GEOSPATIAL-BASED LAND GRADING SYSTEM DEVELOPMENT FOR ENHANCED PROPERTY VALUATION: A CASE STUDY OF ADAMA CITY, ETHIOPIA

Bikila Girma Gidi

A Thesis Submitted to the department of Architecture
College of Civil Engineering and Architecture (CoCEA),

Presented in Partial Fulfillment of the Requirement for the Degree of Master's in Geoinformatics Engineering

Office of Graduate Studies
Adama Science and Technology University

May, 2025
Adama, Ethiopia

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DECLARATION

I declare hereby that this Master Thesis entitled “Geospatial-based land grading system development for enhanced property valuation: a case study of Adama city, Ethiopia” my original work completed under the supervision of **Dejene Tesama (PhD)**and that it has not been submitted for a degree at any other university, and all sources of materials used for this thesis work have been properly acknowledged.

Bikila Girma Gidi	____________________	_____________
Name of Candidate	Signature	Date

RECOMMENDATION

We, the advisor(s) of this thesis, hereby certify that we have read and revised version of thesis entitled "Geospatial-based land grading system development for enhanced property valuation: a case study of Adama city, Ethiopia". Prepared under our guidance by Bikila Girma submitted in partial fulfillment of the requirements for the degree of Masters of Science in Geo-Informatics Engineering. Therefore, we recommend the submission of revised version of the thesis to department following the applicable procedures.

Major Advisor/Supervisor	Signature	Date
______________________	___________	___________

APPROVAL SHEET

We, the advisors of the thesis entitled "Geospatial-based land grading system development for enhanced property valuation: a case study of Adama city, Ethiopia". And developed by Bikila Girma Gidi, hereby certify that the recommendation and suggestions made by the board of examiners are appropriate incorporated into the final version of the thesis.

______________________ ______________________ ______________________

Major Advisor Signature Date

We, the undersigned, members of the Board of Examiners of the thesis by Bikila Girma Gidi have read and evaluated the thesis entitled "Geospatial-based land grading system development for enhanced property valuation: a case study of Adama city, Ethiopia". And examined the candidate during open defense. This is, therefore, to certify that the thesis is accepted for partial fulfillment of the requirement of the degree of Master of Science in Geo-Informatics Engineering.

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Finally, approval and acceptance of thesis is contingent upon submission of its final copy to the Office of Postgraduate Studies (OPGS) through the Department Graduate Council (DGC) and College Graduate Committee (CGC).

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Office of Postgraduate Studies, Dean Signature Date

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List of Acronyms

GIS	Geographic Information System
MCDA	Multi-criteria decision analysis
RS	Remote Sensing

ABSTRACT

The integration of Geographic Information Systems (GIS) into land grading and property valuation processes has gained increasing attention in recent years, driven by advancements in technology and a growing recognition of the importance of spatial data in decision-making. This study aims the integration of geospatial-based land grading systems into property valuation processes in Adama City, Ethiopia. As the city experiences rapid urbanization, accurate property valuation has become crucial for effective urban planning, real estate development, and policymaking. Traditional property valuation methods in Adama have often lacked standardized and data-driven approaches, leading to inconsistencies and inefficiencies. This research employs AHP based Geographic Information Systems (GIS) and remote sensing technologies to develop a land grading system that incorporates the data such as topography, soil quality, infrastructure accessibility, and land use patterns. By analyzing geospatial data, the study creates a grading system that classifies land into categories as "first/G1/," "second/G2/," "third/G3/," "fourth/G4/," and fifith/G5/ grades based on factors influencing land quality and value. The study employs statistical and spatial analysis to assess the relationship between land grades and property prices, demonstrating how geospatial data can enhance valuation accuracy. The results indicate that the overlay analysis of these parameters revealed that G1 grade covers approximately 1,052,807.11 square meters, G2 covers 24,041,834.56 square meters, G3 encompasses 76,736,869.52 square meters, G4 spans 132,334,640.94 square meters, and G5 totals 9,686,237.43 square meters. The findings provide recommendations for integrating this system into land valuation practices in Adama City and other rapidly urbanizing regions of Ethiopia, offering a scalable framework for enhancing land management and urban development strategies.

Key words: *Geospatial, Land, Grading, Property, Valuation*

CHAPTER ONE

1. INTRODUCTION

1.1 BACKGROUND OF THE STUDY

Land is a vital and valuable natural resource, often regarded as both a form of wealth and a key input in production. In developing countries, the role of land as a production resource remains particularly significant, contrasting with its function in developed nations (Tunji, 2008). In Ethiopia, access to land is essential, serving as a major socio-economic asset. Consequently, how land is governed and administered profoundly influences a country's development trajectory (Samira, 2014).

However, many developing nations struggle with ineffective land use planning and management systems (Abubakari & Romanus, 2011). In urban Ethiopia, land management is undergoing a transition and faces numerous interconnected challenges. A primary issue is the shift from traditional urban land valuation systems to more market-oriented approaches involving long-term leases (Olga, 2005). According to the Ministry of Urban Development and Housing Construction (MUDHC, 2014), Ethiopia is among the least urbanized countries, with most urban centers remaining largely unplanned. One significant consequence of this situation is the lack of a legal framework and clear methodologies for preparing, implementing, and revising urban land grading maps.

Land grading is a pivotal aspect of land use planning, infrastructure development, and urban growth management. Its purpose is to assess and modify the topography of land to ensure its suitability for various purposes, including residential, commercial, agricultural, or industrial use. Accurate and efficient land grading is crucial for making informed decisions regarding land development and optimizing land utilization (Carr and Zwick, 2007). Land grade has a crucial role to develop appropriate standard benchmark prices on the lease of land and for the valuation of land related property. It also brings transparent and clear taxation systems that could establish sound and efficient land marketing system that would facilitate investment. However, the existing land grade system of the urban centers of Ethiopia suc has not been very successful in allowing the town to benefit from the advantages of having an efficient land grading system. The major reasons behind the limitations emanate from two main factors. The first reason is related to that important factors have not been exhaustively considered in designing urban land grading system. The second problem is related to a methodological approach on how land grade is prepared and implemented. Moreover, despite the fact that many geographical phenomena like land grade have fuzzy characteristics, currently most of the geographic phenomena are represented by crisp. Hence, the intent of this study is to develop conceptual fuzzy land grade model that is helpful to bring flexible land grading that enables to give decision makers an informed decision. In any of these methods, factor identification, weighting and integrating GIS and fuzzy logic approaches are important prerequisites that serve as platform to develop land grading. To design the conceptual model, five main factors have been considered, namely infrastructure, land use, topographic characteristics, visual and environmental factors and population density.

To sum up, this paper indicates that the fuzzy modeling approach can avoid the loss of information that often arises when the strict Boolean logic is used on the basis of the crisp sets (Yes/No) and can produced a better and more reasonable result than crisp. It is also concluded that FAHP is the best alternative to determine the criteria weights from judgments of decision-making domain of experts.

The integration of Geographic Information Systems (GIS) into land grading and property valuation processes presents a unique opportunity to enhance accuracy, efficiency, and decision-making (Contreras et al, 2008). GIS technology allows for the spatial analysis of various factors influencing land value, such as topography, proximity to services, and zoning regulations. By utilizing GIS, stakeholders can visualize and analyze data more effectively, leading to informed decisions regarding property valuation and development.

Land grading is a critical component in the development and valuation of real estate, as it directly affects the usability and marketability of a property. Traditional methods of property valuation often rely on manual assessments and static data sources, which can lead to inefficiencies and inaccuracies (Carr and Zwick, 2007). The application of GIS in land grading allows for a more dynamic approach, enabling the integration of various data layers that can influence property values. For instance, factors such as soil quality, drainage patterns, and existing infrastructure can be analyzed spatially to determine their impact on land usability and value (Zhang et al., 2020). Urban land grading is fundamentally a process that determines the relative value of urban land for taxation and investment purposes (Daniel, 1992). Accurate grading and pricing of urban land are crucial steps in effective valuation practices, which are essential for the development of a robust real estate market. Furthermore, land grading must be based on objective and scientific evaluations of land quality (Liu, 2002). Thus, land grading plays a critical role by categorizing urban land into various valuation scales, facilitating efficient urban land valuation and pricing

Research has shown that GIS can significantly improve the accuracy of property valuations by providing a comprehensive view of the factors affecting land value. For example, studies have demonstrated that GIS-based models can incorporate multiple criteria, such as environmental conditions and socio-economic factors, to produce more reliable valuation outcomes. Furthermore, the use of GIS in land grading can facilitate better urban planning and resource management, ultimately contributing to sustainable development practices (Goicoechea et al,1982).

The need for efficient property valuation systems is increasingly important in urban areas where land is a limited resource. As cities expand and populations grow, the demand for accurate and timely property assessments becomes critical for effective urban planning and development. By developing a GIS-based land grading system, this research aims to address these challenges and provide a robust tool for property valuation that can adapt to the complexities of modern urban environments in Adama city. This research seeks to develop a GIS-based land grading system that leverages geospatial data and analysis techniques to enhance the accuracy and efficiency of land grading in urban planning. By automating and streamlining the grading process, this system has the potential to revolutionize land use decision-making, ensuring optimal land utilization and sustainable urban development in the city. This method integrated various indicators that describe the efficiency of residential, commercial, and industrial land, utilizing principal component analysis and hierarchical clustering.

1.2 STATEMENT OF THE PROBLEM

Land grading plays a key role in how we plan land use, build infrastructure, and manage urban growth. It helps us figure out what land suits different purposes. But the conventional ways of grading land and valuing property largely rely on subjective and static data, and does not consider spatial variables, which can lead to inconsistency and inefficiencies (Addae & Oppelt, 2019). These methods often miss important information like the topography of the area, properties of soil, and accessibility. This causes inaccurate property values and unfair taxes in rapidly urbanizing areas like Adama City where land characteristics are dynamic and multifaceted (McCluskey & Franzsen, 2017; Enemark et al., 2021). Currently, Adama City only looks at an area of a parcel from title deeds when deciding its value. However, this misses out on all the important factors about land grading,

This approach obviously makes for inefficient taxation and inequities and doesn't provide enough information for planning. For instance, parcels that are the same size but have different features (like their location and the strength of soils) end up with the same value, indicating an unfair tax system. Moreover, failure to consider land grading when valuing property could result in missing out on income.

Moreover, the lack of empirical studies on land grading limits the ability of policymakers to develop equitable valuation models and hinders urban planning efforts by failing to align resource allocation with actual land values. Comparative studies from other regions ((Hajkowicz, 2007) demonstrate that integrating land grading assessments using Geographic Information System (GIS) technology can enhance valuation accuracy, improve tax compliance, and inform urban development policies.

The reliance on traditional manual assessments in land grading processes introduces inconsistencies and inefficiencies that can compromise the suitability of land for different purposes in Adama city. Manual land grading assessments are subjective and prone to human error, resulting in inconsistent grading outcomes. Different individuals may interpret and evaluate land characteristics differently, leading to discrepancies in decision-making. These inconsistencies can have significant implications for land use planning and infrastructure development, as they may result in suboptimal land utilization and inefficient resource allocation in the city. The purpose of this study is to address these challenges by leveraging GIS technology to create a dynamic and efficient land grading system that enhances property valuation accuracy, and support sustainable urban development in Adama City.

1.3 RESEARCH OBJECTIVE

1.3.1. GENERAL OBJECTIVE

To develop and validate a comprehensive Geospatial - based land grading system that effectively assesses determinant factors influencing land grading and evaluates its impact on property values, thereby enhancing the accuracy and efficiency of property valuation processes.

1.3.2. SPECIFIC OBJECTIVES.

1. To identify the determinant factors influencing land grading and property valuation practices
2. To develop a Geospatial -based to analyze land grading system
3. To evaluate the relationship between land grading assessments and property valuation outcomes
4. To validate the GIS-based land grading system through empirical case studies in Adama City

1.4. RESEARCH QUESTIONS

1. What are the key determinants factors that influence land grading practices, and how do these factors vary across different geographical contexts?
2. How can Geospatial technology be effectively utilized in enhancing land grading?
3. What is the relationship between GIS-based land grading assessments and property values?

4. How can GIS applications tested to improve the efficiency of property valuation processes based on land grading system?

1.5. SIGNIFICANCE OF THE STUDY

This research holds significant importance for multiple stakeholders, including urban planners, real estate professionals, policymakers, and academic researchers. By developing a GIS-based land grading system, the study aims to enhance the accuracy and efficiency of property valuation processes, addressing the shortcomings of traditional valuation methods that often rely on manual assessments and static data. The findings will provide a comprehensive understanding of how various determinant factors influence land grading and, consequently, property values.

Furthermore, the integration of spatial data layers—such as topography, soil type, drainage patterns, existing land use, and infrastructure—into the grading system will facilitate a more nuanced analysis, allowing stakeholders to make informed decisions regarding land development and resource management.

This research also contributes to the field of geographic information science by demonstrating the application of GIS technology in real estate valuation, thereby fostering innovation in urban planning practices. Ultimately, the implications of this study extend to promoting sustainable land use and development strategies, which are increasingly vital in the context of rapid urbanization and environmental challenges. By providing a validated framework for assessing land grading impacts, this research aims to serve as a valuable tool for enhancing property valuation accuracy and supporting informed decision-making in real estate markets.

1.6. SCOPE OF THE STUDY

This research focuses on the development and validation of a GIS-based land grading system aimed at enhancing property valuation accuracy. The scope of the study encompasses several key areas that collectively contribute to the project's objectives.

Firstly, the Identification of Determinant Factors will involve an extensive literature review and empirical data collection through surveys and interviews with stakeholders such as real estate professionals, urban planners, and land developers. This phase aims to identify and prioritize the critical factors that influence land grading practices, ensuring a comprehensive understanding of the elements that affect property valuation.

Secondly, the Development of a GIS-Based Framework will involve designing an integrated geospatial system that incorporates various spatial data layers, including topography, soil type, drainage patterns, existing land use, and infrastructure. By utilizing multi-criteria decision analysis (MCDA) tools, this framework will facilitate a robust assessment of land suitability and grading implications, allowing for more informed decision-making.

Thirdly, the Impact Analysis will focus on integrating property value data with the GIS framework to analyze correlations between land grading factors and property values. Employing statistical methods, such as regression analysis, will enable the evaluation of how these factors influence property valuation, providing critical insights into the economic implications of land grading.

Additionally, the research will include Case Studies for Validation, wherein specific locations within Adama City will be selected to assess real-world land grading practices and property valuations.

Importantly, the spatial scope of this study is limited to Adama City. This focus will allow for an in-depth analysis of the unique geographical and environmental contexts that characterize the area, ensuring that the findings are relevant to local conditions while also contributing to broader discussions in the fields of real estate and urban planning. By concentrating on Adama City, the research aims to deliver targeted insights that can enhance property valuation practices within the region, ultimately supporting sustainable development initiatives and informed urban planning strategies.

1.7 ORGANIZATION OF THE THESIS

This thesis comprises five chapters, each serving distinct purposes. Beginning with the introductory chapter, it addresses the background, problem statement, study objectives, research Questions, and scope.

Following this, the subsequent chapter delves into literature reviews, which is well organized but would benefit from more engagement with international studies on land grading and valuation systems

The third chapter expresses the study area, data and software utilized, methodologies, research work flow and various analyses techniques such as AHP.

As for the fourth chapter, it presents the results and discussions derived from the thesis's entirety.

Finally, the concluding chapter summarizes the thesis with its conclusions and Recommendations.

CHAPTER TWO

2. LITRATURE REVIEW

2.1. INTRODUCTION

The integration of Geographic Information Systems (GIS) into land grading and property valuation processes has gained increasing attention in recent years, driven by advancements in technology and a growing recognition of the importance of spatial data in decision-making. This literature review explores key themes related to land grading, property valuation, and the application of GIS, highlighting the determinant factors influencing land grading practices and the implications for property valuation accuracy.

2.2. LAND GRADING PRACTICES

Land grading is a critical aspect of real estate development, as it directly affects land usability, environmental sustainability, and property values. The process of land grading involves altering the land's surface to achieve a desired topography, which can facilitate construction, improve drainage, and enhance the overall functionality of the land for various uses. Effective land grading is essential not only for maximizing the utility of a property but also for minimizing environmental impacts, such as erosion and water runoff, which can lead to significant ecological degradation (Demetriou, 2016).

Traditional grading methods often rely on manual assessments that can be subjective and inconsistent. These methods typically involve visual inspections and basic measurements, which may overlook critical spatial variables that influence grading outcomes (Yomralioglu & Nisanci, 2004). As a result, the reliance on subjective evaluations can lead to discrepancies in grading practices, ultimately affecting the usability and value of the land. The limitations of conventional grading techniques highlight the need for more systematic approaches that incorporate advanced technologies, such as Geographic Information Systems (GIS), to enhance the accuracy and reliability of land grading assessments.

Research has identified a range of factors that influence land grading decisions, including topography, soil characteristics, drainage patterns, and existing land use. Topography plays a significant role in determining how land can be graded, as slopes and elevation changes can affect water drainage and soil stability (Demetriou, 2016). Soil characteristics, such as texture, composition, and moisture retention, are equally important, as they influence the land's ability to support vegetation and withstand erosion. Additionally, drainage patterns must be carefully considered to prevent flooding and waterlogging, which can compromise both land usability and environmental health.

Existing land use is another critical factor that influences grading decisions. Understanding how adjacent properties are utilized can inform grading strategies that align with local zoning regulations and community planning objectives. For instance, grading practices in residential areas may differ significantly from those in commercial or agricultural zones, necessitating tailored approaches that consider the specific needs and characteristics of each land use type (Demetriou, 2016). The centripetal nature of the cities creates intense pressure on the economic and spatial structure of urban systems such as on services and facilities like hospitals, educational institutions, housing, transport, telecommunication systems and energy supply. This is because the provisions of these facilities are expanding at rates slower than the rate of growth of the urban population thus creating a wide margin between demand and supply of urban infrastructural facilities and services.

2.3. Urban land-use Optimization

Land use optimization is used to support and inform land use decision making. There are two key considerations. First, land use decision making drives many of the processes that directly impact on our everyday lives. These include local-scale decisions about which food crops to grow, new building developments, natural flood management strategies, enhancing biodiversity, producing biomass and biofuels, as well as carbon sequestration. Second, land use decisions made now will also shape and have implications for our collective lives in the future. They will, for example, not only determine levels of food security locally and support regional emission targets, but also drive climate change at coarser scales. Sustainable urban form has been recognized as one of the major concerns of the planning practice. Current land use pattern trends with low-density, single-use, leapfrog urban growth on city outskirts call for a more efficient land use development strategies balancing economy, environmental protection, and social equity. In this paper, we present a new multiobjective spatial optimization model, which minimizes the conflicting objectives of open space development, infill and redevelopment, land use neighborhood compatibility, and cost distance to already urbanized areas. Land use allocation is restrained by a density based design constraint.

Additionally, these start to hint at the complexity of land use optimization or allocation (what to put where, what to do where). This aims to determine the spatial composition and configuration of land use that “best” satisfies some objective or combination of objectives. Urban land-use optimization planning is very important to achieve long-term urban sustainability. However, it becomes a global challenge, especially in developing countries, to optimize urban land-use allocation in the face of rapid urbanization, migration, and climate change. Sustainable urban land-use optimization/allocation is considered an effective tool to achieve urban sustainability. Sustainability is one of the important goals of urban land-use planning, which requires taking into account the social, economic, and environmental benefits of people (UN,2019). Sustainable land-use planning encompasses social, economic, and environmental components, each of which has a distinct objective. Additionally, optimality is a fundamental principle of sustainable land-use planning.

Although some of the early studies included sustainability criteria partially, they did not use any established method to quantify sustainability indicators. They used a single variable-based measure to quantify sustainability dimensions. For example, Zhang et al. quantified social benefit as a function of the value of social security services, and quantified social benefit using the spatial compactness of an area, and used spatial accessibility as a proxy for social sustainability. If the land uses are compatible but there is a lack of accessibility, the social benefit is also reduced. Thus, compatibility and accessibility are also factors in determining social benefit. Similarly, there may be additional indicators contributing to the social benefit metric. As a result, we argue that many indicators can be ascribed to the social benefit metric. As a result, some form of the composite index is necessary to quantify societal gain. To resolve this problem, Rahman et al. developed a composite index to quantify social benefit in land-use allocation. In the same way, there was no established method to quantify environmental benefits. Several researchers used several methods to measure environmental benefits in urban land-use allocation. Romano et al. Integrated geographical information systems (GIS) and multicriteria decision analysis (MCDA) to evaluate the potential of a rural coastal area, located in northern Puglia (Southern Italy), to improve its sustainable development through the restoration of farmland. They used only physical criteria for sustainable allocation of farmland. In fact, there was no specific inclusion of sustainability criteria. Therefore, it is evident that although stakeholder participation was addressed in the MCDM approach in land-use optimization/allocation, still, the inclusion of sustainability criteria (social, environmental, and economic) is weak. This inevitably requires incorporating both sustainability criteria and a participatory approach in sustainable urban land-use optimization.

2.4. Determinant Indicators that should be considered in land grading

Indicators are common instruments for monitoring progress towards some larger objectives. For example, economic indicators, such as GDP, distribution of employment, etc., are used regularly to monitor performance of national and local economies. Similarly, access to social services, literacy rates, etc., are used for comparative assessments of social development. Indicators which can be used to monitor change in land quality are still not fully available, and not in a position to take appropriate action on land related issues such as land degradation. Land price is determined by the combination of land price determining factors; and those factors have complex and systematic relationships. Land price determining factors were first developed by analyzing price determining factors of agricultural land (Chae, 1986). However, urbanization and industrialization led to urban growth and the change of social structure; and the price determining factors of urban land began to be studied. In general, land price determining factors are categorized as general factors, regional factors, and individual factors (Chae, 1986). Under the three categories of factors, various detailed factors have been presented (Pham et al., 2019), such as (1) the types of real estate locations: relative position and absolute position. The better the location, higher the real estate price. Real estate is central part of a big city, densely populated, modern living facilities, etc. (Tze., 2013). It will surely be higher than similar properties but located in suburban areas (relative location). The property is located on the big roads, right at the corner of the intersection, near the important traffic axes, the price will be higher than the property located at the end of an alley, in a small road... (2) Size, area, shape of the land: real estate with large area, square shape, not distorted or deformed will have a higher price. (3) Terrain: Real estate is located in high areas, less flooded in the rainy season, the price is higher than those in low-lying areas. (4) Form of construction. (5) Soil characteristics: In areas with a moderate soil hardness, not too soft, favorable for housing construction, the price of real estate is higher. (6) Environmental factors and natural disasters and zone (Bailey et al., 2008). Manning(1988) set up an equilibrium model to analyze the factors for inter-urban land price. Construction cost, population growth, population density, urban climate conditions, and household income of high-income groups are statistically significant to urban land price. Hardie, Parks, Gottleib, and Wear (2000) presented a countylevel land use analysis of 1459 counties in the U.S. South. Their model shows that agricultural land price is related to land proportion, population, household income, real estate price, cost, and urbanization. Similarly, many studies were conducted to analyze price determining factors of Officially Announced Land Price and market price of land. Many of the studies were on the factors of Land Characteristics Survey Table and regional factors, such as population density, industrial structure, distance from the city center, number of adjacent subway stations, distance from the adjacent subway stations, land use status of nearby land, distance from industrial facilities; and the number of parks, river, elementary schools, middle and high schools nearby, etc.(Lee, 2004; Her et al., 2008; Kim et al., 2013; Jung, 2009).

Residential development has been analyzed in the context of urban growth in many publications. According to some authors (Smersh et al. 2003, Renigier-Biłozor and Wiśniewski, 2013), developers focus on the following attributes when choosing a location for residential property:

– Physical suitability for development: slopes, soils, hydrology, land availability,
– Existing land use patterns and location of other residential development,
– Distance to markets with employment opportunities,
– Neighborhood factors: age of surrounding housing stock, schools, universities,
– Health care,
– Recreational areas, including parks, forests, water reservoirs,
– Air pollution.

2.5. PROPERTY VALUATION METHODS

Property valuation is a complex process influenced by a myriad of economic, social, and environmental factors. Accurate property valuation is essential for various stakeholders, including buyers, sellers, investors, and financial institutions, as it informs investment decisions, financing, and taxation. Traditional valuation methods, such as the sales comparison approach, income approach, and cost approach, have long been the cornerstone of property assessment. However, these conventional methods often fail to adequately incorporate spatial variables that can significantly impact property values (Wyatt, 1996). For instance, the sales comparison approach relies heavily on recent sales data of comparable properties, which may not account for unique geographical features or local amenities that could enhance or detract from a property's value.

The limitations of these conventional methods underscore the need for more dynamic approaches that integrate spatial data to improve valuation accuracy. Traditional methods typically focus on historical data and static assessments, which can overlook the influence of real-time geographic factors such as proximity to transportation networks, schools, parks, and commercial centers. These factors can greatly affect property desirability and, consequently, market value. As urban areas continue to evolve rapidly, the traditional valuation methods may become increasingly inadequate, necessitating a shift towards more comprehensive models that consider the spatial context of properties (Demetriou, 2016).

Recent studies have shown that incorporating geographic factors into valuation models can yield more reliable assessments, particularly in rapidly urbanizing areas. For example, research has demonstrated that properties located near public transportation or essential services tend to command higher prices, as these amenities enhance accessibility and convenience for residents (Demetriou, 2016). Additionally, spatial analysis techniques, such as those enabled by Geographic Information Systems (GIS), allow for the visualization and quantification of these geographic influences, providing a more nuanced understanding of property values.

Moreover, the integration of GIS technology into property valuation processes facilitates multi-criteria decision analysis (MCDA), enabling stakeholders to evaluate multiple factors simultaneously and make informed decisions based on comprehensive data analysis. This approach not only enhances the accuracy of property assessments but also supports better urban planning and resource allocation by providing insights into how various factors interact to influence property values.

2.6. Applications of GEOSPATIAL IN Land Grading and Valuation

Geospatial technology has developed rapidly and is widely used for various purposes related to geographic location. Aceh is one of the provinces in Indonesia as rice producer provinces. Aceh province contributes about 2 million tons of rice every year, with local consumption of about 650.000 tons. However, rice fields to support sustainability agriculture mapping in Aceh province are still not yet well verified. The shift of land use for non-agriculture is alarming; coincidently, spatial planning to meet the demand for agriculture activities for every regency in Aceh is another crucial issue. With this current situation, the use of geospatial technology is an essential tool. This article presents a geospatial technology for land use planning and sustainable agricultural mapping in Aceh Province, Indonesia, as a case study. Geospatial analysis combined with descriptive using existing spatial data supported by ground-truthing was carried out for this study. The result shows that geospatial technology, a combination of remote sensing data, a global positing system, and a Geographic Information tool, can represent comparison results from different data sources obtained from other studies. Geographic Information Systems (GIS) technology has emerged as a powerful tool for analyzing spatial data and enhancing decision-making in land grading and property valuation. The ability of GIS to integrate various data layers—such as topography, soil characteristics, land use, and infrastructure—enables a comprehensive analysis of how different factors interact and influence land grading practices. This integration is crucial for understanding the complexities of land development, as it allows stakeholders to visualize spatial relationships and assess the implications of various grading strategies on land usability and environmental sustainability.

Research has demonstrated that GIS can facilitate multi-criteria decision analysis (MCDA), which is essential for evaluating and prioritizing grading factors based on their significance (Yomralioglu & Nisanci, 2004). MCDA within a GIS framework allows urban planners and real estate professionals to systematically analyze multiple criteria simultaneously, leading to more informed and effective decision-making. For instance, when assessing land for development, stakeholders can weigh factors such as soil stability, drainage capacity, and proximity to essential services, thereby optimizing land use and enhancing property valuations.

The application of GIS in land grading and valuation is particularly valuable in urban environments, where land is often scarce and competition for development is high. Studies have shown that GIS can improve the accuracy of property valuations by incorporating spatial variables that traditional methods may overlook. For example, properties located near public transportation or recreational facilities tend to have higher market values due to their increased desirability (Demetriou, 2016). By utilizing GIS to analyze these spatial factors, stakeholders can gain insights into market trends and make data-driven decisions that align with community needs and development goals.

Moreover, GIS technology supports the visualization of complex data sets, making it easier for stakeholders to communicate findings and justify decisions to the public and policymakers. The ability to create detailed maps and spatial analyses enhances transparency in the decision-making process, fostering greater community engagement and support for land development projects.

2.7. THE PRINCIPLE OF GIS COMBINED WITH MCE

GIS combining with MCE is a process combining multiple source information associating with geographical location to expose relations hiding in resource information. Main content of it are as follows: (i) Confirming the goal of evaluation; (ii) Choosing criteria: to confirm effectual factors using for evaluating, (iii) Confirming weights of factors: to confirm comparative weightiness (iv) Calculating factor’s value diffused in every spatial cells: to diffuse attribute value of factors to make them distributing spatially and numerically based on GIS; (v) Calculating combined value of spatial cells: to achieve combined value of spatial cells through numeric overlay calculation; (vi) Classing spatial cells according to their combined value to achieve evaluation results. Fengchang Xue, Zhengfu Bian Geographic Information System (GIS) emerged in 1960s, which functions decision making (MCDM).

Founding Criteria and Calculating Weights the question, requirements of which as follows: (i) Which can mapping the aim of the evaluation synthetically; (ii) Which can be expressed measurably; (iii) Factors in criteria are independent. Weight of factors is used to judge the weightiness of factors in criteria. Generally, methods used to calculate it as follows: A given knowledge system can be expressed as S=,where U is universe, A= C D is the set of attributes on U, C and D are the sets of U×A→V is information mapping from U×A to V. In the attributes set A=C D, x X is an attribute. Resolution enhancement of X after x is joined into X can be taken as a weightiness of x belonging to X. The concept of the attribute weightiness degree (Miao Duo-qian, 2002) in C be a attribute. Marking Sigx as the attribute weightiness degree of x for X: (i) Subjective method: such as Delphi Method, Pairing Comparison, Priority Order Decision and so on. (ii) Objective method: such as Principal Component Analysis, Entropy All of methods above are based on determinate information, but uncertainties widely exist in objective world, human cognition and data processing (Shi Wen-Zhong, 2006). To fit for practical application, it was request that relations of spatial data must be expressed under the condition of lacking determinate and accurate information. Rough set is a novel mathematical tool for dealing with uncertainties and imprecision of geographic information, which can be used to represent uncertainties in multi-levels spatial knowledge (Deng Min, 2006). The follow is a method based on condition and decision attributes of a given knowledge expression system to acquire criteria using useful data and useful characters existing in observed data. GIS Combined with MCE to Evaluate Land Quality The criteria used in MCE must be fit for analyzing the particularity of Technology, Multiobjective Programming Model and so on.

The object of plotting spatial cells is to form units to process spatial analysis and evaluation based on GIS. To fit for GIS, spatial cells must it can be used to map views in any scale. ones so that spatial elements in any resolution can be created and represented. Generally, there are two models to plot spatial cells: shapely model and spatial cells according to boundaries of some irregularly distributing spatial attributes, such as administration boundaries, Voronoi map and so on. In examples of this article, to evaluate land quality, the shapely model and the unshapely model were applied synthetically: for attributes only so on, plotted spatial cells according to administration boundary and land block boundary; for attributes that not only associated with distance but also with orientation, such as effect degree of towns, advantage degree of roads attributes value of all kinds of spatial elements were integrated to a new sets of appropriate grids. In process of plotting spatial cells, units of interiorly equal and exteriorly dissimilar were obtained by controlling grid size. These units composed of basal cells to carry on spatially analyzing to achieve land quality evaluation. 3.3 Diffusing Spatial Attribute Value Factors associated with land quality are being forms of scattering dot, line and field in space, but these factors affect more area around them. In order to represent above affection, spatial interpolation was employed, such as Kriging Interpolation, spline interpolation, polynomial interpolation. In Fengchang Xue, Zhengfu Bian The attribute weightiness degree represents the attribute's affecting on decision-making and reflects the different factors' importance in evaluation, possess two characters as follows at least (Paul A. Longley, 2004): unshapely model. Shapely model refers to plot spatial cells in equal shapes, such as Archimedes spatial plotting. Unshapely model refers to plot and so on, plotted spatial cells according to regular grid. Furthermore, associated with region, such as local economic development, land output and (i) The model of plotting spatial cells should be repeated infinitely so that (ii) The model of plotting spatial cells can be divided into infinitely.

Overlay analysis is basal function of GIS, including arithmetical overlay, logic Overlay, fuzzy Overlay and so on. There is some limitation in general overlay analysis, such as not comparatively considering weightiness of layers, no way to confirm threshold value of consecutively distributing variable and not be able to evaluate all of spatial elements roundly, for example, not be able to order results of evaluation. Because of limitations above, general overlay analysis cannot meet for the requestment of evaluating land quality based on GIS and MCE. Numeric overlay calculation of spatial data refers to that taking attribute value of spatial object as consecutive variable, and transforming them into some new value which falling into some special numeric zone, after these, on spatial cell plotting and spatial attribute value diffusing. Spatial cell plotting divides consecutive space into equal spatial cells and spatial attribute value diffusing transforms consecutive attribute value to discrete dot value which belongs to different spatial cells.

2.8. Case Studies and Empirical Evidence

Several case studies have illustrated the successful application of Geographic Information Systems (GIS) in land grading and property valuation, demonstrating the technology's capacity to enhance traditional assessment methods. In urban environments, where land use is complex and dynamic, GIS-based models have proven particularly effective in accurately predicting property values by incorporating a range of spatial variables. For instance, Demetriou (2016) conducted a study that highlighted how GIS can integrate factors such as proximity to amenities, infrastructure, and environmental features to create more reliable property valuation models. This study found that properties located closer to essential services—such as schools, parks, and public transportation—tended to command higher market values, underscoring the importance of spatial context in real estate assessments.

Another notable case study by Anselin et al. (2006) explored the application of GIS in assessing the impact of environmental features on property values in urban areas. The researchers utilized spatial econometric models to analyze how proximity to green spaces and water bodies influenced residential property prices. Their findings indicated that properties near parks and waterfronts not only had higher values but also experienced greater appreciation over time. This empirical evidence supports the notion that incorporating environmental factors into valuation models can yield a more nuanced understanding of property dynamics, ultimately leading to better-informed decision-making for urban planners and developers.

Furthermore, a study by Knaap and Ding (2008) examined the role of GIS in evaluating the effects of transportation infrastructure on property values. The researchers found that properties situated near major transportation corridors experienced significant increases in value, particularly when access to public transit was improved. This case study illustrates how GIS can be employed to analyze the interplay between transportation networks and property valuation, providing critical insights for urban development strategies.

The empirical findings from these case studies highlight the potential of GIS to enhance traditional valuation methods by offering a more comprehensive view of the factors influencing property values. By integrating spatial data into valuation models, stakeholders can better understand the complexities of real estate markets and make more informed decisions that align with community needs and development goals. As urban areas continue to evolve, the application of GIS in property valuation will likely become increasingly vital, providing the analytical tools necessary to navigate the challenges of modern land management.

2.9. RESEARCH GAPS

Despite the growing body of literature on GIS applications in land grading and property valuation, several critical gaps remain that warrant further exploration. One significant gap is the need for more comprehensive research that systematically identifies and evaluates the determinant factors influencing land grading across various geographical contexts like Adama City. While existing studies have largely focused on developed country experience, there is a lack of research in developing country context. Future research could benefit from comparative studies that examine land grading practices across multiple geographical areas, thus providing a more holistic view of the determinants that influence grading effectiveness and property valuation.

Another important area for future investigation is the integration of GIS with data sources, such as remote sensing information. Advances in technology have made it increasingly feasible to gather and analyze vast amounts of spatial data. For instance, remote sensing technologies can provide up-to-date information on land use changes, vegetation cover, and environmental conditions, which are critical for accurate land grading assessments (Weng, 2010). Integrating these data sources with GIS-based models could significantly enhance the accuracy and responsiveness of property valuation methodologies, allowing stakeholders to make more informed decisions based on the most current information available.

Moreover, the intersection of GIS technology with machine learning and artificial intelligence presents further opportunities for innovation in property valuation. By leveraging advanced analytical techniques, researchers can develop predictive models that account for complex interactions among various grading factors and property values. This approach could lead to more dynamic and adaptable valuation frameworks that respond to changing market conditions and environmental factors.

Previous studies have primarily focused on examining the overall efficiency of land use, but they have failed to adequately consider the heterogeneity of urban land use types and comprehensive characteristics of urban quality. As a result, the spatial accuracy and precision of research findings have been relatively low, and the existing studies lack the consideration of land efficiency evaluation from the perspective of urban regeneration. Therefore, we proposed a comprehensive method for identifying inefficient urban land in existing urban areas.

CHAPTER III

3. RESEARCH MATERIAL AND METHODOLOGY

3.1. Description of the Study Area

The study area (Fig.3.1) viz. Adama City is extending between geographic coordinates of at 8° 30′ 52.1172″N latitude and 39° 16′ 9.3252″ E longitude at some 80 Kilometers away from Addis Ababa City. The maximum elevation of the city is 1712 meters above mean sea level. Owing to its geographical proximity to international port of Djibouti within the distance of about 777 Kilometers, the city is one of the preferred destinations for trade and industry.

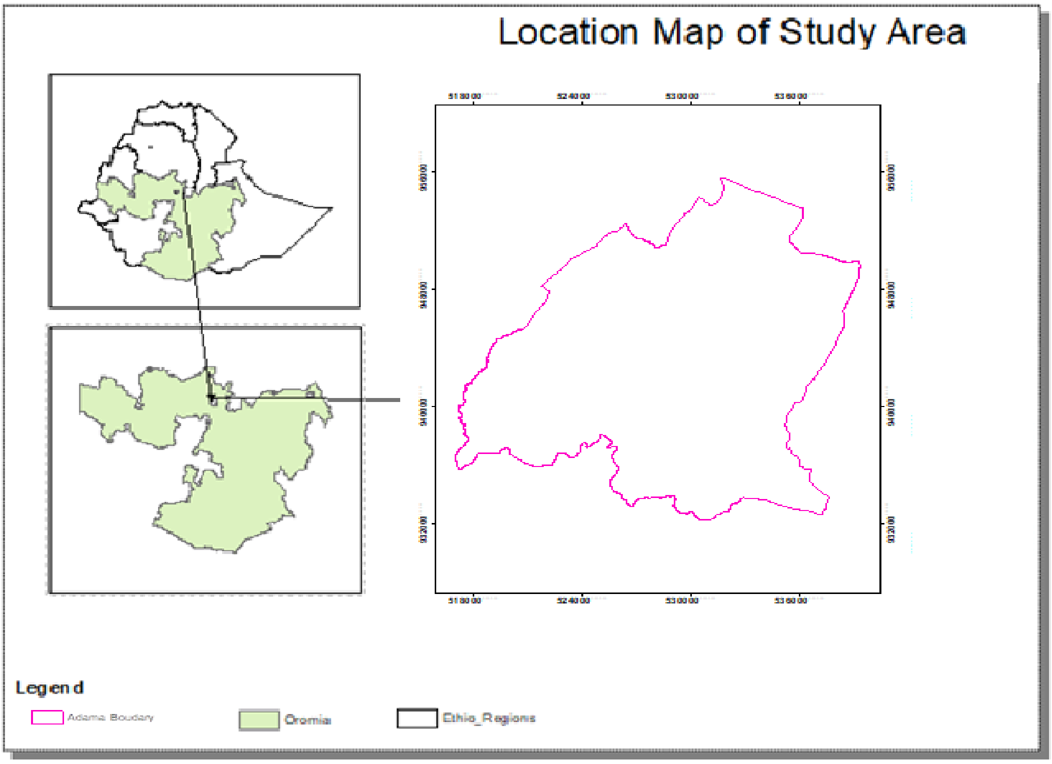

Figure 3.1. Location map Adama city

3.2. Description of Methodology

The following statements outline the detailed methodology steps proposed for this research.

3.2.1 Identification of Determinant Factors

In this phase of the research, the focus will be on identifying the key determinant factors that influence land grading practices. This will involve a two-pronged approach: data collection through surveys and interviews, coupled with the organization of focus group discussions. To gather comprehensive qualitative and quantitative data, structured surveys will be distributed to a diverse group of stakeholders, including real estate professionals, urban planners, and land developers. These surveys will be designed to capture a wide range of factors considered critical in land grading, such as soil characteristics, topographical features, zoning regulations, and environmental constraints. In parallel, semi-structured interviews will be conducted with selected experts to delve deeper into their experiences and perspectives on land grading, allowing for a richer understanding of the nuances involved in the decision-making process.

The procedure for using the AHP can be summarized as:

Model the problem as a hierarchy containing the decision goal, the alternatives for reaching it, and the criteria for evaluating the alternatives.

Establish priorities among the elements of the hierarchy by making a series of judgments based on pairwise comparisons of the elements. For example, when comparing potential purchases of commercial real estate, the investors might say they prefer location over price and price over timing.

Synthesize these judgments to yield a set of overall priorities for the hierarchy. This would combine the investors' judgments about location, price and timing for properties into overall priorities for each property.

Check the consistency of the judgments (Saaty, et al, 2008).

To further enrich the data collection, focus group discussions will be organized, bringing together professionals from various backgrounds in the land development field. These discussions will facilitate interactive dialogue, enabling participants to collaboratively explore and prioritize the determinant factors identified in the surveys and interviews. This dynamic setting encourages the sharing of diverse viewpoints and fosters consensus on the most significant criteria that should be considered in land grading. By employing this comprehensive methodology, the research aims to ensure that the identified factors are both relevant and reflective of current practices in the field, thereby providing a solid foundation for the subsequent development of the GIS-based grading system.

3.2.2. Development of Geospatial-Based Framework

The development of a geospatial-based framework will serve as a critical component of this research, enabling the integration of the identified determinant factors into a cohesive system for land grading assessment. The first step in this process involves designing a framework that effectively incorporates various spatial data layers essential for a comprehensive analysis. These data layers will include topography, which provides insights into elevation and slope; soil type, which affects drainage and stability; drainage patterns, crucial for understanding water flow and potential erosion; existing land use, which can influence both the grading process and property valuation; as well as infrastructure and utility data, which is vital for assessing accessibility and the potential for development. By integrating these elements, the framework will facilitate a holistic view of the land, allowing for a more accurate assessment of its grading.

To enhance the decision-making process within the framework, multi-criteria decision analysis (MCDA) tools available in GIS will be employed. This approach will allow for the weighting of different factors based on their significance in the grading process, enabling the classification of land according to its suitability for various uses. For instance, more weight may be assigned to drainage patterns in areas prone to flooding, while soil type may be prioritized in agricultural contexts. Additionally, infrastructure and utility data will be essential for evaluating how the availability of roads, water supply, and electricity impact land grading decisions.

The selection of appropriate GIS software is crucial for the successful implementation of this framework. Software options such as ArcGIS or QGIS will be evaluated based on their capabilities to handle complex spatial analyses, user-friendliness, and compatibility with various data formats. The chosen software will serve as the platform for developing the framework, allowing for the visualization and analysis of the integrated data layers. By meticulously designing this geospatial-based framework and selecting the right tools, the research aims to create an effective system that enhances land grading assessments and contributes to more reliable property valuation processes.

Impact Analysis of Land Grading on Property Values

In this phase of the research, the focus will be on analyzing the impact of land grading on property values through a systematic integration of data and statistical evaluation. The first step involves the integration of property value data with the previously developed GIS-based grading framework. This will entail gathering comprehensive property valuation datasets from various sources, such as real estate transactions, tax assessments, and appraisal reports. By overlaying this property value data onto the GIS framework, researchers will be able to visualize and analyze the correlations between various land grading factors—such as topography, soil type, drainage patterns, existing land use, and infrastructure—with property values across different locations.

Once the data is integrated, statistical analysis will be employed to rigorously evaluate the impact of the identified land grading factors on property values. Utilizing techniques such as regression analysis will allow researchers to quantify the relationships between the grading factors and property values, controlling for potential confounding variables. This analysis will enable the identification of which grading factors are statistically significant predictors of property value fluctuations and to what extent they influence valuation outcomes. Additionally, multi-variate analysis may be applied to understand the interplay between multiple grading factors and their collective impact on property values. The results of this analysis will not only provide insights into the economic implications of land grading but also support the development of more accurate property valuation models, ultimately contributing to more informed decision-making in real estate and urban planning contexts.

Case Studies for Validation

To ensure the robustness and applicability of the GIS-based grading system, this research will incorporate case studies that facilitate real-world validation of the proposed framework. The first step in this process involves the selection of specific case study areas where diverse land grading practices are implemented and where property values can be comprehensively measured. These locations will be chosen based on criteria such as varying geographical features, different degrees of urbanization, and a range of property types to ensure a representative sample. This diversity will help in understanding how the GIS-based grading system performs across different contexts and conditions.

Following the selection of case study areas, field surveys will be conducted to gather primary data on existing land grading practices and property valuations. These surveys will involve direct observations and measurements of land characteristics, as well as interviews with local stakeholders, including property owners, developers, and real estate professionals. By collecting qualitative and quantitative data firsthand, the research will capture detailed insights into the practical implications of land grading on property value and usability.

After gathering the necessary data, a comparative analysis will be performed to evaluate the outcomes of the GIS-based grading system against traditional valuation methods. This analysis will involve assessing the accuracy of property value predictions generated by the GIS framework in relation to those derived from conventional appraisal techniques. By comparing the results, the research aims to validate the effectiveness and accuracy of the GIS-based system, demonstrating its potential advantages in enhancing property valuation processes. This validation phase is crucial, as it will provide empirical evidence of the framework's utility and support its adoption by professionals in the fields of real estate and urban planning.

Design of Methodology

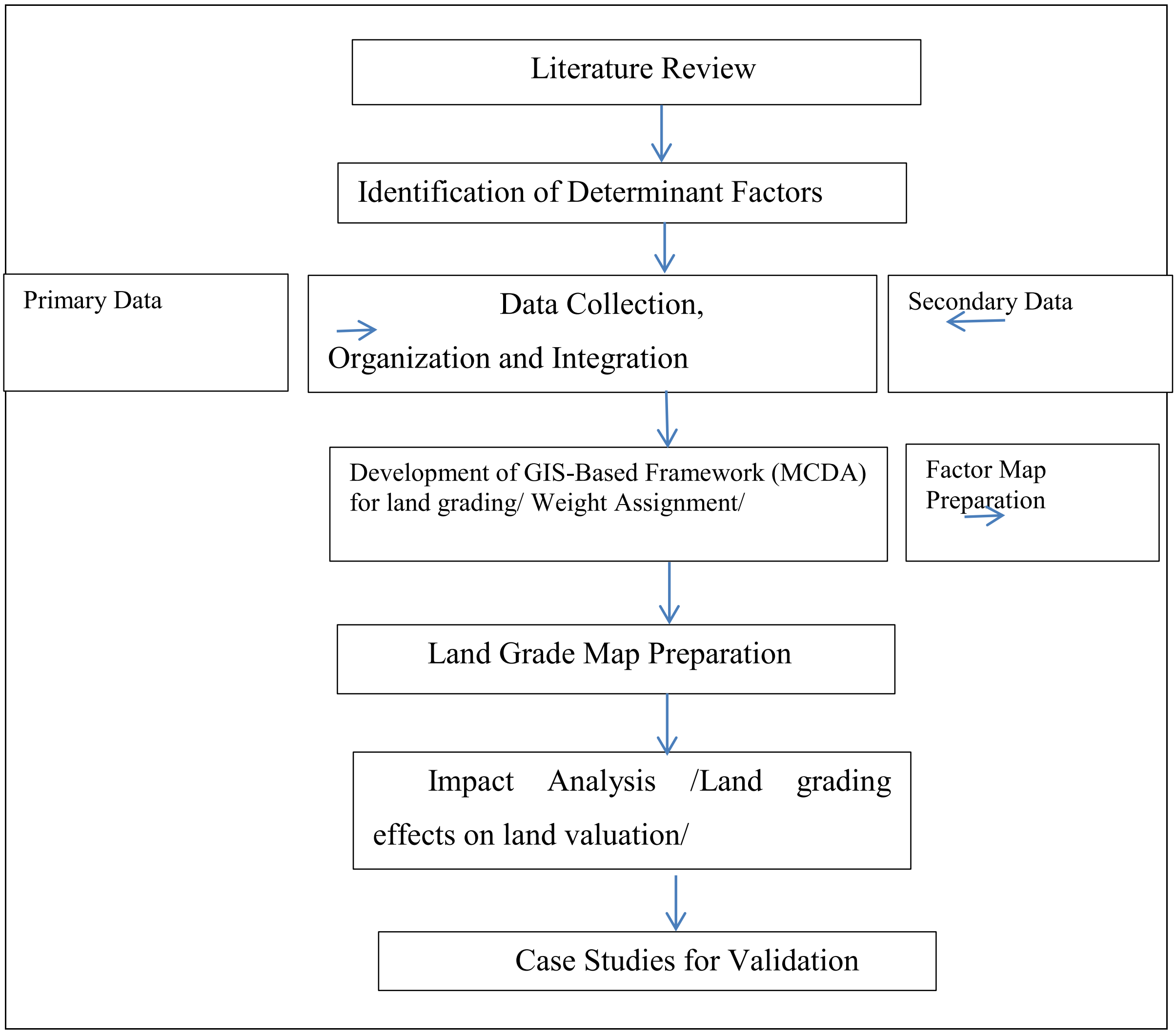

Figure 3.2 Research Methodological Flowchart

The selection of assessment indicators: It will be a critical step in the research methodology, providing a structured framework to evaluate the effectiveness of Adama City's land grading and land valuation management practices. Drawing from the insights gained during the literature review , the researcher will carefully craft a set of indicators that will capture the multifaceted dimensions of the city's land valuation management.

Data Source and software Used

Table 3.1 Data sources

No	Data	Source	purpose
1	selection of indicators	Litreture review	For evaluation analysis
2	OrthoPhoto	Adama Municipality	Spatial data source
3	Hand held GPS	Field data collection: infrastructures data required for this study	Field Verification
4	Land valuation information	Adama Municipality	Non Spatial data source
5	Policy documents	Adama Municipality	Non Spatial data source
6	Structural plan	Adama Municipality	Current land use information

Orthophoto: An orthophoto, orthophotograph, orthoimage or Ortho imagery is an aerial photograph or satellite imagery geometrically corrected ("orthorectified") such that the scale is uniform: the photo or image follows a given map projection. Unlike an uncorrected aerial photograph, an orthophoto can be used to measure true distances, because it is an accurate representation of the Earth's surface, having been adjusted for topographic relief, lens distortion, and camera tilt. In this research it is the main source of spatial data.

Hand held GPS Data: Geodetic control points in this study are the network of the GPS stations based on the national coordinate systems, which is surveyed to control all subsequent GPS measurements. This GPS surveying technique is used to fix X, Y, Z control points in the area. The points were established to locate the precise position of cadastral objects in this research.

Socioeconomic: Timely collection of appropriate, adequate and reliable socioeconomic data and proper use of it for planning, implementation, monitoring and evaluation of various developmental is absolutely essential. In this research, sample socioeconomic data inputs are collected as non-spatial information about specific Land valuation information, and Policy documents to integrated with spatial information toregister land parcel with complete implementation.

Table 3.2 Software's used

No	Software and frame works	Purpose
1	ArcGIS	data digitalization and visualization
2	QGIS Plugins	For System Integration
3	Google earth pro	For validations

CHAPTER IV

4. RESULTS AND DISCUSSION

4.1. Parameters for Urban Land Property Valuation Suitability Modeling

The selection of criteria, ranges, ranks, and weights for the land grading system of Adama City is a critical step in ensuring that the assessment accurately reflects the unique characteristics of the urban environment. These criteria include distance to local administration, water distribution lines, health centers, parks and greenery, market centers, roads, schools, slope, and land use. Each factor was meticulously chosen based on a comprehensive review of existing literature and consultations with experts in urban planning and geography. This collaborative approach ensures that the criteria align with best practices and reflect the needs of the community, providing a robust framework for evaluating land suitability.

The ranges and ranks assigned to each criterion were developed to capture the specific nuances of land use in Adama City. For instance, proximity to local administration is ranked highly due to its significance in facilitating civic engagement and access to governmental services. Similarly, proximity to health centers is prioritized, reflecting the critical importance of accessible healthcare for community well-being. Each criterion's range is designed to quantify how distance impacts suitability, allowing for a more detailed analysis of each parcel's potential. This systematic ranking helps highlight areas that are best suited for development and those that may require additional planning considerations.

The weights assigned to each criterion further emphasize their relative importance in the overall grading system. By quantifying the influence of each factor, the weights ensure that the final land grading reflects a balanced view of various elements that contribute to land suitability. For example, factors such as distance to water distribution lines and schools are weighted to reflect their essential role in supporting residential and commercial development. This thoughtful allocation of weights not only enhances the accuracy of the land grading system but also serves as a valuable tool for policymakers and planners in making informed decisions about land use, infrastructure investment, and community development in Adama City.

4.2. Urban Land grading for Property Valuation Suitability analysis

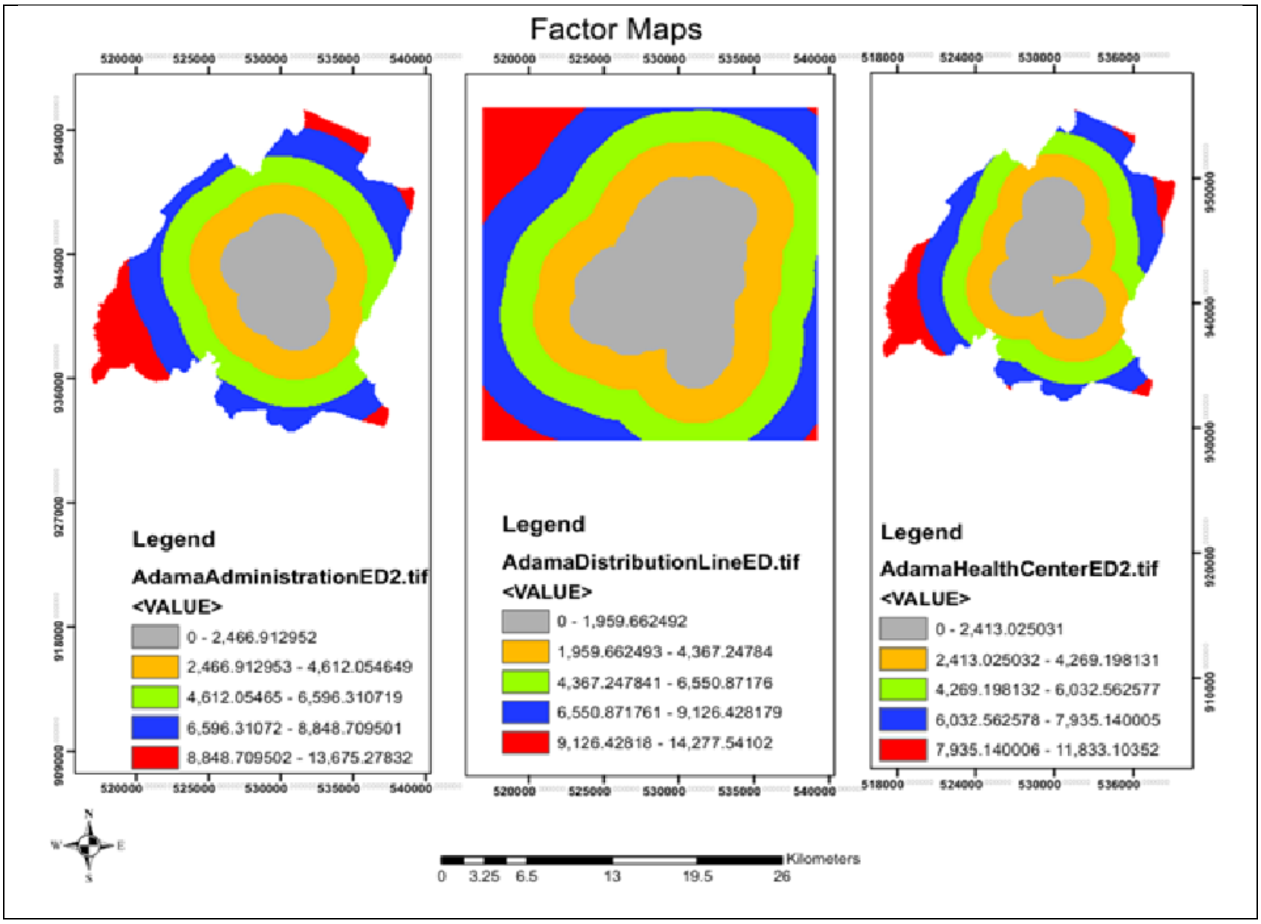

Figure 4.1 Euclidean distance analysis in ArcGIS

Figure 4.1 Shows the use of Euclidean distance analysis in ArcGIS, focusing on three critical factors: administrative centers, water distribution lines, and health centers, within a land grading system. This technique measures the straight-line distances between these features, providing insights into their proximity, which is essential for effective planning and development. Proximity to administration impacts community engagement, while access to water distribution lines is vital for residential and agricultural viability. Additionally, closeness to health centers is crucial for ensuring adequate healthcare access. The findings can inform site selection, infrastructure planning, and promote equitable access to services, helping stakeholders make informed decisions regarding land use. Ultimately, this analysis supports urban planners and policymakers in enhancing community well-being and optimizing resource allocation.

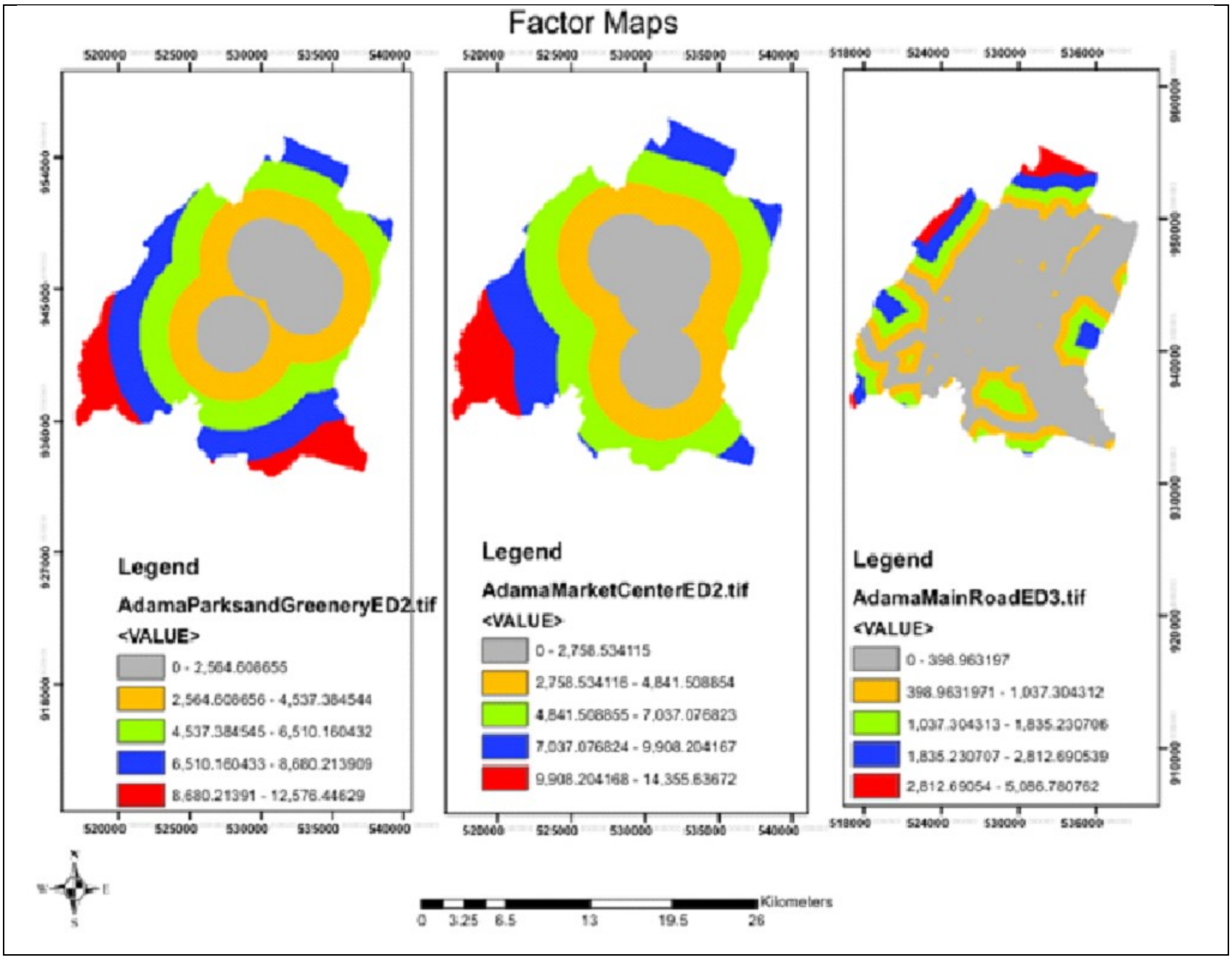

Fig 4.2 Parks ,Road and Market center proximity map of the study area

The research result illustrated in the figure 4.2 demonstrates the application of Euclidean distance analysis within ArcGIS, emphasizing three vital factors: parks and greenery, market centers, and roads, in relation to a land grading system. By measuring the straight-line distances between these features, the analysis provides valuable insights into their spatial relationships, which are crucial for urban planning and community development. Proximity to parks and green areas enhances the quality of life for residents, promoting recreational opportunities and environmental benefits. Access to market centers is essential for economic activity, influencing both consumer behavior and commercial viability. Furthermore, road accessibility is a fundamental component of transportation planning, impacting connectivity and mobility. This analysis aids in identifying optimal locations for future developments, ensuring that new projects are strategically positioned to enhance accessibility to essential services and amenities, ultimately fostering sustainable and livable communities.

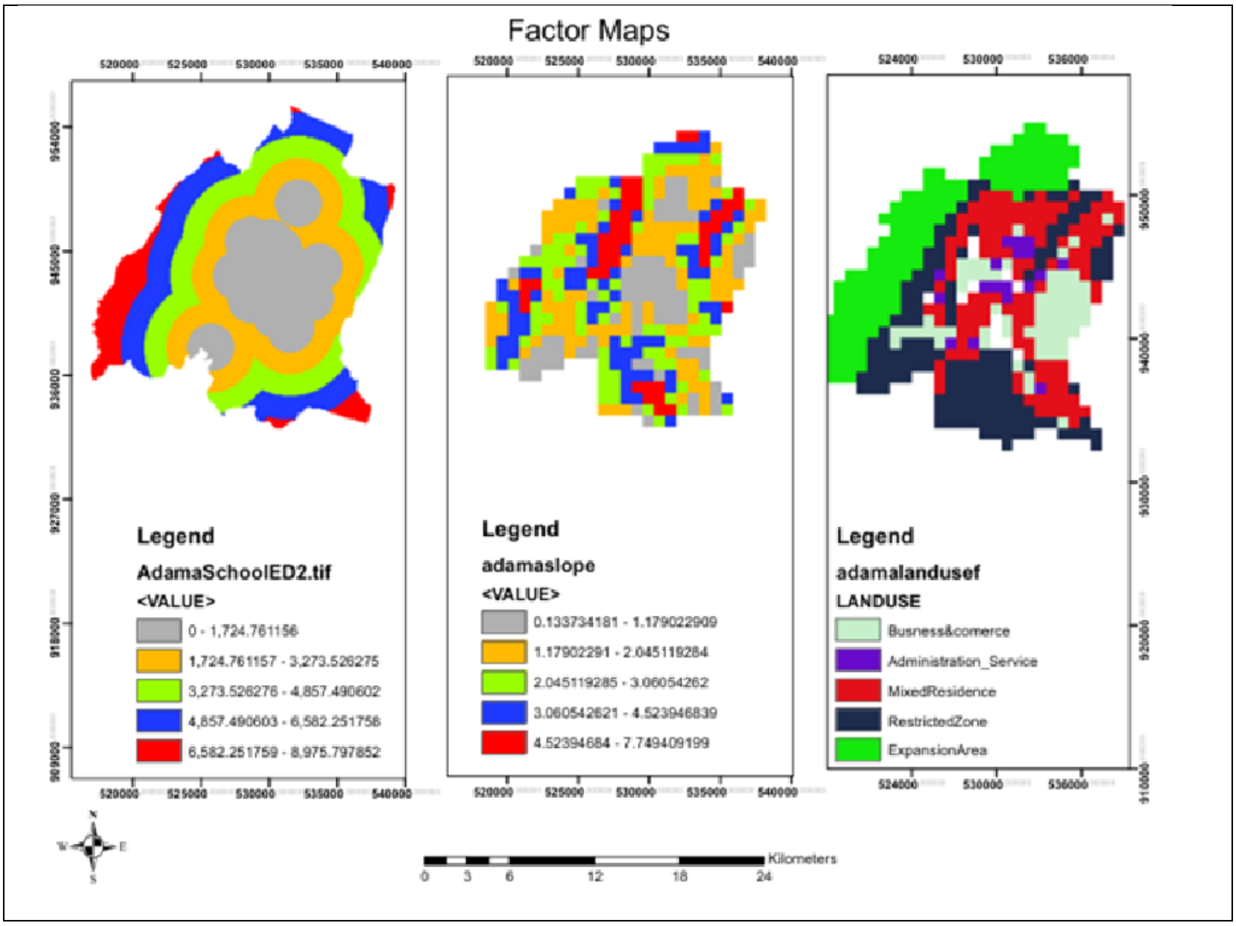

Fig 4.3 School, Slope and Land use proximity map of the study area

The research result depicted in the figure 4.3 highlights the application of Euclidean distance analysis in ArcGIS, concentrating on three essential factors: schools, land use, and slope, within the framework of a land grading system. This analysis measures the straight-line distances between these elements, providing critical insights into their spatial dynamics, which are vital for effective land use planning and development. Proximity to schools is crucial for educational accessibility, influencing residential desirability and community development. The land use factor reflects the existing and planned utilization of the area, which can dictate zoning regulations and development strategies. Additionally, slope analysis is important for assessing the suitability of land for various purposes, such as construction or agriculture, as steep terrains may pose challenges. By integrating these factors, the analysis informs decision-makers about optimal land grading and development strategies, ensuring that new projects are aligned with community needs and environmental considerations, ultimately promoting sustainable growth and improved quality of life.

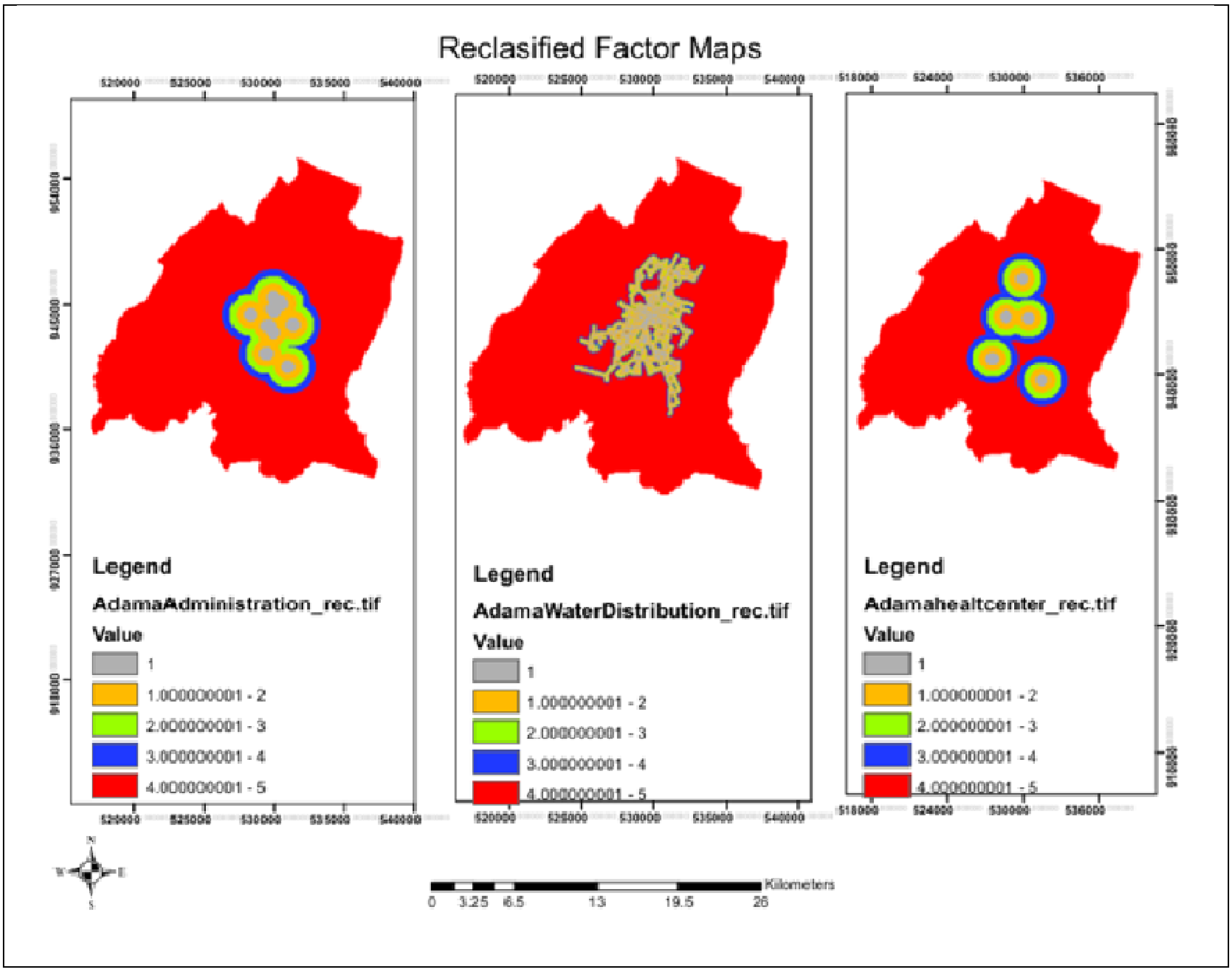

Fig 4.4 Reclassified map of Administration, Water distribution line and health center of the study area

The research result illustrated in the figure 4.4 presents the factor maps for administration, water distribution lines, and health centers, which have been reclassified into five suitability classes using ArcGIS for comprehensive spatial analysis. This reclassification process was meticulously developed based on suitability ranges derived from a thorough review of existing literature and expert recommendations, ensuring that the classifications reflect both theoretical and practical considerations. The administration factor map identifies areas with optimal access to government and administrative services, which can enhance civic engagement and service delivery for residents. The water distribution line map highlights regions with efficient access to water infrastructure, crucial for supporting both residential and agricultural needs. Additionally, the health center classification focuses on proximity to medical facilities, emphasizing the importance of accessible healthcare services for community well-being. By integrating these critical factors into well-defined suitability classes, the analysis equips planners and policymakers with valuable insights, facilitating informed decision-making that promotes equitable access to essential services, improves infrastructure planning, and enhances overall quality of life within the community.

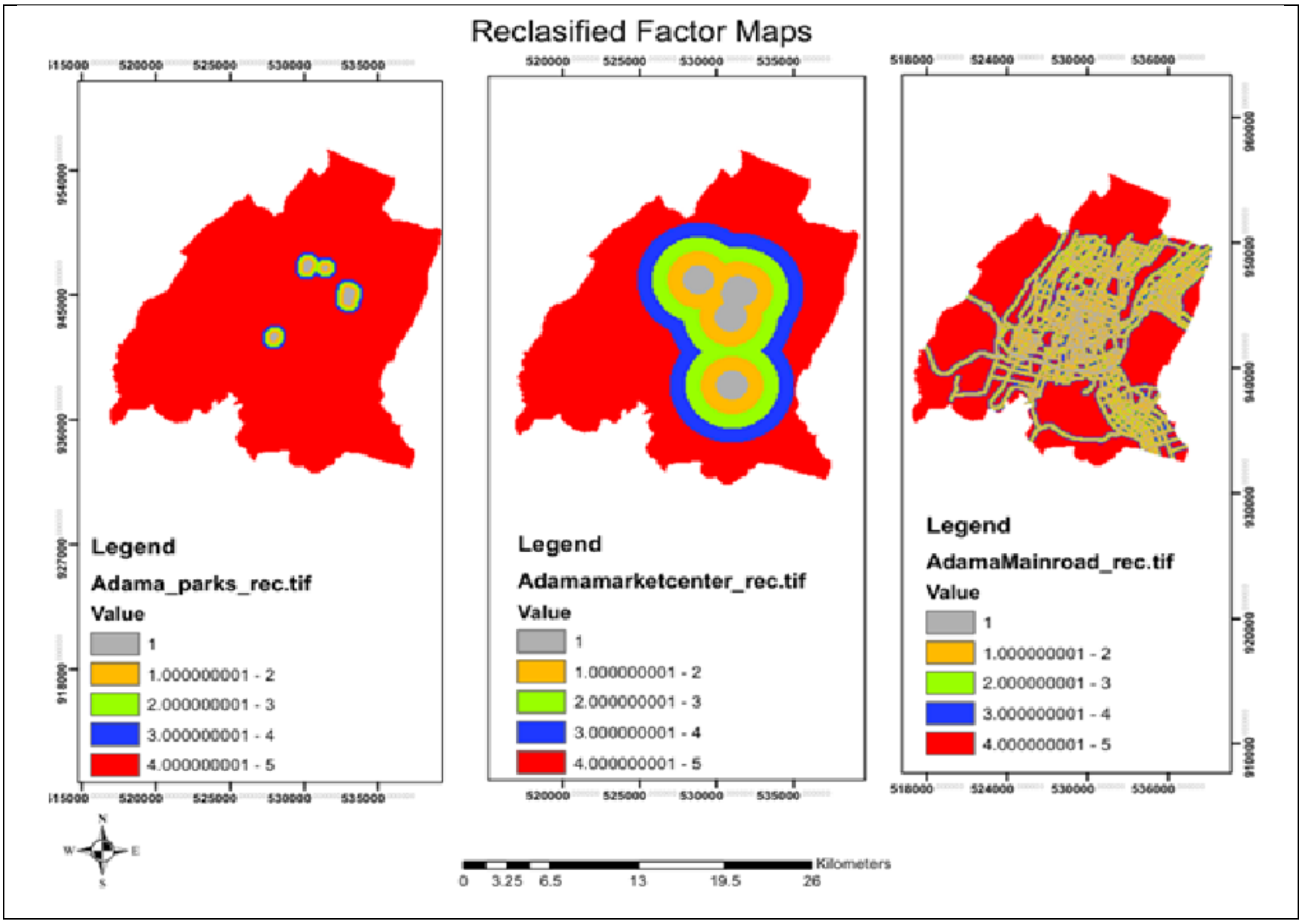

Fig 4.5 Reclassified map of Parks, Road and Market center of the study area

The research result depicted in the figure 4.5 show cases the reclassification of factor maps for parks, market centers, and roads into five suitability classes, utilizing ArcGIS for spatial analysis. This reclassification was guided by suitability ranges established through an extensive review of relevant literature and insights from industry experts, ensuring that the classifications are both scientifically grounded and practical. The parks factor map highlights areas with optimal access to recreational spaces, promoting community well-being and environmental quality. The market center classification identifies regions most conducive to economic activity, facilitating access to goods and services for residents.

Meanwhile, the road factor provides critical information on transportation accessibility, which is essential for connectivity and mobility within the community. By synthesizing these factors into clear suitability classes, the analysis empowers planners and decision-makers to make informed choices about land use and development, ultimately fostering sustainable growth and enhancing the quality of life for residents by ensuring that essential amenities are effectively integrated into urban planning.

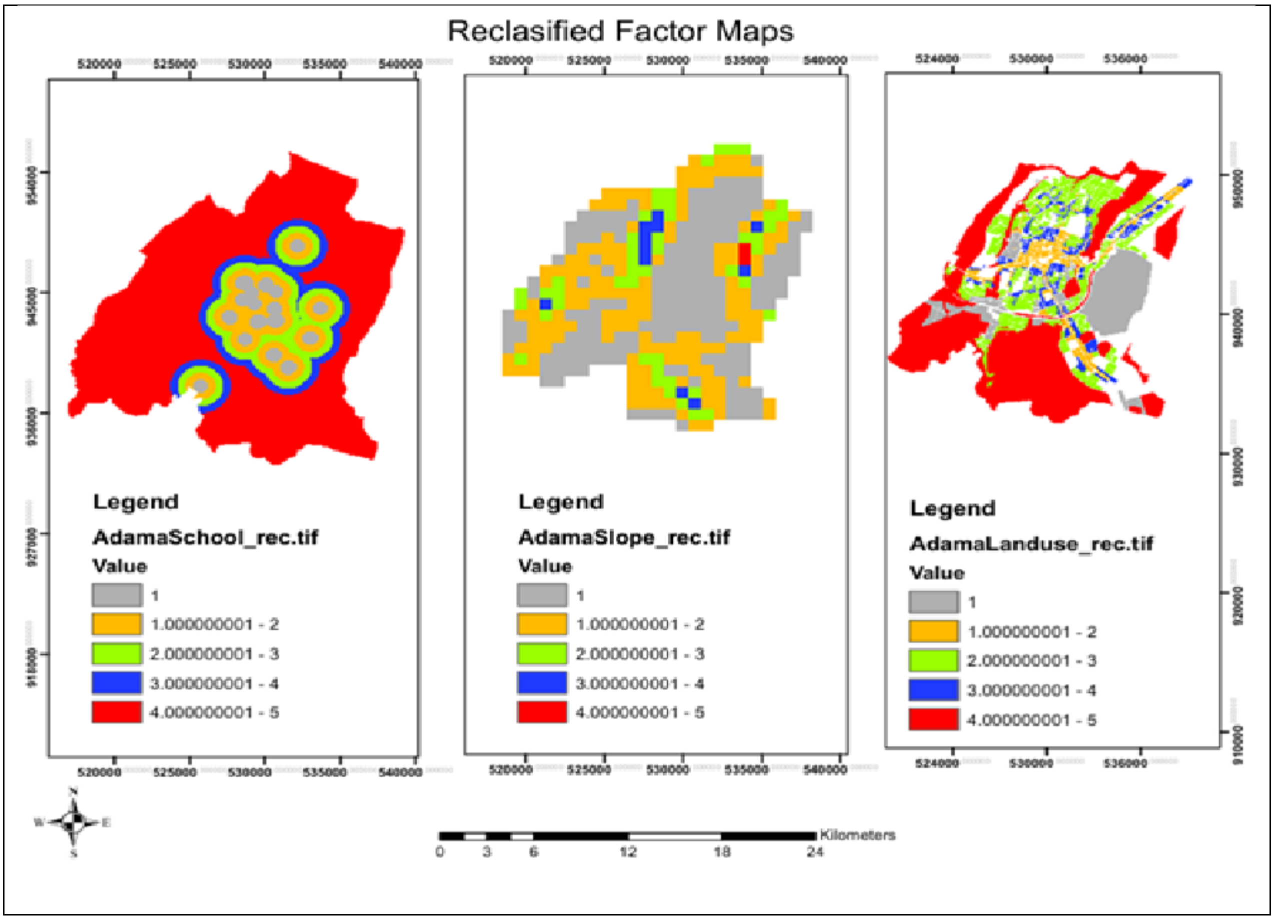

Fig 4.6 Reclassified map of School, Slope and Land use of the study area

The research result illustrated in the figure 4.6 presents the factor maps for schools, land use, and slope, which have been reclassified into five distinct classes to assess suitability within ArcGIS. This reclassification process involved categorizing each factor based on specific suitability ranges that were carefully determined through a combination of literature review and expert input. By employing this systematic approach, the analysis enhances the clarity and usability of the maps, allowing stakeholders to easily identify areas that meet various suitability criteria for development or land use planning. The schools factor highlights regions with optimal access to educational facilities, while the land use classification reflects current and potential uses of the land, ensuring alignment with community goals. The slope classification provides critical information regarding terrain suitability for construction and other activities, as varying slopes can significantly influence land usability. Overall, this comprehensive reclassification allows for more informed decision-making, facilitating strategic planning that considers educational accessibility, land utilization, and environmental factors to promote sustainable development.

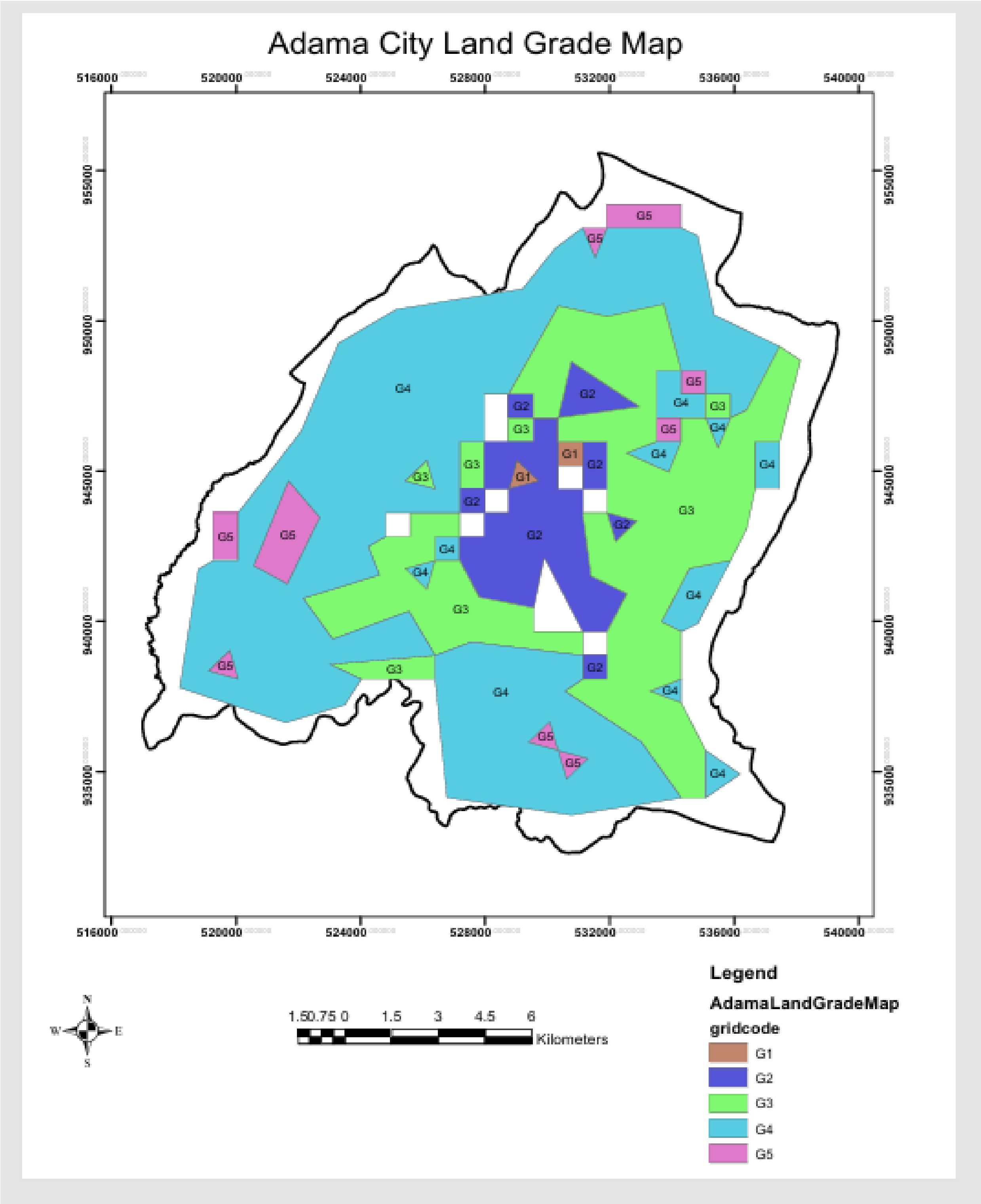

Fig. 4.7 Land grade map of the study area

The land grading map of Adama City, as depicted in the figure 4.7, was generated using a multicriteria analysis that incorporates nine critical factors: administration, water distribution lines, health centers, parks, market centers, roads, schools, slope, and land use. This comprehensive approach allows for a nuanced evaluation of the land's suitability for various uses, reflecting the complex interplay of these factors in urban planning. By assigning appropriate weights to each factor based on a thorough review of relevant literature and expert judgment, the analysis ensures that the resulting map accurately represents the priorities and needs of the community. The integration of these diverse factors highlights the importance of accessibility to essential services, infrastructure, and environmental considerations in determining optimal land use.

The classification of the land grading maps into five categories—G1, G2, G3, G4, and G5—provides a clear framework for understanding the varying degrees of suitability across different areas of the city as shown in figure 4.8. Each class reflects a distinct level of potential for development or land use, with G1 indicating the highest suitability and G5 indicating the lowest. This classification not only aids urban planners and policymakers in making informed decisions regarding land development and resource allocation but also serves as a valuable tool for Property valuation and taxation. By visually representing the suitability of land, the map facilitates discussions around urban growth, infrastructure investment, and the equitable distribution of services, ultimately guiding efforts to foster sustainable development and enhance the quality of life for residents in Adama City.

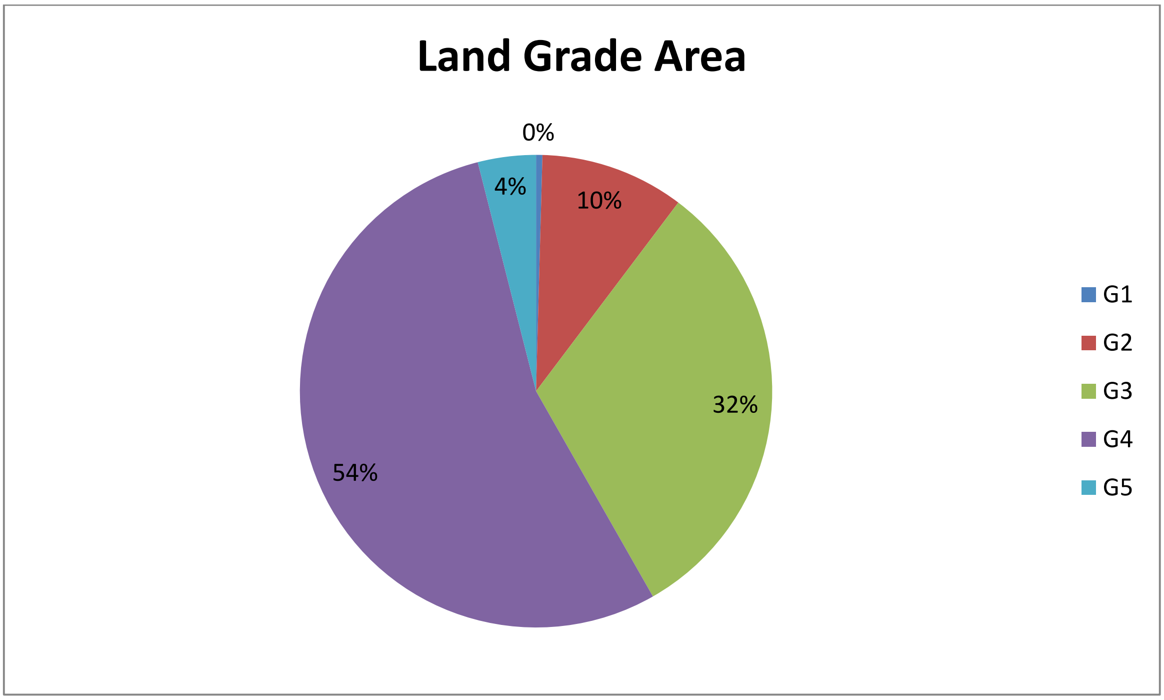

Fig. 4.8 Land grade area

The overlay analysis of the nine parameters reveals significant insights into the spatial distribution of land grades in the studied area. The results indicate that the G4 grade encompasses the largest area, measuring approximately 132,334,640.94 square meters, followed by G3 at around 76,736,869.52 square meters. This distribution suggests that a substantial portion of the land is classified within higher-grade categories, which may correlate with factors such as land quality, development potential, or accessibility. Understanding these spatial dynamics is critical for urban planning and resource allocation, as it can inform strategies aimed at optimizing land use and enhancing economic development in specific regions.

Conversely, the smaller areas associated with G1, G2, and G5 grades—particularly G1, which only covers about 1,052,807.11 square meters—highlight the need for targeted interventions in these lower-grade regions. These areas may possess unique challenges that could hinder development or investment, such as infrastructural deficits or environmental concerns. By analyzing the characteristics associated with each grade, policymakers and planners can develop tailored strategies to improve land use efficiency, promote development in lower-grade areas, and ensure that resources are allocated effectively. Overall, this analysis not only contributes to a deeper understanding of land grading in the region but also serves as a foundation for informed decision-making in property valuation and urban development.

Figure 4.9 illustrates the integration of residential cadastral parcels with the land grading map to assess the land grade of each individual parcel using a GIS spatial join technique. This process involves overlaying the cadastral data—representing property boundaries and ownership—with the land grading classifications, allowing for a detailed analysis of how each parcel aligns with the predefined suitability categories. By conducting this spatial join, the analysis provides insights into the specific land grade associated with each residential parcel, enabling a more precise understanding of its potential value based on the various factors assessed in the land grading process. This methodological approach enhances the accuracy of land assessments, as it contextualizes property characteristics within the broader landscape of urban planning and resource distribution.

The resultant data from this analysis plays a critical role in property valuation and taxation processes. By linking cadastral parcels to their respective land grades, local authorities can establish a more equitable system for determining property values, which is essential for fair taxation practices.

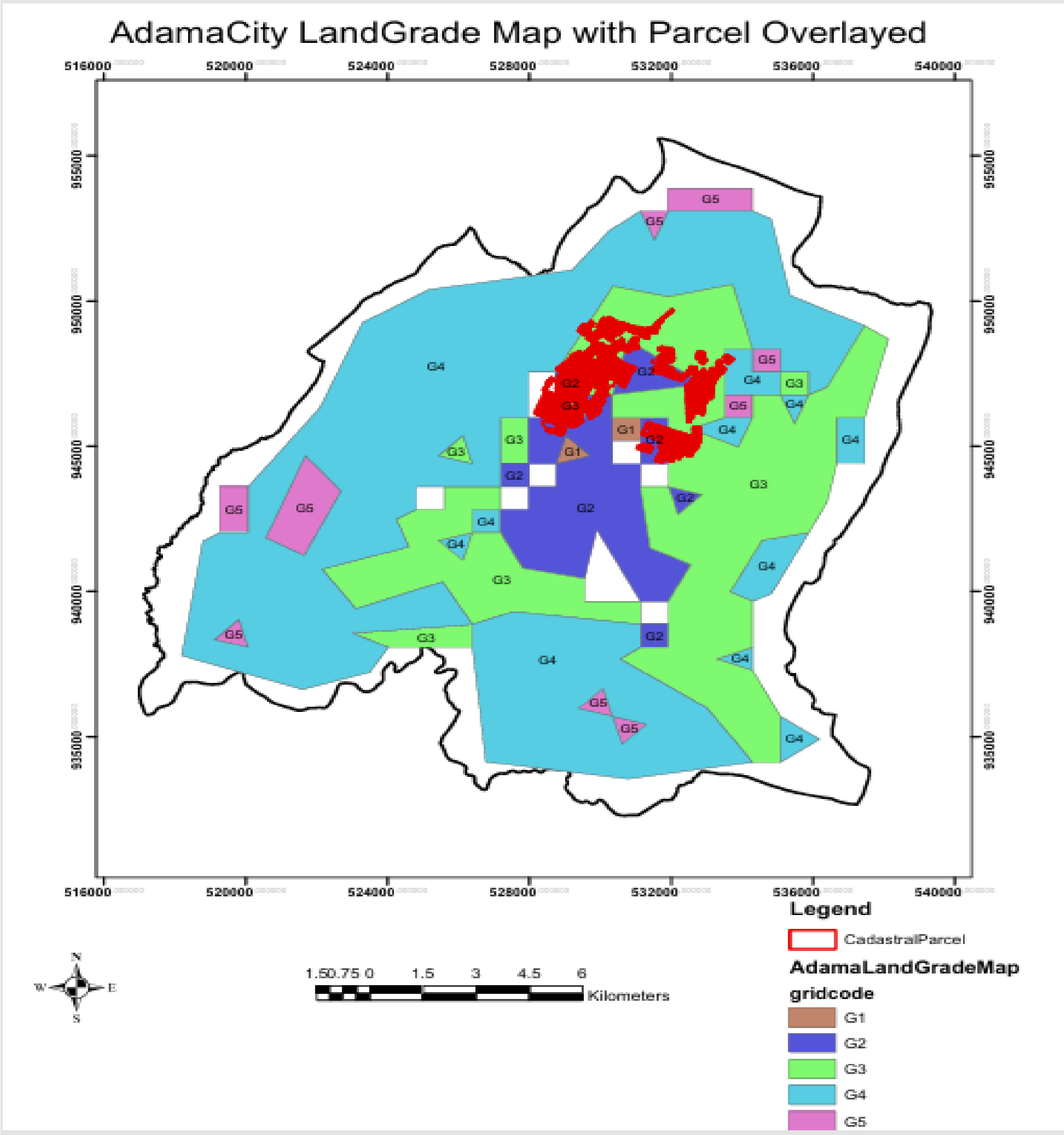

Fig. 4.9 parcel overplayed on land grade map of the study area

This integration allows for adjustments in property assessments that reflect the actual suitability and market potential of the land, thereby ensuring that property taxes are aligned with the intrinsic value derived from location and accessibility to essential services. Furthermore, this approach not only aids in enhancing revenue generation for municipal services but also supports informed decision-making regarding urban development and infrastructure investments, ultimately contributing to more sustainable and efficient urban growth strategies.

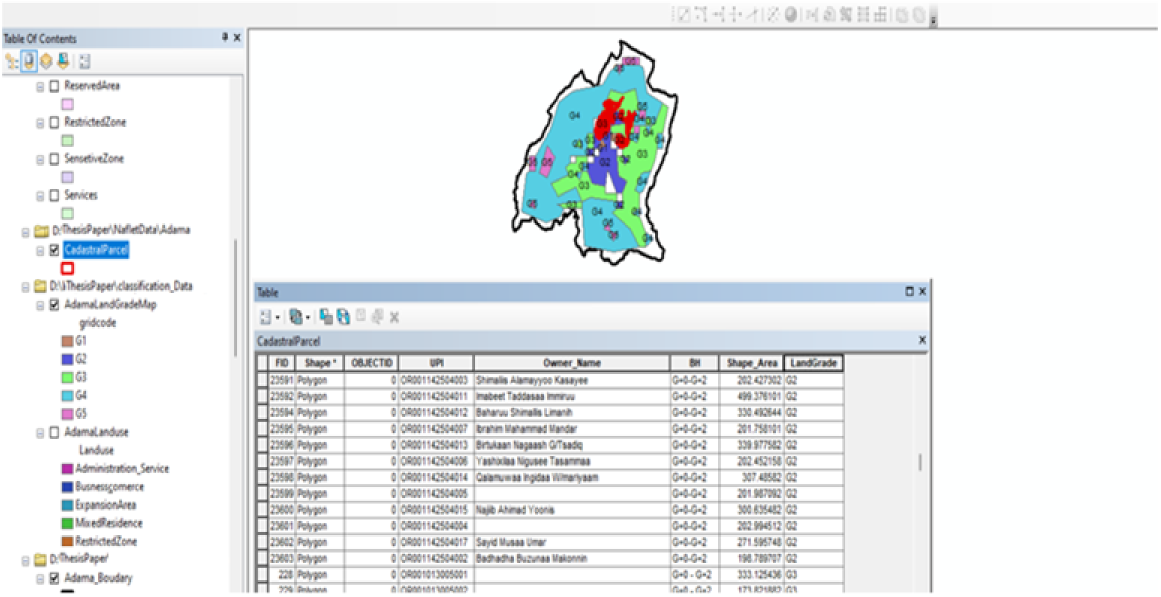

Fig. 4.10 land grade calculated for each parcel

Figure 4.10 illustrates the calculation of land grading for each residential cadastral parcel, which is instrumental in the processes of property valuation and taxation. By determining the land grade associated with each parcel, this analysis provides a detailed assessment that reflects the unique characteristics and suitability of the land. This information forms a crucial basis for understanding the value of properties within the urban landscape, ensuring that evaluations are both accurate and relevant to current market conditions.

The results derived from this land grading analysis play a significant role in establishing fair and equitable property valuations, which are essential for effective taxation systems. By linking the grading of land to individual parcels, local authorities can implement a more nuanced approach to property assessments, taking into account various factors that influence land value. This methodology not only enhances the accuracy of property valuations but also supports the development of more informed taxation policies, ultimately contributing to a balanced approach to urban development and infrastructure funding.

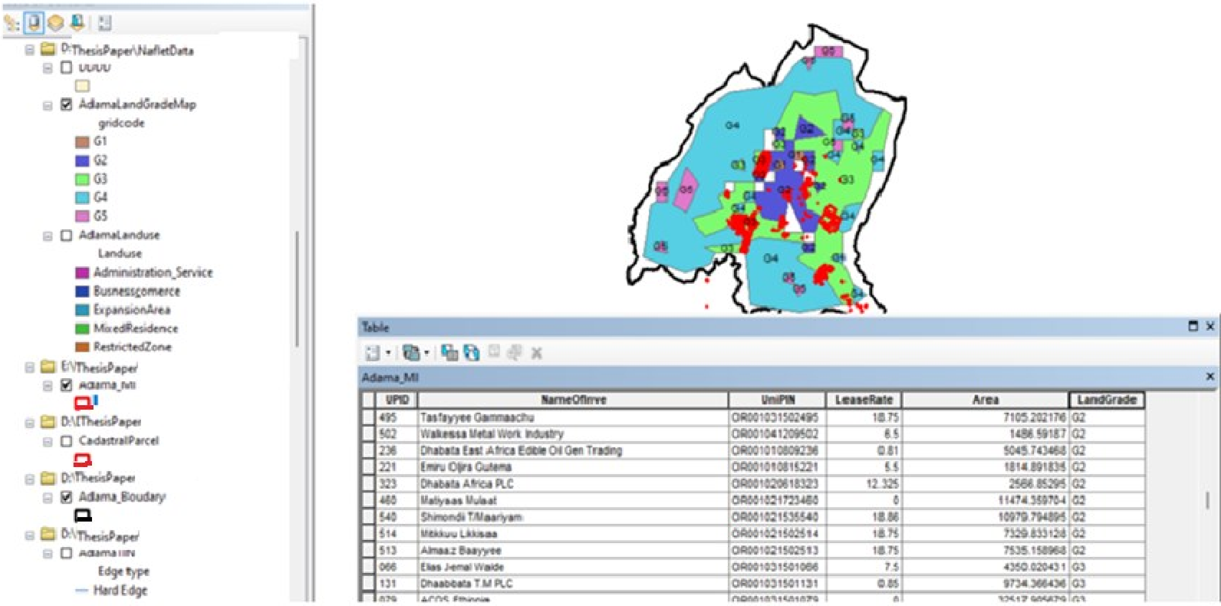

Fig.4.11 Calculation of land grading

Figure 4.11 demonstrates the calculation of land grading for each manufacturing industry parcel, which is essential for property valuation and taxation purposes. By assessing the land grade associated with these industrial parcels, the analysis provides a comprehensive understanding of their unique characteristics and suitability for development. This information is crucial for accurately determining the market value of industrial properties and ensuring that evaluations reflect their true potential within the urban landscape.

The findings from this land grading analysis are pivotal in establishing fair property valuations, which directly impact taxation practices. By correlating the grading of land with individual manufacturing parcels, local authorities can adopt a more refined approach to property assessments, considering various factors that influence industrial land value. This methodology not only improves the precision of property valuations but also aids in formulating equitable taxation policies, ultimately fostering a balanced environment for industrial growth and economic development.

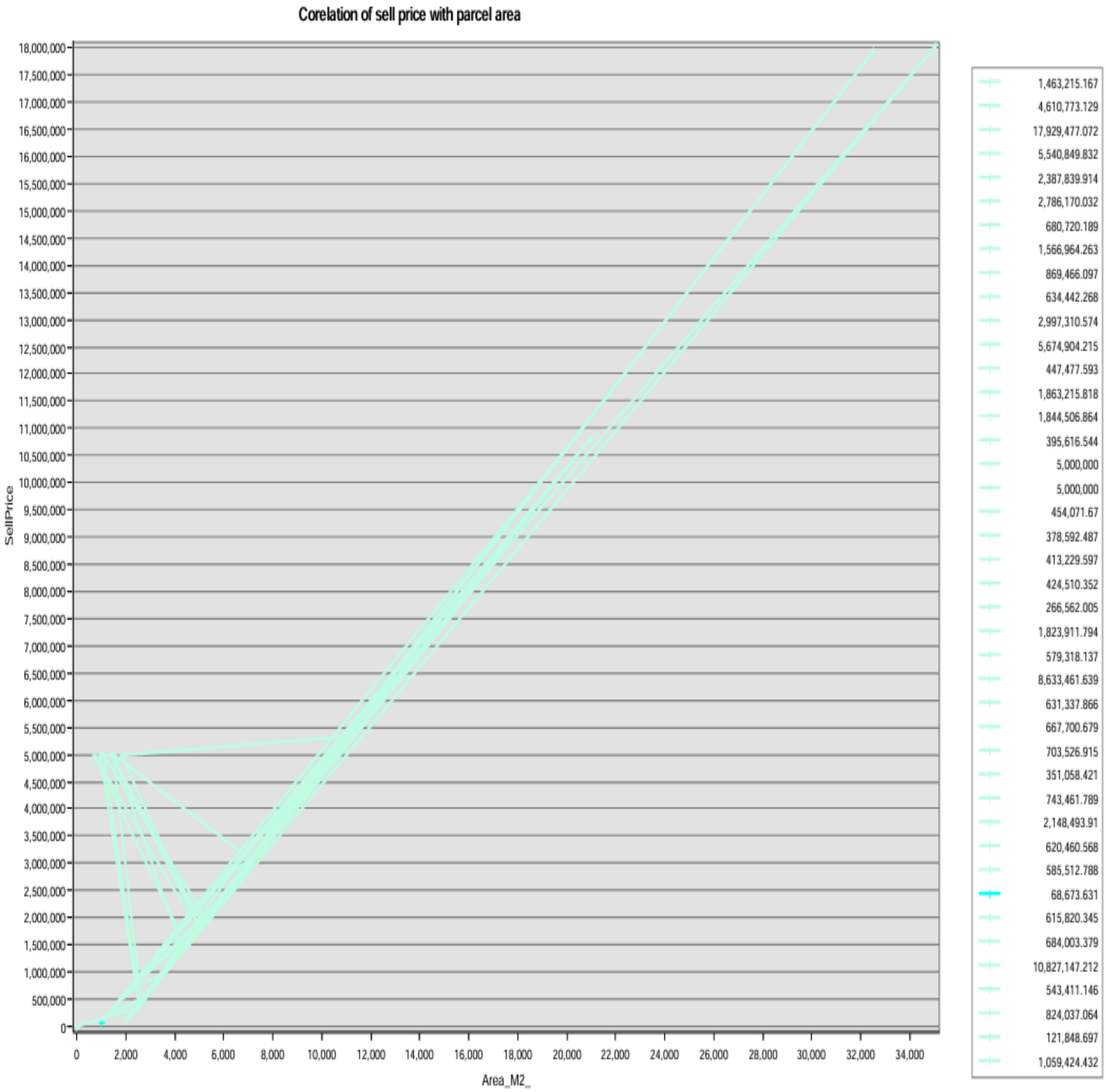

Figure 4.12 Correlation between sell price and parcel area

The research findings indicate a clear positive correlation between the sell price and parcel area in Adama City as shown in figure 4.12, suggesting that larger parcels tend to command higher prices in the real estate market. This trend can be attributed to several factors, including the perception of greater value associated with larger land areas, potential for development, and increased utility. Buyers often view larger parcels as more desirable due to the flexibility they offer for construction, landscaping, and future expansion. As a result, properties with greater land area are frequently priced higher, reflecting an inherent market expectation that larger spaces provide more opportunities for investment and personal use.

However, it is important to note that not all parcels adhere to this trend, as indicated by the exceptions observed in the data. Certain parcels may have unique characteristics, such as location, zoning restrictions, or environmental factors, which can influence their sell price independently of area size. For instance, a smaller parcel situated in a prime location or with desirable amenities may sell for a higher price than a larger parcel in a less favorable area. These anomalies highlight the complexity of real estate valuation, where multiple variables interact to impact pricing beyond simple area measurements. Understanding these nuances is crucial for stakeholders in the real estate market, as it can inform better investment decisions and development strategies.

Table 4.2 Calculated result of different parameters for predicting the sell price

Table

AdamaProperySaleRegression

FID	Shape *	Observed	Cond	LocalR2	Predicted	Intercept	C1_Area_M2	C2_Buildin	Residual	StdError	StdErr_Int	StdErrC1_A	StdErrC2_B	StdResid
0	Polygon	1463215.16691	13.697827	0.832393	2030703.76463	-232373.178787	489.131769	0.103864	-567488.597717	1359988.67581	409289.107367	82.555624	0.482535	-0.41727
1	Polygon	4610773.12932	13.697851	0.832394	4776896.87069	-232376.444045	489.132536	0.103862	-166123.741372	1358558.48234	409289.10784	82.555624	0.482535	-0.12227
2	Polygon	17929477.0718	13.697811	0.832398	16397279.0934	-232381.216015	489.133141	0.103863	1532197.97839	1113601.22141	409289.109393	82.555625	0.482535	1.37589
3	Polygon	5540849.8315	13.69797	0.832382	5588361.9299	-232359.607189	489.13024	0.103861	-47512.098398	1354382.08578	409289.106982	82.555624	0.482535	-0.0350
4	Polygon	2387839.9142	13.699833	0.832283	2883583.51529	-232265.583502	489.125355	0.1038	-495743.601092	1359596.5452	409289.280528	82.555636	0.482535	-0.36462
5	Polygon	2786170.03227	13.699898	0.832281	3240989.38621	-232265.156788	489.125711	0.103798	-454819.353938	1359641.5175	409289.284889	82.555636	0.482535	-0.33451
6	Polygon	680720.188545	13.69985	0.832281	1351845.49886	-232263.18078	489.125027	0.1038	-671125.310312	1356827.35692	409289.2876	82.555636	0.482535	-0.49462
7	Polygon	1566964.26326	13.699827	0.832282	2147041.64419	-232263.117237	489.124858	0.103801	-580077.380932	1358786.65499	409289.286583	82.555636	0.482535	-0.42690
8	Polygon	869466.097351	13.699884	0.83228	1521199.58747	-232263.250245	489.125267	0.103799	-651733.490119	1357339.10766	409289.289149	82.555636	0.482535	-0.48015
9	Polygon	634442.267727	13.699928	0.832279	1310320.33684	-232262.663674	489.125446	0.103797	-675878.069115	1356693.68647	409289.292904	82.555637	0.482535	-0.4981
10	Polygon	2997310.57436	13.699722	0.832282	3430444.66556	-232258.438346	489.123288	0.103807	-433134.091199	1359573.79595	409289.293613	82.555636	0.482535	-0.31858
11	Polygon	5674904.21504	13.699771	0.83228	5832950.51822	-232258.467478	489.123625	0.103805	-158046.303181	1353160.2206	409289.296043	82.555636	0.482535	-0.11679
12	Polygon	447477.592671	13.699806	0.83228	1142568.95519	-232259.649159	489.124077	0.103803	-695091.362523	1356123.79411	409289.294662	82.555636	0.482535	-0.51255
13	Polygon	1863215.81798	13.699833	0.83228	2412858.79746	-232259.964343	489.124313	0.103802	-549642.979484	1359190.00158	409289.295187	82.555636	0.482535	-0.4043
14	Polygon	1844506.86443	13.699877	0.832279	2396070.53764	-232260.284103	489.124669	0.1038	-551563.673211	1359168.1081	409289.296621	82.555637	0.482535	-0.4058
15	Polygon	395616.544433	13.699922	0.832278	1096032.29026	-232260.560922	489.125019	0.103798	-700415.745823	1355956.37633	409289.298203	82.555637	0.482535	-0.51654
16	Polygon	5000000	13.69995	0.832277	306658.363275	-232260.748114	489.125241	0.103796	4693341.63673	1352529.45513	409289.299166	82.555637	0.482535	3.47004
17	Polygon	5000000	13.699965	0.832276	579071.170215	-232259.453518	489.125102	0.103796	4420928.82979	1353838.54006	409289.30346	82.555637	0.482535	3.26547
18	Polygon	454071.669867	13.699923	0.832277	1148483.20878	-232258.882842	489.124712	0.103798	-694411.538911	1356144.26922	409289.30276	82.555637	0.482535	-0.51204
19	Polygon	378592.487211	13.699838	0.832276	1080765.21818	-232252.953648	489.123046	0.103803	-702172.73097	1355900.23541	409289.314638	82.555637	0.482535	-0.51786
20	Polygon	413229.596805	13.699851	0.832276	1111841.83767	-232255.062402	489.123526	0.103802	-698612.240863	1356013.30023	409289.309459	82.555637	0.482535	-0.51519
21	Polygon	424510.351526	13.699871	0.832275	1121964.39085	-232253.431991	489.123352	0.103802	-697454.039329	1356049.44419	409289.315032	82.555637	0.482535	-0.51432
22	Polygon	266562.004618	13.699984	0.832274	980237.667327	-232256.963333	489.124763	0.103796	-713675.662709	1355523.16797	409289.311268	82.555638	0.482535	-0.52649
23	Polygon	1823911.79417	13.697975	0.832345	2344973.38791	-232293.481933	489.118079	0.103877	-521061.593738	1360820.28347	409289.160873	82.555625	0.482535	-0.38290
24	Polygon	579318.136848	13.699825	0.832272	1260874.80649	-232245.05187	489.121487	0.103806	-681556.66964	1356529.31886	409289.336694	82.555638	0.482536	-0.50242

1 (0 out of 91 Selected)

AdamaProperySaleRegression

The research results, as detailed in the table 4.2, provide critical insights derived from the Geographic Weighted Regression (GWR) tool within ArcGIS. The calculated predicted values and observed values illustrate the model's effectiveness in estimating sell prices based on various influential factors, including the intercept and the coefficients for area

(C1) and building cost (C2). The intercept represents the baseline sell price when the area and building cost are both at zero, while the coefficients quantify the impact of each unit increase in area and building cost on the predicted sell price. This detailed breakdown not only enhances our understanding of price determinants in the studied parcels but also lays the groundwork for future valuation efforts.

Furthermore, the inclusion of residuals and standard error metrics enhances the robustness of these predictions. The standard error provides an indication of the variability or uncertainty associated with these predicted values, which is crucial for assessing the reliability of the model. By utilizing these statistical outputs, stakeholders can more confidently calculate the sell prices of other parcels or newly developed properties, thereby facilitating informed decision-making in real estate transactions and investments. This predictive capability is essential for adapting to market dynamics and ensuring that pricing strategies align with current trends and conditions.

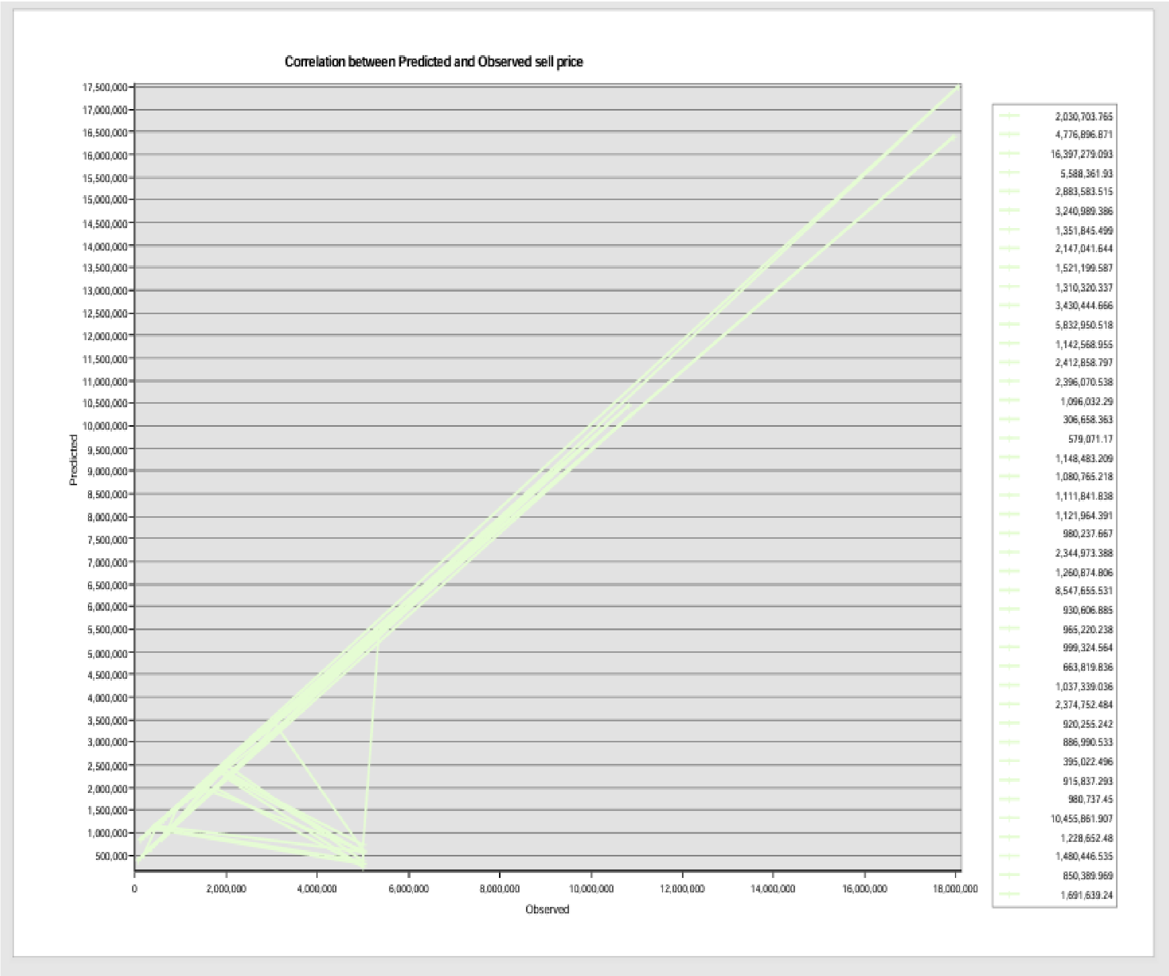

Fig. 4.13 Correlation between predicted and observed sell price

Figure 4.13 illustrating the correlation between predicted sell prices and observed sell prices for Adama City highlights a predominantly positive relationship. This trend indicates that the predictive model used to estimate sell prices is largely effective in capturing the actual market values of the parcels. A strong correlation suggests that the model's underlying assumptions and the variables it incorporates, such as parcel area and building costs, align well with the real estate dynamics in the area. This correlation is crucial for stakeholders, as it validates the model's applicability in making informed decisions related to property investments and pricing strategies.

However, the presence of exceptions—parcels where the predicted values diverge significantly from the observed prices—raises important considerations for further analysis. These anomalies may stem from unique characteristics of certain parcels that the model does not fully account for, such as location advantages, historical significance, or specific buyer preferences. Understanding the factors contributing to these discrepancies is essential for refining the predictive model and enhancing its accuracy. By addressing these outliers, researchers and practitioners can develop more nuanced pricing strategies, ensuring that they consider the multifaceted nature of real estate valuation in Adama City. This understanding can lead to improved investment decisions and more accurate assessments of property value in the future.

Table 4.3 Calculated tax amount from predicted sell price value

Table

AdamaProperySaleRegression

Predicted	Intercept	C1_Area_M2	C2_Buildin	Residual	StdError	StdErr_Int	StdErrC1_A	StdErrC2_B	StdResid	Source_ID	AnualTaxAm
249166.601344	-232346.941249	489.111725	0.103973	4750833.39866	1334419.81966	409289.137871	82.555629	0.482535	3.560224	49	4983.332027
306658.363275	-232260.748114	489.125241	0.103796	4693341.63673	1352529.45513	409289.299166	82.555637	0.482535	3.470048	16	6133.167266
380908.477619	-232381.483452	489.13358	0.10386	4619091.52238	1351409.692	409289.109057	82.555625	0.482535	3.41798	87	7618.169552
395022.4962	-232352.320092	489.120742	0.103918	-326348.864792	1336069.90919	409289.11508	82.555625	0.482535	-0.24426	34	7900.449924
506444.560328	-232359.287382	489.121695	0.103918	-320710.338152	1337275.70921	409289.11655	82.555625	0.482535	-0.239824	69	10128.891207
548436.128305	-232298.002214	489.117989	0.103882	4451563.87169	1352613.95096	409289.152129	82.555625	0.482535	3.291082	59	10968.722566
579071.170215	-232259.453518	489.125102	0.103796	4420928.82979	1353838.54006	409289.30346	82.555637	0.482535	3.265477	17	11581.423404
604533.43299	-232262.835169	489.125327	0.103798	4395466.56701	1353954.73705	409289.291284	82.555637	0.482535	3.246391	56	12090.66866
660566.919138	-232357.047835	489.121468	0.103917	-312919.668547	1338883.81927	409289.115776	82.555625	0.482535	-0.233717	44	13211.338383
663819.835764	-232355.83022	489.120695	0.103921	-312761.415231	1338917.04946	409289.116829	82.555625	0.482535	-0.233593	29	13276.396715
739454.288329	-232255.486204	489.122397	0.10381	4260545.71167	1354547.43174	409289.298961	82.555636	0.482535	3.145365	77	14789.085767
850389.968869	-232257.869647	489.125222	0.103794	-728541.271714	1355009.29399	409289.311124	82.555638	0.482535	-0.537665	40	17007.799377
886159.08633	-232392.440741	489.136579	0.103851	-734743.787184	1354793.56111	409289.11234	82.555625	0.482535	-0.542329	80	17723.181727
886990.533141	-232351.751677	489.12057	0.103918	-301477.745045	1341121.28812	409289.115193	82.555625	0.482535	-0.224795	33	17739.810663
892938.115728	-232353.005798	489.120617	0.103919	-301177.31169	1341178.12366	409289.11561	82.555625	0.482535	-0.224562	61	17858.762315
915837.292839	-232352.897408	489.120917	0.103917	-300016.947648	1341395.72959	409289.114971	82.555625	0.482535	-0.22366	35	18316.745857
920255.242196	-232353.770307	489.120846	0.103918	-299794.673775	1341437.60157	409289.115479	82.555625	0.482535	-0.223488	32	18405.104844
930606.88473	-232358.315972	489.121397	0.103919	-299269.01875	1341535.42481	409289.11665	82.555625	0.482535	-0.223079	26	18612.137695
965220.237976	-232356.725706	489.121247	0.103919	-297519.55934	1341860.05272	409289.116084	82.555625	0.482535	-0.221722	27	19304.40476
974598.021675	-232355.505085	489.120934	0.10392	-297047.493602	1341947.40847	409289.116125	82.555625	0.482535	-0.221356	45	19491.960434
980237.667327	-232256.963333	489.124763	0.103796	-713675.662709	1355523.16797	409289.311268	82.555638	0.482535	-0.526495	22	19604.753347
980737.449757	-232353.891466	489.121183	0.103916	-296734.070428	1342004.36578	409289.114861	82.555625	0.482535	-0.221113	36	19614.748995
999324.563631	-232356.801888	489.120992	0.10392	-295797.649097	1342176.55131	409289.116697	82.555625	0.482535	-0.220387	28	19986.491273
1037339.03601	-232354.68994	489.120686	0.10392	-293877.247454	1342525.34476	409289.11625	82.555625	0.482535	-0.218899	30	20746.78072
1049927.88655	-232631.833846	489.160585	0.103924	-712587.558855	1355562.47987	409290.058971	82.555688	0.482536	-0.525677	90	20998.557731

0 (0 out of 91 Selected)

AdamaProperySaleRegression

Table 4.3 provides a detailed breakdown of the tax amounts assessed for each parcel, calculated using a standardized tax rate of 2% applied to the predicted sell prices. This method of taxation reflects a common practice in property valuation, where the assessed value of a property directly influences the tax obligations of its owner. By linking the tax amount to the predicted sell price, the table underscores the importance of accurate property valuation not only for market transactions but also for municipal revenue generation. This approach ensures that tax assessments are aligned with current market conditions, thereby providing a fair basis for taxation that can be updated as market dynamics evolve.

Furthermore, the implications of these tax calculations extend beyond mere revenue generation; they also play a significant role in shaping property investment decisions. Property owners and potential investors can use this information to better understand their financial responsibilities and the economic feasibility of their investments. Knowing that taxes are directly tied to predicted sell prices, stakeholders can make more informed choices regarding property purchases, renovations, and long-term planning. Additionally, the calculated tax amounts can serve as a critical input for local governments in budgeting and resource allocation, ensuring that community services and infrastructure development are adequately funded. Overall, this comprehensive approach to tax assessment highlights the interconnectedness of property valuation, market trends, and local economic health.

4.3. Discussion of land grading for Urban Land Property Valuation Modeling

In this study, a land grading map was created through multicriteria analysis using ArcGIS, taking into account various factors. Valuation for each parcel was then conducted by considering land grade, parcel area, and building costs. This research underscores the importance of a robust land grading system for property valuation and taxation in Adama City. By utilizing a predictive model to estimate sell prices, the study offers a reliable framework for calculating tax amounts at a standardized rate of 2%. The results reveal a strong positive correlation between predicted and observed sell prices, indicating that the model effectively assesses property values within the local market. This reliability is vital for municipal revenue generation, ensuring that property owners contribute equitably to public resources based on their property's market value.

Additionally, the observed discrepancies in tax calculations highlight the necessity for a nuanced understanding of the local real estate landscape. While the predictive model is a valuable tool, the presence of outliers suggests that certain unique characteristics of parcels may not be fully captured in the existing framework. Therefore, enhancing the land grading system to include additional variables—such as location-specific features, zoning regulations, and buyer preferences—could improve the accuracy of property valuations and tax assessments. Ultimately, refining the land grading system would not only promote fair taxation but also support informed decision-making for property owners and investors, thereby fostering sustainable development and economic growth in Adama City.

The current study identified and analyzed various parameters to determine land value, including slope, land use, road accessibility, and proximity to schools, health centers, and market areas. By employing a multi-criteria evaluation method, the study utilized nine parameters to develop an urban land property valuation model. The overlay analysis of these parameters revealed that G1 grade covers approximately 1,052,807.11 square meters, G2 covers 24,041,834.56 square meters, G3 encompasses 76,736,869.52 square meters, G4 spans 132,334,640.94 square meters, and G5 totals 9,686,237.43 square meters.

Previous research supports the importance of considering diverse parameters in land valuation. For instance, Li, Prussella, et al. (2015) found that factors such as distance to schools, roads, and health facilities significantly influence land value. Similarly, Johnson and Smith (2016) emphasized the relevance of water distribution line density and proximity to government offices in land assessment. Furthermore, Li, Prussella, et al. (2015) conducted a comprehensive literature review, highlighting key determinants of land value, including road accessibility and distance from essential services. This research reinforces the critical role of a land grading system in property valuation, demonstrating that predicted sell prices correlate positively with land grades, even for parcels with smaller areas and building costs. Overall, the current study aligns with existing literature, emphasizing the need to consider a broad range of parameters in land valuation, thereby contributing to a deeper understanding of this complex subject.

This study was made with every effort to gather necessary primary and ancillary data through collection, interpretation, and analysis. Nevertheless, the study faced some limitations, such as the national standard of land grading and unit price of the parcel and constraints to obtain data from various organizations.

CHAPTER V

5. CONCLUSION AND RECOMMENDATION

5.1. Conclusion

This research establishes the vital role of an effective land grading system in enhancing property valuation and taxation processes in Adama City. By integrating a multicriteria analysis approach, the study successfully identified and analyzed key parameters, such as slope, land use, and accessibility to essential services, to develop a comprehensive urban land property valuation model. The results indicate that the overlay analysis of these parameters revealed that Grade/G/: G1 grade covers approximately 1,052,807.11 square meters, G2 covers 24,041,834.56 square meters, G3 encompasses 76,736,869.52 square meters, G4 spans 132,334,640.94 square meters, and G5 totals 9,686,237.43 square meters. The findings also indicate a strong positive correlation between predicted sell prices and land grades, affirming the model's reliability for assessing property values within the local market. This reliability not only facilitates equitable tax assessments but also supports municipal revenue generation, ultimately benefiting community development.

Moreover, the study highlights the necessity for continuous refinement of the land grading system to incorporate unique parcel characteristics that may influence valuation outcomes. Addressing the identified anomalies will enhance the accuracy of property assessments and ensure that all relevant factors are considered. Overall, this research contributes significantly to the existing body of knowledge on land valuation and taxation, providing a robust framework for future studies and practical applications in urban planning and real estate investment in Adama City.

5.2. Recommendations

Based on the findings of this research, several recommendations can be made to enhance the effectiveness of the land grading system for property valuation and taxation in Adama City. First, it is essential to continuously update and refine the grading parameters to include additional variables such as local economic conditions, environmental factors, and emerging urban development trends. Incorporating these elements will provide a more nuanced understanding of property values and better reflect the complexities of the local real estate market.

Second, conducting periodic reviews and validations of the predictive model is crucial to ensure its accuracy and reliability. Engaging stakeholders, including property owners, urban planners, and local government officials, in the feedback process will facilitate improvements and foster a collaborative approach to land valuation. Furthermore, implementing geographic information system (GIS) technology can enhance data collection and analysis, enabling more precise assessments of land value based on real-time data.

Lastly, training and capacity-building initiatives for local officials and property assessors in using the land grading system and predictive models will be vital for effective implementation. By equipping stakeholders with the necessary skills and knowledge, the city can ensure that property valuations are conducted consistently and transparently, ultimately contributing to sustainable urban development and economic growth in Adama City.

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