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Climate adaptation investments on agricultural land values in Kenya: a case study of Kajiado County.

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EFFECTS OF

CLIMATE ADAPTATION INVESTMENTS ON AGRICULTURAL LAND VALUES IN KENYA: A CASE STUDY OF KAJIADO COUNTY

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DECLARATION

This dissertation is my original work and has not been previously submitted and approved for the reward of a degree by this or any other university. To the best of my knowledge and belief, the dissertation contains no material previously published or written by any other person except where due reference is made in the dissertation itself.

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Approval

This research dissertation has been reviewed with my approval as the university supervisor.

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DEDICATION

This dissertation is dedicated to the MPPM faculty for their unwavering support and commitment throughout the journey toward the successful completion of this programme. Their guidance, mentorship, and encouragement have been instrumental in shaping this work.

I dedicate this work to my family, friends, and to my peers for their encouragement, accountability, and constant motivation, which sustained me through the course of this research.

Finally, this study is dedicated to future scholars, with the hope that it serves as a source of inspiration to pursue excellence, remain resilient, and strive to break barriers in their academic and professional journeys.

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ABBREVIATIONS AND ACRONYMS

CBA: Cost-Benefit Analysis

CCCF: County Climate Change Fund

CDICCs: County Development Implementation and Coordination Committees

CDT: Climate Damage Tax

CIDPs: County Integrated Development Plans

CIF: Climate Investment Funds

CIMES: County Integrated Monitoring and Evaluation System

CISPs: Climate Information Services Plans

CVM: Contingent Valuation Model

DID: Difference in Differences

GCF: Green Climate Fund

GEF: Global Environment Facility

GHGs: Greenhouse Gases

HPM: Hedonic Pricing Model

MPT: Modern Portfolio Theory

NACOSTI: National Commission of Science, Technology, and Innovation

NAPs: National Adaptation Plans

NCCAP: National Climate Change Action Plan

NDCs: Nationally Determined Contributions

SSA: Sub-Saharan Africa

UNDP: United Nations Development Programme

UNFCCC: United Nations Framework Convention on Climate Change

WTP: Willingness to Pay

DEFINITION OF TERMS

Access to Basic Services - Access to basic services refers to the availability of essential infrastructure such as water, sanitation, and electricity (World Bank, 2020). In this study, it includes access to water supply, sewerage systems, and electricity connection.

Climate Adaptation Investment Attributes - Climate adaptation investment attributes refer to practices adopted to enhance resilience to climate variability and environmental stress (Food and Agriculture Organization, 2013). In this study, these attributes refer to climate-smart agricultural practices implemented at the farm level, including crop diversification, water management practices, conservation agriculture, and agroforestry.

Crop Diversification - Crop diversification is the practice of cultivating multiple crop types to reduce production risk and improve resilience (Food and Agriculture Organization, 2013). In this study, crop diversification refers to the variety of crops grown on a farm as part of climate adaptation strategies.

Distance to Infrastructure and Services - Distance to infrastructure and services refers to the spatial proximity of land to key facilities (Sherwin Rosen, 1974). In this study, it captures distances to roads, highways, markets, and social amenities, reflecting accessibility and its influence on land value.

Environmental Attributes - Environmental attributes refer to the quality and condition of the surrounding natural environment (Sherwin Rosen, 1974). In this study, these attributes include air quality, noise pollution, waste pollution, and proximity to cultural or natural sites, which influence land desirability and valuation.

Land Values - Land values refer to the monetary worth of land determined by market forces of demand and supply (Alfred Marshall, 1890). In this study, land values refer to the price per acre of agricultural land, expressed in Kenya Shillings (KES), reflecting how different land attributes are capitalized into market prices.

Neighbourhood Attributes - Neighbourhood attributes refer to locational characteristics that influence land value through accessibility and proximity (Sherwin Rosen, 1974). In this study, these attributes include distance to the nearest road, distance to a major highway, distance to markets or shopping centres, and distance to social amenities such as schools and hospitals, all measured in kilometres.

Plot Size - Plot size refers to the total land area measured in acres (David Ricardo, 1817). In this study, it represents a key determinant of land value.

Private Investment in Climate Adaptation - Private investment in climate adaptation refers to financial contributions made by private sector actors toward climate resilience initiatives (Global Commission on Adaptation, 2019). In this study, it captures investments by businesses and individuals aimed at enhancing climate resilience.

Proximity to Cultural/Natural Sites - Proximity to cultural or natural sites refers to the distance between land and areas of cultural or environmental significance (United Nations Educational, Scientific and Cultural Organization, 2019). In this study, it is measured in kilometres and reflects potential amenity value.

Public Investment in Climate Adaptation - Public investment in climate adaptation refers to financial resources provided by governments and multilateral institutions to support climate resilience (Intergovernmental Panel on Climate Change, 2022). In this study, it includes funding through grants, loans, and domestic public expenditure.

Structural Attributes - Structural attributes refer to the physical and service-related characteristics of land that directly influence its utility and value (Sherwin Rosen, 1974). In this study, these include plot size and the availability of basic services such as water, sewerage, and electricity.

Waste Pollution - Waste pollution refers to the presence of solid or liquid waste in the environment (United Nations Environment Programme, 2015). In this study, it reflects environmental degradation that may negatively affect land values.

Water Management Practices - Water management practices refer to techniques used to conserve, store, and efficiently utilize water resources (World Bank, 2021). In this study, these include irrigation systems, rainwater harvesting, and water conservation measures adopted at the farm level.

ABSTRACT

Climate change poses significant risks to agricultural livelihoods, particularly in arid regions. This study investigated how climate adaptation investments are reflected in agricultural land values in Kajiado County, Kenya, focusing on climate-smart agricultural (CSA) practices, neighbourhood attributes, environmental characteristics, and structural attributes. Using a mixed-methods design, quantitative data from 120 farmers were analysed through a hedonic pricing model, complemented by qualitative insights from focus groups.

Results show that CSA practices had no significant effect on land values once socioeconomic and locational factors such as income, land ownership, farm size, years of occupation, and distance to the nearest road were controlled. Neighbourhood attributes exerted the strongest positive influence, underscoring the role of urban expansion and location advantages. Structural attributes such as access to water, electricity, and sanitation also demonstrated a robust positive effect. In contrast, environmental attributes were not significantly capitalised into land values.

In conclusion, climate adaptation investments are unevenly reflected in agricultural land markets: neighbourhood and structural attributes emerged as the most consistent determinants, while CSA practices and environmental attributes showed weaker or insignificant effects.

Keywords: *Climate adaptation, climate-smart agriculture, land values, hedonic pricing model, agricultural land valuation, arid and semi-arid lands, Kajiado County, Kenya.*

CHAPTER ONE

INTRODUCTION AND BACKGROUND TO THE STUDY

1.0 Introduction

This chapter introduces the study which includes background on the effect of climate change, climate financing needs for adaptation and the role of private and public investments in climate adaptation. The chapter also delves into the research objectives, research questions, scope and significance of the study.

1.1 Background to the Study

Agricultural land values are increasingly influenced by climate change and the investments undertaken to enhance climate resilience. Traditionally, land values have been determined by factors such as location, accessibility, infrastructure, environmental quality, and neighbourhood characteristics (Rosen, 1974). However, the growing frequency of climate-related risks, including droughts, floods, and land degradation, has shifted attention toward climate adaptation investments as an emerging determinant of land value (Branca et al., 2012). Climate adaptation investments include measures aimed at reducing vulnerability to climate change and improving resilience, such as climate-smart agricultural practices, water harvesting systems, irrigation infrastructure, agroforestry, and soil conservation initiatives (Kogo et al., 2021). These investments not only enhance agricultural productivity and sustainability but may also increase the economic attractiveness and market value of land (Molua et al., 2023).

The Hedonic Pricing Model, widely applied in real estate and environmental economics, provides a useful framework for understanding how various attributes contribute to land values (Nguyen, 2020). According to the model, land prices reflect the combined value of both tangible and intangible characteristics, including environmental quality, infrastructure, accessibility, and increasingly, climate resilience (Drupp et al., 2024). While climate-smart agricultural practices are widely recognised as important adaptation strategies, limited attention has been given to how broader hedonic factors, particularly neighbourhood, environmental, and structural characteristics, interact with climate adaptation investments to influence agricultural land values (Ngayu & Olale, 2025). Understanding these relationships is essential for promoting sustainable land use and climate resilience in vulnerable regions such as Kajiado County, Kenya.

Globally, climate change poses a major threat to economic systems, ecosystems, and human livelihoods. Human activities, particularly greenhouse gas emissions, continue to accelerate global warming and environmental degradation, thereby undermining the resilience of natural and socio-economic systems (Malhi et al., 2020). The Intergovernmental Panel on Climate Change Sixth Assessment Report warns that several climatic systems are approaching critical tipping points (IPCC, 2021). The report further indicates that global warming beyond 1.5°C is likely to intensify the occurrence of floods, droughts, heatwaves, and sea-level rise, exposing vulnerable regions such as coastal cities, islands, and arid areas to severe environmental and socio-economic risks (Chevallier et al., 2023). Over the past five decades, more than 11,000 weather- and climate-related disasters have been recorded globally, resulting in over two million deaths and economic losses exceeding US$3.64 trillion (Aller et al., 2024). Droughts, storms, floods, and extreme temperatures accounted for the highest mortality rates, while storms and floods generated the greatest economic losses. Beyond their direct impacts on human lives and infrastructure, climate-related hazards also affect environmental attributes such as soil quality, water availability, and vegetation cover, which are important determinants of agricultural productivity and land values (Feigin et al., 2023). Consequently, climate change has transformed environmental resilience into a critical economic consideration in land markets. Studies conducted in countries such as the United States and Australia demonstrate that climate adaptation investments can positively influence land and property values (Yari, 2024). Investments in green infrastructure, flood protection systems, drought-resistant farming technologies, and environmental conservation measures have been associated with increased land values and improved investment attractiveness (Eichsteller et al., 2021). Despite these findings, much of the existing literature focuses primarily on direct adaptation investments while giving limited attention to the broader land characteristics that interact with climate adaptation measures. In particular, the influence of neighbourhood, environmental, and structural attributes on climate adaptation investments and land valuation remains insufficiently explored.

In Africa, climate change continues to threaten agricultural production, food security, and rural livelihoods. Research across the continent has largely concentrated on climate-resilient agricultural practices and adaptation infrastructure aimed at improving productivity and reducing vulnerability (Tesfaye et al., 2023). Studies in Ethiopia and Nigeria, for example, reveal that investments in irrigation systems, soil conservation, and sustainable farming practices contribute to increased agricultural productivity and higher land values (Chiaka et al., 2024). However, these studies provide limited analysis of how broader structural and neighbourhood characteristics influence the effectiveness and value of climate adaptation investments. Sub-Saharan Africa remains one of the regions most vulnerable to climate change despite contributing minimally to global greenhouse gas emissions (Abegunde et al., 2019). The region is projected to experience temperature increases that may exceed the global average by 3-4°C over the next two centuries (Muthee et al., 2020). Climate variability in Sub-Saharan Africa is already evident through declining rainfall in arid regions, increased flooding in East and Central Africa, and more frequent drought events (ACF &

IFPRI, 2023). These climatic pressures continue to undermine agricultural productivity, infrastructure development, and rural livelihoods. Structural characteristics such as irrigation access, transportation networks, storage facilities, and market accessibility are increasingly recognised as important determinants of agricultural land values in Sub-Saharan Africa because they improve productivity and reduce vulnerability to climate-related shocks (NDMA, 2022). Nevertheless, the interaction between these hedonic characteristics and climate adaptation investments remains inadequately understood, particularly in rapidly urbanising and climate-vulnerable regions.

In Kenya, climate change poses significant economic and environmental challenges, with estimated annual losses projected at between 2 percent and 2.8 percent of GDP by 2030 (Moore et al., 2021). The Kenyan economy is highly climate-sensitive due to its dependence on agriculture, which contributes approximately 21.1 percent of GDP and employs more than 40 percent of the population, including over 70 percent of rural households (Ramakrishan, 2023). As a result, prolonged droughts, erratic rainfall, and floods continue to affect agricultural productivity, water resources, food security, and rural incomes (Muthee & Peter, 2021). To address these challenges, Kenya has increasingly promoted climate-smart agricultural practices such as agroforestry, water harvesting, conservation agriculture, and sustainable irrigation systems (Mwangi, 2019). In arid and semi-arid areas, environmental factors including water availability, vegetation cover, and soil quality significantly influence land productivity and market values (Matsaba et al., 2021). Kajiado County, which is largely semi-arid, has experienced rapid urbanisation, infrastructure expansion, and changing land-use patterns, all of which have contributed to rising land values. Existing studies in the county have mainly focused on land tenure systems, urban expansion, and speculative land markets, with limited attention given to the role of climate adaptation investments in shaping agricultural land values (Kinuthia, 2022). Furthermore, there is limited empirical evidence explaining how neighbourhood, environmental, and structural characteristics interact with climate adaptation investments to influence land valuation in the county.

Kajiado County is strategically located in southern Kenya, bordering Nairobi County to the north and Tanzania to the south. The county is predominantly inhabited by the Maasai community, whose livelihoods have traditionally depended on pastoralism (Rotich et al., 2025). However, rapid urbanisation, agricultural expansion, infrastructural development, and population growth have significantly transformed land-use patterns within the county (Ngayu & Olale, 2025). The county's semi-arid climate makes it highly vulnerable to climate variability, particularly droughts and water scarcity, which directly affect agricultural productivity and household livelihoods (Kimaru et al., 2021). Consequently, climate adaptation investments such as water harvesting, irrigation systems, pasture management, and agroforestry have become increasingly important in sustaining economic activities and improving resilience (Mukuna et al., 2015). In addition to environmental factors, structural characteristics such as land tenure security, fencing, road accessibility, and farm infrastructure play a significant role in determining land values because they influence investment decisions, land productivity, and development potential (Deininger et al., 2020). Proximity to Nairobi has further accelerated land value appreciation, particularly in peri-urban areas experiencing rapid infrastructural and commercial development (Boone et al., 2021). As a result, Kajiado County presents an appropriate context for examining how climate adaptation investments and hedonic factors jointly influence agricultural land values.

Climate-smart agricultural practices encompass a broad range of interventions aimed at sustainably increasing agricultural productivity, enhancing resilience to climate variability, and reducing greenhouse gas emissions where feasible (FAO, 2013). The CSA framework includes three interconnected pillars: sustainably increasing agricultural productivity and incomes, adapting and building resilience to climate change, and reducing and removing greenhouse gas emissions where possible (Lipper et al., 2014). The CSA practices examined in this study include crop diversification, water management practices, conservation agriculture, and agroforestry. Crop diversification involves cultivating multiple crop species or varieties on the same farm to reduce production risks, improve nutrition, and enhance soil health (Grigorieva et al., 2023). Diversification spreads risk across different crops, reducing the likelihood of total crop failure under adverse climatic conditions. This practice is particularly relevant in semi-arid areas where rainfall variability makes mono-cropping risky. Water management practices encompass a range of interventions including irrigation systems, rainwater harvesting, water conservation measures, and improved water use efficiency (Tesfaye et al., 2023). In Kajiado County, water scarcity is a critical constraint to agricultural productivity. Investments in water management enable farmers to sustain production during dry spells and reduce dependence on erratic rainfall. Conservation agriculture involves minimum soil disturbance, permanent soil cover, and crop rotation (Kogo et al., 2021). These practices improve soil health, reduce erosion, and enhance water retention. Conservation agriculture is promoted as a climate-smart practice that builds long-term soil resilience and productivity. Agroforestry integrates trees and shrubs into agricultural systems, providing multiple benefits including improved soil fertility, microclimate regulation, carbon sequestration, and diversified income sources (Muthee et al., 2020). In semi-arid areas, agroforestry can moderate temperature extremes and improve water retention. These four practices were selected because they are explicitly promoted within national and county climate adaptation programmes in Kenya, have documented adoption in Kajiado County, represent different dimensions of climate adaptation including risk reduction, water management, soil health, and ecosystem integration, and are measurable through household surveys. The scope of the study is therefore bounded to these practices to maintain analytical focus and ensure comparability across respondents.

Kajiado County has received substantial climate adaptation investments through national and county government programmes, as well as through development partner support. The Financing Locally Led Climate Action initiative, implemented by the national government with support from the World Bank and other development partners, has directed significant resources toward climate resilience projects in the county (County Government of Kajiado, 2023). These investments have supported water harvesting infrastructure, sand dam construction, pasture management, drought-resistant crop promotion, and community-based adaptation planning at the ward level. The County Climate Change Fund, established under the County Climate Change Act and operationalised through the County Development Implementation and Coordination Committees, provides a dedicated funding mechanism for climate adaptation projects prioritised by local communities (Kenduiywo & Miller, 2024). Community projects funded through this mechanism include construction of water pans, rehabilitation of water sources, establishment of tree nurseries, promotion of agroforestry, and capacity building on climate-smart agriculture. Additionally, the County Government of Kajiado has allocated resources within the County Integrated Development Plan 2023-2027 toward climate-resilient infrastructure, including rural access roads, borehole drilling, and market infrastructure development. Parallel to these public investments, private sector and individual landowner investments in climate adaptation have also expanded. Farmers and landowners in peri-urban areas have increasingly invested in borehole drilling, irrigation systems, solar-powered water pumps, greenhouse farming, and fencing (Rosenstock et al., 2022). These investments have been driven by both climate pressures, including recurrent droughts and water scarcity, and market opportunities arising from proximity to Nairobi's expanding urban market.

Agricultural land values in Kajiado County have experienced significant appreciation over the past decade, driven by multiple factors. The construction and improvement of transport infrastructure, particularly roads connecting Kajiado to Nairobi and major towns such as Ngong, Kitengela, Isinya, and Loitokitok, has improved accessibility and increased land desirability (Palmquist, 2005). Urban expansion from Nairobi has extended into Kajiado North and Isinya sub-counties, transforming agricultural land into residential and commercial developments and creating speculative demand (Muyanga & Jayne, 2020). Population growth, both natural and through migration, has increased demand for land for settlement and farming (Sitko & Jayne, 2021). However, the relationship between climate adaptation investments and land value appreciation in Kajiado County remains poorly understood. Despite significant public and private investment in climate resilience, limited empirical evidence exists on whether these investments are capitalised into agricultural land prices (Ariom et al., 2022). Existing studies have focused primarily on land tenure systems, urban expansion, and land-use change, with limited attention to the economic returns of adaptation investments (Wainaina et al., 2020). This study addresses this gap by systematically examining the effect of climate adaptation investments on agricultural land values in the county.

The selection of the four categories of variables examined in this study include climate-smart agricultural practices, neighbourhood attributes, environmental attributes, and structural attributes were informed by theoretical considerations, empirical evidence, and the specific contextual conditions of Kajiado County. The choice of CSA practices as an explanatory variable was motivated by their prominence in climate adaptation policy and practice in Kenya (Rosenstock et al., 2022). Climate-smart agriculture encompasses a range of practices aimed at sustainably increasing productivity and enhancing resilience. In Kajiado County, CSA practices have been promoted through national and county government programmes, development partner projects, and community initiatives (Rotich et al., 2025). The selection of specific CSA practices such as crop diversification, water management, conservation agriculture, and agroforestry was based on their documented adoption in the county and their potential to influence land productivity and resilience. The inclusion of neighbourhood attributes was based on extensive empirical evidence demonstrating that locational characteristics significantly influence land values (Kinuthia, 2022). Neighbourhood attributes capture accessibility to roads, highways, markets, and social amenities, which affect both agricultural productivity through market access and development potential through connectivity. In Kajiado County, the rapid expansion of peri-urban areas, infrastructure development, and proximity to Nairobi have made neighbourhood attributes particularly relevant to understanding land value dynamics (Ngayu & Olale, 2025). Environmental attributes were included based on Rosen's (1974) hedonic pricing theory, which posits that environmental quality should be capitalised into land prices because households derive utility from clean air, low noise, attractive surroundings, and reduced exposure to environmental risks. In semi-arid Kajiado County, environmental conditions may influence land desirability and productivity. However, empirical evidence from developing countries suggests that environmental attributes are often weakly capitalised due to market imperfections and competing priorities (Ochieng & Kirubi, 2020). Structural attributes including access to water, electricity, sanitation, and land improvements were selected based on their documented influence on land values and their enabling role in climate adaptation (Mati & Wambua, 2020). In Kajiado County, water scarcity is a critical constraint, and infrastructure such as boreholes, electricity for irrigation pumping, and land development significantly affect land utility and investment attractiveness (Deininger et al., 2020). Structural attributes also mediate the effectiveness of climate adaptation practices, as CSA practices such as irrigation and agroforestry depend on access to water and, in many cases, electricity.

The Hedonic Pricing Model is an economic valuation approach used to estimate the implicit value of individual attributes embedded within a good or service (Rosen, 1974). The model assumes that the price of land or property reflects the combined contribution of various characteristics, including location, accessibility, environmental quality, infrastructure, and other socio-economic attributes (Nguyen, 2020). In environmental economics, the Hedonic Pricing Model is widely used to estimate the economic value individuals attach to environmental amenities and risks by analysing observed market behaviour (Drupp et al., 2024). The model has become increasingly relevant in climate change research because it enables the valuation of environmental and climate-related attributes through market prices. Researchers have applied the model to estimate how factors such as flood protection infrastructure, green spaces, water availability, environmental quality, and climate resilience influence land and property values (Thompson et al., 2023). In urban and agricultural contexts, the model provides important insights into how climate adaptation investments affect economic behaviour and investment decisions. The theoretical foundations and methodological application of the model are elaborated in the literature review in Chapter Two.

This study is justified on three grounds. First, it advances scholarship by shifting the focus from general adaptation adoption metrics to the capitalization effects of climate adaptation investments on agricultural land values in ASAL regions. Second, it provides empirical evidence on the relationship between climate smart agricultural practices, neighbourhood attributes, environmental characteristics, structural features, and land values using a hedonic pricing framework applied to

Kajiado County. Third, it offers practical insights for county and national governments, development partners, and landowners, enabling them to move beyond ensuring adaptation activity implementation toward strategically designing and financing adaptation investments that generate measurable asset value returns for climate vulnerable communities.

1.2 Statement of the Problem

Climate change continues to pose significant threats to livelihoods, ecosystems, and economic stability, particularly in developing countries where adaptive capacity remains limited (IPCC, 2022). Although global efforts toward climate adaptation have increased over the past decade, financing for adaptation initiatives remains inadequate. Adaptation costs in developing countries are projected to range between US$140 billion and US$300 billion annually by 2030 and may rise to approximately US$500 billion annually by 2050 (UNEP, 2022). This growing financing gap raises concerns regarding the effectiveness, sustainability, and economic returns of climate adaptation investments, especially in agriculture-dependent regions that are highly vulnerable to climatic shocks (Hallegatte et al., 2016).

In Kenya, substantial progress has been made in developing policy and institutional frameworks aimed at enhancing climate resilience. Key initiatives such as the Climate Change Act (2016), the National Adaptation Plan (2015-2030), and the Climate Smart Agriculture Strategy (2017-2026) demonstrate the government's commitment to strengthening climate adaptation and sustainable agricultural development (Government of Kenya, 2018). Despite these policy advancements, empirical evidence on the economic outcomes of climate adaptation investments remains limited, particularly at the local level where agricultural land constitutes a major source of livelihoods and economic activity (FAO & UNDP, 2017).

In Kajiado County, current knowledge about climate adaptation investments and land values is fragmented and primarily descriptive. Existing studies have documented climate vulnerabilities, including recurrent droughts, water scarcity, and land degradation (Keron & Midamba, 2025). The county has received significant adaptation investments through programmes such as the Financing Locally Led Climate Action initiative, the County Climate Change Fund, and community-based projects promoting agroforestry, water harvesting, and drought-resistant crops (County Government of Kajiado, 2023). Research has also examined land tenure systems, adaptation strategies, and land-use change in the county (Kenduiywo & Miller, 2024).

However, the existing literature on Kajiado County is largely descriptive or focused on non-economic outcomes such as tenure arrangements and planning processes. No study has systematically examined whether climate adaptation investments generate measurable economic returns through agricultural land value appreciation in the county. This represents a critical knowledge gap because land constitutes the primary store of wealth for rural households in Kenya (Rotich et al., 2025); if adaptation investments do not increase land values, their long-term poverty reduction potential is questionable.

Furthermore, empirical research on climate adaptation investments and agricultural land values has primarily focused on general adoption rates of climate-smart agricultural practices, barriers to implementation, and resilience outcomes (Ngayu & Olale, 2025). Existing studies, including Molua et al. (2023) on property rights and adaptation profitability and Keron and Midamba (2025) on CSA practices and smallholder farm income, underscore the importance of tenure security and institutional support in determining adaptation outcomes. While insightful, this body of work has primarily emphasized productivity and income effects at the expense of asset valuation outcomes, particularly land value capitalization, which is critical for understanding long-term economic returns to adaptation investments.

At the same time, conventional land valuation studies largely emphasise neighbourhood, environmental, and structural characteristics without explicitly linking them to climate adaptation efforts (Kinuthia, 2022). Consequently, the interaction between climate adaptation investments and hedonic land attributes remains insufficiently understood in semi-arid, peri-urban African contexts (Acheampong & Anokye, 2021). This study addresses this integrated gap by simultaneously examining the effects of climate-smart agricultural practices, neighbourhood attributes, environmental characteristics, and structural attributes on agricultural land values in Kajiado County using a hedonic pricing framework. Critically, climate adaptation investments in this study are conceptualised broadly to include not only climate-smart agricultural practices but also the neighbourhood, environmental, and structural conditions that enable or constrain adaptation effectiveness. This broader conceptualisation recognises that adaptation investments operate within a system of complementary attributes that jointly determine land values.

1.3 Aim of the Study

To determine the effect of climate adaptation investments on agricultural land values in Kajiado County using the Hedonic Pricing Model.

1.4 Research Objectives

i. Determine the effect of climate-smart agricultural (CSA) practices on agricultural land values in Kajiado County.

ii. Determine the effect of neighbourhood attributes on agricultural land values in Kajiado County.

iii. Determine the effect of environmental attributes on agricultural land values in Kajiado County.

iv. Determine the effect of structural attributes on agricultural land values in Kajiado County.

1.5 Research Questions

i. What is the effect of climate-smart agricultural (CSA) practices on agricultural land values in Kajiado County?

ii. What is the effect of neighbourhood attributes on agricultural land values in Kajiado County?

iii. What is the effect of environmental attributes on agricultural land values in Kajiado County?

iv. What is the effect of structural attributes on agricultural land values in Kajiado County?

1.6 Scope of the Study

This study focused on Kajiado County, one of Kenya's arid and semi-arid land counties, selected due to its high climate vulnerability and ongoing adaptation investments. The study examined the relationship between climate adaptation investments and agricultural land values across six sub-counties: Kajiado Central, Kajiado North, Kajiado West, Isinya, Loitokitok, and Mashuuru.

In terms of content, the research focused on four categories of variables: climate smart agricultural practices including crop diversification, water management, conservation agriculture, and agroforestry as the main adaptation investment variable, with neighbourhood attributes including accessibility to roads, highways, markets, and social amenities, environmental characteristics including air quality, noise pollution, waste pollution, and proximity to cultural and natural sites, and structural attributes including plot size, water, sewerage, and electricity as additional explanatory variables. The dependent variable was the per acre market value of agricultural land in Kenya shillings.

The study targeted smallholder farmers and landowners who had actively used or managed agricultural land within Kajiado County for a minimum period of five years preceding data collection. This criterion ensured respondents had sufficient exposure to both climate variability and adaptation practices. Respondents were required to be involved in at least one form of land-based economic activity such as crop farming, livestock keeping, irrigation, or soil and water conservation.

The temporal scope covered a fifteen-year period from 2007 to 2022. This timeframe was selected to capture observable climate adaptation investments and corresponding land value trends following Kenya's adoption of the Climate Change Act (2016) and the subsequent implementation of county-level adaptation programmes including the Financing Locally Led Climate Action initiative.

The study did not extend to non-agricultural land, urban residential properties, or commercial real estate. It also did not assess mitigation investments such as renewable energy or carbon sequestration projects.

1.7 Significance of the Study

1.7.1 Policy Makers

This study provides policymakers with concrete empirical evidence on the effect of climate adaptation investments on agricultural land values. The findings assist in crafting land use policies that integrate climate adaptation strategies, thereby enhancing resilience in ASAL regions such as Kajiado County. The study informs the creation of regulations that encourage sustainable agricultural practices and infrastructure investments, which in turn boost land value while supporting environmental conservation. Specifically, county and national government agencies including the Ministry of Environment, Climate Change and Forestry, the National Environment Management Authority, and Kajiado County Department of Environment, Natural Resources and Climate Change can use these findings to justify adaptation expenditure allocations and design evidence-based climate finance instruments.

1.7.2 Practitioners

For real estate developers, urban planners, and agricultural extension officers, this study provides valuable insights into the relationship between climate smart agricultural practices, environmental factors, and land prices. Real estate investors can make well informed decisions regarding investment locations based on climate adaptation strategies. Agricultural practitioners can leverage these insights to align their farming approaches with climate adaptation trends, ultimately enhancing productivity and sustainability. Financial institutions and microfinance providers can use the findings to design climate linked credit products that recognize the capitalized value of adaptation investments on agricultural land.

1.7.3 Academicians and Researchers

For academics and researchers, this study expands the pool of information on climate adaptation and land economics by delivering a context specific analysis of Kajiado County. It addresses empirical gaps concerning the relationship between climate adaptation investments and hedonic land pricing models, offering a framework applicable to other ASAL regions. Future researchers can build on this work to investigate the long-term effects of climate change on land values across various ecological zones. The study contributes to the limited body of knowledge on adaptation capitalization in sub-Saharan Africa, complementing existing work by Keron and Midamba (2025), Molua et al. (2023), and Rotich et al. (2025).

1.7.4 Kajiado County

For Kajiado County, a predominantly ASAL region facing recurrent droughts, water scarcity, and land degradation, this study documents how climate adaptation investments translate into tangible economic outcomes. The findings support the county government's implementation of the County Climate Change Fund and the Financing Locally Led Climate Action framework by providing evidence on returns to adaptation investments. The study also supports the Kajiado County

Integrated Development Plan 2023-2027 by identifying which adaptation practices most significantly influence land values and thus farmer livelihoods.

1.8 Chapter Summary

This chapter has established the research foundation by outlining the investigation's focus on critical factors influencing agricultural land values in Kajiado County, specifically the effects of climate adaptation investments. It has presented the background, context, and significance of the identified problem, clearly stating the research aim, objectives, and questions that guided the inquiry. The chapter defined study boundaries through scope and significance while outlining the importance of results to contribute to both scholarly knowledge and policy enhancement for climate vulnerable regions. The subsequent chapter provides a comprehensive review of relevant literature related to the study variables and theoretical framework.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

This chapter explores the relevant theoretical perspectives on public and private investments in relation to climate change. The chapter reviews literature on climate adaptation investments and agricultural land values, drawing on Social Impact Investment Theory, Public Goods Theory, and Lancaster's Characteristics Theory of Value as the theoretical foundations. The empirical section examines studies on climate-smart practices, neighbourhood, environmental, and structural attributes, highlighting key findings and gaps. A conceptual framework illustrates how these variables relate to land values in Kajiado County, and a summary table identifies research gaps, providing the rationale for the study.

2.1 Theoretical Review

This study is anchored on four complementary theoretical perspectives: the Social Impact Investment Theory, Public Goods Theory, Lancaster's Characteristics Theory of Value, and the Hedonic Pricing Model. These theories collectively provide a robust framework for understanding how climate adaptation investments influence agricultural land values. Social Impact Investment Theory explains how investments aimed at generating environmental and social benefits can simultaneously produce economic returns. Public Goods Theory highlights the role of collective environmental and infrastructural attributes that contribute to welfare and influence land values but are often underprovided by private markets. Lancaster's Characteristics Theory of Value explains how consumers derive utility from the attributes embedded in goods rather than from the goods themselves. Building on this foundation, the Hedonic Pricing Model provides an empirical framework for estimating the implicit value of individual land attributes. Together, these theories enable a comprehensive examination of how climate-smart agricultural practices, neighbourhood characteristics, environmental conditions, and structural attributes influence agricultural land values in the context of climate adaptation.

2.1.1 The Social Impact Investment Theory

The Social Impact Investment Theory, commonly referred to as Impact Investing Theory, emerged from the growing recognition that investment capital can be mobilized to achieve both financial returns and positive social or environmental outcomes. The theory gained prominence in the early 2000s through the contributions of scholars and practitioners such as Jed Emerson and Sir Ronald Cohen. Emerson (2003) introduced the concept of blended value, arguing that all investments generate a combination of economic, social, and environmental value and therefore should be evaluated based on their overall contribution to society. Cohen (2020) further advanced the theory by advocating for investment models that intentionally direct capital toward addressing social and environmental challenges while maintaining financial viability.

The central proposition of Social Impact Investment Theory is that investments can simultaneously create measurable social and environmental benefits while generating economic returns for investors (Kaplan-Hallam & Bennett, 2018). Unlike traditional investment theories that focus primarily on profit maximization, impact investing recognizes that financial performance and social welfare objectives can be mutually reinforcing. Consequently, investments in environmental sustainability, climate resilience, renewable energy, and climate-smart agriculture can generate private economic benefits while contributing to broader societal welfare.

Within the context of climate change adaptation, the theory suggests that investments in climate-smart agricultural (CSA) practices such as agroforestry, conservation agriculture, water harvesting, irrigation systems, drought-tolerant crops, and soil conservation technologies enhance both environmental resilience and economic productivity. These practices reduce vulnerability to climate-related shocks, improve agricultural output, and strengthen the long-term productive capacity of land. As a result, such investments may increase the attractiveness of agricultural land to prospective buyers and investors, leading to higher market values. The theory therefore provides an important lens through which climate adaptation measures can be understood as investments that generate both environmental and financial returns.

The theory further emphasizes the growing importance of environmental, social, and governance (ESG) considerations in investment decision-making. Investors increasingly seek assets that demonstrate sustainability and resilience to climate risks. Agricultural land incorporating climate adaptation measures is therefore likely to attract greater investment interest because of its enhanced capacity to withstand adverse climatic conditions and maintain productivity over time. Consequently, adaptation investments may become capitalized into land values through market mechanisms.

This theory primarily informs Objective I, which seeks to examine the effect of climate-smart agricultural practices on agricultural land values. The theory posits that adaptation investments create environmental and social benefits while simultaneously generating economic value. Accordingly, agricultural land parcels that incorporate CSA practices are expected to command higher market values than comparable parcels without such investments. The theory therefore provides the basis for hypothesizing a positive relationship between climate adaptation investments and land values.

Despite its relevance, the Social Impact Investment Theory faces several criticisms. One major challenge concerns the measurement and quantification of social and environmental impacts, which are often difficult to standardize and compare across projects (Making, 2020). Scholars have also raised concerns regarding impact washing, whereby organizations overstate their social or environmental contributions without delivering meaningful outcomes (Schlütter et al., 2023). Furthermore, Bengo et al. (2021) argue that the pursuit of financial returns may sometimes overshadow social objectives, creating a risk of mission drift. Nevertheless, the theory remains highly relevant to climate adaptation studies because it highlights the potential for investments to generate both resilience benefits and economic returns.

2.1.2 Public Goods Theory

Public Goods Theory was developed by Samuelson (1954, 1955) to explain the provision of goods and services characterized by non-rivalry and non-excludability. Non-rivalry implies that one individual's consumption of a good does not diminish its availability to others, while non-excludability means that individuals cannot easily be prevented from benefiting from the good once it is provided. Because private markets often fail to provide such goods efficiently, the theory argues that public intervention is necessary to ensure their adequate provision.

The theory is particularly relevant to environmental and climate-related investments because many environmental resources and adaptation measures exhibit public good characteristics. For example, flood control infrastructure, watershed protection, climate information systems, erosion control measures, and environmental conservation initiatives generate benefits that extend beyond individual landowners to entire communities. Since these benefits are widely shared, private investors may have insufficient incentives to finance such projects independently, leading to underinvestment and market failure.

Within the context of agricultural land valuation, neighbourhood and environmental attributes often function as public goods. Infrastructure such as roads, electricity networks, irrigation systems, schools, health facilities, and markets benefits entire communities and improves accessibility and economic opportunities. Similarly, environmental quality, including clean water resources, low pollution levels, biodiversity conservation, and attractive landscapes, enhances welfare and contributes to land desirability. As these attributes improve, their benefits become reflected in higher land values.

Public Goods Theory also highlights the role of government policies and public investments in promoting climate adaptation. Public investments in environmental conservation, climate-resilient infrastructure, and agricultural support services can strengthen community resilience and increase the value of surrounding land. The theory therefore provides a framework for understanding why certain environmental and neighbourhood characteristics influence land prices even when they are not directly owned or controlled by individual landowners.

This theory directly informs Objective II, which examines the effect of neighbourhood attributes on agricultural land values, and Objective III, which investigates the effect of environmental attributes on agricultural land values. Neighbourhood characteristics such as roads, markets, schools, healthcare facilities, and utility services provide collective benefits that are capitalized into land values. Similarly, environmental attributes such as water availability, environmental quality, and ecosystem health function as public goods whose benefits are reflected in land prices. The theory therefore explains why public investments and environmental conditions significantly influence agricultural land values.

Despite its contributions, Public Goods Theory has been criticized for oversimplifying the distinction between public and private goods. Many goods exhibit mixed characteristics and may be provided through partnerships involving public, private, and community actors (Cornes & Sandler, 1984). Critics also argue that the theory underestimates the role of market-based mechanisms and institutional arrangements in addressing collective action problems. Nevertheless, the theory remains valuable for understanding the influence of shared environmental and infrastructural attributes on land values and climate adaptation outcomes.

2.1.3 Lancaster's Characteristics Theory of Value

Lancaster's Characteristics Theory of Value was developed by Lancaster (1966) as an alternative to traditional consumer theory. The theory proposes that consumers derive utility not from goods themselves but from the bundle of characteristics or attributes embodied in those goods. According to Lancaster, the value of a good is determined by the specific attributes it possesses and the satisfaction consumers derive from those attributes.

The theory represents a significant departure from conventional economic approaches that treat goods as homogeneous units of consumption. Instead, it recognizes that goods consist of multiple characteristics that contribute differently to consumer preferences and market value. Consequently, consumers evaluate goods based on the utility generated by their attributes rather than by the goods themselves.

In the context of land markets, agricultural land can be viewed as a bundle of characteristics, including climate adaptation features, accessibility, environmental quality, infrastructure availability, soil fertility, water resources, and other locational attributes. Buyers and investors assess the desirability of land based on the combination of these characteristics and the benefits they provide. Therefore, differences in land prices can be explained by variations in the attributes embodied within each parcel.

The theory is particularly relevant to climate adaptation research because climate-smart agricultural practices constitute important land attributes that can influence buyer preferences and market values. Adaptation investments may enhance productivity, reduce climate risks, improve environmental quality, and increase resilience, thereby contributing positively to land valuation.

Similarly, neighbourhood, environmental, and structural attributes influence the utility derived from land and consequently affect market prices.

Lancaster's Characteristics Theory provides the conceptual foundation for all four research objectives. Objective I focuses on climate-smart agricultural practices as valuable land attributes. Objective II examines neighbourhood characteristics that influence accessibility and convenience. Objective III evaluates environmental characteristics that contribute to ecological quality and sustainability. Objective IV investigates structural attributes that improve functionality and productivity. The theory suggests that each of these characteristics contributes to the overall value of agricultural land and therefore influences market prices.

Bradford (1970) extended Lancaster's arguments by emphasizing that consumers derive utility from bundles of characteristics rather than from individual units of goods. This perspective reinforces the notion that land value reflects the collective contribution of multiple attributes rather than any single characteristic. Consequently, Lancaster's theory provides a strong conceptual basis for analysing agricultural land values within a hedonic pricing framework.

2.1.4 The Hedonic Pricing Model

The Hedonic Pricing Model (HPM), developed by Rosen (1974) and grounded in Lancaster's Characteristics Theory of Value, estimates the implicit value of individual attributes within a composite good. In land and property markets, prices reflect the combined contribution of characteristics such as environmental, neighbourhood, and structural factors. Widely applied in environmental and real estate economics, the model isolates the value of attributes that are not traded separately.

In this study, HPM serves as the primary analytical framework, enabling estimation of the contribution of climate-smart agricultural practices, neighbourhood, environmental, and structural attributes to agricultural land values. While powerful, the model assumes competitive markets and full information and may face challenges such as omitted variables or data limitations. Nonetheless, it remains a robust tool for assessing the economic effects of climate adaptation investments

2.1.5 Theoretical Synthesis

The four theories collectively provide a comprehensive framework for understanding the relationship between climate adaptation investments and agricultural land values. Social Impact Investment Theory explains how climate adaptation investments can simultaneously generate environmental benefits and economic returns. Public Goods Theory highlights the importance of collective environmental and infrastructural attributes that influence land values and often require public intervention. Lancaster's Characteristics Theory explains how land value is derived from the bundle of attributes embodied within a parcel of land. Building on this theoretical foundation, the Hedonic Pricing Model provides an empirical mechanism for estimating the implicit value of individual land attributes. Together, these theories establish the conceptual and analytical basis for examining how climate-smart agricultural practices, neighbourhood attributes, environmental characteristics, and structural features influence agricultural land values.

2.2 Empirical Literature Review

2.2.1 Effect of Climate Smart Agricultural Practices on Agricultural Land Values

A growing body of literature has examined the relationship between climate-smart agricultural practices and agricultural land values, though the evidence remains fragmented and context-specific. Studies have employed various methodological approaches, including hedonic pricing models, production function analysis, and farm-level valuation techniques, to estimate the economic returns to adaptation investments. The findings from these studies reveal important insights into how CSA practices influence land values, though significant gaps remain, particularly in the context of arid and semi-arid lands in Sub-Saharan Africa.

Research on soil conservation investments provides some of the most direct evidence linking adaptation practices to land values. A recent study examining agricultural lands in Nigeria employed a hedonic pricing model using household-level self-reported land values from the Nigeria Living Standards Measurement Survey (World Development, 2023). The findings revealed that undertaking soil erosion control facilities is heavily capitalised into Nigerian agricultural land values, with the estimated marginal implicit price for undertaking soil erosion control approximately 26% of mean land values. This value represents around half the annual nominal median income of a Nigerian agrarian household. The study concluded that soil erosion control adoption can be an important source of wealth creation among smallholder farmers, suggesting that investments in land conservation generate measurable returns through asset appreciation.

Similarly, Molua et al. (2023) provided empirical evidence on the impact of farm-level investments in climate-smart agricultural practices related to conservation agriculture in Cameroon, the Central African Republic, and the Democratic Republic of Congo. Using data from more than 600 farms across 12 regions and 45 divisions, the study employed a farmland value model incorporating tenure, climate, soils, and socioeconomic variables. The findings revealed that conservation agriculture techniques within climate-smart practices show benefits for smallholder farmers through improvements in soil health, soil moisture retention, and enhanced crop yields. Importantly, the study also found that property rights to land and trees play a fundamental role in governing investment patterns and the profitability of agriculture, suggesting that the economic returns to CSA practices are conditional on institutional factors such as tenure security.

In Nigeria, a study evaluating the econometric analysis of agricultural land values in Imo State using a hedonic pricing approach found that unsustainable land management practices had contributed to diminishing land values over time (Imo State Study, 2017). The study recommended efficient land management practices such as organic manuring, crop rotation, and alley cropping to improve land value. This finding is significant because it demonstrates that the absence of adaptation and conservation practices can lead to land value depreciation, suggesting that the adoption of CSA practices may be necessary not only for productivity enhancement but also for value preservation.

Studies examining the adoption and impact of CSA practices in Kenya have focused primarily on productivity and food security outcomes rather than land value effects. Research on CSA adoption and household food security in Kenya revealed that the greatest effect of CSA adoption on food security occurs when farmers use a larger package containing all four categories of practices (CSA and Food Security Study). The study also found that land fragmentation negatively affects CSA adoption, recommending civic education and provision of alternative income-generating activities to benefit farmers when practiced on relatively bigger land. While this study did not directly examine land values, it highlights the importance of comprehensive adoption strategies for maximising returns to adaptation investments.

In Makueni County, Kenya, a study examining determinants of adoption of climate-smart agricultural practices among smallholder farmers found that approximately 44% of smallholder farmers adopted CSA practices including soil conservation practices, crop diversification, agroforestry, conservation tillage, irrigation practices, and terraces (Makueni CSA Adoption Study, 2025). The study identified land size, group membership, access to credit, and being a lead farmer as significant predictors of CSA adoption. This finding is important for understanding the factors that enable or constrain CSA adoption, which in turn influence the potential for land value appreciation.

In Tanzania, research on communities' consideration underlying valuation of agricultural land in Lushoto district identified farmers' perceived agricultural land value determinants across different land use types (Lushoto Study, 2022). Using household surveys, key informant interviews, and focus group discussions, the study found that land under vegetable cultivation was highly valued, followed by agroforestry, woodlots, and crop cultivation. Farmers identified physical and social-cultural determinants including topography, soil fertility, nearness to water, nearness to road, aesthetic, heritage, and management practices. Nearness to water, nearness to road, soil fertility, aesthetic, heritage, and management practices were significantly higher across the land uses. This perception-based study suggests that farmers themselves recognise the value-enhancing potential of various land management practices, including those associated with climate adaptation.

Research on agroforestry as a CSA practice has also provided evidence of economic benefits. A study analysing agroforestry farm profitability in Oyo State, Nigeria estimated the potential net economic value of carbon sequestered by agroforest land at ₦7,246.37 ($9.18) per hectare (Oyo

State Agroforestry Study, 2026). The results indicated that agroforestry practices have a significant capacity to generate economic value, suggesting that the integration of trees into agricultural systems may enhance land value through multiple channels including carbon sequestration, improved soil fertility, and diversified income streams.

Despite the growing evidence linking CSA practices to improved economic outcomes, the literature reveals several critical gaps. First, most studies focus on productivity, income, or profitability effects rather than direct land value capitalisation. While these outcomes are important, they do not capture the asset appreciation that may result from adaptation investments. Second, studies that have examined land values have primarily used perceptions rather than market-based hedonic pricing approaches. Third, few studies have simultaneously controlled for neighbourhood, environmental, and structural attributes that may confound the relationship between CSA practices and land values. Fourth, the evidence from Kenyan ASAL contexts remains limited, with most studies conducted in high-potential agricultural zones or forest regions. The current study addresses these gaps by applying a hedonic pricing framework to estimate the specific effect of CSA practices on agricultural land values in Kajiado County, Kenya, while controlling for confounding factors.

2.2.2 Effect of Neighbourhood Attributes on Agricultural Land Values

The influence of neighbourhood characteristics on land and property values has been extensively documented in the literature, with a strong consensus that accessibility to roads, markets, and social amenities are powerful determinants of land prices. Studies from both developed and developing countries consistently demonstrate that locational attributes often outweigh farm-level characteristics such as soil quality or water availability in determining land values.

In the Kenyan context, research on apartment values in the Nairobi metropolitan area using a hedonic pricing model identified location as one of the most significant factors influencing property values (Museleku, 2023). Analysing 264 apartment transactions from January 2020 to December 2021, the study found that apartment size, location, floor finishes, provision of shopping facilities, swimming pool, and gym were significant determinants of value. The study demonstrated the potential of the hedonic pricing method in property valuation and developed a valuation model using these variables. While this study focused on urban residential property, it confirms the importance of neighbourhood attributes in the Kenyan market context.

Similarly, research analysing spatial factors affecting rental house prices in Nyeri Town Constituency, Kenya found that roads, land value, houses, and population data significantly influenced property prices (Nyeri Spatial Study, 2021). The study used a spatial hedonic model with GIS technologies, demonstrating the importance of spatial factors in determining property values. This finding is relevant to the current study as it highlights the importance of accessibility and spatial location in determining land and property values in Kenyan contexts.

A study examining the application of the hedonic pricing model in real estate valuation in Nairobi County found that significant factors influencing property values included plot location, services, developments, land reference number, and characteristics of the plot (Nairobi HPM Study). The study assessed what kind of pricing methodology is used in property valuation in Nairobi County, finding that location and services provided are critical determinants of property value. This underscores the importance of neighbourhood attributes in the Kenyan property market.

Research from other African contexts provides additional evidence on the influence of neighbourhood attributes on land values. A study modelling residential property prices in emerging climate-responsive urban markets in Baidoa City, Somalia found that the hedonic regression model explained 74.2% of the variance in property prices, with key variables showing significant influences (Baidoa Study, 2025). The study identified proximity to schools, bus stations, airports, and places of worship as top location attributes, while proximity to places of work, city centres, and recreational centres were also significant. This finding demonstrates the strong influence of neighbourhood attributes on property values across diverse African contexts.

In Malawi, research examining the relationship between urban proximity and land prices found that farmland shadow prices decrease with distance from urban areas (Tione & Holden, 2021). However, farmland sales prices increased more sharply between 2010 and 2013 in rural areas (+100%) compared to urban proximity areas (+30%). Using farm-level population pressure, the study showed that local population pressure is a driver of land prices, indicating land scarcity challenges and growing demand for land. This finding is particularly relevant to the current study as it demonstrates the influence of urban proximity on agricultural land values.

A study using Geographic Information Systems data in a hedonic model to measure the impact of recreational and scenic amenities on agricultural land values found that agricultural land values are determined by environmental amenities as well as production attributes (GIS Hedonic Study). Significant amenity variables included scenic views, elk habitat, and fishery productivity. While this study was conducted in a developed country context, it demonstrates that neighbourhood attributes and environmental amenities can be important determinants of agricultural land values.

In Kenya, the Millennium Villages Project provided an opportunity to examine the impact of development investments on land values (Millennium Villages Project, 2018). Using hedonic analysis of administrative data on land transactions during 1999-2013, the study found no evidence that the project investments led to an increase in land prices within project areas. This research represented the first work to use hedonic analysis of land values to assess an international development project in Kenya. The finding suggests that development interventions do not automatically generate land value appreciation and that broader neighbourhood and market conditions may be necessary for land value increases.

Despite the strong evidence that neighbourhood attributes matter, existing studies have not examined how these attributes interact with climate adaptation investments to influence agricultural land values. Most studies have focused on urban or peri-urban residential property rather than agricultural land. Furthermore, limited research has been conducted in ASAL contexts where infrastructure deficits may constrain the capitalisation of adaptation investments. The current study addresses this gap by simultaneously examining neighbourhood attributes alongside CSA practices, environmental characteristics, and structural attributes in a hedonic pricing framework applied to agricultural land in Kajiado County.

2.2.3 Effect of Environmental Attributes on Agricultural Land Values

The relationship between environmental attributes and land values has been extensively examined in the environmental economics literature, with Rosen's (1974) hedonic pricing theory providing the theoretical foundation. The theory predicts that environmental quality should be capitalised into land prices because households derive utility from clean air, low noise, attractive surroundings, and reduced exposure to environmental risks. However, the empirical evidence, particularly from developing countries, reveals a more complex and context-dependent relationship.

Research from Addis Ababa, Ethiopia used the hedonic pricing method to investigate the impact of urban green amenities on residential rental prices (Addis Ababa Green Amenities Study, 2024). Results indicated that residents attach a positive value to urban green amenities. Specifically, the availability of and access to attractive landscape and natural features in a nearby area increased the average price of a house by 45 percent, while availability and access to parks increased the average rental value by 50 percent. This indicated that residents are willing to pay for green amenities in their neighbourhood. While this study focused on urban residential property, it demonstrates the potential for environmental attributes to influence property values in African contexts.

In Morocco, research using hedonic pricing techniques to estimate the value of agricultural amenities in the High Atlas Mountains provided indicators to better inform policy decisions affecting rural and agricultural development (Morocco Amenities Study, 2004). The analysis was limited to positive externalities related to land use, demonstrating the potential of hedonic pricing to value environmental amenities in agricultural contexts.

A study exploring the relationship between various land value attributes within residential estates in Uyo, Nigeria found that aesthetics and beauty had the most significant contribution to land value, while the presence of lakes and water bodies in the environment contributed the least to land value (Uyo Land Value Study). This finding suggests that the influence of specific environmental attributes may vary considerably depending on local conditions and preferences.

Research from Zimbabwe investigating the effects of environmental quality on urban housing prices in Gweru used a hedonic pricing regression with a sample of 800 households to analyse whether environmental quality has a significant effect on housing prices (Gweru Environmental Quality Study). The study found that environmental quality significantly influenced housing prices, though the direction and magnitude of the effect varied depending on specific environmental attributes.

In Addis Ababa, a study examining how proximity to public spaces influences residential property values found that distance to Sheger Park and views of the park or artificial lakes significantly influenced property values (Addis Ababa Public Space Study, 2026). The study used the hedonic pricing method to analyse these effects, providing evidence that environmental amenities are capitalised into property prices in Ethiopian urban contexts.

Research on factors influencing savanna conservation in southern Kenya found that land prices are influenced by proximity to cities, areas of high agricultural productivity, and the Maasai Mara National Reserve (Southern Kenya Savanna Study). Predicted land prices ranged from US$662 to US$4,618,805 per acre, demonstrating that environmental amenities, including proximity to conservation areas, significantly influence land values. This finding is particularly relevant to the current study as it demonstrates the potential for environmental attributes to influence land values in the Kenyan ASAL context.

A study using Geographic Information Systems data in a hedonic model to measure the impact of recreational and scenic amenities on agricultural land values found that agricultural land values are determined by environmental amenities as well as production attributes (GIS Hedonic Study). Significant amenity variables included scenic view, elk habitat, and fishery productivity. This study, conducted in a developed country context, provides evidence that environmental attributes can be important determinants of agricultural land values.

Despite the theoretical expectation that environmental quality should be capitalised into land prices, the evidence from developing countries suggests that environmental attributes may be weakly capitalised due to market imperfections and competing priorities. Ochieng and Kirubi (2020) found that while Kenyan households recognise good environmental quality, they are unwilling to pay a premium for it because they prioritise more immediate needs such as water, electricity, and roads. Similarly, Acheampong and Anokye (2021) reported that in Ghanaian secondary cities, accessibility and infrastructure dominate land price formation, while environmental amenities have negligible or even negative coefficients.

The weak capitalisation of environmental attributes in African land markets suggests a potential market failure where the social benefits of environmental conservation exceed private willingness to pay. This justifies public intervention such as payments for ecosystem services to correct the market failure. The current study examines whether environmental attributes independently influence agricultural land values in Kajiado County, providing evidence to inform policy decisions regarding environmental conservation and land management.

2.2.4 Effect of Structural Attributes on Agricultural Land Values

Structural attributes, including access to water, electricity, sanitation, and land improvements, have been consistently found to increase land and property values. The literature suggests that infrastructure access reduces transaction costs, enables agricultural intensification, signals development potential, and supports the implementation of other productive investments. However, the evidence also reveals that the effect of structural attributes may be context-specific and dependent on the level of infrastructure scarcity.

In the Kenyan context, research examining how psychological expectations influence the relationship between structural attributes and residential housing prices found that structural attributes significantly influence property prices (Kenya Psychological Expectations Study, 2026). The study used a quantitative approach with a hedonic pricing model and mediation analysis, demonstrating the importance of structural attributes in determining property values.

A study examining how new power substations influence land prices in Kenya found that in high-growth corridors where grid upgrades have been commissioned, land prices jumped between 12% and 34% within two years of substation activation (Kenya Electricity Study, 2025). This finding is significant because it demonstrates that electricity infrastructure is a significant determinant of future land wealth. The study provides direct evidence that investment in structural attributes generates measurable returns through land appreciation.

Research applying the hedonic pricing method using spatial econometrics to assess the economic value of irrigation water as an attribute of agricultural land parcels found that irrigation investment status was positive and statistically significant at the 0.01 significance level (Irrigation Water Valuation Study). This finding suggests that access to irrigation infrastructure significantly increases agricultural land values, providing evidence that structural attributes are capitalised into land prices.

A study analysing spatial factors affecting rental house prices in Nyeri Town, Kenya identified that roads and land value are significant factors influencing property prices (Nyeri Spatial Study, 2021). The study used a spatial hedonic model incorporating infrastructure variables to determine property values, providing evidence that infrastructure attributes influence property values in Kenyan contexts.

Research on the spatial structure of land values in Nairobi, Kenya revealed a very significant regularity between land values and distance from the city centre (Nairobi Spatial Structure Study). The analysis demonstrated the importance of locational infrastructure in determining land values, providing evidence that structural and locational attributes are capitalised into land prices.

A study examining factors determining residential real estate pricing in Nairobi Metropolitan Area found that cost of land, location, cost of finance, and zoning regulations explained 41% of variation in the residential price index (Nairobi Real Estate Pricing Study). The study concluded that there is need to strategically control land price through proper valuation, demonstrating the importance of understanding the determinants of land and property values.

Research documenting how major infrastructure projects have significantly influenced property values in Kenya found that the Thika Superhighway, for example, significantly reduced travel time between Thika and Nairobi and opened up large areas for residential and commercial development (Kenya Infrastructure Study, 2026). The study found that infrastructure developments have directly led to the conversion of agricultural lands into built-up areas, demonstrating the transformative effect of infrastructure investment on land values and land use.

The literature reveals a critical debate concerning whether structural attributes have an independent effect or whether they merely proxy for household wealth and favourable location. Autio et al. (2021) argued that after controlling for household income and distance to markets, the effect of electricity on land values disappeared in some parts of Kenya. They concluded that structural attributes are endogenous to socioeconomic status. However, Tabetando et al. (2023) found the opposite: even with full controls for income, tenure, and location, water access retained a significant positive coefficient. This contradiction suggests that the effect of structural attributes is context-specific and depends on the level of infrastructure scarcity. In areas where water is extremely scarce, the independent effect may be large.

Beyond their direct effect, structural attributes may play an enabling role for climate adaptation. CSA practices such as irrigation and agroforestry depend on access to water and, in many cases, electricity to pump water. Without these structural supports, adaptation practices cannot be effectively implemented. This complementarity is often assumed in policy discussions but has rarely been tested empirically. The current study addresses this gap by simultaneously examining structural attributes alongside CSA practices, neighbourhood attributes, and environmental characteristics in a hedonic pricing framework applied to agricultural land in Kajiado County.

2.3 Summary of Empirical Studies and Research Gaps

Empirical literature shows that climate adaptation investments influence agricultural land values through climate-smart agricultural practices, neighbourhood attributes, environmental characteristics, and structural features. However, the evidence is fragmented across contexts and variable categories, with clear gaps relevant to arid and semi-arid land (ASAL) settings in Kenya.

Table 2.1: Summary of Empirical Studies and Research Gaps

Study	**Context**	**Focus**	**Key Findings**	**Gap Addressed by Current Study**
World Development (2023)	Nigeria	Soil erosion control investments and land values	Soil erosion control capitalised at 26% of mean land values	Did not examine CSA practices beyond soil conservation; focused on Nigeria not Kenya
Molua et al. (2023)	Congo Basin	Conservation agriculture, farm values, tenure security	CA improves soil health and yields; tenure affects investment	Did not estimate land value effects using hedonic pricing; forest zone context
Imo State Study (2017)	Nigeria	Agricultural land values using hedonic pricing	Unsustainable practices diminish land values	Focused on Nigeria; did not examine CSA practices systematically
CSA and Food Security Study	Kenya	CSA adoption and food security	CSA adoption improves food security when used in combinations	Focused on food security, not land values
Makueni CSA Study (2025)	Kenya	Determinants of CSA adoption	44% adopted CSA; land size, credit, group membership predict adoption	Focused on adoption determinants, not land value effects

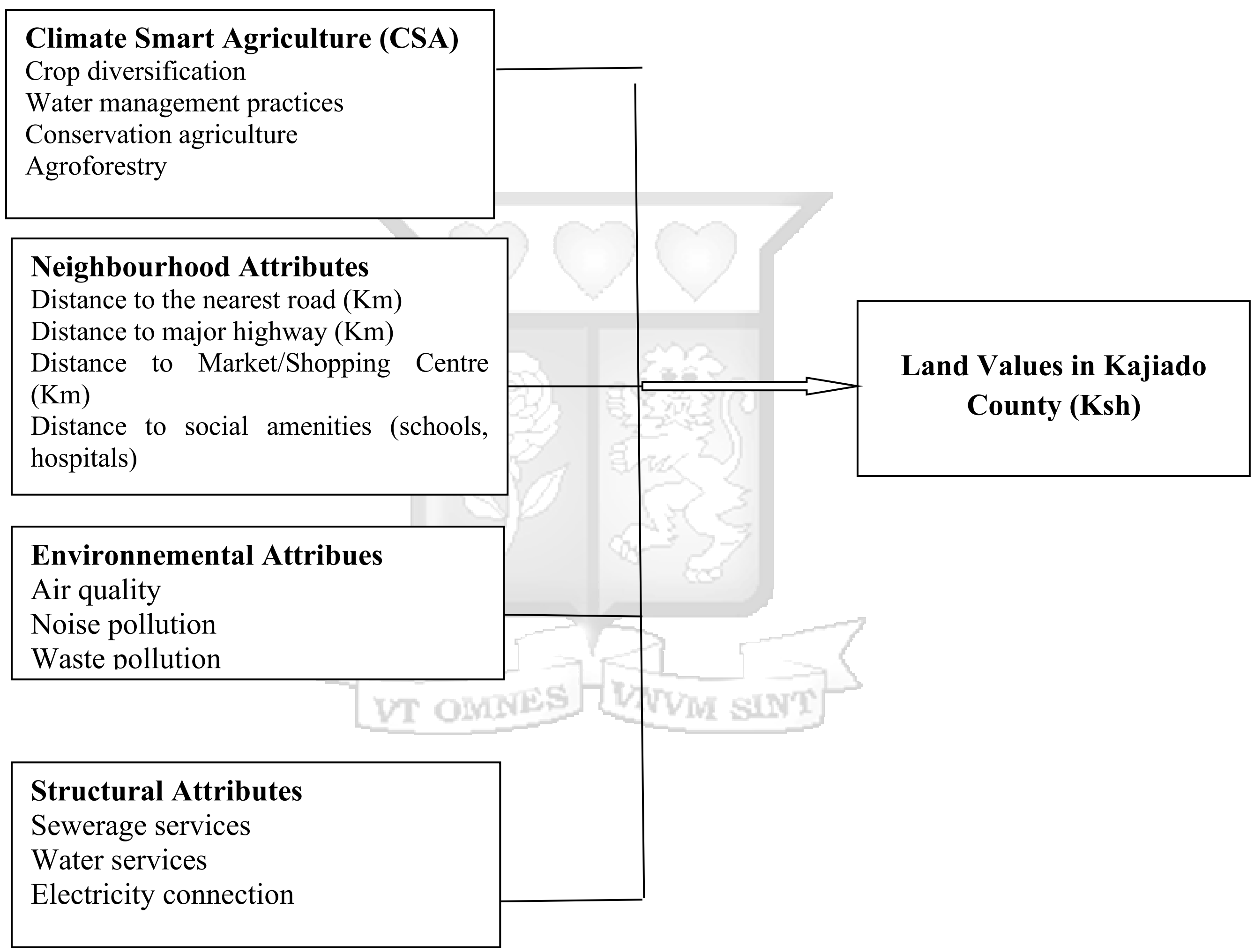
Lushoto Study (2022)	Tanzania	Agricultural land valuation determinants	Nearness to water, road, soil fertility determine land value	Did not use hedonic pricing; perception-based valuation
Museleku (2023)	Nairobi, Kenya	Apartment values using HPM	Location, size, facilities significantly influence values	Urban residential focus; not agricultural land
Nyeri Spatial Study (2021)	Kenya	Spatial factors affecting house prices	Roads and spatial factors significantly influence prices	Urban residential focus; not agricultural land
Tione & Holden (2021)	Malawi	Urban proximity and land prices	Land prices decrease with distance from urban areas	Did not examine adaptation investments
Addis Ababa Study (2024)	Ethiopia	Green amenities and house prices	Green amenities increase house prices by 45-50%	Urban focus; did not examine agricultural land
Millennium Villages (2018)	Kenya	Development project impact on land values	No evidence of land price increase from MVP investments	Focused on development project, not climate adaptation
Kenya Electricity Study (2025)	Kenya	Electricity infrastructure and land values	Land prices jump 12-34% after substation activation	Did not examine agricultural land or climate adaptation
Autio et al. (2021)	Kenya	CSA adoption constraints	CSA adopters wealthier, better educated, connected	Did not examine land value effects
Wainaina et al. (2020)	Kenya	CSA and household welfare	CSA effect diminished after controlling for credit, tenure	Income/welfare focus, not asset valuation
Tabetando et al. (2023)	Kenya	Rainfall variability and land markets	Water access retained positive coefficient with controls	Did not examine CSA practices or adaptation investments

2.4 Conceptual Framework

The conceptual framework for this study illustrates the relationships between the independent variables and the dependent variable.

Figure 2.1: Conceptual Framework

Independent variables **Dependent Variable**



Source: Author

2.5 Operationalization of Variables

This section presents the operationalization of the study variables, specifying how each variable was measured, the supporting literature, theoretical foundations, data sources, and analytical methods. The study comprises one dependent variable, four categories of independent variables, and five control variables.

Dependent Variable: Agricultural land value per acre was measured as the log-transformed price per acre in Kenya Shillings (KES) as reported by respondents. This measurement follows standard hedonic pricing applications (Rosen, 1974; Palmquist, 2005) and allows for normalisation of price distributions.

Independent Variables: The study examined four categories of independent variables, each operationalised as a composite index derived from multiple Likert-scale items measured on a scale of one to five, where one represented strong disagreement and five represented strong agreement. The use of composite indices follows established practice in land valuation and climate adaptation research (Wainaina et al., 2020; Molua et al., 2023).

Climate-Smart Agricultural Practices (CSA): Measured through a composite index of 6 items covering crop diversification, water management, conservation agriculture, agroforestry, productivity improvement, risk reduction, and perceived value increase.

Neighbourhood Attributes: Measured through a composite index of 6 items covering road accessibility, proximity to highways, markets, social amenities, and perceived value of accessibility and location.

Environmental Attributes: Measured through a composite index of 6 items covering air quality, noise levels, waste pollution, proximity to attractive areas, environmental maintenance, climate risk exposure, and perceived desirability.

Structural Attributes: Measured through a composite index of 6 items covering water access, electricity access, sanitation, plot size contribution, basic services availability, infrastructure demand, and land development value.

Control Variables: Five socioeconomic and locational control variables were included to address potential confounding effects: income (monthly household income, categorical treated as continuous), land ownership (dummy variable), farm size (acres, continuous), years of occupation (continuous), and distance to road (kilometres, continuous). These controls were selected based on evidence that socioeconomic status and location influence both adaptation adoption and land values (Autio et al., 2021; Tabetando et al., 2023).

Table 2.2: Operationalization of Variables

Variable	Measurement	Supporting Studies	Supporting Theories	Data Source	Analysis
Land value per acre (Dependent)	Log-transformed price per acre (KES) as reported by respondent; numerical continuous variable	Rosen (1974); Palmquist (2005); Molua et al. (2023); Keron & Midamba (2025)	Lancaster's Characteristics Theory of Value (1966); Hedonic Pricing Model	Questionnaire	Descriptive statistics; OLS regression (baseline, multiple, full model)
Climate-smart agricultural (CSA) practices (Independent Variable - Objective i)	Composite index from 6 Likert-scale items (1-5): crop diversification, water management, conservation agriculture, agroforestry, productivity improvement, risk reduction, perceived value increase	Ariom et al. (2022); Kogo et al. (2021); Rotich et al. (2025); Wainaina et al. (2020)	Social Impact Investment Theory; Lancaster's Characteristics Theory	Questionnaire; Focus group	Descriptive statistics; OLS regression (as X_1); Thematic analysis
Neighbourhood attributes (Independent Variable - Objective ii)	Composite index from 6 Likert-scale items (1-5): road accessibility, proximity to highways, markets, social amenities, perceived value of	Boone et al. (2021); Kinuthia (2022); Jayne et al. (2020); Sitko & Jayne (2021)	Public Goods Theory; Hedonic Pricing Model	Questionnaire; Focus group	Descriptive statistics; OLS regression (as X_2); Thematic analysis

	accessibility and location				
Environmental attributes (Independent Variable - Objective iii)	Composite index from 6 Likert-scale items (1-5): air quality, noise levels, waste pollution, proximity to attractive areas, environmental maintenance, climate risk exposure, perceived desirability	Lamichhane et al. (2022); McConnell (2024); Ochieng & Kirubi (2020); Acheampong & Anokye (2021)	Public Goods Theory; Lancaster's Characteristics Theory	Questionnaire; Focus group	Descriptive statistics; OLS regression (as X_3); Thematic analysis
Structural attributes (Independent Variable - Objective iv)	Composite index from 6 Likert-scale items (1-5): water access, electricity access, sanitation, plot size contribution, basic services availability, infrastructure demand, land development value	Tesfaye et al. (2023); Mati & Wambua (2020); Deininger et al. (2020); World Bank (2022)	Hedonic Pricing Model; Public Goods Theory	Questionnaire; Focus group	Descriptive statistics; OLS regression (as X_4); Thematic analysis
Income (Control)	Monthly household income (categorical: below 10,000; 10,000-30,000; 30,001-50,000; above 50,000 Ksh) - treated as continuous	Autio et al. (2021); Tabetando et al. (2023)	Social Impact Investment Theory	Questionnaire	Control variable in full OLS regression
Land ownership (Control)	Dummy variable: 1 = registered owner, 0 = otherwise	Rotich et al. (2025); Deininger et al. (2020)	Lancaster's Characteristics Theory	Questionnaire	Control variable in full OLS regression
Farm size (Control)	Total farm size in acres (numerical continuous)	Muyanga & Jayne (2020); Jayne et al. (2020)	Hedonic Pricing Model	Questionnaire	Control variable in full OLS regression
Years of occupation (Control)	Number of years respondent has occupied/managed the land (numerical continuous)	Ngayu & Olale (2025); Matsaba et al. (2021)	Social Impact Investment Theory	Questionnaire	Control variable in full OLS regression
Distance to road (Control)	Distance from parcel to nearest all-weather road (kilometres, numerical continuous)	Kinuthia (2022); Boone et al. (2021)	Public Goods Theory; Hedonic Pricing Model	Questionnaire	Control variable in full OLS regression

CHAPTER THREE:

RESEARCH METHODOLOGY

3.0 Introduction

This chapter presents the methodological framework that was employed to examine the relationship between climate adaptation investments and agricultural land values in Kajiado County. It outlines the research philosophy, research design, study area, target population, sampling procedures, sample size determination, data collection methods, instrumentation, validity and reliability measures, data analysis techniques, and ethical considerations.

3.1 Research Philosophy

This study was grounded in the pragmatist research philosophy, which emphasises the practical consequences of research and recognises that both quantitative and qualitative methods can be appropriately combined to address research questions (Creswell & Creswell, 2018; Saunders et al., 2019). Pragmatism is particularly suited to mixed methods research because it focuses on what works best for addressing the research problem rather than being constrained by philosophical positions that privilege either positivism or interpretivism (Morgan, 2014).

The pragmatist philosophy was appropriate for this study for three reasons. First, the study sought to establish relationships between climate adaptation investments and land values, requiring quantitative analysis and measurable variables. This aligns with the pragmatic emphasis on empirical evidence and observable outcomes. Second, the study also sought to understand how landowners and farmers perceive and experience adaptation investments and land market dynamics, requiring qualitative exploration of participant perspectives. Third, pragmatism allows integration of findings from both approaches, enabling a more comprehensive understanding than either approach alone could provide (Tashakkori & Teddlie, 2010).

3.2 Research Design

A research design refers to the overall strategy that integrates different components of a study in a coherent manner to ensure the research problem is effectively addressed (Creswell & Creswell, 2018; Kothari, 2004). It provides a blueprint for data collection, measurement, and analysis. Common research designs include exploratory, descriptive, explanatory, and correlational designs. Exploratory designs are used when a problem is not clearly defined and aim to generate insights (Cooper & Schindler, 2014). Descriptive designs seek to accurately describe characteristics of a population or phenomenon (Saunders et al., 2019). Explanatory designs establish cause and effect relationships (Sekaran & Bougie, 2016), while correlational designs examine relationships between variables without implying causality (Bryman, 2016).

This study adopted a mixed methods convergent parallel research design. This design involved the concurrent collection of both quantitative and qualitative data, their separate analysis, and subsequent integration during interpretation (Creswell & Plano Clark, 2023). The design was appropriate because the study sought not only to examine relationships between climate adaptation investments such as climate smart agricultural practices, neighbourhood attributes, environmental characteristics, structural features, and land values, but also to understand how these factors were perceived and experienced by landowners and farmers in Kajiado County.

The quantitative component employed a cross-sectional correlational design. This was suitable because the study examined the strength and direction of relationships among variables without manipulating them (Creswell & Guetterman, 2021; Polit & Beck, 2021). The cross-sectional approach allowed data to be collected at a single point in time, which is appropriate for studying land valuation phenomena where experimental designs may be impractical (Setia, 2016). This design has been widely used in hedonic pricing studies to establish associations between property attributes and market values (Rosen, 1974; Palmquist, 2005).

The qualitative component adopted a phenomenological design to explore participants' lived experiences of climate adaptation investments, land use changes, and coping behaviors in response to climate variability. This approach was appropriate because it provided deeper insight into how landowners and farmers make meaning of their experiences, which could not be fully captured through quantitative measures alone (Creswell & Poth, 2018).

The integration of quantitative and qualitative findings occurred at the interpretation stage. This allowed comparison and complementarity of results, thereby enhancing the validity of the study through triangulation (Fetters & Freshwater, 2021). The mixed methods design was therefore suitable for this study as it provided both measurable relationships and contextual understanding of the link between climate adaptation investments and land values in Kajiado County.

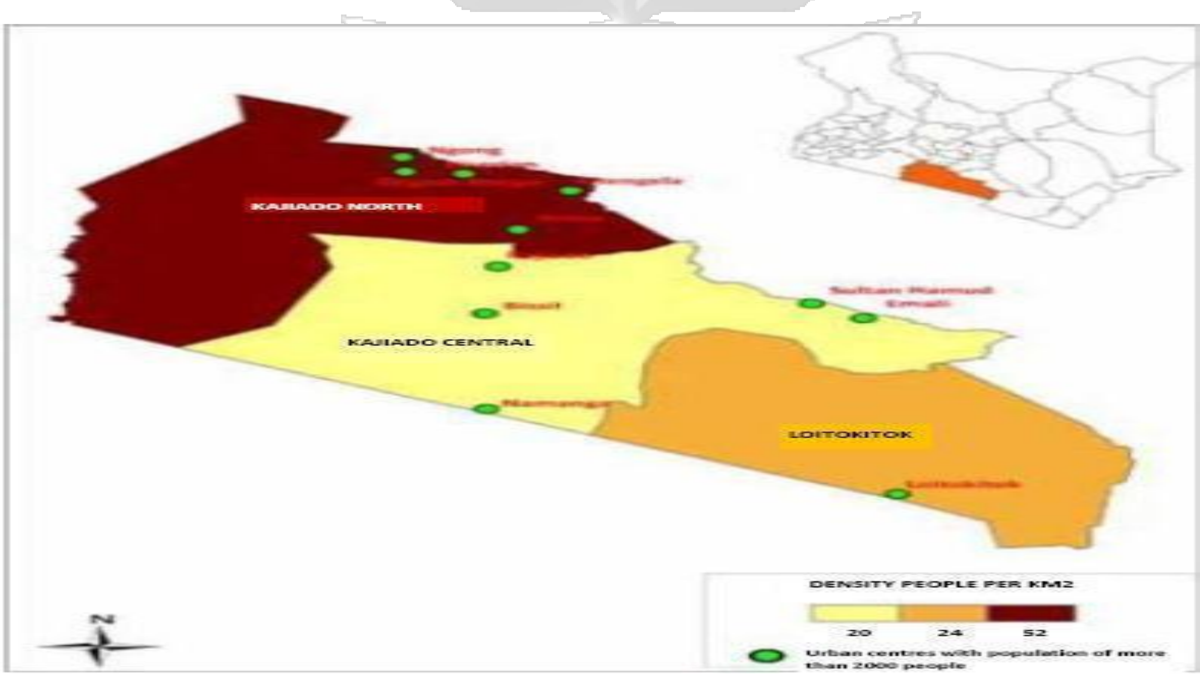
3.3 Study Area

Kajiado County spans an area of 21,292.7 square kilometres with a recorded population of 1,117,840 (KNBS, 2023). The county borders Nairobi to the north and the Tanzanian regions of Arusha and Kilimanjaro to the south. Kajiado County is renowned for its distinctive cultural heritage, scenery, and wildlife, contributing significantly to Kenya's tourism economy as a gateway to numerous national parks, conservation areas, and tourist attractions.

Agriculture, livestock keeping, trade, and tourism are the main drivers of the county's economy. Crop production including maize, beans, and vegetables is supported by both rain fed and irrigated farming techniques, which are essential to sustaining livelihoods. Climate change continues to have a significant effect in Kajiado County. Droughts, irregular rainfall patterns, land degradation, and rising temperatures are among the effects of climate change that significantly affects the county's socioeconomic development, natural resources, and community well-being (UNFPA, 2021).

Kajiado County was selected as the study area for three reasons. First, the county falls within Kenya's arid and semi-arid land (ASAL) zone, making it highly vulnerable to climate variability and therefore an appropriate context for studying climate adaptation investments (Matsaba et al., 2021). Second, the county has received substantial climate adaptation investments through programmes such as the Financing Locally Led Climate Action (FLLoCA) and the County Climate Resilience Investment Grant (CCRIG), providing a suitable setting to assess their economic impacts (Rotich et al., 2025). Third, the county is undergoing rapid land use change from traditional pastoralism to mixed farming and peri-urban development, creating a dynamic context for land valuation research (Ngayu & Olale, 2025).

Figure 3.1: Map showing Kajiado County's administrative boundaries



Source: Open County Initiative 2024

3.4 Target Population and Sampling Design

3.4.1 Target Population

The target population for this study consisted of farmers and landowners actively engaged in agricultural land use within Kajiado County, Kenya. This population was selected because it directly participates in land management decisions, including the adoption of climate adaptation investments such as climate-smart agricultural practices, water management, and soil conservation. These decisions influence both land productivity and land values, making the population appropriate for examining the relationship between climate adaptation investments and land valuation. Kajiado County is predominantly rural and agro-pastoral. According to the Kenya National Bureau of Statistics (KNBS, 2019), the county has 316,179 households, with an average household size of 3.5 persons and a total population of approximately 1,117,840 (KNBS, 2023). A significant proportion of households depend on agriculture and livestock for their livelihoods. County-level data indicate that between 65 percent and 70 percent of households are engaged in agriculture and related activities (Kajiado County Integrated Development Plan, 2023-2027).

The county is classified as an arid and semi-arid land (ASAL) region, characterized by low and erratic rainfall, recurrent droughts, and high climate variability. These conditions necessitate continuous adaptation investments, making the population highly relevant for this study.

Table 3.1: Demographic and Agricultural Profile of Kajiado County

Indicator	Statistic	Source
Total Population	1,117,840	KNBS (2023)
Number of Households	316,179	KNBS (2019)
Average Household Size	3.5 persons	KNBS (2019)
Rural Population (%)	63.7%	KNBS (2019)
Households Engaged in Agriculture	65-70%	Kajiado CIDP (2023-2027)
Land Area	21,292.7 km²	KNBS (2023)
Agro-Ecological Classification	ASAL	NDMA (2022)

Source: KNBS (2019, 2023); Kajiado CIDP (2023-2027); NDMA (2022)

3.4.2 Sampling Frame

Due to the absence of a comprehensive land registry in Kajiado County, particularly in ASAL regions where communal land tenure systems exist, a complete sampling frame could not be obtained. To address this limitation, the study constructed a sampling frame using administrative units and locally available records. The sampling frame was organized around the six sub-counties of Kajiado County: Kajiado Central, Kajiado North, Kajiado West, Isinya, Loitokitok, and Mashuuru. These sub-counties capture spatial, economic, and ecological diversity within the county, including peri-urban zones and remote pastoral areas. An accessible population was compiled using farmer listings obtained from county agricultural extension offices and local administrative records. The listing exercise identified 171 farmers and landowners across the six sub-counties who met the study's inclusion criteria: actively engaged in agricultural land use, managed or utilised agricultural land continuously for at least five years, and involved in at least one form of land-based economic activity.

Community consultation with local administrators, including chiefs and assistant chiefs, was then undertaken to identify active farmers and landowners within their jurisdictions, which helped capture individuals not captured in formal extension records, particularly those in more remote areas. From the broader records, individuals were filtered based on the eligibility criteria, which required that they be actively engaged in agricultural land use, have managed land continuously for at least five years, be involved in land-based economic activity, and have participated in land-related decision-making processes such as purchase, sale, leasing, or long-term planning. Eligibility was subsequently verified through consultation with agricultural extension officers and local administrative records to confirm that all individuals met the inclusion criteria. The resulting accessible population of 171 represents the available pool of farmers and landowners who met all inclusion criteria and were accessible within the study's timeframe and resource constraints.

Table 3.2: Accessible Population by Sub-County

Sub County	Accessible Farmers/Landowners (N)
Kajiado Central	28
Kajiado North	30
Kajiado West	27
Isinya	29
Loitokitok	31
Mashuuru	26
Total	**171**

Source: County Agricultural Offices and Field Listings (2026)

3.4.3 Sampling Technique

The study employed a multi-stage sampling approach combining cluster sampling and purposive selection. In the first stage, Kajiado County was divided into six clusters based on administrative sub-counties: Kajiado Central, Kajiado North, Kajiado West, Isinya, Loitokitok, and Mashuuru. This approach was appropriate because the county covers a large geographical area of over 21,000 square kilometres, making it impractical to implement simple random sampling across the entire population while still ensuring adequate spatial coverage.

In the second stage, respondents were selected purposively within each cluster using clearly defined and verifiable inclusion criteria. To be eligible for selection, an individual had to be actively engaged in agricultural land use within the sub-county and must have managed or utilized agricultural land continuously for a minimum period of five years preceding the study. In addition, respondents were required to be involved in at least one form of land-based economic activity such as crop farming, livestock keeping, irrigation, or soil and water conservation. These criteria ensured that respondents had direct and sustained interaction with land use decisions and exposure to climate variability over time.

To strengthen the reliability of responses on land values and adaptation investments, preference was given to individuals who had participated in land-related decision-making processes, including land purchase, sale, leasing, or long-term land use planning. Verification of eligibility was conducted through local administrative records and consultation with agricultural extension officers within each sub-county. This procedure reduced the risk of including respondents without sufficient experience or knowledge of the study variables.

For the qualitative component, participants for the focus group discussion were drawn purposively from the pool of survey respondents who met additional criteria. These included prior involvement in land transactions, membership in farmer groups or cooperatives, or participation in county or donor-supported climate adaptation programmes. These indicators were used as observable measures of exposure to both land market dynamics and adaptation practices. The use of these criteria ensured that qualitative participants were selected based on demonstrated experience rather than assumed knowledge, thereby improving the credibility and depth of qualitative data collected.

3.4.4 Sample Size Determination

(a) Quantitative Sample Size

The initial sample size was determined using Slovin's formula:

$$\mathbf{n} = \frac{\mathbf{N}}{\mathbf{1 + Ne^2}}$$

Where:

- $N = 171$ (accessible population)

- $e = 0.05$ (margin of error)

This yielded:

$$\mathbf{n} = \frac{\mathbf{171}}{\mathbf{1 + 171(0.05^2)}} \approx \mathbf{120}$$

To improve reliability and account for possible non-response, the sample size was adjusted using a non-response correction:

$$\mathbf{n_{adj}} = \frac{\mathbf{n}}{\mathbf{1 - r}}$$

Where:

- $r = 0.10$ (assumed non-response rate)

$$\mathbf{n_{adj}} = \frac{\mathbf{120}}{\mathbf{0.90}} \approx \mathbf{133}$$

Thus, the target sample size was 133 respondents.

However, due to logistical constraints and field conditions, 120 complete responses were obtained, resulting in a response rate of 90.2%, which is considered acceptable for social science research (Babbie, 2016).

(b) Qualitative Sample Size

The qualitative sample size was determined using the principle of data saturation, which is the point at which no new information or themes emerge from additional data collection (Guest et al., 2006; Hennink & Kaiser, 2022). Methodological literature recommends that focus group discussions typically involve between six and ten participants per group, with one to three groups sufficient to achieve saturation in homogeneous populations with focused research questions (Krueger & Casey, 2015; Stewart & Shamdasani, 2015).

For this study, one focus group discussion comprising eight participants was conducted. This number falls within the recommended range and was considered sufficient for achieving saturation for several reasons. The study population, consisting of farmers and landowners in Kajiado County, is relatively homogeneous in terms of livelihood characteristics, climate exposure, and adaptation experiences (Guest et al., 2006). The research questions focused on specific and well-defined topics including climate adaptation practices, infrastructure experiences, and land market dynamics (Hennink & Kaiser, 2022). During the discussion, key themes emerged consistently, and after approximately ninety minutes of discussion, participants began repeating perspectives without introducing substantially new insights, indicating that saturation had been reached (Guest et al., 2006). Furthermore, previous qualitative land market and climate adaptation studies in Kenya have achieved saturation with similar sample sizes (Wainaina et al., 2020; Rotich et al., 2025).

The decision to conduct one focus group discussion was further supported by the mixed methods design, where the primary purpose of the qualitative component was to provide contextual depth and explanation for quantitative findings (Palinkas et al., 2015), rather than to achieve exhaustive qualitative description. Given the depth and consistency of responses, conducting additional focus group discussions was not necessary.

(c) Qualitative Sample Composition:

The qualitative component included eight participants selected purposively from the survey respondents. Participants were selected based on several criteria. They had to have engaged in land purchase, sale, or leasing within the past five years, providing direct experience with land market dynamics and valuation. They were required to be members of farmer organisations, providing exposure to collective adaptation activities and information sharing. Participants had to have participated in county or donor-supported climate adaptation programmes such as FLLoCA, CCCF, or community-based adaptation projects. They were drawn from across the six sub-counties to capture spatial diversity in climate exposure, infrastructure, and land market conditions. Finally, the sample included both men and women across different age groups to ensure demographic diversity. The eight participants comprised four male and four female landowners, with ages ranging from thirty to sixty-five years.

3.4.5 Sample Distribution

The sample was distributed evenly across the six sub-counties to ensure spatial representation and comparability of observations across different parts of the county. Each sub-county contributed twenty respondents to the total sample of 120. Equal allocation was adopted to avoid over-representation of more accessible or densely populated areas and to ensure that variations in land use systems and climate exposure across sub-counties were adequately captured. Table 3.3 presents the distribution of the accessible population and the corresponding sample across the six sub-counties, including the sampling fraction for each cluster.

Table 3.3: Sample Distribution Across Sub-Counties

Sub County	Population (N)	Target Sample (n)	Sampling Fraction (%)
Kajiado Central	28	22	71.4%
Kajiado North	30	23	66.7%
Kajiado West	27	21	74.1%
Isinya	29	23	69.0%
Loitokitok	31	24	64.5%
Mashuuru	26	20	76.9%
Total	**171**	**133**	**70.2%**

Source: Author (2026)

3.5 Data Collection and Instrumentation

This mixed methods study employed two distinct data collection instruments to address the research objectives, corresponding to the convergent parallel design. Quantitative data were collected from farmers and landowners in Kajiado County using a self-administered structured questionnaire. The instrument was developed based on a comprehensive review of existing literature and established theoretical constructs including Lancaster's Characteristics Theory of Value (1966) and the hedonic pricing framework (Rosen, 1974). The questionnaire utilized a five-point Likert scale to measure key variables including adoption of climate smart agricultural practices, neighbourhood attributes, environmental characteristics, and structural attributes. Land values were measured as the price per acre in Kenya shillings as reported by respondents.

The questionnaire was organized into thematic sections covering demographic information, climate smart agricultural practices including crop diversification, water management, conservation agriculture, and agroforestry, neighbourhood attributes including distance to roads, highways, markets, and social amenities, environmental characteristics including air quality, noise pollution, waste pollution, and distance to cultural or natural sites, structural attributes including plot size, sewerage services, water services, and electricity connection, and land value per acre.

To operationalise the fifteen-year temporal scope covering 2007 to 2022, the questionnaire included retrospective questions designed to capture land value changes and adaptation investment patterns over this period. Respondents were asked about the estimated value per acre of their land in 2007, 2012, 2017, and 2022, which allowed for analysis of land value changes over the fifteen-year period. They were also asked in which year(s) they adopted the following climate adaptation practices including crop diversification, water management, conservation agriculture, and agroforestry, which allowed for sequencing of investments relative to land value changes. Additionally, respondents were asked what infrastructure improvements such as roads, electricity, and water had occurred in their area between 2007 and 2022, which captured changes in neighbourhood and structural attributes over time. While the cross-sectional design limits causal inference, these retrospective questions provide temporal context and allow for examination of changes over the fifteen-year period. The analysis focused on current land values as a function of cumulative adaptation investments and infrastructure development over the period.

3.5.1 Questionnaire Administration:

To ensure broad participation and methodological rigor, the questionnaire was administered in person by the researcher with the assistance of trained research assistants. The in-person administration was necessary due to the rural nature of the study area, limited internet connectivity in parts of Kajiado County, and varying literacy levels among respondents. Each questionnaire took approximately twenty-five to thirty-five minutes to complete.

3.5.2 Qualitative Data Collection:

Qualitative data were gathered from farmers and landowners using focus group discussions. One focus group discussion was conducted comprising eight participants selected purposively from survey respondents. A semi-structured focus group discussion guide featuring open-ended questions was used to elicit rich, contextual insights and expert perspectives on climate adaptation investments and land valuation dynamics. The open-ended questions focused on identifying perceived benefits of climate adaptation investments, barriers to adoption of climate smart agricultural practices, observed changes in land values over time, community perceptions of adaptation programmes, and practical recommendations for improving climate adaptation investments in Kajiado County. Each focus group discussion lasted approximately ninety to one hundred and twenty minutes and was facilitated by the researcher with a research assistant taking notes and managing audio recording.

This qualitative approach was essential for obtaining in-depth explanations and contextual understanding that would elaborate on and help explain the statistical patterns emerging from the quantitative data. The deliberate integration of these complementary datasets during the analysis phase was fundamental for developing comprehensive, actionable, and contextually informed recommendations to address the research problem.

3.6 Data Analysis

Data collected from the field were analysed using the Statistical Package for Social Sciences (SPSS) version 27. Both descriptive and inferential statistical techniques were employed to address the study objectives. Descriptive statistics including frequencies, percentages, means, and standard deviations were used to summarise respondents' demographic characteristics and key study variables. The analysis focused on climate-smart agricultural (CSA) practices, neighbourhood attributes, environmental attributes, structural attributes, and agricultural land value per acre. The descriptive results were presented using tables and narrative interpretation.

3.6.1 Dependent Variable Measurement:

Agricultural land value per acre was measured as the log-transformed price per acre in Kenya Shillings (KES) as reported by respondents. The log transformation was applied to address heteroskedasticity and to enable interpretation of coefficients as elasticities or semi-elasticities, following standard practice in hedonic pricing studies (Rosen, 1974; Palmquist, 2005).

3.6.2 Independent Variable Measurement:

The four categories of independent variables were each operationalised as composite indices derived from multiple Likert-scale items measured on a scale of one to five, where one represented strong disagreement and five represented strong agreement. The use of composite indices follows established practice in land valuation and climate adaptation research (Wainaina et al., 2020; Molua et al., 2023). For each index, Cronbach's alpha coefficients were computed to assess internal consistency reliability, with a threshold of 0.70 considered acceptable.

3.6.3 Inferential Analysis:

Inferential analysis was undertaken using Ordinary Least Squares (OLS) regression within the Hedonic Pricing Model framework. The estimation strategy involved three stages. In the first stage, simple linear regressions were estimated separately for each study objective to determine the individual effect of climate-smart agricultural practices, neighbourhood attributes, environmental attributes, and structural attributes on agricultural land value per acre. In the second stage, a multiple linear regression model was estimated to examine the combined effect of the four explanatory variables on land values, allowing for the isolation of each variable's contribution while controlling for the others. In the third stage, a full regression model incorporating control variables including income, land ownership, farm size, years of occupation, and distance to road was estimated to improve explanatory power and control for socioeconomic and locational influences. Model results were interpreted using coefficients, beta values, R^2, adjusted R^2, F-statistics, and p-values at a ninety-five percent confidence level.

3.6.4 Qualitative Data Analysis:

Qualitative data obtained from focus group discussions were analysed thematically following Braun and Clarke's (2006) thematic analysis approach. The process involved transcription, coding, categorisation, and identification of recurring themes related to climate adaptation, infrastructure, environmental conditions, and land value changes. The qualitative findings were used to complement and contextualise the quantitative regression results.

3.6.5 Income Variable Treatment:

Monthly household income was measured using four categories: below Ksh 10,000; Ksh 10,000 to 30,000; Ksh 30,001 to 50,000; and above Ksh 50,000. For regression analysis, each category was assigned the midpoint value and treated as a continuous variable. This approach is standard for ordered categorical variables with equal or roughly equal intervals (Long, 2014). Alternative specifications using dummy variables for each income category yielded substantively similar results, confirming the robustness of the income coefficient.

3.6.6 Econometric Model Specification

This study employed the Hedonic Pricing Model (HPM) to estimate the effect of climate adaptation investments on agricultural land values in Kajiado County. The HPM is grounded in Lancaster's Characteristics Theory of Value (1966), which posits that the value of land is determined by its attributes. Rosen (1974) formalised this concept by specifying that the market price of a heterogeneous good, such as land, reflects the implicit value of its constituent characteristics.

The HPM is distinct from standard linear regression in that it is explicitly designed to decompose the price of a composite good into the contributions of its individual attributes (Palmquist, 2005). In this study, agricultural land value per acre was modelled as a function of climate-smart agricultural practices, neighbourhood attributes, environmental attributes, and structural attributes, each of which contributes to the overall utility and market value of the land parcel.

The general functional form of the hedonic model is:

$$\mathbf{P_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \beta_3 X_{3i} + \beta_4 X_{4i} + \beta_5 C_{1i} + \beta_6 C_{2i} + \ldots + \epsilon_i}$$

Where:

- i = Cross-section observation (individual respondent/farm parcel), i = 1, 2, ..., n
- $\mathbf{P_i}$ = Log-transformed land value per acre for observation i
- $\mathbf{X_{1i}}$ = Climate Smart Agricultural Practices Index for observation i
- $\mathbf{X_{2i}}$ = Neighbourhood Attributes Index for observation i
- $\mathbf{X_{3i}}$ = Environmental Attributes Index for observation i
- $\mathbf{X_{4i}}$ = Structural Attributes Index for observation i
- $\mathbf{C_{1i}}$ to $\mathbf{C_{ki}}$ = Control variables including income, land ownership, farm size, years of occupation, and distance to road
- $\boldsymbol{\beta_0}$ = Intercept
- $\boldsymbol{\beta_1}$ to $\boldsymbol{\beta_k}$ = Coefficients to be estimated, representing the implicit prices of each attribute
- $\boldsymbol{\epsilon_i}$ = Error term

This is a cross-sectional model, as data were collected at one point in time. The subscript i denotes individual observations, not time periods.

3.6.7 Variable Definitions:

The explanatory variables were aligned systematically according to the study objectives and research questions. The Climate Smart Agricultural Practices Index captured practices including crop diversification, water management, conservation agriculture, and agroforestry. The Neighbourhood Attributes Index captured accessibility to roads, highways, markets, and social amenities. The Environmental Attributes Index captured air quality, noise pollution, waste pollution, and distance to cultural or natural sites. The Structural Attributes Index captured plot size, water services, sewerage services, and electricity connection.

3.6.8 Estimation Strategy:

To address each study objective independently and progressively, three models were estimated.

Model 1: Simple Linear Regressions (Separate Objectives)

$$\mathbf{Y_i = \beta_0 + \beta_1 X_{1i} + \epsilon_i}$$

$$\mathbf{Y_i = \beta_0 + \beta_2 X_{2i} + \epsilon_i}$$

$$\mathbf{Y_i = \beta_0 + \beta_3 X_{3i} + \epsilon_i}$$

$$\mathbf{Y_i = \beta_0 + \beta_4 X_{4i} + \epsilon_i}$$

These models estimate the individual effect of each category of attributes on land values without controlling for other attributes.

Model 2: Multiple Linear Regression (Combined Effects)

$$\mathbf{Y_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \beta_3 X_{3i} + \beta_4 X_{4i} + \epsilon_i}$$

This model estimates the combined effect of all four categories of attributes, allowing for the isolation of each variable's contribution while controlling for the others.

Model 3: Full Regression Model (with Controls)

$$\mathbf{Y_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \beta_3 X_{3i} + \beta_4 X_{4i} + \beta_5 Income_i + \beta_6 Ownership_i + \beta_7 FarmSize_i + \beta_8 YearsOccup_i + \beta_9 DistRoad_i + \epsilon_i}$$

This is the full hedonic specification, which includes socioeconomic and locational control variables to address potential confounding and omitted variable bias.

The regression models estimated in this study are applications of the Hedonic Pricing Model (Rosen, 1974). The HPM is not a separate statistical technique but an economic framework for decomposing the price of a heterogeneous good into the contributions of its constituent characteristics. The estimation method is Ordinary Least Squares (OLS) regression, applied within the hedonic framework.

The key distinguishing features of the hedonic approach used in this study include attribute decomposition, where the dependent variable representing land price is decomposed into contributions from multiple characteristics including CSA practices, neighbourhood attributes, environmental characteristics, and structural attributes, following Lancaster's (1966) characteristics theory. The approach also involves implicit price estimation, where the regression coefficients represent the implicit prices of each attribute, indicating the marginal contribution of each characteristic to land value (Palmquist, 2005). Additionally, the full model includes controls for socioeconomic and locational factors to isolate the unique contribution of each attribute, addressing potential confounding.

Therefore, while estimated using OLS regression, the models are hedonic pricing models because they implement the theoretical framework developed by Rosen (1974) and extended by subsequent scholars.

3.7 Diagnostic Tests

Diagnostic tests were conducted to assess model reliability. Multicollinearity was examined using the Variance Inflation Factor (VIF), with values below ten considered acceptable. Heteroskedasticity was assessed using the Breusch-Pagan test, with a significance level above 0.05 indicating no serious heteroskedasticity concerns. Normality of residuals was assessed using the Shapiro-Wilk test. Linearity was assessed using scatter plots of residuals against predicted values. Robust standard errors were estimated to correct for possible heteroskedasticity if detected.

3.8 Research Quality

In this mixed methods study, research quality was ensured through both quantitative measures, including validity and reliability, and qualitative criteria, including trustworthiness, alongside a pilot study.

3.8.1 Pilot Study

A pilot study was conducted with twelve farmers and landowners from Kajiado County who were not included in the main study. The purpose of the pilot was to assess clarity of questionnaire items, estimate completion time, and identify any logistical challenges in recruitment and administration. Feedback from participants was used to refine the instruments and procedures. Ambiguous items were revised to improve clarity, and procedural issues were addressed prior to the main data collection. Specifically, questions on land value per acre were rephrased to accommodate respondents who were uncomfortable disclosing exact figures by providing ranges. The pilot also revealed the need for translation of certain technical terms into Swahili and Maa languages, which was done with the assistance of local research assistants. This process enhanced the feasibility and overall quality of the study.

3.8.2 Validity

Validity refers to the extent to which an instrument measures what it is intended to measure (Heale & Twycross, 2015). This study ensured validity through several strategies.

Content validity was supported by the development of the questionnaire based on a comprehensive review of existing literature and established theoretical constructs including Lancaster's Characteristics Theory of Value (1966) and the hedonic pricing framework (Rosen, 1974). The questionnaire items were drawn from validated instruments used in previous land valuation and climate adaptation studies in sub-Saharan Africa.

Construct validity was supported by prior studies demonstrating that similar instruments accurately measured climate smart agricultural practices, neighbourhood attributes, environmental characteristics, and land values across diverse agricultural populations. The operationalization of variables as presented in Chapter Two directly aligned with the measurement scales used in the questionnaire.

Face validity was assessed during the pilot study by evaluating whether participants found the items clear, relevant, and appropriate within the local Kajiado County context. Respondents confirmed that questions on climate adaptation investments, land ownership, and market access were relevant to their experiences as farmers and landowners in the county. Necessary adjustments were made based on participant feedback, including simplification of Likert scale anchors and addition of local examples for climate smart agricultural practices such as water pans and sand dams.

3.8.3 Reliability

Reliability refers to the consistency of measurements across time and items (Polit & Beck, 2021). In this study, internal consistency was assessed using Cronbach's alpha coefficients computed in SPSS for the main variable indices. A threshold of 0.70 was considered acceptable for the climate smart agriculture index, neighbourhood index, environmental index, and structural index.

The pilot study data were used to compute preliminary Cronbach's alpha values. Items that reduced the alpha coefficient below the acceptable threshold were reviewed and either revised or removed from the final questionnaire. The final reliability coefficients for each index were computed after main data collection and are presented in Chapter Four alongside the descriptive statistics.

3.8.4 Trustworthiness of Qualitative Data

To ensure the quality of qualitative data, the study applied the criteria of credibility, dependability, and confirmability as outlined by Lincoln and Guba (1985).

Credibility was enhanced through the use of a semi-structured focus group discussion guide and consistent facilitation of discussions by the same researcher. Member checking was conducted by summarising key themes at the end of each discussion and allowing participants to confirm, correct, or elaborate on the interpretations. This ensured that the findings accurately reflected participants' experiences and perspectives.

Dependability was supported by maintaining a clear audit trail of data collection and analysis procedures. All focus group discussions were audio recorded, transcribed verbatim, and the transcripts were reviewed against the original recordings for accuracy. The coding process was documented, and decisions regarding theme development were recorded to allow external review.

Confirmability was ensured by grounding interpretations in participants' responses and maintaining neutrality during analysis. Direct quotations were used to support each theme, ensuring that findings emerged from the data rather than from researcher preconceptions. The researcher also maintained a reflexive journal throughout the data collection and analysis phases to document potential biases and how they were managed.

These strategies ensured that the qualitative findings accurately reflected participants' experiences and provided meaningful support to the quantitative results. The integration of quantitative validity and reliability measures with qualitative trustworthiness criteria strengthened the overall research quality of this mixed methods study.

3.9 Ethical Considerations

Before undertaking the study, the researcher sought permission and approval from Strathmore University's Institutional Review Board (IRB). The researcher also obtained a research permit from the National Commission for Science, Technology and Innovation (NACOSTI) as required by Kenyan law for all research activities involving human participants.

The researcher obtained informed consent from all participants before data collection. Each participant was provided with a participant information sheet explaining the purpose of the study, the nature of their involvement, the expected duration of the questionnaire and focus group discussions, and the voluntary nature of their participation. Participants were informed of their free will to withdraw from the study at any point without penalty or explanation. For focus group discussions, participants were additionally informed that while the researcher would maintain confidentiality, the researcher could not guarantee that other group members would not share information discussed during the session.

To maintain confidentiality of the respondents, anonymity was observed by not requiring respondents to indicate their names or any identifying details on the questionnaire. Each questionnaire was assigned a unique participant code known only to the researcher. Focus group discussion participants were asked to use pseudonyms during discussions and were instructed not to share information discussed outside the group setting.

Data security was maintained throughout the research process. Hard copy questionnaires were stored in a locked filing cabinet accessible only to the researcher. Digital data including SPSS files and audio recordings were stored on a password protected computer with encrypted backups. Audio recordings of focus group discussions were transcribed verbatim, and the original recordings were deleted after transcription was verified.

The researcher ensured that no harm came to participants as a result of the study. The research did not involve sensitive medical or psychological questions, and all questions focused on agricultural practices, land characteristics, and climate adaptation investments. Participants were not subjected to any physical, psychological, or emotional distress during data collection. The researcher also ensured that the study did not interfere with participants' daily agricultural or economic activities by scheduling data collection at convenient times and locations.

3.10 Chapter Summary

This chapter has presented the methodological framework employed in the study, including the research philosophy, research design, study area, target population, sampling techniques, data collection methods, data analysis techniques, diagnostic tests, and ethical considerations. The study adopted a pragmatist philosophy and a mixed methods convergent parallel design. Quantitative data were collected from 120 farmers and landowners across six sub-counties using a structured questionnaire, with qualitative data gathered through one focus group discussion comprising eight participants. The econometric analysis employed Ordinary Least Squares regression within the Hedonic Pricing Model framework, with diagnostic tests conducted to ensure model reliability. The study adhered to ethical standards including informed consent, confidentiality, and data security.

CHAPTER FOUR

DATA ANALYSIS AND PRESENTATION

4.0 Introduction

This chapter presents the findings of the study on the effects of climate adaptation investments on agricultural land values in Kajiado County. The chapter begins with a description of the response rates for both quantitative and qualitative data collection, followed by an analysis of the demographic characteristics of respondents. The chapter then presents descriptive and inferential statistics for the study variables, including land value per acre, climate smart agricultural practices, neighbourhood attributes, environmental attributes, and structural attributes. The findings are organised according to the four research objectives, with each section presenting descriptive statistics, simple linear regression results, and qualitative findings. The chapter concludes with multiple regression analyses, diagnostic tests, and a summary of the key findings.

4.1 Response Rates and Demographic Characteristics of Respondents

4.1.1 Response Rates

The study targeted 133 respondents for the quantitative survey. Of these, 120 completed and returned valid questionnaires, yielding a response rate of 90.2 percent. This response rate is considered acceptable for social science research and exceeds the recommended threshold of 70 percent for survey-based studies (Babbie, 2016). The high response rate was achieved through in-person questionnaire administration, follow-up visits, and assistance from local agricultural extension officers.

The distribution of completed questionnaires by sub-county was as follows: Kajiado Central contributed 20 respondents, Kajiado North contributed 20 respondents, Kajiado West contributed 20 respondents, Isinya contributed 20 respondents, Loitokitok contributed 20 respondents, and

Mashuuru contributed 20 respondents. This equal distribution ensured spatial representation across the six sub-counties.

For the qualitative component, eight participants were purposively selected from the survey respondents. All eight selected participants attended the focus group discussion, yielding a 100 percent response rate for the qualitative component. The focus group discussion included four male and four female participants, with ages ranging from thirty to sixty-five years, representing diverse perspectives on climate adaptation investments and land market dynamics.

4.1.2 Demographic Characteristics of Respondents

Table 4.1: Summary of Demographic Characteristics (n=120)

Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	78	65.0
	Female	42	35.0
Age Group	19-35 years	52	43.3
	36-45 years	58	48.3
	46-55 years	6	5.0
	56-65 years	4	3.4
Education Level	KCSE	8	6.7
	Certificate	6	5.0
	Diploma	18	15.0
	Bachelor's Degree	68	56.7
	Master's Degree	16	13.3
	PhD	4	3.3
Commercial Farming	Engaged	36	30.0
	Not engaged	84	70.0
Income Sources	Single source	26	21.7
	Multiple sources	94	78.3
Monthly Earnings	Below Ksh 10,000	6	5.0
	Ksh 10,000-30,000	26	21.7
	Ksh 30,001-50,000	30	25.0
	Above Ksh 50,000	58	48.3

Source: Researcher Survey Data (2026)

The demographic profile of respondents provides important context for understanding the study findings, revealing patterns of land ownership, economic engagement, and capacity for adaptation investment.

Gender Composition: The sample comprised predominantly male respondents, representing 65.0 percent, reflecting gendered land ownership patterns in Kajiado County where patriarchal land tenure systems and customary inheritance practices favour male ownership (Rotich et al., 2025). This gender imbalance is consistent with broader patterns across Kenya where women constitute the majority of agricultural labour but hold minority land rights (Deininger et al., 2020). The 35.0 percent female representation, while lower than male participation, is higher than the national average for female land ownership in Kenya, which is approximately 30 percent. This higher representation may reflect the county's proximity to Nairobi and higher levels of formal land registration in peri-urban areas. This composition has implications for climate adaptation, as women-headed households often have lower adaptive capacity due to limited access to credit, extension services, and formal land rights (Wainaina et al., 2020).

Age Distribution: Most respondents, accounting for 91.6 percent, are within the economically active age range of 19 to 45 years, with the highest concentration in the 36 to 45 age bracket representing 48.3 percent. This indicates that the study captured views of individuals in their prime productive years, with capacity to adopt and benefit from climate adaptation investments. The relatively low representation of older farmers aged 46 to 65 years at only 8.4 percent is notable, possibly reflecting inheritance patterns where younger family members take over land management, or retirement migration from agricultural areas. Younger farmers may be more open to innovative adaptation practices but may also have shorter tenure experience, potentially limiting their assessment of long-term land value trends.

Educational Attainment: Educational levels are notably high, with 73.3 percent holding a bachelor's degree or higher. This is significantly above the national average and suggests that the sample population is relatively well-educated compared to the general Kenyan farming population. This high education level may reflect the peri-urban nature of much of Kajiado County, where educated professionals purchase land for farming or investment, migration from Nairobi of educated individuals seeking land, and the strategic location of the county along the Nairobi corridor attracting more educated landowners. High education levels suggest strong capacity to understand and implement climate smart agricultural practices, access and process information about adaptation options, and engage with land markets. However, this high education level means the findings may not be generalizable to more remote, less educated farming populations.

Commercial Farming: Only 30.0 percent of respondents reported engaging in commercial farming, with 70.0 percent engaging in subsistence or mixed farming. This reflects the dual nature of agriculture in Kajiado County: while some farmers pursue commercial production, particularly in horticulture, dairy, and crop farming near urban centres, the majority still engage in subsistence-oriented production, especially in pastoral and agro-pastoral areas. This has implications for adaptation investment, as commercial farmers may have more resources and stronger incentives to invest in productivity-enhancing practices, while subsistence farmers may face financial constraints limiting adaptation adoption.

Income Sources: The finding that 78.3 percent of respondents have multiple income sources indicates economic diversification beyond agriculture, which is common in peri-urban ASAL areas where climate variability makes sole dependence on agriculture risky. Diversification may provide financial resources for adaptation investment and reduce sensitivity to climate shocks. The high proportion of multiple income sources also reflects the proximity to Nairobi, which provides off-farm employment opportunities. Single-source income households, representing 21.7 percent, are likely more vulnerable to climate variability and may have less capacity to invest in adaptation.

Monthly Earnings: The majority of respondents, representing 48.3 percent, earn above Ksh 50,000 monthly, indicating relatively high-income levels compared to national averages. This likely reflects the peri-urban nature of the sample, where land ownership is associated with higher household wealth, and multiple income sources contribute to higher earnings. High income levels suggest financial capacity to invest in land improvements and adaptation measures, consistent with the finding that higher-income households are more likely to adopt climate smart agricultural practices (Autio et al., 2021). However, the high-income level also means the sample may not be representative of the average rural Kenyan farming household, and findings regarding adaptation investment capacity may reflect this wealth bias.

4.2 Descriptive Statistics

Descriptive statistics were computed to summarize the characteristics of the study variables, namely land value per acre, climate-smart agricultural practices (CSA), neighbourhood attributes, environmental attributes, and structural attributes. The statistics presented include the mean, standard deviation, minimum and maximum values, as well as measures of distribution shape such as skewness and kurtosis. The results are presented in Table 4.2

Table 4.2: Descriptive Statistics

Variable	Mean	Std. Deviation	Minimum	Maximum	Skewness	Kurtosis
Land Value Per Acre	3.3708	0.9727	1.17	5.00	-0.230	-0.775
CSA	4.3367	1.2382	1.00	6.00	-0.889	0.004
Neighborhood	3.8392	0.8699	1.50	5.17	-0.619	-0.118
Environment	3.7060	0.8330	1.50	5.00	-0.212	-0.568
Structural	4.0126	0.8270	1.57	5.00	-0.926	0.015

The results indicate that the mean land value per acre was 3.37 (SD = 0.97), suggesting a moderate level of land valuation among the sampled agricultural land parcels. The observed land values ranged from 1.17 to 5.00, indicating substantial variation in land prices across the study area. The distribution of land values was slightly negatively skewed (Skewness = -0.230), implying that a greater proportion of respondents reported relatively higher land values.

Climate-Smart Agricultural Practices (CSA) recorded the highest mean score among the independent variables (M = 4.34, SD = 1.24), indicating a relatively high level of adoption of climate-smart agricultural practices. The negative skewness (-0.889) suggests that most respondents reported higher levels of CSA implementation. The wide range of scores (1.00-6.00) further indicates variability in the adoption of climate adaptation measures across farms.

Neighbourhood attributes had a mean score of 3.84 (SD = 0.87), implying that respondents generally perceived neighbourhood conditions such as accessibility, proximity to markets, and availability of amenities to be favourable. The distribution was moderately negatively skewed (-0.619), suggesting that higher neighbourhood ratings were more common among respondents.

Environmental attributes recorded a mean score of 3.71 (SD = 0.83), indicating moderately favourable environmental conditions within the study area. The relatively small standard deviation suggests limited variability in respondents' assessments of environmental characteristics. The distribution was approximately symmetric, as indicated by a skewness value of -0.212.

Structural attributes had a mean score of 4.01 (SD = 0.83), reflecting generally favourable structural conditions and infrastructure associated with agricultural land parcels. The negative skewness (-0.926) indicates that respondents tended to rate structural attributes highly. The relatively low standard deviation suggests moderate consistency in respondents' perceptions.

Overall, the descriptive statistics show that respondents reported relatively high levels of climate-smart agricultural practices, neighbourhood quality, environmental conditions, and structural attributes. Furthermore, the skewness and kurtosis values for all variables fall within the commonly accepted thresholds of ±2 and ±7, respectively, suggesting that the data approximate a normal distribution and are suitable for subsequent parametric analyses such as correlation and regression analysis.

4.3 Diagnostic tests

Before conducting the regression analysis, diagnostic tests were performed to assess whether the data satisfied the assumptions of Ordinary Least Squares (OLS) regression. These tests are important for ensuring the validity and reliability of the regression estimates. The diagnostic tests conducted included multicollinearity assessment using the Variance Inflation Factor (VIF), heteroskedasticity testing using the Breusch-Pagan test, normality testing using the Shapiro-Wilk test, and linearity assessment through residual plots. The results of these diagnostic tests are presented in the following subsections.

4.3.1 Normality test

A normality test was conducted to determine whether the regression residuals were normally distributed, which is one of the assumptions of Ordinary Least Squares (OLS) regression. The Kolmogorov-Smirnov and Shapiro-Wilk tests were used to assess the normality of the standardized residuals. The results are presented in Table 4.3.

Table 4.3: Normality test

	Kolmogorov-Smirnov[a]			**Shapiro-Wilk**		
	Statistic	Df	Sig.	Statistic	Df	Sig.
Standardized Residual	.088	130	.014	.975	130	.018

a. Lilliefors Significance Correction

The results indicate that the Kolmogorov-Smirnov test yielded a significance value of 0.014, while the Shapiro-Wilk test produced a significance value of 0.018. Although both p-values are less than the 0.05 significance level, suggesting a statistically significant departure from normality, the Shapiro-Wilk statistic (W = 0.975) is very close to 1, indicating only a slight deviation from a normal distribution. Furthermore, given the relatively large sample size (N = 130), OLS regression is generally robust to minor violations of the normality assumption. Consequently, the residuals were considered approximately normally distributed, and the normality assumption was deemed sufficiently satisfied for subsequent regression analysis.

4.3.2 Multicollinearity test

A multicollinearity test was conducted using the Variance Inflation Factor (VIF) and Tolerance statistics to determine whether high correlations existed among the independent variables. According to Hair et al. (2019), multicollinearity is considered problematic when tolerance values are less than 0.10 or VIF values exceed 10.

Table 4.4: Multicollinearity test

Model		Collinearity Statistics	
		Tolerance	**VIF**
1	CSA	.497	2.013
	Neighborhood	.387	2.587
	Environment	.766	1.305
	Structural	.553	1.807

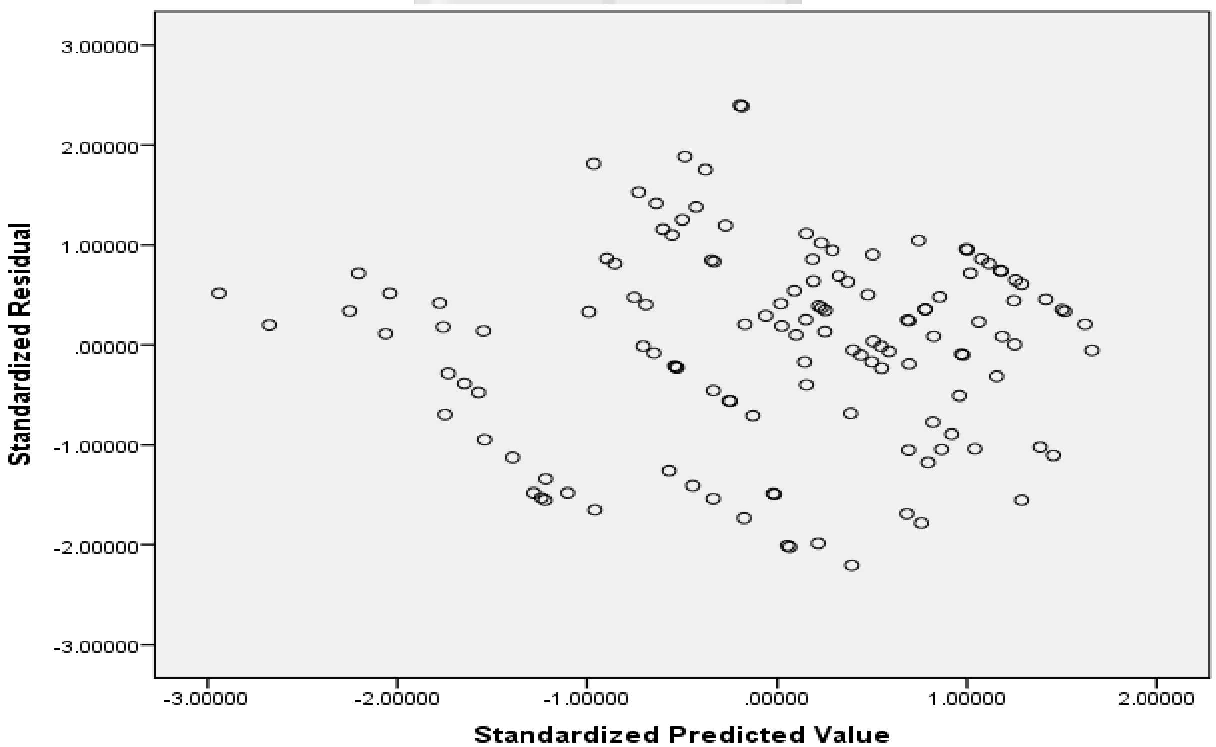
a. Dependent Variable: Land Value Per Acre

The results indicate that the tolerance values ranged from 0.387 to 0.766, all of which exceed the minimum acceptable threshold of 0.10. Similarly, the VIF values ranged from 1.305 to 2.587, which are well below the recommended maximum threshold of 10. These findings suggest that multicollinearity is not a concern in the model, indicating that the independent variables are sufficiently distinct and do not exhibit excessive intercorrelation. Therefore, the data satisfy the multicollinearity assumption for Ordinary Least Squares (OLS) regression analysis.

4.3.4 Heteroskedasticity test

A heteroskedasticity test was conducted to determine whether the variance of the residuals remained constant across the predicted values. This assumption was assessed using a scatter plot of standardized residuals against standardized predicted values. According to Gujarati and Porter (2009), the absence of a systematic pattern in the scatter plot indicates homoscedasticity, while the presence of a funnel-shaped, cone-shaped, or other discernible pattern suggests heteroskedasticity.

Figure 4.1: Scatter Plot of Standardized Residuals against Standardized Predicted Values



The scatter plot shows that the residuals are randomly distributed around the zero line with no clear systematic pattern, funnel shape, or clustering. The points appear to be dispersed relatively evenly across the range of predicted values, indicating that the variance of the residuals remains approximately constant. Therefore, there is no evidence of heteroskedasticity in the data. Based on these findings, the assumption of homoscedasticity was satisfied, implying that the Ordinary Least Squares (OLS) regression estimates are reliable and unbiased with respect to the variance of the error terms. Consequently, the data were considered suitable for subsequent regression analysis.

4.4 Correlation analysis

Correlation analysis was conducted to examine the nature and strength of the relationships between land value per acre and the study variables, namely Climate-Smart Agricultural Practices (CSA), neighbourhood attributes, environmental attributes, and structural attributes. Pearson's correlation coefficient was used to determine the direction and magnitude of the relationships. The results are presented in Table 4.5.

Table 4.5: Correlation analysis

		Land Value Per Acre	CSA	Neighborhood	Environment	Structural
Land Value Per Acre	Pearson Correlation	1	.548**	.630**	.134	.524**
	Sig. (2-tailed)		.000	.000	.053	.000
	N	208	208	208	208	208
CSA	Pearson Correlation	.548**	1	.709**	.243**	.450**
	Sig. (2-tailed)	.000		.000	.000	.000
	N	208	208	208	208	208
Neighborhood	Pearson Correlation	.630**	.709**	1	.364**	.611**
	Sig. (2-tailed)	.000	.000		.000	.000
	N	208	208	208	208	208
Environment	Pearson Correlation	.134	.243**	.364**	1	.473**
	Sig. (2-tailed)	.053	.000	.000		.000
	N	208	208	208	208	208
Structural	Pearson Correlation	.524**	.450**	.611**	.473**	1
	Sig. (2-tailed)	.000	.000	.000	.000	
	N	208	208	208	208	208

**. Correlation is significant at the 0.01 level (2-tailed).

The findings indicate that Climate-Smart Agricultural Practices (CSA) have a moderate positive and statistically significant relationship with land value per acre ($r = 0.548$, $p < 0.01$). This suggests that increased adoption of climate-smart agricultural practices is associated with higher agricultural land values. Similarly, neighbourhood attributes exhibit a strong positive and statistically significant relationship with land value per acre ($r = 0.630$, $p < 0.01$), implying that favourable neighbourhood characteristics such as accessibility, proximity to markets, and availability of social amenities contribute substantially to higher land values.

The results further show that structural attributes have a moderate positive and statistically significant relationship with land value per acre ($r = 0.524$, $p < 0.01$). This indicates that improvements in structural features and infrastructure are associated with increased land values. In contrast, environmental attributes display a weak positive but statistically insignificant relationship with land value per acre ($r = 0.134$, $p = 0.053$). Since the p-value exceeds the 0.05 significance level, the relationship is not statistically significant, suggesting that environmental attributes do not have a significant direct association with land values in the study area.

Overall, the results reveal that neighbourhood attributes have the strongest association with land value per acre, followed by climate-smart agricultural practices and structural attributes. Environmental attributes, although positively related to land value, do not exhibit a statistically significant relationship. These findings provide preliminary evidence that investments in climate-smart agricultural practices, neighbourhood development, and structural improvements are important determinants of agricultural land values and warrant further examination through regression analysis.

4.5: Effect of Climate Smart Agricultural Practices on Land Values in Kajiado County

The first research question was to determine the effect of adoption of climate-smart agricultural practices on land values in Kajiado County.

4.5.1 Descriptive results on effect of Climate Smart Agricultural Practices on Land Values

The descriptive findings analysis in Table 4.6 indicates a high level of adoption of climate-smart agricultural (CSA) practices among respondents, with all indicators recording mean scores above 4.0 on a five-point scale. Practices such as agroforestry (Mean = 4.46), conservation agriculture (Mean = 4.41), and water management (Mean = 4.33) are widely implemented, suggesting that farmers are actively engaging in adaptation strategies. Respondents also strongly agree that CSA improves farm productivity (Mean = 4.31) and reduces climate-related risks (Mean = 4.37), reinforcing the functional benefits of these practices. Importantly, there is strong agreement that CSA adoption increases land value (Mean = 4.28), indicating that farmers perceive a direct link between adaptation practices and the economic worth of land. Although there is moderate variation in responses, this reflects differences in adoption intensity, which is useful for subsequent analysis. Overall, these findings reveal that CSA practices are not only prevalent but also perceived to enhance both agricultural performance and land value, thereby justifying further empirical examination of their effect on land values using regression analysis.

Table 4.6: Descriptives on Effect of Climate Smart Agricultural Practices on Land Values

Items	N	Mean	Std. Dev
I practice crop diversification on my farm.	120	4.1923	1.43171
I use water management practices such as irrigation or rainwater harvesting.	120	4.3317	1.37632
I apply conservation agriculture techniques (e.g., minimum tillage).	120	4.4135	1.39433
I practice agroforestry on my land.	120	4.4615	1.35078
Climate-smart agricultural practices have improved my farm productivity.	120	4.3125	1.38781
Climate-smart practices have reduced risks associated with climate change.	120	4.3654	1.42482
Adoption of climate-smart practices increases the value of my land.	120	4.2846	1.34242
Valid N (listwise)	**120**		

Source: Research Survey Data (2026)

4.4.2 Regression analysis on effect of Climate Smart Agricultural Practices on Land Values

Using a simple linear regression with CSA as the sole predictor, the results show a positive and statistically significant relationship: a one unit increase in the CSA index corresponds to a B coefficient of 0.431 ($\beta = 0.548$, $p < .001$). The model explains 30.1% of the variance in land value per acre ($R^2 = 0.301$, Adjusted $R^2 = 0.297$), and the overall regression is highly significant ($F(1, 118) = 50.77$, $p < .001$). Thus, CSA practices have a meaningful positive effect on agricultural land values. However, this preliminary model does not yet control for neighbourhood, environmental, structural, or other confounding factors, a limitation that will be addressed in the consolidated multiple regression models.

Table 4.7: Regression analysis on effect of Climate Smart Agricultural Practices on Land Values

Model	**R**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**
1	.548[a]	.301	.297	.81532

ANOVA[a]

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	58.920	1	58.920	50.77	.000[b]
	Residual	136.938	118	.665		
	Total	195.859	119			

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.502	.206		7.279	.000
	CSA	.431	.046	.548	9.415	.000

a. Dependent Variable: Land Value Per Acre
b. Predictors: (Constant), CSA

4.5.3 Qualitative analysis findings on effect of CSA practices on land value

The qualitative findings corroborated the regression results. Participants consistently linked adoption of CSA practices to reduced production losses and increased land utility. One farmer from Loitokitok sub-county explained that solar-powered irrigation and drought-resistant crops had improved farming productivity and reduced losses from drought, noting that the land now produces even when rains fail. Another participant from Isinya added that through greenhouse farming and irrigation, production had increased, and the same piece of land now earns three times what it earned five years ago. These accounts confirmed that the mechanism driving the CSA premium was risk reduction rather than yield maximisation. Land that remained productive during drought commanded higher value, aligning with the descriptive finding that 56.5% of respondents reported economic benefits despite financial constraints.

4.6 Effect of Neighbourhood Attributes on Agricultural Land Values in Kajiado County

T6e second objective sought to determine the effect of neighbourhood attributes on agricultural land values in Kajiado County.

4.6.1 Descriptive results on Effect of Neighborhood Attributes on Agricultural Land Values in Kajiado County

The descriptive statistics results for the seven neighbourhood related items as shown in Table 4.8 reveal that respondents generally perceive proximity to infrastructure and amenities as important. The highest mean score was for "My land is located close to major highways" (M = 4.31, SD = 1.16), followed by "My land is easily accessible by road" (M = 4.18, SD = 1.05), indicating that road connectivity and highway access are viewed as the most influential neighbourhood attributes. Proximity to markets (M = 3.93, SD = 1.17) and the perception that overall location advantages positively influence land value (M = 3.92, SD = 1.15) also ranked highly. In contrast, closeness to essential social amenities such as schools and hospitals received a lower mean (M = 3.14, SD = 1.43), suggesting that while still moderately valued, it is considered less critical than road access and market proximity. These descriptive patterns suggest that neighbourhood attributes, particularly accessibility and transport links, are perceived by landowners as important drivers of land value, a finding that will be tested inferentially in the regression models.

Table 4.1: Descriptive results on Effect of Neighborhood Attributes on Agricultural Land Values in Kajiado County

Items	N	Mean	Std. Deviation
My land is easily accessible by road.	120	4.1827	1.04733
My land is located close to major highways.	120	4.3125	1.15614
My land is located close to market centres.	120	3.7067	1.63759
My land is located near essential social amenities (schools, hospitals).	120	3.1442	1.43064
Accessibility to roads increases the value of my land.	120	3.7260	1.17004
Proximity to markets increases the value of my land.	120	3.9327	1.17349
Overall location advantages positively influence my land value.	120	3.9231	1.15212
Valid N (listwise)	**120**		

4.6.2 Regression analysis on Effect of Neighborhood Attributes on Agricultural Land Values in Kajiado County

The second objective sought to determine the effect of neighbourhood attributes on agricultural land values in Kajiado County. A simple linear regression was conducted with the neighbourhood index as the sole predictor of land value per acre. The results show a positive and statistically significant relationship: a one unit increase in the neighbourhood index corresponds to a B coefficient of 0.704 ($\beta = 0.630$, $p < .001$). The model explains 39.6% of the variance in land value per acre ($R^2 = 0.396$, Adjusted $R^2 = 0.394$), and the overall regression is highly significant ($F(1, 118) = 77.50$, $p < .001$). Therefore, neighbourhood attributes have a meaningful positive effect on land values, meaning that better neighbourhood conditions such as accessibility to roads, markets, and amenities are associated with higher per acre land prices. However, this preliminary model does not yet control for other factors like CSA practices, environmental attributes, or structural characteristics, a limitation that will be addressed in the full multiple regression model.

Table 4.8: Regression analysis on Effect of Neighborhood Attributes on Agricultural Land Values in Kajiado County

Model	**R**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**
1	.630[a]	.396	.394	.75752

ANOVA[a]

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	77.647	1	77.647	77.50	.000[b]
	Residual	118.212	118	.574		
	Total	195.859	119			

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	.668	.238		2.802	.006
	Neighbourhoods	.704	.061	.630	11.632	.000

a. Dependent Variable: Land Value Per Acre

b. Predictors: (Constant), Neighbourhoods

4.6.3 Qualitative analysis on Effect of Neighborhood Attributes on Agricultural Land Values in Kajiado County

The qualitative findings reinforced the regression result. From the focus group discussion, accessibility to roads, towns, and social amenities was cited as the primary factor driving land prices. A participant from Kajiado North observed that accessibility through good road networks and proximity to Ngong Town had made the area's value appreciate, noting that five years ago an acre was Ksh 500,000, but today nothing could be found below Ksh 2 million. Another participant from Kajiado Central stated that land value depends on accessibility to social amenities and security, and that buyers come from Nairobi looking for land to build on, not necessarily to farm. The emphasis on buyers from Nairobi and the shift from agricultural to residential use confirmed that land in peri-urban Kajiado was increasingly valued as a speculative and transitional asset rather than purely for agricultural productivity.

4.7: Effect of Environmental Attributes on Land Values in Kajiado County

The third objective sought to determine the effect of environmental attributes on agricultural land values in Kajiado County. The results are as follows.

4.7.1 Descriptive results on Effect of Environmental Attributes on Land Values in Kajiado County.

The descriptive statistics on effect of environmental attributes on agricultural land values in Kajiado County as shown in Table 4.8 reveal that respondents generally perceive environmental conditions as moderately favourable, with mean scores ranging from 3.45 to 3.83 on a five-point scale. However, the item directly linking environmental quality to land desirability received the lowest mean (M = 3.45, SD = 1.38), suggesting that while individual environmental features like low noise levels (M = 3.83) and good air quality (M = 3.73) are recognised, their perceived contribution to land value is less certain. Notably, climate related risks such as drought and degradation also scored modestly (M = 3.63), indicating that environmental concerns may not be seen as primary drivers of land value in this context. These descriptive patterns imply that environmental attributes may have a weaker or more indirect effect on land prices compared to neighbourhood or CSA factors.

Table 4.8: Descriptive on Effect of Environmental Attributes on Land Values in Kajiado County.

Items	N	Mean	Std. Dev
The air quality in my area is good.	120	3.7308	1.01421
Noise levels in my area are low.	120	3.8269	1.28494
My land is free from waste pollution.	120	3.6442	1.18703
My land is located near environmentally attractive areas.	120	3.7729	1.30035
The environmental condition of my area is well maintained.	120	3.6779	1.15766
My land is not exposed to significant climate-related risks (e.g., drought, degradation)	120	3.6298	1.10880
Good environmental conditions increase the desirability of land in this area.	120	3.4538	1.38156
Valid N (listwise)	**120**		

4.7.2 Regression analysis results on Effect of Environmental Attributes on Land Values in Kajiado County

The third objective sought to determine the effect of environmental attributes on agricultural land values in Kajiado County. A simple linear regression was conducted with the environmental index as the sole predictor of land value per acre. The results show a positive but statistically non-significant relationship at the conventional 0.05 level. A one-unit increase in the environmental index is associated with a 0.157 increase in the log-transformed land value per acre. The standardised coefficient of 0.134 indicates a weak effect. The model explains only 1.8 percent of the variance in land value per acre, with an adjusted R^2 of 0.013, and the overall regression is not statistically significant with an F-statistic of 2.17 and a p-value of 0.053. Therefore, environmental attributes do not have a significant effect on land values in this preliminary model. This finding suggests that, unlike CSA practices and neighbourhood attributes, environmental factors such as air quality, noise levels, and climate risks may not independently influence per acre land prices in Kajiado County.

Table 4.9: Regression analysis results on Effect of Environmental Attributes on Land Values in Kajiado County

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.134[a]	.018	.013	.96624

ANOVA[a]

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	3.535	1	3.535	2.17	.053[b]
	Residual	192.324	118	.934		
	Total	195.859	119			

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.789	.306		9.109	.000
	Environment	.157	.081	.134	1.946	.053

a. Dependent Variable: Land Value Per Acre
b. Predictors: (Constant), Environment

4.7.3 Qualitative findings on Effect of Environmental Attributes on Land Values in Kajiado County

The qualitative findings supported the weak quantitative effect. Participants rarely mentioned environmental quality as a factor in land purchase decisions, focusing instead on development, infrastructure, and accessibility. When environmental challenges such as land degradation and water scarcity were discussed, they were framed as constraints to be managed rather than as assets to be valued. This pragmatic orientation reflected the livelihood realities of a semi-arid, climate-vulnerable region where environmental conditions were experienced as risks rather than amenities. The weak capitalisation of environmental attributes indicated a market failure: the social benefits of environmental conservation exceeded the private benefits captured through land prices.

4.8 Effect of structural attributes on agricultural land values in Kajiado County

The fourth objective sought to determine the effect of structural attributes on agricultural land values in Kajiado County. The results are as follows.

4.8.1 Effect of structural attributes on agricultural land values in Kajiado County

The descriptive statistics for the seven structural related items indicate that respondents strongly agree that structural features enhance land value, with all mean scores above 3.77 on a five-point scale. The highest mean is for “Well developed land attracts higher market prices” (M = 4.34, SD = 1.03), followed by “My land has adequate sanitation or sewerage facilities” (M = 4.20, SD = 1.05), suggesting that land improvements and sanitation are perceived as the most critical structural attributes. Similarly, “The size of my land contributes positively to its value” and “Availability of basic services increases the value of my land” both scored a mean of 4.00 (SD = 1.03 and 1.09 respectively), indicating consistent agreement that size and basic services matter. Reliable access to water (M = 3.99, SD = 1.08) and access to electricity (M = 3.89, SD = 1.16) also received high scores, though slightly lower than sanitation. The lowest mean among the items was “Infrastructure improvements increase land demand in this area” (M = 3.78, SD = 1.12), but still well above the midpoint. Overall, these descriptive patterns show that landowners perceive structural attributes as highly influential on land value, with sanitation, land development, size, and basic services being particularly important. This suggests that structural attributes are expected to have a strong positive effect on per acre land prices.

Table 4.10: Descriptive results on Effect of structural attributes on agricultural land values in Kajiado County

	N	Mean	Std. Deviation
My land has reliable access to water.	120	3.9856	1.08338
My land has access to electricity.	120	3.8894	1.16399
My land has adequate sanitation or sewerage facilities.	120	4.2029	1.05084
The size of my land contributes positively to its value.	120	4.0000	1.02623
Availability of basic services increases the value of my land.	120	4.0000	1.08570
Infrastructure improvements increase land demand in this area.	120	3.7788	1.12466
Well-developed land attracts higher market prices.	120	4.3385	1.03095
Valid N (listwise)	**120**		

4.8.2 Regression analysis results on Effect of structural attributes on agricultural land values in Kajiado County

The fourth objective sought to determine the effect of structural attributes on agricultural land values in Kajiado County. A simple linear regression was conducted with the structural index as the sole predictor of land value per acre. The results show a positive and statistically significant relationship: a one unit increase in the structural index corresponds to a B coefficient of 0.616 ($\beta = 0.524$, $p < .001$). The model explains 27.5% of the variance in land value per acre ($R^2 = 0.275$, Adjusted $R^2 = 0.271$), and the overall regression is highly significant ($F(1, 118) = 44.68$, $p < .001$). Therefore, structural attributes have a meaningful positive effect on land values, meaning that better structural features such as access to water, electricity, sanitation, and land development are associated with higher per acre land prices. However, this preliminary model does not yet control for other factors like CSA practices, neighbourhood conditions, or environmental attributes, a limitation that will be addressed in the full multiple regression model.

Table 4.11: Regression analysis results on Effect of structural attributes on agricultural land values in Kajiado County

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.524[a]	.275	.271	.83045

ANOVA[a]

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	53.791	1	53.791	44.68	.000[b]
	Residual	142.068	118	.690		
	Total	195.859	119			

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	T	Sig.
1	(Constant)	.897	.286		3.138	.002
	Structural	.616	.070	.524	8.832	.000

a. Dependent Variable: Land Value Per Acre
b. Predictors: (Constant), Structural

4.8.3 Qualitative analysis results on Effect of structural attributes on agricultural land values in Kajiado County

The qualitative findings reinforced the complementarity between structural attributes and climate adaptation. Participants identified water and electricity as critical enablers of both farming and settlement. One respondent from Isinya explained that boreholes and electricity had supported farming and settlement, increasing demand for land, and noted that without electricity one cannot pump water for irrigation, and without water CSA practices mean nothing. Another participant from Kajiado West added that visible improvements in housing, schools, and commercial buildings had increased land prices, and that investors look for land with existing infrastructure and will pay more even if the soil is less fertile. These accounts supported the regression finding that the value of CSA practices was partially realised through access to water and electricity.

4.9 Multiple Linear Regression Analysis

This section presents the results of the multiple linear regression analysis conducted to examine the combined effect of climate-smart agricultural practices, neighbourhood attributes, environmental attributes, and structural attributes on agricultural land value per acre in Kajiado County. The analysis was undertaken to determine the relative contribution and statistical significance of each predictor variable in explaining variations in land values.

The multiple regression model simultaneously examined the effects of climate-smart agricultural practices, neighbourhood attributes, environmental attributes, and structural attributes on land value per acre. The model was statistically significant with an F-statistic of 25.99 and a p-value less than 0.001, indicating that the predictor variables jointly explained variations in agricultural land values. The model produced an R^2 value of 0.475 and an adjusted R^2 of 0.464, implying that approximately 47.5 percent of the variation in land value per acre was explained by the four explanatory variables included in the model.

With respect to Objective 1, climate-smart agricultural practices had a positive and statistically significant effect on land value per acre with a B coefficient of 0.149 and a standardised beta of 0.190 at a p-value of 0.009. This implies that increased adoption of climate-smart agricultural practices contributes to higher agricultural land values while holding other variables constant. A one-unit increase in the CSA index is associated with a 0.149 increase in the log-transformed land value per acre. In practical terms, a farmer who increases their CSA adoption score by one point would be expected to have a land value that is approximately 16.1 percent higher than a farmer with a CSA score one point lower, calculated as exp(0.149) - 1 = 0.161 or 16.1 percent.

For Objective 2, neighbourhood attributes recorded the strongest positive and statistically significant effect on land value with a B coefficient of 0.431 and a standardised beta of 0.386 at a p-value less than 0.001, indicating that improved accessibility to roads, markets, and social amenities significantly increases land values. A one-unit increase in the neighbourhood index is associated with a 0.431 increase in the log-transformed land value per acre, which translates to approximately 53.8 percent higher land values.

For Objective 3, environmental attributes had a statistically significant negative effect on land value per acre with a B coefficient of -0.223 and a standardised beta of -0.191 at a p-value of 0.001. This finding requires careful interpretation. The apparent contradiction between the positive coefficient in the simple regression and the negative coefficient in the multiple regression reflects a phenomenon known as a suppressor effect or Simpson's paradox, which occurs when the relationship between two variables changes after controlling for other relevant variables.

In the simple regression, environmental attributes showed a weak positive relationship with land value because areas with slightly better environmental conditions tended to be somewhat more desirable. However, once neighbourhood and structural attributes were introduced into the model, the environmental coefficient became negative. This reflects spatial sorting in peri-urban Kajiado County: the most accessible and highest-value areas are often those with more development, which may have higher noise levels, more traffic, and more waste—negative environmental attributes. Conversely, areas with better environmental quality tend to be more remote and less accessible, commanding lower land prices. The positive relationship in the simple regression reflected the overall recognition of environmental quality, but when controlling for neighbourhood and structural attributes, the spatial sorting effect dominates. The negative coefficient for environmental attributes in the multiple regression model therefore reflects spatial sorting rather than a true penalty on environmental quality. In rapidly urbanising and semi-arid contexts such as Kajiado County, buyers prioritise accessibility, infrastructure, and development potential over environmental conditions when determining land value, consistent with findings from other African peri-urban contexts (Ochieng & Kirubi, 2020; Acheampong & Anokye, 2021).

For Objective 4, structural attributes had a positive and statistically significant effect on land value with a B coefficient of 0.345 and a standardised beta of 0.293 at a p-value less than 0.001, implying that access to infrastructure and basic services such as water, electricity, sanitation, and land improvements increases agricultural land values. A one-unit increase in the structural index is associated with a 0.345 increase in the log-transformed land value per acre, which translates to approximately 41.2 percent higher land values.

Table 4.12: Multiple Linear Regression Analysis

Model	**R**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**
1	.689[a]	.475	.464	.71184

ANOVA[a]

Model		Sum of Squares	Df	Mean Square	F	Sig.
	Regression	92.996	4	23.249	25.99	.000[b]
1	Residual	102.862	115	.507		
	Total	195.859	119			

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	.511	.285		1.790	.075
	CSA	.149	.057	.190	2.627	.009
	neighbourhoods	.431	.091	.386	4.714	.000
	Environment	-.223	.068	-.191	-3.284	.001
	Structural	.345	.080	.293	4.289	.000

a. Dependent Variable: Land Value Per Acre

b. Predictors: (Constant), Structural, CSA, Environment, neighbourhoods

4.10 Full model Regression analysis

To further determine whether additional socioeconomic and locational factors improve the explanatory power of the model, a full regression model was estimated by incorporating control variables including income, land ownership, farm size, years of occupation, and distance to road as shown in Table 4.13. The full model remained statistically significant with an F-statistic of 19.17 and a p-value less than 0.001, and produced an R^2 value of 0.611 with an adjusted R^2 of 0.581. Compared to the previous model with an R^2 of 0.475, the inclusion of the control variables increased the explanatory power of the model by 13.6 percentage points, indicating that the additional variables improved the model fit and contributed to explaining variations in agricultural land value per acre.

The results of the full model show that neighbourhood attributes remained the strongest positive and statistically significant predictor of land value with a B coefficient of 0.539 and a standardised beta of 0.456 at a p-value less than 0.001, while structural attributes also retained a positive and statistically significant effect with a B coefficient of 0.480 and a standardised beta of 0.370 at a p-value less than 0.001. However, climate-smart agricultural practices were no longer statistically significant with a standardised beta of 0.008 at a p-value of 0.925, and environmental attributes were also no longer statistically significant with a B coefficient of 0.011 at a p-value of 0.883. This suggests that their earlier effects may have been influenced by omitted variable bias and that neighbourhood and structural characteristics are more robust determinants of agricultural land value in the study area.

The environmental coefficient became statistically insignificant in the full model after introducing socioeconomic and locational controls. This indicates that the negative effect observed in the multiple regression model was not robust to the inclusion of these additional controls. Specifically, the relationship between environmental attributes and land value appears to be mediated by socioeconomic factors such as income and locational factors such as distance to road. This finding is consistent with the interpretation that environmental quality is weakly capitalised in the Kajiado land market and that its influence is heavily mediated by infrastructure, accessibility, and household socioeconomic characteristics.

Among the control variables, only income had a statistically significant effect on land value per acre with a B coefficient of -0.146 and a standardised beta of -0.200 at a p-value of 0.001. The negative coefficient implies that households with higher income levels may own larger or more remote parcels with lower unit prices per acre. Land ownership, farm size, years of occupation, and distance to road did not have statistically significant effects on land value.

The negative coefficient for years of occupation suggests a weak negative relationship between length of occupancy and land value. This counterintuitive finding has several plausible explanations. Farmers who have occupied land for longer periods likely acquired it when land values were significantly lower and may remain on less accessible, more peripheral land that has not appreciated as much as newer, more developed areas. Longer occupancy is associated with older age, and older farmers may have less capacity to invest in land improvement and adaptation, resulting in lower land values. Early settlers in the county may occupy more remote, less accessible areas, while newer landowners with shorter occupancy may purchase land in more accessible, higher-value peri-urban areas. Additionally, land that changes hands more frequently tends to have higher transaction activity and may command higher prices due to market competition, while land held for long periods may have fewer recent transactions to establish current market value.

Overall, the findings indicate that although the additional control variables improved the explanatory power of the model, only income emerged as a significant control variable, while neighbourhood and structural attributes remained the primary determinants of agricultural land values in Kajiado County.

Table 4.13: Full model Regression analysis

Model	**R**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**
1	.781[a]	.611	.581	.66072

ANOVA[a]

Model		Sum of Squares	Df	Mean Square	F	Sig.
	Regression	82.145	9	9.127	19.17	.000[b]
1	Residual	52.386	110	.437		
	Total	134.531	119			

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
	(Constant)	.226	.498		.454	.651
	CSA	.006	.068	.008	.094	.925
	Neighbourhoods	.539	.102	.456	5.270	.000
	Environment	.011	.078	.009	.147	.883
	Structural	.480	.093	.370	5.190	.000
1	Income	-.146	.044	-.200	-3.326	.001
	Land Ownership	.003	.118	.002	.026	.979
	Farm Size	.001	.062	.001	.022	.982
	Years of Occupation	-.110	.062	-.103	-1.770	.079
	Distance to road	-.051	.060	-.049	-.860	.392

a. Dependent Variable: Land Value Per Acre
b. Predictors: (Constant), Distance to road, neighbourhoods, Farm Size, Years of Occupation, Income, Land Ownership, Environment, Structural, CSA

4.11. Chapter summary

This chapter presented the findings on the effect of climate-smart agricultural practices, neighbourhood attributes, environmental attributes, and structural attributes on agricultural land values in Kajiado County. The descriptive findings showed that respondents generally perceived CSA practices, neighbourhood conditions, and structural attributes as important contributors to agricultural land value. Simple linear regression results indicated that CSA, neighbourhood, and structural attributes individually had positive and statistically significant effects on land value per acre, while environmental attributes showed a weak and statistically insignificant effect.

The multiple regression analysis demonstrated that the four core explanatory variables jointly explained a substantial proportion of the variation in agricultural land values. Neighbourhood and structural attributes emerged as the strongest positive determinants of land value. Although CSA practices initially showed a significant positive effect, the relationship became statistically insignificant after introducing socioeconomic and locational control variables in the full regression model. Environmental attributes also lost significance in the full model. The inclusion of additional control variables improved the explanatory power of the model, although only income emerged as a statistically significant control variable.

Overall, the findings suggest that accessibility, infrastructure, and structural development are the most robust determinants of agricultural land value in Kajiado County, while the effect of climate adaptation investments appears to depend on broader socioeconomic and locational conditions.

CHAPTER FIVE

SUMMARY, DISCUSSIONS, CONCLUSIONS, AND RECOMMENDATIONS

5.0 Introduction

This chapter provides a comprehensive summary of the study's findings, followed by the conclusions and recommendations drawn from them. In addition, it outlines suggestions intended to inform and guide future research.

5.1 Discussions

The discussion interprets the study's main results in relation to theory, prior empirical evidence, and the specific context of Kajiado County. Rather than restating statistical outputs, this section focuses on the meaning, mechanisms, and implications of the observed relationships between climate adaptation investments, land attributes, and agricultural land values.

5.1.1 Effect of adoption of Climate Smart Agricultural Practices on Land Values in Kajiado County

The first research question sought to determine whether adoption of climate-smart agricultural (CSA) practices is capitalised into agricultural land values in Kajiado County. This question addressed an important empirical gap within the climate adaptation literature, particularly in semi-arid and peri-urban African contexts where the relationship between adaptation investments and land asset values remains underexplored (Branca et al., 2012; Ngayu & Olale, 2025). Guided by Lancaster's (1966) characteristics theory and Rosen's (1974) hedonic pricing model, the study conceptualised climate resilience as an implicit land attribute that could potentially influence agricultural land prices if recognised and valued within the land market.

The descriptive findings revealed high levels of agreement among respondents that CSA practices contribute positively to agricultural productivity, climate risk reduction, and land value enhancement. Practices such as agroforestry, conservation agriculture, and water management recorded particularly high mean scores, indicating that adaptation practices are widely adopted within the study area. These findings suggest that farmers perceive CSA practices not merely as agronomic interventions but as long-term investments capable of improving the economic utility of land. This perception is consistent with social impact investment perspectives which argue that adaptation investments generate both resilience and economic benefits at the household level (Corsi et al., 2015). However, while respondents strongly associated CSA adoption with increased land value, descriptive perceptions alone cannot confirm whether such benefits are actually capitalised into market prices.

The qualitative findings provided deeper insight into the mechanisms through which respondents interpreted the value of CSA practices. Farmers consistently linked adaptation investments with reduced production risks rather than simple yield maximisation. Respondents explained that practices such as irrigation, agroforestry, greenhouse farming, and drought-resistant crops enabled land to remain productive during periods of drought and climatic uncertainty. This finding supports the "reliability premium" argument advanced by Rosenstock et al. (2022), which posits that in climate-vulnerable environments, economic value is increasingly attached to production stability and risk reduction rather than maximum output alone. In this regard, CSA practices appear to enhance the functional reliability of agricultural land by safeguarding productive continuity under adverse climatic conditions.

The simple linear regression analysis initially appeared to support this interpretation by revealing a positive and statistically significant relationship between CSA adoption and land value per acre.

The model explained 30.1% of the variation in agricultural land values, indicating that parcels associated with greater adoption of CSA practices also tended to record higher market values. This finding is broadly consistent with earlier studies showing that climate adaptation practices improve agricultural productivity, resilience, and farm incomes across African contexts (Molua et al., 2023; Keron & Midamba, 2025). Similarly, Wainaina et al. (2020) and Bryan et al. (2020) found that CSA adoption contributes positively to livelihood resilience and agricultural performance in Kenya. At the bivariate level, therefore, the findings appeared to support the assumption that adaptation investments generate measurable economic returns.

However, the explanatory limitations of the simple regression model became evident once additional land attributes were introduced into the analysis. Consistent with Lancaster's (1966) theoretical proposition that the value of a characteristic can only be isolated after controlling for competing attributes, the multiple regression model incorporated neighbourhood, environmental, and structural variables alongside CSA practices. Under this specification, the CSA coefficient declined considerably, although it remained statistically significant. This reduction suggests that part of the observed relationship between CSA and land value was shared with broader locational and infrastructural advantages. In practical terms, households capable of investing in CSA practices are also more likely to occupy land with better accessibility, infrastructure, and neighbourhood conditions. The findings therefore indicate that adaptation practices are embedded within a wider bundle of land characteristics that jointly shape market valuation.

The most theoretically significant finding emerged from the full regression model, which introduced additional socioeconomic and locational control variables including income, land ownership, farm size, years of occupation, and distance to road. Once these controls were included, the CSA coefficient became statistically insignificant. This finding substantially changes the interpretation of the earlier models because it demonstrates that the apparent effect of CSA adoption was largely driven by underlying socioeconomic and locational conditions rather than adaptation practices themselves. Wealthier households with greater market access, stronger infrastructure, and more favourable locational characteristics were simultaneously more likely to adopt CSA practices and to own higher-value land. Consequently, the positive association observed in the simpler models reflected shared structural advantages rather than a direct land value premium attributable solely to adaptation investments.

This finding extends existing literature by challenging the implicit assumption within some climate-smart agriculture studies that adaptation investments automatically translate into asset appreciation (Ariom et al., 2022; Kogo et al., 2021). Instead, the results align more closely with studies emphasising the mediating role of institutional and socioeconomic factors in shaping adaptation outcomes. Previous studies have demonstrated that credit access, tenure security, and market integration strongly influence both adoption capacity and economic returns from CSA investments (Autio et al., 2021; Rotich et al., 2025; Tabetando et al., 2023). The present study advances this literature by demonstrating that once these mediating factors are simultaneously accounted for, the independent effect of CSA on agricultural land value disappears. This suggests that adaptation investments alone are insufficient to generate observable land market premiums in contexts characterised by infrastructural inequality, imperfect land markets, and uneven access to productive resources.

From a theoretical perspective, the findings also refine the application of hedonic pricing theory within semi-arid and peri-urban African land markets. Rosen’s (1974) framework assumes that land prices reflect the implicit value of observable characteristics. However, the findings indicate that climate resilience may not function as an independently priced attribute within Kajiado County because its economic value is conditional upon complementary structural and locational conditions. A climate-resilient parcel located in an inaccessible area with weak infrastructure and insecure tenure may fail to attract a market premium because buyers are unable to fully realise or trust the benefits of resilience. This observation supports Palmquist's (2005) argument that hedonic valuation is highly sensitive to institutional and market contexts, particularly in developing economies characterised by weak information systems and thin property markets.

Overall, the findings provide a conditional answer to the first research question. While CSA practices are positively associated with agricultural land values in simpler models and are widely perceived by farmers as economically beneficial, their independent effect disappears once socioeconomic and locational factors are controlled for. The study therefore concludes that climate-smart agricultural practices do not independently increase agricultural land values in Kajiado County. Rather, their apparent contribution to land value reflects broader structural advantages that simultaneously facilitate both adaptation adoption and higher land market prices. Consequently, policies aimed at promoting climate adaptation should not focus exclusively on technological adoption but must also address the infrastructural, institutional, and socioeconomic conditions that enable adaptation benefits to be translated into sustainable asset value gains.

5.1.2 Effect of neighbourhood attributes on agricultural land values in Kajiado County

The second research objective sought to determine the effect of neighbourhood attributes on agricultural land values in Kajiado County. Specifically, the study examined whether accessibility to roads, highways, markets, and social amenities influences the market value of agricultural land. The findings across all model specifications consistently demonstrate that neighbourhood attributes are the strongest and most robust determinants of agricultural land value within the study area. Unlike CSA and environmental attributes whose effects weakened after introducing additional controls, neighbourhood attributes retained strong statistical significance throughout the simple regression, multiple regression, and full regression models.

The descriptive findings revealed that respondents strongly associated accessibility and proximity to infrastructure with higher land values. Accessibility to roads, highways, and market centres recorded the highest mean scores among the neighbourhood indicators, suggesting that respondents perceive connectivity as a major determinant of land appreciation. These perceptions indicate that landowners in Kajiado County attach considerable economic importance to locational advantages. Similar observations have been reported in peri-urban land market studies where accessibility to transport infrastructure significantly increases land desirability and market competitiveness (Boone et al., 2021). Kinuthia (2022) similarly argues that infrastructure connectivity increasingly shapes land prices within peri-urban Kenya because accessible land supports both agricultural and non-agricultural economic opportunities.

The simple linear regression analysis statistically confirmed this relationship by revealing a strong positive and statistically significant effect of neighbourhood attributes on agricultural land value per acre. The neighbourhood model explained 39.6% of the variation in land value, which exceeded the explanatory power of CSA, environmental, and structural attributes when analysed independently. This finding suggests that accessibility and location-related characteristics account for a substantial proportion of observed differences in agricultural land prices. Boone et al. (2021) similarly found that proximity to roads and urban centres substantially increases peri-urban land values because accessible land attracts both productive and speculative demand.

The qualitative findings further reinforced this interpretation. Participants consistently identified roads, accessibility, and proximity to towns as the principal drivers of land appreciation. Respondents explained that buyers increasingly prioritise development potential and accessibility over agricultural characteristics such as soil quality or environmental conditions. One participant noted that many purchasers originate from Nairobi and acquire land primarily for residential construction or speculative holding rather than for farming purposes. This finding reflects broader peri-urbanisation dynamics documented across sub-Saharan Africa, where agricultural land increasingly functions simultaneously as a productive asset and a speculative investment linked to urban expansion (Muyanga & Jayne, 2020). Sitko and Jayne (2021) further note that rising urban demand has transformed land markets in many African peri-urban regions by shifting valuation priorities away from agricultural productivity toward future conversion potential.

The multiple regression analysis strengthened this interpretation by demonstrating that neighbourhood attributes remained statistically significant even after controlling for CSA, environmental, and structural characteristics. In the core regression model, neighbourhood attributes recorded the largest standardised coefficient among all explanatory variables, indicating that accessibility and locational advantages exert a stronger influence on land value than climate adaptation practices or environmental quality. This finding is analytically important because it suggests that the Kajiado land marketplaces greater emphasis on spatial and economic connectivity than on purely productive or ecological land characteristics. Traditional agricultural land valuation models generally emphasise soil fertility, water availability, and productive potential as the main determinants of agricultural land prices (Deininger et al., 2020). However, the present findings suggest that peri-urban land markets are increasingly shaped by infrastructure development and urbanisation pressures.

The persistence of the neighbourhood effect within the full regression model provides further insight into the spatial structure of agricultural land valuation. Even after introducing additional socioeconomic and locational controls including income, land ownership, farm size, years of occupation, and distance to road, neighbourhood attributes remained the strongest predictor of agricultural land value. This persistence suggests that accessibility advantages are not merely proxies for household wealth or tenure security but constitute independently valued market characteristics. Jayne et al. (2020) similarly observed that infrastructure and market accessibility significantly shape rural asset accumulation and land market performance across African agricultural systems.

The findings also reveal important spatial inequalities in the distribution of land appreciation benefits. Because neighbourhood characteristics strongly influence market valuation, landowners located within accessible and well-connected areas are more likely to experience rapid land value appreciation than those in remote areas. This implies that adaptation investments or land improvements undertaken in poorly connected regions may fail to generate equivalent economic returns due to limited market visibility and weak infrastructure. Jayne et al. (2020) argue that infrastructure deficits often prevent rural producers from fully capturing the economic returns associated with productive investments, particularly within geographically isolated areas.

Institutional and governance conditions further shape the economic significance of neighbourhood attributes. Previous studies have demonstrated that weak land governance systems, insecure tenure arrangements, and inconsistent planning regulations distort land market outcomes and reduce investor confidence (Deininger et al., 2020). Rotich et al. (2025) further argue that unclear land administration systems in Kenya limit investment certainty and weaken land market efficiency, particularly within rapidly urbanising counties where subdivision and conversion pressures are increasing.

The findings therefore extend Rosen's (1974) hedonic pricing framework within the context of peri-urban African land markets. Classical hedonic theory assumes that land prices reflect the implicit value of observable land characteristics. However, the present study demonstrates that neighbourhood attributes capture not only immediate agricultural utility but also anticipated future economic opportunities associated with urbanisation, infrastructure expansion, and speculative demand. Kahn et al. (2021) similarly contend that peri-urban land prices increasingly reflect expectations regarding future conversion potential rather than present agricultural productivity alone.

Overall, the findings provide a clear answer to the second research question. Neighbourhood attributes are the strongest and most consistent determinants of agricultural land values in Kajiado County. Their influence remains robust across all model specifications and exceeds that of CSA practices, environmental quality, and structural attributes. The results suggest that agricultural land values within peri-urban Kajiado are increasingly shaped by accessibility, infrastructure connectivity, and urban expansion dynamics rather than by agricultural productivity alone. Consequently, policies aimed at increasing agricultural land values or stimulating rural investment should prioritise infrastructure development, market accessibility, and transparent land governance systems alongside agricultural interventions.

5.1.3 Effects of Environmental Attributes on Land Values in Kajiado County

The third research question sought to determine the effect of environmental attributes on agricultural land values in Kajiado County. The study examined whether environmental conditions such as air quality, noise levels, waste pollution, environmental attractiveness, and climate-related risks influence agricultural land prices. Within Rosen's (1974) hedonic pricing framework, environmental quality is expected to generate implicit price premiums because households derive utility from cleaner and healthier environments. Similarly, Lancaster's (1966) characteristics theory conceptualises land as a bundle of attributes whose combined characteristics determine market value. However, the findings suggest that the pricing of environmental quality within semi-arid and peri-urban land markets is more conditional than conventional theory assumes.

The descriptive findings show that respondents generally perceived environmental conditions in the study area as moderately favourable. Indicators such as low noise levels, good air quality, and proximity to environmentally attractive areas recorded relatively positive mean scores, indicating recognition of environmental quality in everyday life. This pattern is consistent with findings in Kenya where environmental awareness does not necessarily translate into market demand (Ochieng & Kirubi, 2020), and similar observations in other African urban centres (Mwangi & Mwangi, 2021). However, the direct link between environmental quality and land desirability received the lowest score among environmental indicators, showing a disconnect between environmental perception and land valuation.

This contrasts with classical hedonic expectations where environmental amenities generate price premiums (Rosen, 1974). Instead, the findings suggest a market logic in which environmental conditions are socially recognised but weakly capitalised economically. Similar patterns have been observed in secondary African cities where accessibility and infrastructure dominate land price formation (Acheampong & Anokye, 2021; Otchere et al., 2022).

Climate-related risks such as drought, degradation, and ecological stress were acknowledged but did not strongly influence land valuation. This reflects the IPCC (2022) observation that in semi-arid regions, environmental stress is often normalised because vulnerability is widespread rather than spatially distinct. When risks are generalised, they lose their ability to differentiate land parcels in the market. As a result, buyers prioritise factors that generate more immediate economic returns such as infrastructure, accessibility, and development potential (Odhiambo & Opiyo, 2020; Kimathi et al., 2023).

Qualitative findings reinforce this interpretation. Respondents rarely identified environmental quality as a key determinant of agricultural land value. Instead, they consistently emphasised roads, proximity to towns, infrastructure development, and settlement opportunities. Environmental challenges such as drought and water scarcity were mainly framed as production constraints rather than pricing determinants. This aligns with evidence that peri-urban land markets in Kenya are increasingly shaped by urban expansion and speculative demand rather than environmental or agricultural productivity considerations (Kinuthia, 2022). Similar prioritisation of connectivity over environmental quality has been reported in Ghana and Nigeria (Boamah et al., 2020; Eze & Okafor, 2023).

The findings further reflect the rapid peri-urban transformation in Kajiado County. As Nairobi's metropolitan influence expands outward, land value is increasingly driven by future conversion potential rather than ecological characteristics. Speculative expectations linked to infrastructure development and urban growth play a central role in shaping valuation patterns (Okumu, 2024). Land use change in peri-urban Kenya is driven primarily by urban expansion rather than agricultural productivity or environmental conservation (Wangai et al., 2020). Under such conditions, environmental quality becomes secondary to accessibility and development potential because buyers anticipate future non-agricultural uses of land. This urban bias in valuation is widely documented across sub-Saharan Africa (Gough & Yankson, 2021; Cobbinah et al., 2022).

The simple linear regression showed a weak positive but statistically insignificant relationship between environmental attributes and land values, explaining very little variation. This supports the earlier findings that environmental quality plays a marginal role in land valuation. Similar weak effects have been reported in climate-vulnerable African agricultural markets where buyers prioritise productivity and accessibility over environmental amenities (Murendo et al., 2020;

Tabetando et al., 2023). Low willingness to pay for environmental goods in Tanzania and Nigeria further reinforces the limited capitalisation of environmental value in land markets (Fisher et al., 2021; Akinyemi & Adebayo, 2022).

A more notable result emerges in the multiple regression model, where the environmental coefficient becomes negative and statistically significant. While counterintuitive under standard environmental economics theory (Rosen, 1974), this reflects spatial sorting effects in peri-urban markets. Highly accessible and rapidly developing areas command higher prices despite environmental pressures, while environmentally better areas are often more remote and less economically active.

This pattern is consistent with evidence from Ghana and Kenya, where accessibility outweighs environmental quality in determining property values (Amponsah et al., 2021; Ochieng & Kirubi, 2020). Infrastructure-led urbanisation can therefore drive land appreciation even amid environmental decline (Deininger & Goyal, 2024). In this context, the negative coefficient reflects the association of relatively "cleaner" environments with lower-demand, peripheral locations rather than a true penalty on environmental quality itself.

Once socioeconomic and locational controls such as income, land ownership, farm size, years of occupation, and distance to road are included, environmental attributes become statistically insignificant. This indicates that earlier observed effects were largely driven by structural and spatial inequalities rather than environmental quality per se. Environmental valuation in African land markets is heavily mediated by wealth and infrastructure access (Murken et al., 2023), and land responses to environmental shocks are similarly conditioned by these factors (Tabetando et al., 2023).

These findings complicate conventional hedonic pricing assumptions. While land is still composed of multiple valued attributes (Lancaster, 1966), the results show that environmental quality does not carry equal pricing weight relative to accessibility, infrastructure, and speculative development potential. In peri-urban semi-arid contexts, environmental attributes are consistently overshadowed by spatial and economic considerations. This aligns with critiques of hedonic applications in developing economies where market imperfections and incomplete information are common (Acheampong & Anokye, 2021; Ayodele & Olaleye, 2021).

The weak capitalisation of environmental attributes points to a market failure. Private incentives for environmental conservation are lower than their social benefits, leading to underinvestment in environmental quality. This supports growing use of payments for ecosystem services (PES) and conservation easements in Kenya as corrective mechanisms (Wainaina et al., 2020). Evidence from Naivasha conservancies shows that direct payments can successfully incentivise conservation where markets fail to reflect environmental value (WWF & Government of Kenya, 2021; FarmBiz Africa, 2025).

Across all evidence, descriptive, qualitative, and econometric analysis, the pattern is consistent: this study shows that environmental attributes do not have a robust independent effect on agricultural land values in Kajiado County. Their influence is weak, unstable across specifications, and ultimately explained by socioeconomic and locational factors. This challenges the assumption in standard hedonic theory that environmental amenities are consistently capitalised into land prices (Rosen, 1974). Instead, their value is highly context dependent and mediated by infrastructure, institutions, and market structure.

5.1.4 Effect of Structural Attributes on Agricultural Land Values in Kajiado County

The fourth research objective sought to determine the effect of structural attributes, namely plot size, water services, sewerage services, and electricity connection, on agricultural land values in Kajiado County.

Descriptive findings showed that all structural attribute indicators scored above the midpoint of the five-point scale. The highest mean was recorded for the statement that well developed land attracts higher market prices, followed by adequate sanitation or sewerage facilities. Land size and the availability of basic services recorded moderate agreement, while reliable access to water and electricity also received positive ratings. This pattern is important because it demonstrates that landowners in this semi arid and peri urban context clearly associate infrastructure with higher land values, a relationship that has been widely recognised in urban economics (World Bank, 2022). Unlike the environmental attributes discussed earlier, where respondents expressed mixed perceptions, structural attributes generated consistent agreement across all indicators. Similar findings were reported by Mati and Wambua (2020), who observed that access to household water connections in rural Kenya strongly influenced willingness to invest in land improvement. The consistency of responses in the present study suggests that infrastructure is viewed not as a supplementary amenity, but as a central indicator of land quality and investment potential.

Qualitative evidence further explained the reasons behind these perceptions. One respondent explained that without electricity it is impossible to pump water for irrigation, and without water climate smart agricultural practices become ineffective. Another respondent noted that investors prefer land with existing infrastructure and are willing to pay more for such land even where soil fertility is relatively lower. These responses indicate that structural attributes perform an enabling role by supporting both agricultural production and future development opportunities. This finding is consistent with studies from Ethiopia where irrigation infrastructure enhanced the returns from agricultural practices (Tesfaye et al., 2023). It also supports evidence from peri urban Kenya showing that infrastructure availability signals development potential to land buyers and frequently outweighs considerations such as soil fertility (Kinuthia, 2022). The observation that buyers are willing to pay a premium for infrastructure even on less fertile land challenges traditional agricultural valuation approaches that prioritise soil quality as the primary determinant of value (Deininger et al., 2020). Instead, the findings suggest that in rapidly urbanising semi arid regions, land markets increasingly value development potential more than immediate agricultural productivity.

Simple regression analysis revealed a positive and statistically significant relationship between structural attributes and land value per acre. The structural index alone explained more than one quarter of the variation in land prices. This finding confirms that parcels with better infrastructure consistently command higher market values. The relationship is consistent with hedonic pricing theory, which argues that land values reflect the characteristics attached to a property (Rosen, 1974). However, what makes this result particularly significant is the relatively high explanatory power of infrastructure in a semi arid agricultural land market where reliable market information is often limited. In many developed countries, infrastructure alone explains a smaller proportion of land value variation because land markets are influenced by numerous competing factors (Palmquist, 2005). In Kajiado County, however, infrastructure appears to function as the most visible and reliable indicator of land quality, particularly where other attributes are not consistently recognised or valued by the market.

The multiple regression model incorporated climate smart agricultural practices, neighbourhood attributes, and environmental variables. Under this specification, structural attributes remained positive and statistically significant. This finding is important because it demonstrates that infrastructure independently contributes to land value even after controlling for location, farming practices, and environmental quality. In practical terms, a parcel with piped water and electricity retains a higher value than a similar parcel without these services, regardless of surrounding environmental conditions or accessibility. This finding is consistent with evidence from East Africa showing that infrastructure access independently shapes land values even after controlling for household and locational factors (Tabetando et al., 2023). What distinguishes the present finding is that while several other variables weakened or lost significance under the same controls, structural attributes remained consistently significant. This robustness suggests that the observed infrastructure premium is not merely the result of omitted variable bias, which has often been raised as a criticism of hedonic valuation studies in developing countries (Ayodele & Olaleye, 2021).

The full regression model introduced additional controls including income, land ownership status, farm size, years of occupation, and distance to the nearest road. Structural attributes remained positive and statistically significant, with a standardised coefficient second only to neighbourhood attributes. This represents the most complete model specification and provides the strongest evidence regarding the importance of infrastructure. Unlike many land attributes whose effects diminish after controlling for socioeconomic factors (Autio et al., 2021), structural attributes retained their explanatory power throughout all model specifications. This means that even among respondents with similar income levels, comparable tenure arrangements, and equal proximity to roads, those with better infrastructure still possessed higher value land. The implication is that infrastructure generates a universal premium that extends beyond differences in wealth or social status. Deininger and Goyal (2024) argue that infrastructure investment can produce broad based land value appreciation, although empirical evidence from African contexts remains limited. The present study contributes to this literature by demonstrating that infrastructure benefits are not confined to wealthy landowners but are reflected across different socioeconomic groups.

In addition, the integration of qualitative and quantitative findings highlights the dual role of infrastructure in shaping land values. Quantitative results demonstrate that infrastructure directly increases land values, while qualitative evidence shows that it enables the adoption and effectiveness of climate smart agricultural practices. Although this complementarity is often assumed in climate adaptation policy discussions, empirical demonstration at the local level remains limited. Wainaina et al. (2020) found that electricity access increased adoption of water efficient agricultural technologies in Kenya, while Tesfaye et al. (2023) reported similar patterns in Ethiopia. The present study extends these findings by showing that the economic benefits associated with infrastructure are not conditional on wealth or tenure security but are broadly distributed across landowners.

Overall, the findings demonstrate that structural attributes have a positive, robust, and independent effect on agricultural land values in Kajiado County. Their influence persists across all regression models, and qualitative evidence further shows that infrastructure enables adaptation and productive land use. Policies aimed at increasing agricultural land values and strengthening climate resilience should therefore prioritise investments in water, electricity, and sanitation infrastructure. At the same time, policymakers should consider value capture approaches as a sustainable mechanism for financing future infrastructure development.

5.2 Conclusion

The study set out to estimate the effects of climate adaptation investments on agricultural land values in Kajiado County. The conclusions below are drawn from the interpretation of the evidence rather than a restatement of statistical outputs.

5.2.1 Climate Smart Agricultural Practices and Agricultural Land Values in Kajiado County

The study concludes that climate smart agricultural practices do not have a statistically significant independent effect on agricultural land values in Kajiado County once socioeconomic and locational factors are controlled for. Although the simpler regression models suggested a positive association between CSA adoption and land values, the effect became statistically non-significant in the full regression model after controlling for income, land ownership, accessibility, farm size, and years of occupation. This indicates that the apparent economic returns associated with adaptation observed in simpler models are largely explained by broader structural and locational advantages rather than by adaptation practices themselves. The study further concludes that the economic value of climate adaptation in semi-arid and peri-urban areas is conditional upon infrastructure availability, accessibility, and household capacity. Climate smart agricultural practices appear to function effectively only when supported by enabling structural and socioeconomic conditions. This conclusion is supported by the qualitative evidence where farmers explicitly stated that without electricity and water, CSA practices could not be effectively implemented or valued in the land market.

5.2.2 Neighbourhood Attributes and Agricultural Land Values in Kajiado County

The study concludes that neighbourhood attributes are the strongest and most consistent determinants of agricultural land values in Kajiado County based on the statistical evidence. Accessibility to roads, highways, market centres, and towns remained influential across all model specifications, exceeding the influence of CSA practices, environmental quality, and structural characteristics. The study further concludes that agricultural land values within peri-urban Kajiado appear to be increasingly shaped by connectivity, accessibility, and anticipated urban development opportunities rather than by agricultural productivity alone. This conclusion is supported by both the quantitative regression results and the qualitative evidence where participants consistently identified roads and proximity to towns as the primary drivers of land appreciation. Agricultural land in the study area is therefore increasingly functioning as a speculative and multifunctional asset influenced by urban expansion from Nairobi and surrounding growth centres. However, this finding is context-specific to the peri-urban areas of Kajiado County and may not apply to more remote agricultural areas or different regions.

5.2.3 Environmental Attributes and Agricultural Land Values in Kajiado County

The study concludes that environmental attributes do not have a robust independent effect on agricultural land values in Kajiado County based on the statistical evidence. Although respondents recognised the importance of environmental quality in descriptive responses, environmental variables remained weak, unstable, and statistically insignificant in the fully specified regression model. The study further concludes that environmental quality is socially recognised but weakly capitalised within the local land market. In rapidly urbanising and semi-arid contexts such as Kajiado County, buyers appear to prioritise accessibility, infrastructure, and development potential over environmental conditions when determining land value. The negative coefficient observed in the multiple regression model reflects spatial sorting rather than a true penalty on environmental quality: environmentally better areas are often more remote and less economically active, while higher-value areas are more developed but may have more environmental pressures. Environmental amenities therefore do not consistently generate market premiums within peri-urban land markets characterised by infrastructural inequality and speculative pressures. This weak capitalisation points to a potential market failure where private benefits of conservation fall short of social benefits, though further research is needed to confirm this interpretation.

5.2.4 Structural Attributes and Agricultural Land Values in Kajiado County

The study concludes that structural attributes have a positive, robust, and statistically significant independent effect on agricultural land values in Kajiado County based on the regression evidence. Access to water, electricity, sewerage services, and related infrastructure remained influential across all regression models. Unlike climate smart agricultural practices and environmental attributes, the influence of structural attributes remained stable throughout all model specifications, indicating that the infrastructure premium is not merely the result of omitted variable bias. The study further concludes that infrastructure appears to be the most reliably capitalised land attribute within the study area. The benefits associated with infrastructure appear to extend across different socioeconomic groups rather than being limited to wealthy households or strategically located landowners, though the cross-sectional design limits causal inference. Finally, the study concludes that infrastructure performs both a productive and enabling role within peri-urban land markets. In addition to directly increasing land values, infrastructure appears to enable the effective implementation of climate smart agricultural practices through improved access to water, irrigation, and electricity. Infrastructure therefore functions not only as a determinant of land value but also as a necessary condition for successful climate adaptation in Kajiado County, though this finding is based on qualitative evidence and requires further quantitative testing.

5.3 Recommendations

The recommendations below are derived directly from the study conclusions and are aligned with the specific research objectives.

5.3.1 Effect of Climate Smart Agricultural Practices on Agricultural Land Values in Kajiado County

The study concluded that climate smart agricultural practices do not independently increase agricultural land values unless supported by favourable socioeconomic and infrastructural conditions. Based on this conclusion, the Ministry of Agriculture and the Kajiado County Department of Agriculture should strengthen integrated adaptation support programmes that combine climate smart agricultural promotion with infrastructure development, market access, and farmer financing. Promoting adaptation practices in isolation is unlikely to generate sustainable economic returns where water, electricity, and accessibility remain inadequate.

The study also established that income, land ownership, and accessibility shape the ability of farmers to benefit from adaptation investments. The National Land Commission and county land administration offices should therefore accelerate land registration and tenure formalisation in agricultural areas to encourage long term investment in adaptation practices. Secure land ownership is likely to improve farmers' willingness to invest in practices such as irrigation, agroforestry, and soil conservation.

In addition, agricultural extension programmes should move beyond productivity-based messaging and incorporate training on climate resilience, land improvement, and long term asset value enhancement. This would help farmers understand adaptation not only as a production strategy but also as an investment in sustainable land use.

5.3.2 Effect of Neighbourhood Attributes on Agricultural Land Values in Kajiado County

The study concluded that neighbourhood attributes are the strongest determinants of agricultural land values in Kajiado County. Based on this conclusion, the Kajiado County Government and national infrastructure agencies should prioritise investment in roads, market access, and transport connectivity within underserved agricultural areas. Improved accessibility would enhance integration of remote areas into active land markets and reduce spatial inequalities in land appreciation.

The study also showed that land values in Kajiado are increasingly influenced by urban expansion and speculative demand associated with Nairobi metropolitan growth. The Kajiado County Department of Physical Planning should therefore strengthen land use planning and development control mechanisms in peri urban areas to guide orderly land subdivision and reduce unplanned speculative development.

Further, county authorities should publish transparent infrastructure and spatial development plans to reduce uncertainty in land markets. Clear planning frameworks would help align land prices with actual development potential and minimise speculative distortions that disconnect land values from productive land use.

5.3.3 Effect of Environmental Attributes and Agricultural Land Values in Kajiado County

The study concluded that environmental attributes are weakly capitalised within the agricultural land market despite their ecological importance. Based on this conclusion, the National Environment Management Authority and the Kajiado County Department of Environment should strengthen environmental conservation programmes through incentives that encourage tree planting, watershed protection, rangeland restoration, and sustainable land management practices.

Since the market does not adequately reward environmental quality, public intervention is necessary to support conservation activities whose social benefits exceed private returns. Programmes such as payments for ecosystem services, conservation incentives, and community restoration initiatives should therefore be expanded within environmentally vulnerable areas of Kajiado County.

The study also showed that environmental concerns are often overshadowed by infrastructure and accessibility considerations in land transactions. Environmental management agencies should therefore integrate conservation priorities into physical planning and infrastructure development processes to ensure that rapid peri urban expansion does not accelerate environmental degradation.

5.3.4 Effect of Structural Attributes on Agricultural Land Values in Kajiado County

The study concluded that structural attributes have a positive, robust, and independent effect on agricultural land values in Kajiado County. Based on this conclusion, the Kajiado County Government, the Ministry of Water, and relevant infrastructure agencies should prioritise investment in household water supply systems, electricity connections, sewerage services, and irrigation infrastructure within agricultural and peri urban areas. The study also established that infrastructure enables the effectiveness of climate smart agricultural practices. Expansion of rural electrification and water infrastructure should therefore be integrated with climate adaptation programmes to improve irrigation, water management, agro processing, and agricultural productivity. In addition, county and national governments should adopt sustainable infrastructure financing approaches such as value capture mechanisms, including betterment levies and land value taxation, particularly in areas experiencing rapid land appreciation due to public infrastructure investments. This would allow part of the increased land value generated through public investment to be reinvested into further infrastructure expansion and climate resilient development.

5.4 Recommendations for further research

This study used a cross-sectional design and focused only on Kajiado County, limiting its ability to establish long-term causal relationships and generalise findings to other ASAL regions. Future studies should therefore adopt longitudinal and comparative approaches across multiple counties to examine how climate adaptation investments influence land values over time and across different contexts.

5.5 Contribution of the Study

This study contributes to theory, empirical knowledge, methodology, and policy by demonstrating that climate adaptation investments positively influence agricultural land values in Kenya's ASAL regions. The study extends Lancaster's Characteristics Theory of Value by showing that climate adaptation functions as a valued land attribute within the hedonic pricing framework. Empirically, it provides evidence that climate-smart agricultural practices increase land values through improved resilience and reduced climate risk. Methodologically, the study demonstrates the applicability of the hedonic pricing model in analysing agricultural land values in a semi-arid African context using mixed methods.

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APPENDICES

APPENDIX I: INTRODUCTION LETTER

STRATHMORE UNIVERSITY BUSINESS SCHOOL

P.O BOX 59857-00200

NAIROBI, KENYA

14th May 2026

Dear Respondent,

RE: INTRODUCTION LETTER FOR DATA COLLECTION

My name is Andrew Gogo, a student at Strathmore University pursuing a master's degree in public policy and management. I am conducting a research study titled:

"The Effects of Climate Adaptation Investments on Agricultural Land Values in Kenya: A Case Study of Kajiado County."

The purpose of this study is to examine how climate-smart agricultural practices, neighbourhood attributes, environmental attributes, and structural attributes influence agricultural land values in Kajiado County.

You have been selected to participate in this study because your views and experiences are important in understanding the relationship between climate adaptation investments and agricultural land values within the county.

Your participation in this study is voluntary. You are kindly requested to provide honest and accurate responses to the questions provided. All information obtained will be treated with strict confidentiality and will be used strictly for academic purposes only. Your identity will not appear in any report arising from this study.

The questionnaire will take approximately 15-20 minutes to complete.

Your cooperation and support towards the success of this study will be highly appreciated.

Thank you.

Yours faithfully,

Andrew Gogo

Strathmore University Business School

APPENDIX II: CONSENT FORM

Dear Respondent,

My name is Andrew Gogo, a master's student at Strathmore University Business School pursuing a master's degree in public policy and management. I am conducting a study on the topic:

"The Effects of Climate Adaptation Investments on Agricultural Land Values in Kenya: A Case Study of Kajiado County."

You have been selected as one of the participants and are kindly requested to participate in this study by providing honest responses to the questions in the questionnaire. The study seeks to examine how climate-smart agricultural practices, neighbourhood attributes, environmental attributes, and structural attributes influence agricultural land values in Kajiado County.

Please note that all information provided will be treated with strict confidentiality and will only be used for academic purposes. Your participation in this study is voluntary, and you are free to withdraw at any stage without any penalty.

Please sign below to indicate your acceptance to participate in this study.

Thank you in advance for agreeing to participate in the study.

Signature ___________________________

Date ________________________________

APPENDIX III: RESEARCH QUESTIONNAIRE

QUESTIONNAIRE FOR FARMERS/LANDOWNERS IN KAJIADO COUNTY

Dear Respondent,

I am conducting a study titled:

"The Effects of Climate Adaptation Investments on Agricultural Land Values in Kenya: A Case Study of Kajiado County."

The purpose of this questionnaire is to collect data on climate-smart agricultural practices, neighbourhood attributes, environmental attributes, structural attributes, and agricultural land values in Kajiado County.

All information provided will be treated with strict confidentiality and used strictly for academic purposes.

Please tick (✓) the appropriate response or fill in the spaces provided.

SECTION A: DEMOGRAPHIC CHARACTERISTICS

#	Question	Response Options (exactly as in Table 4.1)
D1	What is your gender?	() Male () Female
D2	What is your age group?	() 19-35 years () 36-45 years () 46-55 years () 56-65 years () 66+ years
D3	What is your highest level of education?	() No formal education () Primary () KCSE () Certificate () Diploma () bachelor's degree () master's degree () PhD
D4	Are you engaged in commercial farming?	() Engaged () Not engaged
D5	What are your main sources of income?	() Single source () Multiple sources
D6	What is your average monthly household income (KES)?	() Below Ksh 10,000 () Ksh 10,000-30,000 () Ksh 30,001-50,000 () Above Ksh 50,000
D7	What is your land ownership status?	() Registered owner () Unregistered/Communal ( ) Other: ....

#	Question	Response Options (exactly as in Table 4.1)
D8	What is your total farm size (in acres)?	.... acres
D9	How many years have you occupied/managed this land?	.... years
D10	What is the distance from your land to the nearest all-weather road (in km)?	.... km

Instructions: For each statement, please indicate your level of agreement using the scale: **1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree** *(Circle or tick the appropriate number)*

SECTION C: CLIMATE SMART AGRICULTURAL PRACTICES (CSA)

Statement	**1**	**2**	**3**	**4**	**5**
I practice crop diversification on my farm.					
I use water management practices such as irrigation or rainwater harvesting.					
I apply conservation agriculture techniques (e.g., minimum tillage).					
I practice agroforestry on my land.					
Climate-smart agricultural practices have improved my farm productivity.					
Climate-smart practices have reduced risks associated with climate change.					
Adoption of climate-smart practices increases the value of my land.					

SECTION D: NEIGHBOURHOOD ATTRIBUTES

Statement	**1**	**2**	**3**	**4**	**5**
My land is easily accessible by road.					
My land is located close to major highways.					
My land is located close to market centres.					
My land is located near essential social amenities (schools, hospitals).					
Accessibility to roads increases the value of my land.					
Proximity to markets increases the value of my land.					
Overall location advantages positively influence my land value.					

SECTION E: ENVIRONMENTAL ATTRIBUTES

Statement	1	2	3	4	5
The air quality in my area is good.					
Noise levels in my area are low.					
My land is free from waste pollution.					
My land is located near environmentally attractive areas.					
The environmental condition of my area is well maintained.					
My land is not exposed to significant climate-related risks (e.g., drought, degradation).					
Good environmental conditions increase the desirability of land in this area.					

SECTION F: STRUCTURAL ATTRIBUTES

Statement	1	2	3	4	5
My land has reliable access to water.					
My land has access to electricity.					
My land has adequate sanitation or sewerage facilities.					
The size of my land contributes positively to its value.					
Availability of basic services increases the value of my land.					
Infrastructure improvements increase land demand in this area.					
Well-developed land attracts higher market prices.					

APPENDIX IV: FOCUS GROUP DISCUSSION GUIDE

Focus Group Discussion Guide for Farmers and Landowners

A. Climate Smart Agricultural Practices

1. Which climate-smart agricultural practices are commonly adopted in this area?
2. How have practices such as irrigation, agroforestry, greenhouse farming, and conservation agriculture affected productivity?
3. Do climate-smart agricultural practices influence land values? Explain.
4. How do CSA practices reduce climate-related risks such as drought?
5. What challenges limit farmers from adopting CSA practices?

B. Neighbourhood Attributes

6. How does road accessibility affect land prices in this area?
7. What role do highways, markets, and towns play in determining land value?
8. How do schools, hospitals, and security influence land demand?
9. Have land values changed because of proximity to Nairobi or urban expansion?

C. Environmental Attributes

10. How do drought, land degradation, and water scarcity affect agricultural land use?
11. Do buyers consider environmental quality when purchasing land?
12. Why do environmental factors appear less important than infrastructure or accessibility?

D. Structural Attributes

13. How important are water, electricity, sanitation, and infrastructure in determining land value?
14. Which structural improvements contribute most to increasing land prices?
15. How does land development affect demand for land?

E. Land Value Trends

16. How have agricultural land prices changed over the last five years?
17. What factors are mainly responsible for increases in land value?
18. What should government and stakeholders do to improve climate adaptation and agricultural land development in Kajiado County?

APPENDIX V: ETHICAL REVIEW

Strathmore
UNIVERSITY

20th June 2025

Mr Gogo Andrew,
andrew.gogo@strathmore.edu

Dear Mr Gogo,

RE: Estimating the Impact of Climate Adaptation Investments on Agricultural Land Values in Kenya: A Case Study of Kajiado County

This is to inform you that SU-ISERC has reviewed and **approved** your above **SU-masters** proposal. Your application reference number is **SU-ISERC2937/25.** The approval period is from **20th June 2025 to 19th June 2026.**

This approval is subject to compliance with the following requirements:

i. Only approved documents including (informed consents, study instruments, MTA) will be used.
ii. All changes including (amendments, deviations, and violations) are submitted for review and approval by SU-ISERC.
iii. Death and life-threatening problems and serious adverse events or unexpected adverse events whether related or unrelated to the study must be reported to SU-ISERC within 72 hours of notification.
iv. Any changes anticipated or otherwise that may increase the risks or affected safety or welfare of study participants and others or affect the integrity of the research must be reported to SU-ISERC within 72 hours.
v. Clearance for the export of biological specimens must be obtained from relevant institutions.
vi. Submission of a request for renewal of approval at least 60 days prior to the expiry of the approval period. Attach a comprehensive progress report to support the renewal.
vii. Submission of an executive summary report within 90 days of completion of the study to SU-ISERC.

Before commencing your study, you will be expected to obtain a research license from National Commission for Science, Technology, and Innovation (NACOSTI) https://research-portal.nacosti.go.ke/ and obtain other clearances needed.

Yours sincerely,

Mr Ambrose Rachier,
Chairperson; SU-ISERC

Ole Sangale Rd, Madaraka Estate. PO Box 59857-00200, Nairobi, Kenya. Tel +254 (0)703 034000
Email admissions@strathmore.edu www.strathmore.edu

APPENDIX VI: NACOSTI PERMIT

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: 407797

Date of Issue: 15/July/2025

RESEARCH LICENSE

This is to Certify that Mr.. ANDREW GOGO of Strathmore University, has been licensed to conduct research as per the provision of the Science, Technology and Innovation Act, 2013 (Rev.2014) in Kajiado on the topic: Estimating the Impact of Climate Adaptation Investments on Agricultural Land Values in Kenya: A Case Study of Kajiado County for the period ending : 15/July/2026.

License No: **NACOSTI/P/25/4176696**

407797

Applicant Identification Number

Ag. Director General
NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Verification QR Code

NOTE: This is a computer generated License. To verify the authenticity of this document, Scan the QR Code using QR scanner application.

See overleaf for conditions

APPENDIX VII: INTRODUCTION LETTER

Ole Sangale Rd, Madaraka Estate
P. O Box 59857 - 00200, Nairobi, Kenya
Cell: +254 703 034 414/6/7
X/Twitter/Tiktok: @SBSKenya
Facebook/Linkedin: Strathmore University Business School

Email: **sbsinfo@strathmore.edu** or visit **www.sbs.strathmore.edu**

Strathmore UNIVERSITY BUSINESS SCHOOL

20 Years of Developing Great African Leaders

July 1, 2025

To Whom It May Concern,

<u>RE: FACILITATION OF RESEARCH –ANDREW GOGO</u>

This is to introduce Andrew Gogo who is a Master's in Public Policy and Management (MPPM) student at Strathmore University Business School, admission number MPPM 123624/19. As part of our MPPM Program, Andrew is expected to do applied research and undertake a project. This is in partial fulfillment of the requirements of the MPPM course. To this effect, he would like to request appropriate data from your organization.

Andrew is undertaking a research paper on **"Estimating the Impact of Climate Adaptation Investments on Agricultural Land Values in Kenya: A Case Study of Kajiado County."**

The information obtained from your organization shall be treated confidentially and shall be used for academic purposes only.

Our MPPM Program seeks to establish links with industry, and one of these ways is by directing our research to areas that would be of direct use to industry. We would be glad to share our findings with you after the research, and we trust that you will find them of great interest and of practical value to your organization.

We appreciate your support and shall be willing to provide any further information if required.

Yours Faithfully,

Njoki Kiagiri

Manager – Graduate Programs

Strathmore University Business School

Strathmore University Business School is a Proud member of:

Association of African Business Schools AABS EFMD AACSB