4. 12: Proximity from Round About

Table4. 12: Land Value based on Proximity Distance from Roundabout

No	Proximity Distance from Round About (m)	Land value	Area(m^2)	Area (%)
1	0-500	Very high	12,605,000	10.17
2	500-1000	High	28,173,400	22.73
3	1000-2000	Moderate	48,857,400	39.41
4	2000-3000	Low	14,369,300	11.59
5	>3000	Very low	19,952,100	16.10
Sum			123,957,250	100

4.1.13. Road Accessibility Proximity

The table presents the findings of a study on the relationship between proximity distance from the road network and various factors, including land value and area percentage. The results indicate that there is a clear association between proximity distance from the road network and land value. As the distance decreases from 0 to 100 meters, the land value is classified as very high, and properties located very close to the road network tend to have higher values. Moving further away from the road, within the distance range of 100 to 500 meters, the land value is categorized as High. As the distance increases to the range of 500 to 1000 meters, the land value is classified as Moderate. The decline in value is due to reduced accessibility and potential challenges in terms of transportation and convenience. In the distance range of 1000 to 2000 meters, the land value is categorized as Low. Lastly, properties located at distances greater than 2000 meters from the road network are classified as Very low in terms of land value.

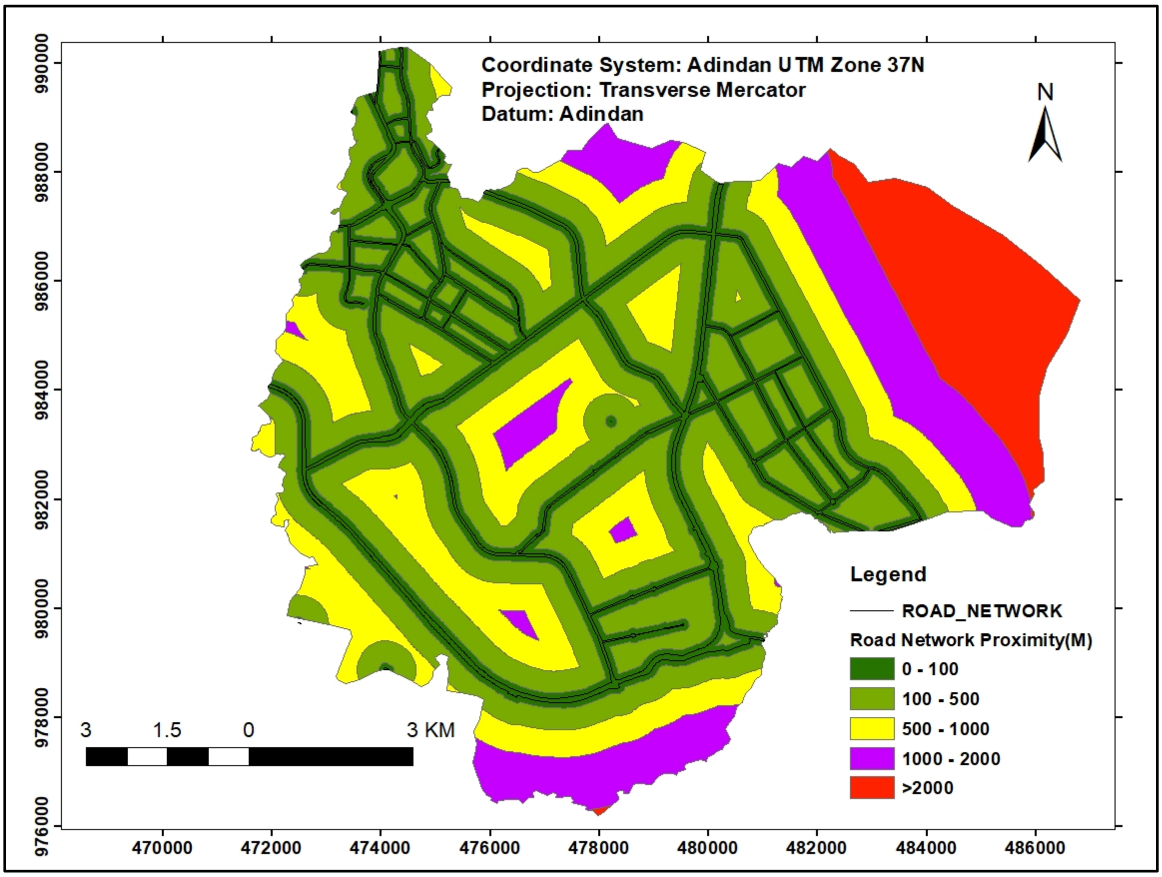

Fig4. 13: Road Accessibility Proximity map of the study area

Table4. 13: Land Value and Area Distribution based on Distance from Road Network

No	Distance from road network (m)	Land value	Area(m^2)	Area (%)
1	0 – 100	Very high	24,951,400	20.13 %
2	100 – 500	High	47,163,800	38.05 %
3	500 – 1000	Moderate	25,933,600	20.92 %
4	1000 -2000	Low	14,591,000	11.77 %
5	>2000	Very low	11,317,400	9.13 %
Sum			123,957,250	100.00

4.2. Urban Land Property Valuation

The Urban Land Property Valuation Model made an overlay of 13 parameters to determine the value of properties in the study area. By assigning weights to each parameter, the model calculates a composite score that reflects the overall desirability and value of a particular property. As displayed in Table 3.14 land value are distributed across different areas. The percentages of the area coverage represent the proportion of land in each category: very high, high, moderate, low, and very low. According to the current study, 35.17% of the total land area falls under the category of very high land value. This indicates that a significant portion of the land has a high development opportunity due to various factors such as accessibility, infrastructure, and potential for development. The next category is high, which accounts for 28.88% of the total study area. High land-value areas are still potential for development but might lack certain attributes that make them not extremely valuable. The moderate category represents 15.37% of the total study area. These areas have a moderate land value and offer some potential for development or investment but might not be as highly wanted after as the previous two categories. The low category accounts for 12.00% of the total area. These areas have relatively lower land value compared to the previous categories. Low-value areas characterized by limited development opportunities, less desirable locations, or inadequate infrastructure. Lastly, the very low category represents 8.59% of the total area. These areas have the lowest land value among all categories mentioned in the table. Very low-value areas might include remote or inaccessible regions, locations with significant limitations on development.

The existing tax collection system of Addis Ababa city administration is based on the income collected and does not take into account the cost incurred for improvement, access to infrastructure and services that have been developed and should be developed by the government. Therefore, in order to look at the actual situation in this study, it is observed that properties classified as very high that having development potential, are given a low tax rate, while on the contrary, land properties holding classified as very low that are needing the attention of the government for infrastructural and service delivery inquiries are given a high tax rate. The purpose of this study was to show that this is unfair tax collection system and to locate the way to the government should collect higher tax rate from the government services well provided and well developed areas. This study indicates that higher tax assessment should be imposed in areas where government services and infrastructure are accessible, while on the contrary, lower tax assessment should be imposed in areas where government services and infrastructure are not accessible. In addition, the areas with low tax assessment need the attention of the government and should be developed, which means that the required tax assessment will be imposed on them as higher ones.

Let’s take for instance, the land holding with unique parcel identification number AA000070800491 is assigned as grade 3 (Moderate), but as the study finding indicates that it has full access of infrastructures and civic amenities and also suitable topography. On this study this land holding is laid on a very high land value due to its accessibility to infrastructures and suitable topographies, which makes it as grade 1 land value grading. Not only that two land grades grade 3 and grade 1 are seen as they are tangent to each other, which implied that the consistency of the grading system was unfairly missed. The current study can enables the land grading system for taxation to be consistent throughout the study area.

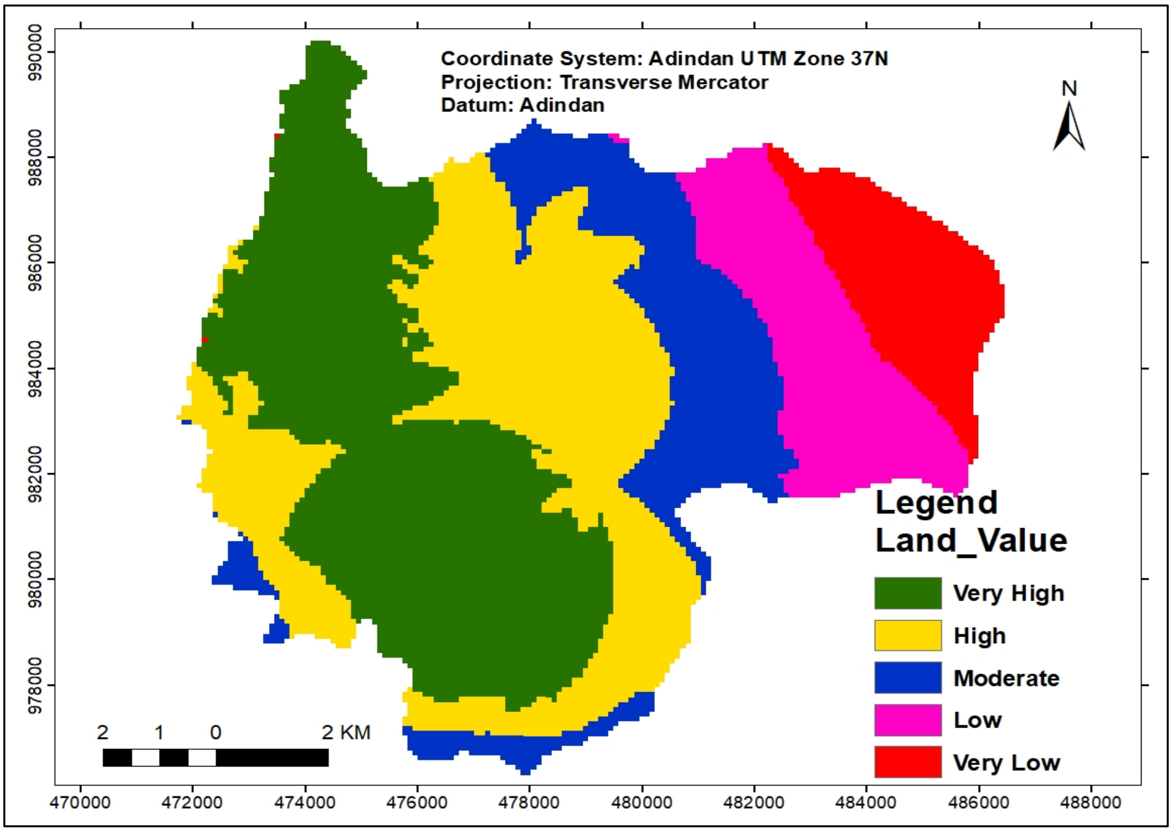

Fig4. 14: land value model map of the study area

Table4. 14**:** Land Value Area Classification of the study area

No	Land Value	Area(m^2)	Area (%)
1	Very high	43,590,150	35.165
2	High	35,801,690	28.882
3	Moderate	19,045,950	15.365
4	Low	14,873,380	11.999
5	Very low	10,646,080	8.589
Sum		123,957,250	100.00

4.3. Attribute table database of Land Property Value

In the current study, the land value model is produced and used to identify parcels with different land value levels. This involves categorizing the parcels based on their assessed land values as determined by the model. Parcels with higher land values are often located in prime locations with favorable characteristics, while those with lower values have limitations or less desirable attributes. To produce an attribute table database using the information from the land value model, each parcel's area, area division, city code, region code, sub-city code, Woreda code, shape length, shape area, and land value are linked to its corresponding land value level. This database also includes additional attributes such as parcel size, and any other relevant data that can provide a comprehensive overview of the parcels within the study area. By integrating the land value model with parcel-specific data, a detailed attribute table database was created to support further analysis and decision-making in land evaluation processes. The ID column represents the unique identifier for each parcel. The area column provides information about the size of the parcel in square units. The city-code column represents the code for the city where the parcel is located. Following the city code, there are region code, sub-city code, and Woreda code columns, which provide the respective codes for the region, sub-city, and Woreda where the parcel is located. The shape length and shape area columns provide numerical values representing the length and area of the parcel shape, respectively (Table 15). The land value column indicates the value of the land where the parcel is located and was categorized whether as Very High, or High, or Moderate, or Low (Fig 4.15).

As shown on the table below, the field columns other than "Land Value" were retrieved from the archive system of Akaki Kality sub-city land holding registration and information agency; and were integrate or joined with the study result land property value.

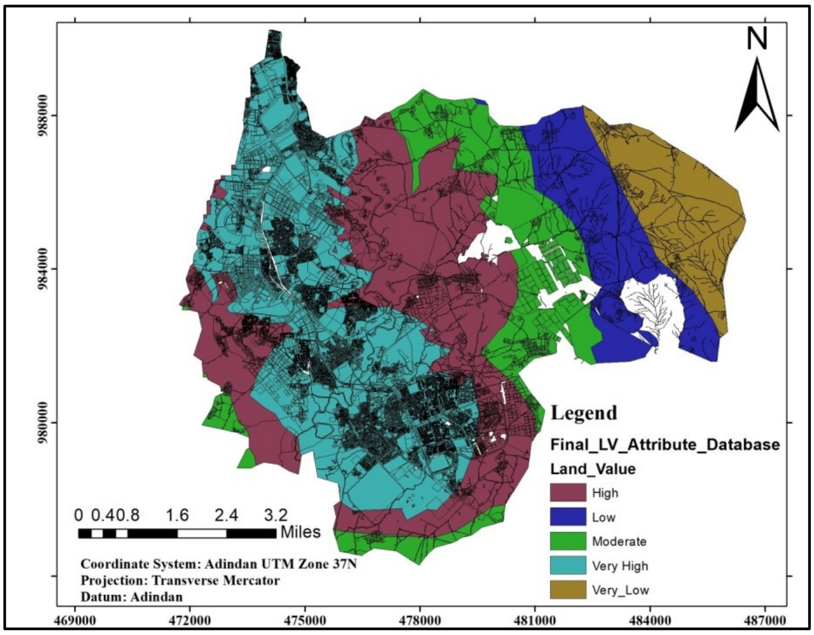

Figure 4.15 land values Attribute table database map of the study area

Table 4.15: Land value Attribute Table Database

Unique Parcel Id	City Code	Region Code	Sub-City Code	Woreda Code	Shape_ Length	Shape_ Area (m^2)	Land Value
AA000070100809	AA	000	07	o1	109.081	699.519	Very High
AA000070500756	AA	000	07	05	111.641	699.850	Very High
AA000070112407	AA	000	07	01	156.670	699.999	Very High
AA000071000496	AA	000	07	10	108.817	700.020	High
AA000070501702	AA	000	07	05	107.440	700.148	Very High
AA000070301191	AA	000	07	03	119.995	700.529	Very High
AA000070600711	AA	000	07	06	109.509	700.630	Very High
AA000070102069	AA	000	07	o1	114.232	700.679	Very High
AA000070801561	AA	000	07	08	129.597	700.825	Very High
AA000070701714	AA	000	07	07	115.154	701.010	Very High
AA000070500999	AA	000	07	05	116.156	701.056	Very High
AA000071100664	AA	000	07	11	106.542	701.450	Very Low
AA000070800416	AA	000	07	08	211.938	701.521	Very High
AA000070401777	AA	000	07	04	123.893	701.524	High
AA000070700954	AA	000	07	07	121.716	701.681	Very High
AA000071100441	AA	000	07	11	774.659	701.794	Low
AA000070803097	AA	000	07	08	110.398	701.860	High
AA000070700877	AA	000	07	07	112.364	701.880	Very High
AA000071100380	AA	000	07	11	108.625	701.974	Moderate
AA000070801892	AA	000	07	08	107.440	702.000	Very High
AA000070700646	AA	000	07	07	110.170	702.019	Very High
AA000070101657	AA	000	07	01	108.439	702.078	Very High
AA000070801918	AA	000	07	08	110.215	702.223	Very High
AA000070400112	AA	000	07	04	118.059	702.234	High

CHAPTER FIVE: DISCUSSION

5. Discussion

In the current study, to determine the value of land various parameters identified and analyzed. These parameters include slope, road accessibility, proximity to schools and colleges, hospitals and health centers, police stations, financial centers, distance from bus stations, market centers, railway stations, drainage density, government offices, roundabouts, and electric power lines.

Areas with very low slopes (0-2 degrees) have the highest land value compared to other slope categories. As the slopes become steeper, the land value decreases. Areas with slopes between 2-5 degrees still maintain a relatively high land value, while areas with slopes ranging from 5-10 degrees have a lower land value. Steeper slopes of 10-15 degrees experience a significant decrease in land value, and areas with slopes greater than 15 degrees have the lowest land value among all slope categories. The relationship between slope and land value is often discussed in various studies have found similar trends to those mentioned in the statement. For instance, a study conducted by Kumar & Shaikh, (2013) investigated the impact of slope on land value in Mussoorie Municipal, India. They found that areas with gentle slopes had higher land values, while steeper slopes negatively affected property values. This is consistent with the idea that low-slope areas are preferred for construction due to their ease of development and reduced risk of landslides. Another study by Hussien et al., n.d., (2019) explored the relationship between slope and land value in a mountainous region of China. The results revealed that steep slopes had a negative impact on land value, with properties in areas with moderate slopes experiencing higher prices. It was suggested that steep slopes restrict development options and may pose challenges for infrastructure and construction, ultimately influencing land value.

To develop the urban land property valuation model of the study area by using Multi-criteria evaluation method, this study was used 13 parameters namely, Slope, Road accessibility, distance to Schools & colleges, distance Hospitals & Health centers, distance to police stations, distance to financial center, distance to bus station, distance to market Centers, distance to rail Way station, drainage Density, distance to government office, distance to Round About, and distance to Electric power lines. The overlay result of the above listed 13 parameters indicates that the majority of the total land area falls under the categories of very high (35.16%) and high (28.88%) land value. These areas have highly accessibility and potential for development. The moderate category represents 15.37% of the area and offers some potential for development. The low category accounts for 12% of the area and has lower land value due to limited development opportunities or undesirable locations. The very low category represents 8.59% of the area and has the lowest land value. Overall, these findings provide insights into the distribution of land value and potential for development within the study area. Previous studies have also emphasized the importance of considering various parameters when determining the value of land. For instance, Li, Prussella, et al., (2015) conducted a similar study and found that factors such as distance to schools, distance to roads, distance to police station, distance to railway station, distance to health facilities, land-use type and distance to government buildings were crucial in determining land value. Similarly, Johnson and Smith (2016) highlighted the significance of drainage density and proximity to government offices in land valuation. Moreover, Li, Prussella, et al., (2015) conducted a comprehensive literature review on land valuation and identified similar parameters to be important determinants of land value. Their review emphasized the significance of considering factors such as road accessibility, distance from essential services like hospitals and schools, and proximity to transportation nodes. Overall, the current study is in line with existing literature that underscores the importance of considering a wide range of parameters when determining the value of land. By analyzing slope, road accessibility, proximity to various amenities, transportation, drainage density, and other factors, this study aims to provide a comprehensive understanding of land valuation, thus contributing to the existing body of literature on this subject.

CHAPTER SIX:

CONCLUSION AND RECOMMENDATION

6.1. Conclusion

In the current study, to determine the land value model of the study area, the study demonstrates a clear relationship between the distance to factors and land value. Areas near road accessibility, schools and colleges, hospitals and health centers, police stations, financial centers, bus stations, market centers, railway stations, government offices, roundabouts, and electric power lines are highly valued, while those farther away experience a decline in desirability and property prices. Moreover, the slope of the land plays a crucial role in determining land value. Areas with steeper slopes generally have lower land values, while areas with gentler slopes tend to have higher land values. Steeper slopes pose challenges in terms of land use and development. As a result, the practicality of utilizing land with steep slopes is often limited, which can decrease its overall value. Steep slopes can make it difficult to access the land, especially for transportation purposes.

As the drainage density decreases, it means that there are fewer streams and rivers present, resulting in a smaller proportion of the study area being covered by water bodies. As drainage density decreases, it suggests that there is less surface runoff and more infiltration of water into the soil. In areas with high drainage density, water tends to flow quickly over the surface, leading to increased erosion and sediment transport.

To develop the urban land property valuation model using the multi-criteria evaluation method, factors such as slope, road accessibility, proximity to schools and colleges, hospitals and health centers, police stations, financial centers, distance from bus stations, market centers, drainage density, government offices, roundabouts, and electric power lines are employed. This model can assist local authorities or tax assessors in determining fair and accurate tax rates for urban land properties in the study area. A significant portion of the total study area falls under the category of very high land value, accounting for 35.16% of the study area. This implies that these areas have highly developed surroundings due to various factors such as accessibility, infrastructure, and potential for development. The next category, high land value, accounts for 28.88% of the total study area, suggesting that these areas also have a considerable market value but may not possess all the characteristics of very high-value areas. The moderate category represents 15.37% of the total study area, indicating that these areas have a moderately developed by accessibility compared to the previous categories. They may have some desirable features but may lack certain factors that contribute to higher land values. The left low and very low categories account for 20.59% of the total area, suggesting that these areas have relatively lower land values compared to the previous categories. These areas are characterized by less desirable locations, or inadequate infrastructure, lack significant development potential or possess undesirable characteristics that make them less valuable in terms of land value.

6.2. Recommendation

Based on the results of the study, the following recommendations are provided for the study area:

- Following to this study the concerned body can give coefficients (a multiplying number that can give numerical value per square unit of the parcels) to each land value model. Then this makes the study meaningful and easy delivery of governmental services especially tax related aspects.
- The current study recommends that by incorporating GIS functionalities into land administration systems, land management officers should visualize and analyze various factors that influence land values, such as proximity to amenities, infrastructure, and environmental conditions. This integration will facilitate better decision-making processes by providing a comprehensive understanding of the spatial context in which land values are determined.
- Before making any investment decisions, developers should carefully evaluate the potential risks and rewards of each area by using GIS technique.
- Based on the study, a significant portion of the land falls under the very high and high-value categories; it is advisable to prioritize investment and development in these areas. These locations offer favorable conditions and present opportunities for profitable projects.
- Consider upgrading moderate-value areas: The moderate-value areas represent a potential opportunity for improvement and development. Investing in infrastructure upgrades, amenities, or other enhancements could help increase their market value and attract more investment.
- Evaluate low-value areas: While the low-value areas may have limitations, it is important to assess their potential for improvement. Conducting feasibility studies to identify ways to overcome challenges.
- Following to this study any familiar researcher or any other concerning governmental body can conduct the study on the whole portion of the city Addis Ababa in up-to-date and resourceful manner to overcome the problem on the field.

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Appendices

OBJECTID	Name	X_Coordinate	Y_Coordinate
1	Akaki Alem Bank Bus terminal	477778.8811	979979.8242
2	Tulu Dimtu Bus terminal	480136.2572	980817.5628
3	Akaki Bus terminal	476666.5044	980092.6692
4	Akaki Meshualekiya Bus terminal	476608.8251	981086.9753
5	Kality Total Bus terminal	474847.2258	983098.871
6	Akaki Kality Subcity Bus terminal	474662.5463	983343.3465
7	Kality Gebriel Bus terminal	474085.2243	984496.9321
8	Kality Wuha Limat Bus terminal	474449.8208	986908.8786
9	Abo Mazoria Bus terminal	474236.5927	988555.4369
10	Saris Bus terminal	473940.4175	989643.0459
11	Adey Abeba Bus terminal	473977.3534	990021.0304
12	Adey Abeba Addis Sefer Bus terminal	474332.9806	989902.1573
13	Abo Bus terminal	474528.2435	988532.9358
14	Abo Bus terminal	474547.8227	988624.4819
15	Koye Adebabay Bus terminal	479469.6117	983508.8852
16	Kilinto Condominium Bus terminal	478360.2116	982871.2381

Appendix 1 Bus Terminals data collected using Handheld GPS

OBJECTID	Name	X_Coordinate	Y_Coordinate
1	UNISA Square	478271.8478	978626.4949
2	Technique ena Muya Square	478622.686	979510.9988
3	Arsema Metatefia Adebabay	479005.5389	980358.7254
4	Taf Oil Adebabay	478599.1381	980208.7064
5	Alem Bank Adebabay	477796.6552	979872.1557
6	Meshualekia	476488.5526	980986.583
7	Kilinto	478387.6033	982872.9336
8	Kality Total	474956.4797	983014.8828
9	Kality Gebriel	474014.8258	984623.2881
10	Wuha Limat	474331.4004	986667.9922
11	Kality Maselitegna	474118.9395	987406.975
12	Saris Abo	474537.0482	988568.4981
13	Koye Adebabay	479568.1103	983542.1764
14	Tuludimtu Adebabay	480097.1458	980772.0275
15	Gelan Condominium	473803.754	981007.8379
16	Hachalu Hundes Square	480088.1014	986873.0668
17	Industriy Park	477703.9098	985692.573

Appendix 2 Roundabout and Squares data collected using Handheld GPS

OBJECTID	Station_Name	X_Coordinate	Y_Coordinate
1	Kality	473863.0942	987806.3384
2	Abo Mazoriya	474216.2508	988574.7393
3	Saris	473905.5808	989358.4166
4	Adey Abeba	473953.0522	989871.4564

Appendix 3 Railway Stations data collected using Handheld GPS

OBJECTID	Name	X_Coordinate	Y_Coordinate
1	Akaki Gebiya	476512.5828	980049.7074
2	Saris Gebeya	473969.535	989602.8715
3	Adey Abeba Shoping Center	474151.9655	989946.0368

Appendix 4 Markets Center data collected using Handheld GPS

No	Kebele	Facil_Name	Facility_T	catagory	Owner	Sub_City	Woreda	X_Coordina	Y_Coordina
1	12/13	Oromiya Denena Dure Ensesat Derejet Sheger Br.	Gov't.Org	Gov't Org	Gov	Akaki_Kality	06	473736.32051900000	989248.41026200000
2	12/13	Eresha Sebel	Gov't.Org	Gov Org	Gov	Akaki_Kality	06	474355.35575500000	989202.10134200000
3	12/13	Ye Construction & buna tecnology masfafiya	Gov't.Org	Gov Org	Gov	Akaki_Kality	06	474385.01301100000	988820.65444000000
4	12/13	ELPA	Gov't.Org	Gov't Org	Gov	Akaki_Kality	06	473649.54923400000	988786.09413800000
5	12/13	Geberna Ena Garge	Gov't.Org	Gov't Org	Gov	Akaki_Kality	06	474260.80974800000	988649.95424600000
6	12/13	Ethiopian Coustems & Revenue Authorety	Gov't.Org	Gov Org	Gov	Akaki_Kality	06	474223.36047600000	987999.53002300000
7	10/11	Jinad Stor	Gov't.Org	Gov Org	Gov	Akaki_Kality	05	473596.14902800000	987690.46516100000
8	10/11	Jinad Stor	Gov't.Org	Gov Org	Gov	Akaki_Kality	05	473811.57001000000	987576.66503100000
9	10/11	Etde	Gov't.Org	Gov't Org	Gov	Akaki_Kality	05	473660.09023800000	987535.17936500000
10	10/11	Oromiya weter Work Constraction	Gov't.Org	Gov Org	Gov	Akaki_Kality	05	473722.50903900000	987411.86417500000
11	10/11	Ethiopia weter Technology center	Gov't.Org	Gov Org	Gov	Akaki_Kality	05	473917.37748800000	987419.47622300000
12	10/11	Kality Trening Centere	Gov't.Org	Gov Org	Gov	Akaki_Kality	05	474497.16954800000	987376.80459800000
13	10/11	Oromiya weter Work Constraction	Gov't.Org	Gov Org	Gov	Akaki_Kality	05	474051.47641500000	987252.26488400000
14	10/11	Oromiya weter Menester	Gov't.Org	Gov Org	Gov	Akaki_Kality	05	474118.46244400000	987233.99596700000
15	10/11	AA House Agency	Gov't.Org	Gov Org	Gov	Akaki_Kality	05	473980.43062600000	987012.73908200000
16	10/11	Senedoch Maregagecha	Gov't Org	Gov Org	Gov	Akaki_Kality	05	474359.57965900000	986808.86559900000
17	10/11	Weter work constraction	Gov't.Org	Gov Org	Gov	Akaki_Kality	05	474746.28463400000	986801.47180800000
18	10/11	Ethi-Sience & Technology	Gov't.Org	Gov Org	Gov	Akaki_Kality	05	474076.20152100000	986281.16854500000
19	10/11	Ethiopia Road Autority Garaj &Store	Gov't.Org	Gov't Org	Gov	Akaki_Kality	05	474732.58294600000	986250.35946800000
20	10/11	Qola Zinb	Gov't.Org	Gov't Org	Gov	Akaki_Kality	07	473463.67299200000	984487.59151900000
21	10/11	National Artifical Insemination Center	Gov't.Org	Gov't Org	Gov	Akaki_Kality	07	474979.87437500000	984034.47518200000
22	07/08/09	Argawiyane Metoria	Gov't.Org	Gov't Org	Gov	Akaki_Kality	08	475178.39848000000	983712.32890700000
23	10/11	EELPA Akaki district	Gov't.Org	Gov't Org	Gov	Akaki_Kality	07	474392.30869400000	983693.77247000000
24	10/11	Ethiopian Tele Comnection	Gov't.Org	Gov't Org	Gov	Akaki_Kality	07	474427.66604300000	983695.45145000000
25	07/08/09	Akaki Kality fetehe biro	Gov't.Org	Gov't Org	Gov	Akaki_Kality	08	474768.69324300000	983386.55456800000
26	07/08/09	Akaki Kality Sub City Administration Office	Gov't.Org	Gov't Org	Gov	Akaki_Kality	08	474823.34474800000	983306.49998800000
27	07/08/09	Akaki Kality Woreda 8 Office	Gov't.Org	Gov't Org	Gov	Akaki_Kality	08	474931.07000700000	983105.27550000000

Appendix 5 Governmental Administrative and Service Institutions Data collected from Plan Commission

No	Facil_Name	Facility_T	catagory	Owner	Sub_City	Woreda	No	X_Coordina	Y_Coordina
1	Zenbaba General Hospital	Health Center	Hospital	Private	Akaki_Kality	06	6	474078.8998	989714.9240
2	Akaki Kality Community Midium Clinic	Health Center	Mediume	Mesion	Akaki_Kality	01	67	477196.3348	980126.7966
3	Yabsira Mekakelgna Clinic	Health Center	Mediume	Private	Akaki_Kality	01	79	477282.5996	979423.7382
4	Aliyance of development	Health Center	Mediume	Private	Akaki_Kality	01	76	477242.8454	979593.2060
5	Kidus Giyorgise Mekakelgna Clinic	Health Center	Mediume	Private	Akaki_Kality	01	73	476959.0488	979776.9170
6	D/R Mulugeta Mekakelgna Clinic	Health Center	Mediume	Private	Akaki_Kality	01	65	476701.4848	980099.5268
7	Zequla Abo Getere Medihanite bete	Health Center	Pharmacy	Private	Akaki_Kality	01	66	476692.0830	980093.8644
8	T/ Markos Mekakelgna Clinic	Health Center	Mediume	Private	Akaki_Kality	01	64	476686.2676	980138.1695
9	D/R Mesfin Mekakelgna Clinic	Health Center	Mediume	Private	Akaki_Kality	01	62	476690.2191	980220.0824
10	Tena Tabiya	Health Center	Tena Tabiya	Gov't	Akaki_Kality	01	59	476842.7227	980434.2062
11	Raeiy Mekakelgna Clinic	Health Center	Mediume	Private	Akaki_Kality	01	55	476646.8624	980815.2500
12	Medhanialem Mekakelgna Clinic	Health Center	Mediume	Private	Akaki_Kality	03	72	476847.7477	979808.7043
13	Kenema medihanite bete	Health Center	Pharmacy	Gov't	Akaki_Kality	03	70	476763.9467	979897.8260
14	Ketema medihanite bete	Health Center	Pharmacy	Private	Akaki_Kality	03	68	476719.9522	979948.5961
15	Yosef medihanite bete	Health Center	Pharmacy	Private	Akaki_Kality	03	61	476649.4936	980261.8274
16	Yordan Clinic	Health Center	Mediume	Private	Akaki_Kality	02	77	477094.6367	979540.5025
17	Hiwot Higher Clinic	Health Center	Higher	Private	Akaki_Kality	06	2	474020.1397	989929.5718
18	Ameha Genet Higher Clinic	Health Center	Higher	Private	Akaki_Kality	06	3	474135.4407	989918.4681
19	Saris Higher Clinic	Health Center	Higher	Private	Akaki_Kality	06	5	473946.0008	989695.5917
20	Bruhe Mekakelgna Clinic	Health Center	Higher	Private	Akaki_Kality	06	7	474150.1465	989634.0467
21	Daniel Pharmacy	Health Center	Pharmacy	Private	Akaki_Kality	06	8	474471.2810	989463.8461
22	Abo Higher Clinic	Health Center	Higher	Private	Akaki_Kality	06	9	474564.4333	989399.4172
23	Konale Higher Clinic	Health Center	Higher	Private	Akaki_Kality	06	12	474503.0508	988552.2665
24	Fana Mekakelgna Clinic	Health Center	Mediume	Private	Akaki_Kality	05	13	475062.8901	987502.3965
25	Tekle Haimanot Mekakelgna Clinic	Health Center	Mediume	Private	Akaki_Kality	05	14	474875.5086	987480.8625
26	Eagle Vesion Clinic	Health Center	Mediume	Private	Akaki_Kality	07	19	474135.6567	984362.8932
27	Kality Health Center	Health Center	Tena Tabiya	Gov	Akaki_Kality	07	24	474369.6281	983780.3406

Appendix 6 Health Centers Data collected from Plan Commission

Id	Kebele	Facil_Name	Facility_T	catagory	Owner	Sub_City	Woreda	No	X_Coordena	Y_Coordena
1	02/04	Police Station	Police & Justice Center	Police Station	Gov	Akaki_Kality	02	42	478931.21552000000	978169.12821500000
2	10/11	Court	Police & Justice Center	Court	Gov	Akaki_Kality	07	12	473765.85084300000	985161.52832300000
3	10/11	Police Station	Police & Justice Center	Police Station	Gov	Akaki_Kality	07	18	474082.54828900000	984602.04933600000
4	10/11	Federal Police	Police & Justice Center	Federal Police	Gov	Akaki_Kality	05	8	474973.05718000000	987537.16928000000
5	07/08/09	Court	Police & Justice Center	Court	Gov	Akaki_Kality	08	29	474872.49057700000	983191.24727200000
6	07/08/09	Comunity Police	Police & Justice Center	Comunity Police	Gov	Akaki_Kality	08	35	476125.28926900000	981974.99385200000
7	07/08/09	Police Station	Police & Justice Center	Police Station	Gov	Akaki_Kality	08	36	476449.08507000000	981822.72734200000
8	7/8/9	W4 Police Station	Police & Justice Center	Police Station	Gov	Akaki_Kality	04	30	474753.54364500000	983142.21167000000
9	1/3	Prison	Police & Justice Center	Prison	Gov	Akaki_Kality	01	33	477524.39430800000	982347.99333100000
10	1/3	Akaki Kality Sub-City Police Station	Police & Justice Center	Police Station	Gov	Akaki_Kality	01	39	476730.44622100000	980016.99192600000
11	10/11	Comunity Police	Police & Justice Center	Comunity Police	Gov	Akaki_Kality	05	9	474851.67115700000	987057.98146800000
12	10/11	Comunity Police	Police & Justice Center	Comunity Police	Gov	Akaki_Kality	05	10	475780.33652500000	986457.94692000000
13	12/13	Comunity Police	Police & Justice Center	Comunity Police	Gov	Akaki_Kality	06	1	474290.35460900000	990163.73158000000
14	12/13	Comunity Police	Police & Justice Center	Comunity Police	Gov	Akaki_Kality	06	2	474248.04811200000	989703.64843200000
15	12/13	Comunity Police	Police & Justice Center	Comunity Police	Gov	Akaki_Kality	06	3	474523.04033800000	989217.12372500000
16	12/13	Comunity Police	Police & Justice Center	Comunity Police	Gov	Akaki_Kality	06	5	474417.27409700000	988529.64316000000
17	12/13	Comunity Police	Police & Justice Center	Comunity Police	Gov	Akaki_Kality	06	6	474575.92345800000	988471.47172800000
18	12/13	Comunity Police	Police & Justice Center	Comunity Police	Gov	Akaki_Kality	06	4	473692.77534800000	988831.07694600000
19	12/13	Comunity Police	Police & Justice Center	Comunity Police	Gov	Akaki_Kality	06	7	473814.40652500000	988085.42494900000
20	7/8/9	Comunity Police	Police & Justice Center	Comunity Police	Gov	Akaki_Kality	04	31	473497.58855900000	982801.43971400000
21	7/8/9	Comunity Police	Police & Justice Center	Comunity Police	Gov	Akaki_Kality	04	34	473963.31425900000	982233.76851600000
22	7/8/9	Comunity Police	Police & Justice Center	Comunity Police	Gov	Akaki_Kality	04	38	475184.19067500000	981040.94798600000
23	7/8/9	Comunity Police	Police & Justice Center	Comunity Police	Gov	Akaki_Kality	04	37	474331.21883800000	981359.56614100000
24	2/4	Comunity Police	Police & Justice Center	Comunity Police	Gov	Akaki_Kality	02	40	476952.33570900000	979439.62689800000
25	2/4	Comunity Police	Police & Justice Center	Comunity Police	Gov	Akaki_Kality	02	41	476853.39605600000	979040.62147800000
26		Police Station	Police & Justice Center	Police Station	Gov	Akaki_Kality	10	28	478625.09369600000	983640.66317500000
27	10/11	Comunity Police	Police & Justice Center	Comunity Police	Gov	Akaki_Kality	07	11	473548.93326100000	985551.26582200000

Appendix 7 Police and Justice Institution Data Collected from Plan Commission

Final_LV_Attribute_Database

UNIQUE_PARCEL_ID	AREA_M	AREA_D	CITY_CODE	REGION_CODE	SUBCITY_CODE	WOREDA_CODE	Shape_Length	Shape_Area	Land_Value
AA000070705022	2517.99573	2500	AA	000	07	07	203.793565	2517.995734	Very High
AA000070704490	2469.32523	2500	AA	000	07	07	207.287688	2469.326132	Very High
AA000070705561	2691.31322	2500	AA	000	07	07	208.080222	2691.313692	Very High
AA000070703833	2526.431	2500	AA	000	07	07	206.981592	2526.430941	Very High
AA000070705298	2578.76274	2500	AA	000	07	07	204.397966	2578.761546	Very High
AA000070705456	2450.37674	2500	AA	000	07	07	198.290904	2450.37628	Very High
AA000070706398	2582.3547	2500	AA	000	07	07	208.140913	2582.35876	Very High
AA000070702454	2468.92738	2500	AA	000	07	07	198.72093	2468.927064	Very High
AA000070705020	2444.71481	2500	AA	000	07	07	200.0574	2444.714807	Very High
AA000070702501	2560.12524	2500	AA	000	07	07	203.246318	2560.125559	Very High
AA000070705021	2608.23788	2500	AA	000	07	07	206.301165	2608.237883	Very High
AA000070707091	2541.06069	2500	AA	000	07	07	203.855406	2541.064881	Very High
AA000070700883	2549.62387	2500	AA	000	07	07	200.757903	2549.623865	Very High
AA000070707454	2459.8261	2500	AA	000	07	07	201.070273	2459.823337	Very High
AA000070405233	2503.35787	2500	AA	000	07	04	196.395984	2503.357378	Very High
AA000070405531	2547.11587	2500	AA	000	07	04	215.672493	2547.115071	Very High
AA000070405624	2478.55794	2500	AA	000	07	04	197.477708	2478.557698	Very High
AA000070405873	2500.05573	2500	AA	000	07	04	200.004878	2500.054022	Very High
AA000070405874	2497.16728	2500	AA	000	07	04	199.887877	2497.174601	Very High
AA000070405284	2566.64649	2500	AA	000	07	04	209.410105	2566.63005	Very High
AA000070404669	2525.24086	2500	AA	000	07	04	101.108783	611.088074	Very High
AA000070404905	2443.65041	2500	AA	000	07	04	202.367112	2443.652521	Very High

(0 out of 43918 Selected)

Appendix 8 Parcels that have "Very High" Land Property Value

Table

Final_LV_Attribute_Database

UNIQUE_PARCEL_ID	AREA_M	AREA_D	CITY_CODE	REGION_CODE	SUBCITY_CODE	WOREDA_CODE	Shape_Length	Shape_Area	Land_Value
AA000070108986	94.63973	94.64	AA	000	07	01	39.659976	94.63973	High
AA000070108987	94.63973	94.64	AA	000	07	01	39.659976	94.63973	High
AA000070108988	94.64154	94.64	AA	000	07	01	39.660286	94.641544	High
AA000070108979	94.63965	94.64	AA	000	07	01	39.659956	94.639649	High
AA000070108980	94.63965	94.64	AA	000	07	01	39.659956	94.639649	High
AA000070108981	94.63965	94.64	AA	000	07	01	39.659956	94.639649	High
AA000070108982	94.64146	94.64	AA	000	07	01	39.660266	94.641463	High
AA000070108983	94.63973	94.64	AA	000	07	01	39.659976	94.63973	High
AA000070105083	94.64015	94.64	AA	000	07	01	39.659991	94.639876	High
AA000070105080	94.63975	94.64	AA	000	07	01	39.659991	94.639942	High
AA000070109290	94.38431	94.64	AA	000	07	01	7.443706	2.421938	High
AA000070107209	94.63945	94.64	AA	000	07	01	31.292517	37.121381	High
AA000070107214	94.63992	94.64	AA	000	07	01	38.154112	90.688792	High
AA000070109668	94.52944	94.64	AA	000	07	01	39.63918	94.529453	High
AA000070109669	94.55964	94.64	AA	000	07	01	39.640078	94.560233	High
AA000070109670	94.50626	94.64	AA	000	07	01	39.62677	94.506999	High
AA000070109671	94.45292	94.64	AA	000	07	01	39.613369	94.453208	High
AA000070109672	94.39956	94.64	AA	000	07	01	39.600066	94.400177	High
AA000070109673	94.34797	94.64	AA	000	07	01	39.586864	94.347759	High
AA000070109674	94.40006	94.64	AA	000	07	01	39.60007	94.400202	High
AA000070109675	94.45328	94.64	AA	000	07	01	39.613271	94.452813	High
AA000070109676	94.50652	94.64	AA	000	07	01	39.626677	94.506629	High

0 (0 out of 43918 Selected)

Final_LV_Attribute_Database

Appendix 9 Parcels that have "High" Land Property Value

Table

Final_LV_Attribute_Database

UNIQUE_PARCEL_ID	AREA_M	AREA_D	CITY_CODE	REGION_CODE	SUBCITY_CODE	WOREDA_CODE	Shape_Length	Shape_Area	Land_Value
AA000070901396	2280.93513	0	AA	000	07	09	218.359779	2280.943471	Moderate
AA000070901397	2168.46935	0	AA	000	07	09	232.539493	2168.475068	Moderate
AA000070901473	7572.89889	0	AA	000	07	09	1435.92929	6995.836061	Moderate
AA000070900524	1784416.72887	0	AA	000	07	09	3654.925826	331839.94961	Moderate
AA000070901474	1227.19796	0	AA	000	07	09	170.634184	1227.191581	Moderate
AA000070901475	949.38421	0	AA	000	07	09	131.624064	949.385764	Moderate
AA000070901477	452.79797	0	AA	000	07	09	87.462193	452.797806	Moderate
AA000070901478	1484.78686	0	AA	000	07	09	155.618276	1484.789319	Moderate
AA000070901479	1101.12916	0	AA	000	07	09	147.783136	1101.126913	Moderate
AA000070901480	2331.85992	0	AA	000	07	09	680.59426	2331.85852	Moderate
AA000070901481	1426.1468	0	AA	000	07	09	155.393163	1426.146495	Moderate
AA000070901482	4097.11086	0	AA	000	07	09	271.355557	4097.113562	Moderate
AA000070901483	903.62623	0	AA	000	07	09	164.50004	903.628615	Moderate
AA000070901484	311.54806	0	AA	000	07	09	114.824589	311.549979	Moderate
AA000070901485	1569.56223	0	AA	000	07	09	169.457894	1569.565348	Moderate
AA000070901486	400.40696	0	AA	000	07	09	92.626297	400.408599	Moderate
AA000070901487	2912.59876	0	AA	000	07	09	268.341359	2912.599277	Moderate
AA000070901587	1512.2949	0	AA	000	07	09	163.270261	1512.292856	Moderate
AA000070901588	1244.1679	0	AA	000	07	09	156.250428	1244.166601	Moderate
AA000070901589	2429.33574	0	AA	000	07	09	213.714408	2429.332528	Moderate
AA000070901590	1032.17442	0	AA	000	07	09	129.842316	1032.176687	Moderate
AA000070901591	3746.19737	0	AA	000	07	09	498.10291	3530.031288	Moderate

0 (0 out of 43918 Selected)

Final_LV_Attribute_Database

Appendix 10 Parcels that have "Moderate" Land Property Value

Table

Final_LV_Attribute_Database

UNIQUE_PARCEL_ID	AREA_M	AREA_D	CITY_CODE	REGION_CODE	SUBCITY_CODE	WOREDA_CODE	Shape_Length	Shape_Area	Land_Value
AA000070902202	205.46757	0	AA	000	07	09	302.945128	205.467759	Low
AA000070902203	351.99521	0	AA	000	07	09	79.497271	351.995363	Low
AA000070902204	42.24999	0	AA	000	07	09	74.302055	42.249669	Low
AA000070902205	1209.61434	0	AA	000	07	09	374.006069	1047.732625	Low
AA000070902206	4373.98683	0	AA	000	07	09	339.965832	4171.731866	Low
AA000070902207	974.33225	0	AA	000	07	09	77.844216	215.104872	Low
AA000070902208	1660.81443	0	AA	000	07	09	186.187828	1660.813557	Low
AA000070902209	9337.09597	0	AA	000	07	09	659.885479	9337.097394	Low
AA000070902210	281.19071	0	AA	000	07	09	108.452161	281.190708	Low
AA000070902128	89.44567	0	AA	000	07	09	79.928354	89.446654	Low
AA000070902130	365.18072	0	AA	000	07	09	544.396908	365.180674	Low
AA000070902131	722.93669	0	AA	000	07	09	462.978278	722.941033	Low
AA000070902132	2609.24305	0	AA	000	07	09	1432.418985	2071.657647	Low
AA000070902133	1035.31222	0	AA	000	07	09	1043.52072	1035.311498	Low
AA000070902134	130.24414	0	AA	000	07	09	105.811324	130.243632	Low
AA000070902135	33.29109	0	AA	000	07	09	66.889564	33.291192	Low
AA000070902136	507.41143	0	AA	000	07	09	597.401377	507.413091	Low
AA000070902137	1159.34784	0	AA	000	07	09	930.510761	1159.350978	Low
AA000070902138	880.49421	0	AA	000	07	09	695.65018	880.495843	Low
AA000070902168	215.35985	0	AA	000	07	09	236.335936	215.359529	Low
AA000070902211	229.87167	0	AA	000	07	09	245.01427	229.873796	Low
AA000070902212	238.02235	0	AA	000	07	09	112.151983	93.333758	Low

0 (0 out of 43918 Selected)

Final_LV_Attribute_Database

Appendix 11 Parcels that have "Low" Land Property Value

Table

Final_LV_Attribute_Database

UNIQUE_PARCEL_ID	AREA_M	AREA_D	CITY_CODE	REGION_CODE	SUBCITY_CODE	WOREDA_CODE	Shape_Length	Shape_Area	Land_Value
AA000071101009	707.76291	0	AA	000	07	11	442.344731	707.762906	Very_Low
AA000071101010	93684.84922	0	AA	000	07	11	1282.158421	13551.272864	Very_Low
AA000071101012	2085.24261	0	AA	000	07	11	2360.728501	2085.24261	Very_Low
AA000071101013	551009.27789	0	AA	000	07	11	7431.458291	551009.277889	Very_Low
AA000071100226	1056624.95692	0	AA	000	07	11	3799.366406	193357.239806	Very_Low
AA000071100413	9264.38857	0	AA	000	07	11	1372.020911	5364.239408	Very_Low
AA000071100414	1278.16626	0	AA	000	07	11	206.251701	1278.166259	Very_Low
AA000071100018	34585.64516	0	AA	000	07	11	3083.933781	10542.158644	Very_Low
AA000071100484	10168.28982	0	AA	000	07	11	557.547646	10168.289817	Very_Low
AA000071100494	3565.36909	0	AA	000	07	11	780.63338	3565.369093	Very_Low
AA000071100498	1231.3858	0	AA	000	07	11	144.737649	1231.385802	Very_Low
AA000071100504	399.10548	0	AA	000	07	11	80.162638	399.105481	Very_Low
AA000071101118	208615.16189	0	AA	000	07	11	3077.114615	73783.758269	Very_Low
AA000071100505	467.22355	0	AA	000	07	11	210.567019	467.223549	Very_Low
AA000071100449	8113.27275	0	AA	000	07	11	600.301588	8113.272752	Very_Low
AA000071100450	1001.74411	0	AA	000	07	11	118.120506	1001.744112	Very_Low
AA000071100512	4482.72884	0	AA	000	07	11	420.607325	4482.728839	Very_Low
AA000071100392	9160.81514	0	AA	000	07	11	2003.978065	4814.966486	Very_Low
AA000071100465	511.39378	0	AA	000	07	11	91.176413	511.393775	Very_Low
AA000071100408	94.97239	0	AA	000	07	11	27.556848	47.517844	Very_Low
AA000071100464	10624.43001	0	AA	000	07	11	752.82774	10624.430007	Very_Low
AA000071101085	326.25787	0	AA	000	07	11	70.013541	135.060222	Very_Low

0 (0 out of 43918 Selected)

Final_LV_Attribute_Database

Appendix 12 Parcels that have "Very Low" Land Property Value