CONVERSION AND HEDONIC PRICE ANALYSIS OF AGRICULTURAL LAND DUE TO URBANIZATION IN NJORO SUB-COUNTY, KENYA

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A Thesis Submitted to the Graduate School in Partial Fulfillment for the Requirements of Master of Science Degree in Agriculture and Applied Economics of Egerton University

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DECLARATION AND RECOMMENDATION

Declaration

I hereby declare that this thesis is entirely my original work and to the best of my ability, and has not been submitted for the award of a degree before this or any other university.

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Recommendation

This thesis has been submitted to the Graduate school of Egerton University with our approval as university supervisors.

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DEDICATION

This thesis is dedicated to my parents Charles Muleke and Margaret Andiavo, and to my siblings: Albert, Everlyne and Christine who have always invested their time and resources to enable me pursue my education.

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ABSTRACT

Over the years, Njoro Sub-County in Kenya has become increasingly urbanized, transforming from a transcendently rustic, horticultural territory, to dominatingly urban non-agrarian locale; driven mainly by growth of population. Agriculture being the main source of livelihood for the rural and semi-urban residents is being acutely jeopardized by rapid urbanization. Despite extensive studies on agricultural land conversion, there exists a knowledge gap on the extent of agricultural land conversion as a result of urbanization in Njoro Sub-County. This study aimed at contributing towards improved livelihood through sustainable agricultural land conversion as a result of urbanization among small-scale farmer production systems in Njoro Sub-County, Kenya. Specifically, this study intended to; characterize the current land use practices by small scale farmers, analyze the extent of agricultural land conversion and identify the role of land and socio-economic attributes in influencing the prices of agricultural land in Njoro Sub-County, Kenya. Multistage sampling technique was employed in sampling 384 farmers in Njoro Sub-County. Primary data was collected from 384 randomly selected smallholder farmers, by the use of semi-structured questionnaires and key witness interviews. Descriptive statistics were employed to characterize the current land use practices and Craggit estimator was used to identify the extent of agricultural land converted. Hedonic price model was used to analyze determinants of land prices. Results revealed that 57.60% of the respondents had converted agricultural land to non-agricultural practices. Furthermore, 67% of the total initial agricultural land owned by households had been converted to non-agricultural purposes whilst (33%) of the initial size of total initial agricultural land was still being utilized for agricultural purposes. The results also show socio-economic and institutional factors significantly affected the decision to convert and extent of land conversion. Risk attitude, contacts with extension agents and soil fertility had a positive influence on prices of agricultural land. This study recommends coherent policies that take into consideration farmer socio-economic and bio-physical characteristics that could stimulate behavioral change towards land conversion. The government could also adopt strategies that align all stakeholders from different sectors, provide secure rights to land and incentivize solutions for sustainable agriculture by making agriculture more competitive. This study concluded that agricultural land is being converted to non-agricultural purposes in the face of growing urbanization hence need to for policies that encourage farmers to retain agricultural land. This study also concluded that socio-economic and land attributes play an important role in determining prices of agricultural land.

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LIST OF ABBREVIATIONS AND ACRONYMS

AERC	African Economic Research Consortium
APE	Average Partial Effects
CAPE	Conditional Average Partial Effects
FAO	Food and Agricultural Organization of the United Nations
KNBS	Kenya National Bureau of Statistics
LC	Land Commission
LVB	Land Valuation Board
MOALF	Ministry of Agriculture, Livestock and Fisheries
NCAPD	National Coordinating Agency for Population and Development
NFNSP	National Food and Nutrition Security Policy
NMR	Nairobi Metro Region
SPSS	Statistical Package for Social Sciences
UAPE	Unconditional Average Partial Effects
UNDESA	United Nations Department of Economic and Social Affairs
UNDP	United Nations Development Program
UNFPA	United Nations Fund for Population Activities

CHAPTER ONE
INTRODUCTION

1.1 Background information

The speedy development of extensive urban areas in developing nations has attracted noteworthy attention from researchers, planners, and policymakers (Turok, 2013). For instance, in 2016, twenty-four cities in developing countries and regions appeared in the list of thirty-one biggest metropolises worldwide, and developed at a standard yearly rate of 2.4 per cent (United Nations, 2016). The process of urbanization is accentuated as being one of the most imperative drivers of change in the third world countries, particularly those in Africa (Hall and Pfeiffer, 2000; Simon, 2007; Pieterse, 2008). According to Rakodi (1997), "it is just about an axiom that the planet's future is an urban one and that the biggest and quickest developing urban areas are basically in emerging economies". Roughly 54.5 per cent of the total Africa's mainland population lived in towns and urban communities in 2016. Also, urban territories are anticipated to accommodate 60 per cent of individuals by 2030 owing to the consolidated impacts of rural to urban movement and high birth rates (United Nations, 2016). Nonetheless, across the globe, one in three individuals will dwell in urban areas with no less than half a million occupants. These projections are anticipated to be twice as much by 2050 (Hall and Pfeifer, 2000; Thomas *et al*., 2008).

Urban sprawl, the infringement of urban uses on agricultural land, has turned into a typical marvel all through the third world countries (Liu *et al*., 2011). Swift urban development of towns in countries deemed as "still developing" is often followed by an amplified strain on urban conditions as a result of mounting energy demands, deplorable living conditions, water and clamor contamination, and loss of farming area to non-farming purposes (Braimoh *et al*., 2007). Modern research undertakings reveal that nearly world's total populace development will happen in urban centers; somewhat epitomizing the rustic-urban relocation patterns driven by relative job openings (Xu and Zhou, 2009). In Sub-Saharan Africa, urban masses are expected to be thrice as much in the coming 40 years (United Nations, 2016). Rising urbanization trends worldwide consequently have vital ramifications on agri-business and farming practices altogether.

Urbanization is stressed as notably significant amid the most essential measurements of financial and physical change particularly those in Africa such as Kenya (Thuo, 2013; Agarwal *et al*., 2018). In mid and low-income ranked countries, urbanization is essentially

on account of individuals moving in light of better economic prospects in urban zones, or hardly any financial openings in their farms, homes or rural communities (Goudie, 2018). In this context, the progression of urbanization can in general be depicted as a surge in residential population and growth of non-farm enterprises and industries which transforms an area from transcendently rustic, horticultural territory, to dominatingly urban non-agrarian region (Li *et al*., 2013). It is largely dictated by population increase. As population grows in the developing world it portrays a growing demand for land resource especially for residential housing and other non-agrarian purposes (Thuo, 2013), thus bringing a change in the pattern of land use in a particular region. This has in turn increased placed enormous strain on agriculturists making it more exorbitant and hard to undertake conventional farming. A swell in urban masses, residential units and other non-agricultural enterprises such as shopping centers, has crippled the functional capabilities and usefulness of peri-urban agriculture as food producer.

Aguilar *et al*. (2003) contend that the fast development of urban populace has not only stimulated a heightened demand for land especially for housing, but also quench alternative non-agricultural endeavors. Furthermore, in numerous nations, the growing interest for land is impacting peri-urban zones where expansion of urban sprawl is as of now infringing into farming terrains and small villages. Provisional rustic urban peripheries are exemplified by an assortment of land utilization practices, which frequently vary in connection to the utilitarian linkages to urban and to rustic areas. They are transitional in nature, implying they become more continuously agrarian as one moves away from the urban focus into the county side setting. Because of the varying land uses, most population here consists of a mixed set including native inhabitants, agriculturalists, transient occupants, recreation land clients, mechanical and industrial users, financial specialists and theorists, engineers and other developers.

Land utilization in Kenyan urban and rustic regions has been a noteworthy area of concern to all Kenyans. Issues of quick urbanization, poor land use planning; unsustainable agrarian and modern production strategies, deprived ecological administration and debased social practices, improper management of the eco-system are rampant, and require suitable intervention plans (Thuo, 2013). The absence of clearly defined and enforced land use policies in Kenya following years of independence has brought about an indiscriminate way of dealing with the distinctive land use practices and management policies. Moreover, land

use issues tend to be addressed through numerous ungainly legal and policy frameworks that have done little to disentangle the various issues influencing land use planning. The issue of apt and gainful utilization of land in Kenya has gained eminence amid developing populace and mounting interest for land assets. This calls for reasonable and participatory planning and use of these assets in an evenhanded, proficient and maintainable way that optimizes production (Hope, 2012).

In Kenya, agricultural sector plays an essential role of sustaining the livelihood of individuals and the country at large. According to survey by the Government of Kenya on food security status, the sector contributes 26 per cent of the overall Gross Domestic Product (GDP) and 27 per cent of the GDP indirectly via associations with processing, distribution and other service sectors such as hotels, botanical gardens, transportation etc (Government of Kenya, 2017). Therefore sustained agricultural productivity in any region in Kenya is of key importance as agriculture has long been regarded as the fabric upon which political and social permanence are anchored on. In addition, the agricultural sector assumes a vital part in providing extensive employment opportunities to individuals, economic solidity and evaluating the standard of a country's milestone achievements, in light of the proficiency of farmers. The importance of agriculture is further emphasized through the concept of food security as it is still the principal segment charged with the responsibility of bolstering a substantial proportion of the populace (Government of Kenya, 2013).

As demonstrated by the Food and Agriculture Organization of the United Nations (FAO), nourishment security is accomplished when everybody always has physical and financial access to sufficient, innocuous and sustenance to fulfill their dietary needs and nourishment tendencies for a dynamic and sound life (Pinstrup, 2009). This definition includes four estimations of food security: promptly available, steadiness, wellbeing and accessibility. The first estimation insinuates the general accessibility of satisfactory amount of nourishment. Later on, agriculture may be challenged to fulfill the nourishment demands of the masses that are foreseen to increase massively and become swiftly urbanized (Mendez *et al*., 2004). All things considered, the future nourishment security in each developing city is as of now facing turmoil.

Endeavors to achieve food security must depend on local assets that incorporate diversification and utilization of available agricultural land to shun dependency on the supply

from overseas. However, in many regions in Kenya, the agricultural sector is facing challenges such as urbanization due to rapid populace expansion. According to the Kenya National Bureau of Statistics (2017) report on Kenya's population projections, Kenya's populace was growing at a steady rate of 2.5 per cent with an overall countrywide urban populace growth rate of 31 per cent. This has resulted in unprecedented consequences among them: a budge in the supply and utilization of land meant for farming purposes, settlements and non-agricultural ventures such as schools, hospitals, shopping centers etc. This exerts pressure on existing resources through transformation of traditional land use systems and conversion of agricultural land (Thuo, 2013). In this context, conversion of agricultural land is the specific change of land use practices from agriculture to urban, non-agrarian uses.

Urbanization of an area brings with it many positive effects such as; employment opportunities, improved housing facilities, better social amenities, technological transfer, and provide readily available market for agricultural produce (Kirkby, 2018). On the other hand, rapid urbanization may generate undesirable outcomes which include; limited or practically no command over land conversion from agriculture to non-agrarian utilization, general medical issues arising from contamination of water and air, rapid spread of transmittable diseases due to congestion, unemployment, scarcity of accommodation amenities and undesirable social impacts such as, crime, drug abuse and savagery (Clark, 2009; Jedwab, 2015).

Significant changes in land use have been taking place in Njoro Sub-County over the past 20 years as its population has been progressively increasing. According to the 2009 populace census, Njoro Sub-County accounted for around 11 per cent Nakuru County's residents of 1,603,325. The Kenya National Bureau of Statistics anticipated that the populace in Njoro Sub-County will develop at a yearly rate of 3.1 percent and will rise from 178,180 to 227,419 occupants in 2017 (KNBS, 2013). With a constant area of 780Km^2, this steady population growth in Njoro Sub-County has heightened demand for agricultural land necessitating land fragmentation whereby more and more land is being divided and converted into residential and commercial blocks (Shifa, 2017). Change in land utilization, nonetheless, does not come without costs. Conversion of agricultural land to urban uses lessens the quantity of land accessible for sustenance and production of timber. Soil erosion, desertification and other debasements related to intensive farming diminish the quality of land resource which threaten the future viability and profitability of agriculture (Lubowski *et al.*, 2006).

1.2 Statement of the problem

In Njoro Sub-County, population has been progressively increasing over the years bringing with it a progressive change from its traditional rural agricultural area into a more urbanized region. As this trend continues, the once productive land is being converted to non-agricultural purposes which may lead to food insecurity particularly among small scale farmers. This is because, non-farm ventures in Njoro Sub-County are increasingly becoming more profitable and offer the best outcome compared to practicing agriculture which is plagued by seasonality in revenue, produce and dependence on rainfall. As such, this has led to wide spread conversion of agricultural land to non-farm uses in Njoro Sub-County. Also, recent urbanization of Njoro Sub-County has the potential to change agricultural land prices because of increased expected value of land due to anticipated changes in land use. Thus, agricultural lands near urban centres are experiencing conversion due to urbanization. However, the determinants of the intensity of conversion of agricultural land to urban use and implications on food security in Njoro Sub-County have not been clear in empirical literature. Also, the socio-economic characteristics, institutional factors and land attributes influencing agricultural land price differentials as a result of urbanization in Njoro Sub-County have not been clear. Previous studies (Zhang, 2011; Yawson *et al*., 2017) have relied on land prices as dictated by demand and supply framework in the land markets, climate and land selling agencies. This might be misleading as reported values are often inflated to incorporate profits and operation costs. Therefore, this study was geared towards filling the knowledge gap with an exploratory study in Njoro Sub-County, Kenya.

1.3 Objectives

1.3.1 General objective

To contribute to improved livelihood through sustainable agricultural land conversion resulting from urbanization among small scale farmer production systems in Njoro Sub-County, Kenya.

1.3.2 Specific objectives

i. To characterize the current land use practices by small scale farmers in Njoro Sub-County.
ii. To identify socio-economic, land attributes and institutional drivers of agricultural land conversion in Njoro Sub-County.
iii. To determine the socio-economic characteristics, institutional factors and land attributes that influence agricultural land price differentials in Njoro Sub-County.

1.4 Research questions

i. What are the characteristics of current land use practices as a result of urbanization in Njoro Sub-County?
ii. What are the socio-economic, land attributes and institutional drivers of agricultural land conversion in Njoro Sub-County?
iii. What are the socio-economic characteristics, institutional factors and land attributes that influence agricultural land price differentials in Njoro Sub-County?

1.5 Justification of the study

According to Tacoli *et al.* (2010), agricultural land conversion has led to undesirable outcomes. It is important that development strategies are put in place to address the problem of agricultural land conversion in Kenya. Such policies could facilitate the realization of the country's National Food and Nutritional Security policy (NFNSP) objective of achieving good nutrition for optimum health through protecting agricultural lands used for food production thus increasing the quantity and quality of food available (Government of Kenya, 2013). Curbing land conversion could also help the country achieve the Sustainable Development Goals (SDGs) on food and habitation that: aim at eradicating hunger, achieve food security and enhanced nourishment, and support sustainable farming (Government of Kenya, 2013) by 2030. In addition, contribute towards making urban communities and habitable human settlements comprehensive, accommodating, secure, flexible and feasible (UNDP, 2015) by 2030. Findings from this study could be important in informing policy makers on designing and implementing policies on minimizing or at least ensuring sustainable agricultural land conversion.

1.6 Scope and limitation of the study

This study was undertaken in Njoro Sub-County located in Nakuru County. The primary data looked into agricultural land conversion as a result of urbanization and its extent within the study area. The target population was limited to small-scale farmers who have lived in Njoro Sub-County in the last 20 years.

1.7 Operational definition of terms

Urbanization: An increase in human residential populace and growth of non-farm businesses and industries which transforms an area from a predominantly rural agricultural region to an urban non-agricultural center.

Effects of urbanization: These are primarily positive and negative effects of urbanization e.g. pollution, crime, improvement in infrastructure, drug abuse, better health facilities, convinience of goods and services, access to better institutions etc.

Land conversion: This is the specific change in land utilization from agriculture and farming to urban, non-agrarian uses.

Agricultural land: This is land that is devoted for farming purposes. It consists of land in farms, including cropland, pasture etc.

Urban area: An area reminiscent of the characteristics of a city or town. Such as high human populace and increased building construction, administrative offices, etc.

Subsistence farmers: These are farmers who practice agriculture for the purpose of feeding themselves and their entire household usually without any considerable surplus for sale.

Small-scale farmers: These are farmers who practice agriculture on a small piece of land (less than 10 acres) without necessarily using expensive and advanced technology (small scale production).

Limitations: These are the constraints in the design or methodology of a plan or study that affect the interpretation of results from a research or survey such as sample size, sample profile etc.

Farming system: It is a combination of farm enterprises comprising farm household, crop and livestock systems that can land capital and other factors of production into useful products that can be consumed or sold.

Urban sprawl: This is the rapid expansion of the geographic extent or boundary of a particular urban area.

CHAPTER TWO
LITERATURE REVIEW

2.1 Introduction

Urbanization is a characteristic result of economic transformation that occurs as a nation grows. The constructive attribute of urbanization is at times eclipsed by the palpable decline in the physical surroundings and living standards in the urban zones as a result of increasing disparities between demand and supply of basic human requirement, transport and communication networks (Muni, 2007). Even though constant monetary development is a vital clause for eradicating poverty and boundless increment in individual wellbeing, monetary advancement has, in most cases, potentially unfriendly natural impacts. Nature of ecological issues relies on the dimension of financial advancement, the level of urbanization, the viability of public strategies and the nature of industrialization (Brenner, 2018). This section outlines the overall and provincial patterns of urbanization, drivers of urbanization and ramifications on farming.

2.2 A developing world in the context of urbanization

The recent couple of decades have conveyed huge changes to the world's city settlements, smaller urban focuses and towns. They incorporate new types of urban centers and metropolitan zones, some of incomparable size (United Nations, 1994). By the early years of the 21st century, the larger fraction of men, ladies, and youngsters in each state will be residing in urban environment. This will be for the most part determined by spatial patterns, quickened by the globalization and advancement of the world economy and in addition, significant and continuous financial and social change within states (Noorbakhsh, 1998). Speedy urban development over the previous decades, particularly in emerging nations, has actually changed the essence of our planet. A worldwide urban human progress will profoundly affect the prototypes of national and global advancement and financial development, and will surely change the substance and focal point of national and global strategies (Held, 1995).

The world's aggregate populace in 2010 was evaluated at 6.9 billion. The pace at which it has been developing was basically consistent at approximately 1.2 percent a year between 2000 and 2010 (United Nations, 2017). From a global perspective, a bigger number of individuals dwell in urban regions than in rustic territories, with 54 per cent of the total populace living in urban regions in 2014. In 1950, 30 per cent of the total populace was urban, and by 2050, 66

per cent of the total populace is anticipated to be urbanized (DESAP, 2014). Presently, the most urbanized locales comprise; Europe (73 per cent), Latin America and the Caribbean (80 percent) and Northern America (82% living in urban zones in 2014). Interestingly, Africa and Asia remain for the most part rustic, with 40 and 48 percent of their particular masses living in urban territories. In all nations urban proportions are anticipated to augment in the subsequent years, though at speckled rates (United Nations, 2014). As at 2018, there were around 7.6 billion individuals on the planet (4.2 billion in urban and 3.4 billion in rustic territories). By 2050, it is anticipated that 68 percent of the total populace will be located in urban regions (an expansion from 54 percent in 2016) (Klein, 2010). Actually, by 2050 there are not very many nations where provincial masses are anticipated to surpass the urban populace proportions. Such nations comprise Pacific Island States, Guyana and Latin America (Burgess *et al*., 2014).

Population projections for 2100 predict that the world urban masses will develop by 3 to 5 billion (United Nations, 2016). Different protrusions propose that the vast majority of the urban development is anticipated to occur in diminutive and average magnitude urban communities of one million or less (Montgomery, 2008). Worldwide urbanization protuberances are important since urban areas have turned out to be predominant substances on the planet's social, monetary, political and ecological domains. As worldwide focuses of manufacture and consumption, urban zones depend on assets and environment services from building materials to waste management, which are disseminated far and wide globally. An in-depth comprehension of the urban development process on a global platform is imperative due to the critical financial and ecological effects of urbanization. The effect on the ecology comes at different levels including; territorial precipitation patterns, loss of wildlife habitation and bio-diversity, transformation of farming area to non-farm uses, increment in air contamination, overcrowding, and noteworthy increased demand for water, vitality, and horticultural assets (Johnson, 2001; McKinney, 2002; Kaufmann *et al*., 2007; Seto *et al*., 2014). An enhanced conception of urban development forms and urban morphology will enable us to more readily counter worldwide ecological change and effects on farming and nourishment security in general.

2.2.1 Urban development trends in Africa

Throughout the previous three decades, Africa has been characterized by swift urban development owing principally to progression policies that stressed urban development to the

detriment of horticultural and rustic advancement. Subsequently, the rate of increment in the span of the non-agrarian populace presently surpasses the rate of increment in important non-farming business openings prompting a phenomenon commonly referred to as 'over urbanization' (Findlay *et al.*, 2008). The foundations of fast urbanization in Africa can be mapped out to the area's provincial past and high populace increment. The colonists set up hubs of life in the form of managerial centers, social, monetary, and frivolous activities in territories that gave them access to ports and rich agrarian fields. Such access to ports was indispensable on the grounds that it considered the outward exportation of crude materials back to the colonizing nations and the internal shipment of processed merchandise. Likewise, prime rustic agricultural plains provided basic sustenance requirements for the developing populace and crude materials for farming enterprises (Findlay *et al.*, 2008).

The European settler supremacy had perceived the protectorates as a wellspring of basic raw materials and as an outlet for moving their produces. Thus, the spatial structures of most African economies turned out to be firmly centered on few port centers and prolific alluvial fields. It was on these urban communities that recently developed infrastructure systems were concentrated and it was towards these urban communities that the populace floated. As the colonial era came to an end, populace redistribution towards these urban communities did not stop. In contrast, it expanded as these urban communities persisted broadening their ascendancy as the essential strongholds of economic activities and thrived to wind up the largest urban centers of the twentieth century (Ling, 2007).

As from 1950, the urban extent of the total populace has risen quickly and this pattern is likely to carry on well into the predictable future. Almost 66 per cent of the urban inhabitants on the planet dwell in the Third World. The extent of the populace dwelling in urban territories in Africa was anticipated to swell from roughly 34 per cent in the year 1990 to 57 per cent by 2025 with huge variety in the dimension of urbanization amid the areas. In 1990, roughly 22 per cent of the East African populace dwelt in urban zones which contrasted with 33 per cent, 45 per cent, and 55 per cent for West Africa, North Africa, and Southern Africa, correspondingly. This assortment and position arrangement is anticipated to be kept up through 2025, though at a larger margin. The urban rate is anticipated to fluctuate from 47 per cent in Eastern Africa to 74 per cent in Southern Africa (Sadik, 1991; Heilig, 2012).

Urbanization rate is the alacrity at which a populace is urbanizing. It very well may be described as the normal yearly rate of progress of the proportion of inhabitants living in urban territories. It is likewise the contrast between the development rate of the urban populace and that of the aggregate populace. The speedy development of the urban growth in Africa can be ascribed to a budge in equilibrium between the urban and rustic economies. In addition, urbanization is likewise credited to high populace increment. Augmentation in populace could be artificial or natural. A natural increase in populace happens when birth rates surpass death rates. Artificial populace development is caused by rustic to urban relocation as a result of pull or push factors (Jaysawal, 2014).

2.2.2 Urbanization in East Africa

East Africa's urbanization can be scrutinized from three interconnected dimensions. First, as a idiom of the composition of societal qualities which almost certainly impacts the choice of a particular area at a given point in time. Secondly, as an essential constituent in the arrangement of spatial association, that entangles the number of inhabitants in East Africa into specific prototype of social and spatial relations. Lastly, it is a pragmatic structure within which to evaluate on a normative premise, the causes and outcomes of contemporary monetary, social, and political advancement issues and the endeavors made by the independent countries of Kenya, Uganda and Tanzania to manage them (Soja, 2016).

Since liberation of member states from colonial grip, urbanization in East Africa has been firmly inhibited by the frontier inheritance of underdevelopment and the needy spatial structures that came with it. In spite of the endeavors of the liberated African governments to change their settler legacy, urban advancement since 1960 has been slightly in excess of strengthening of previously existing prototypes and connections, and the more open expression of issues intrinsic to the political economy. This has been especially clear in Kenya, the most profoundly underdeveloped of the three states amid the colonialist era. While Kenya has plainly pursued a transcendently entrepreneur approach, permitting the passage of a few Africans into the prevailing affluent society, yet altering little else. Tanzania and to some degree Uganda have pursued drastically extraordinary courses and, as it were, have figured out how to debilitate the structures of reliance upon foreign and local capita (Dewar *et al*., 2017).

Nonetheless, it has been extremely intricate to reorganize the effectively embedded spatial foundation of underdevelopment, which endures regardless of generous ideological, attitudinal, and institutional variation. Taking into account the seriousness of prevailing urban issues and the tireless clutch of colonially created social and spatial structures; it is no bolt from the blue that the East African nations, especially Tanzania and Kenya, have dedicated significant thoughtful measures pertaining the intended rebuilding of their settlement frameworks. The most fundamental spatial guiding principles have been presented in Tanzania, where progressions of feebly incorporated projects have been set up (Shorter, 2013).

2.2.3 Urban growth and development in Kenya

Like a large portion of Africa, Kenya is likewise described by speedy urban advancement and urban development. Urbanization has traditionally been described as the process of development in the urban percentage of a nation's whole populace, as opposed to only in the urban populace in essence. As such, the suitable evaluation of urbanization rate is the distinction between the development rates of the urban masses and the national inhabitants. At elevated amounts of urbanization the importance of financial improvement can end up bewildered and suitable national urbanization measures should be actualized (Hope, 2012).

In the course of recent decades, between the years 1970 and 2010, the urban laypeople of Eastern Africa swelled from 11.2 million to 77.2 million with the urban percentage mounting from 10 per cent to 24 per cent amid a similar epoch (UN-HABITAT, 2010). For Kenya, its aggregate populace expanded from 10.9 million in 1969 to 38.6 million in 2009 at a yearly normal intercensal development rate varying from 2.9 per cent to 3.4 per cent (KNBS, 2009). The urban populace as a percentage of the aggregate populace expanded from 8.8 per cent between 1960 and 1970, to 20.9 per cent in 2010 and is anticipated to surpass 36 per cent by 2040. The urban population has been developing at a yearly standard rate surpassing 7.9 per cent between 1970 and 1980 and is anticipated to average about 4 per cent beyond 2010 through to 2040. The typical yearly rate of urban progress was 3.3 per cent from 1960 to 1970 and was assessed to average 2 per cent by 2040. The typical yearly rate of urban progress is the standard exponential pace of progress of the urban proportion in a given period (UNDESA, 2010). This demonstrates one out of five Kenyans presently dwell in urban domains contrasted with one out of twelve during the 1960s showing that urbanization

and urban population development in Kenya have been increasing at a quick pace over the past fifty five years since freedom.

2.3 Drivers of urbanization in Kenya

There has been rapid rate of urbanization observed in Kenya since gaining independence in 1963. Urbanization in this circumstance alludes to the process by which rustic locales end up urbanized due to economic advancements and industrialization. That is, urbanization is the swell in the amount of individuals living in towns and urban communities (Aguayo *et al*., 2007). The sovereignty from colonial grasp secured opportunities of development for individuals, which impelled high rate of bucolic to urban movement. Against the rapid urban development, Kenya has witnessed debasement of institutional and physical framework. Thus, Kenyan urban regions are marred by broad casual settlements; poor water and sanitation conditions and services. Likewise, the 1990s introduced widespread poverty, a phenomenon that is likely to intensify in the future (Mireri, 2006).

Urbanization in Kenya is firmly connected to innovation, industrialization, and the sociological system of validation. Urbanization is not just a cutting edge incident, but a fast and notable change of human social roots on a worldwide scale whereby, transcendently rustic culture is hastily being supplanted by overwhelmingly urban culture (Jaysawal, 2014). Urbanization ensues as individuals, businesses, and administrative endeavors lessen time and cost in driving and enhance open doors for employment, education, residential housing and transportation. Majority of rustic dwellers migrate to the city for purposes of looking for fortunes and social versatility. However, the image of urbanization is not as splendid as it appears. Present day urban areas have developed in an erratic and spontaneous way because of swift industrialization. Urban areas in developing nations wind up over-populated and congested somewhat because of the expansion in populace throughout the decades and to some extent due to migration (Amitabh, 2009).

Urbanization can be as a result of several factors such as; development of processing and manufacturing industries, employment opportunities, development of infrastructure network, and human resettlement (Lopez *et al.*, 2001). In Kenya, the essential factors propelling rapid urbanization and urban development are speedy natural populace increment, rustic to urban migration and other underlying factors namely exiles and refuge searchers. A natural populace surge happens when birth rates surpass death rates. In Kenya, national birth rates at

present surpass death rates by 27.3 per 1,000 persons. In the urban regions, rising fertility rates and natural development of the urban populace are assessed to represent roughly 55 per cent of Kenya's urban development (Hope, 2012).

Rural to urban movement in Kenya is mainly necessitated by the quest for better economic social and environmental standards. As such, individuals living in rustic zones are pulled to the city. Many at times, they are prejudiced by the notion that the living standards in urban territories will be much better than in bucolic locales. They relocate to urban centers principally in light of the better business and monetary prospects that are in abundance compared to rural areas (pull factors). Push factors are elements that prompt individuals to move from countryside setting to urban territories. Individuals relocate to flee debasing conditions like dearth, flooding, starvation and internal conflict (Hope, 1998). As an approach to break away from destitution, vast quantities of Kenyans search for better openings by relocating to urban communities and urban zones.

2.4 Impact of urbanization on agriculture in Kenya

Once viewed as being emphatically connected with higher efficiency and industrialization, it has now turned out to be progressively evident that there are negative outcomes related with the intense economic activities and unplanned populace growth in urban territories (Sarosa, 2006). Advantages of urbanization encompass; decreased transport costs, exchange of ideas, economic development, expansion of business enterprises, socio-cultural assimilation, availability of infrastructure and social amenities, etc. Urban areas present opportunities to individuals that are scarce in rural areas. Conversely, the negative impacts of urbanization include; general health problems that ensue from polluted water and air, spread of transmittable illnesses due to congestion, joblessness, scarcity of affordable housing and harmful social impacts for instance; poverty, mental issues, liquor addiction, crime, brutality and other deviant behavioral manifestations (Firman, 2012).

Conversion of agrarian land to non-agricultural purposes is another significant negative effect related with urbanization. It is essential as this influences sustenance security and general nourishment of the populace (Li *et al*., 2014). Human undertakings particularly urbanization, have brought about a noteworthy loss of farming area throughout the previous decades around the globe. Extensive regions of rural land including; cropland, timberland and pasture land have been converted into artificial or impenetrable surfaces (Pandey, 2015). The

transformation of agrarian lands to urban development is a trend presently influencing developing nations such as Kenya as their populace develops. Even though urban spread may not undermine general agricultural output of a nation it results in variation and decrease in local farming activities and to the loss of agrarian land (Li *et al*., 2014).

2.5 Land tenure and land availability in Kenya

The characteristics of Land proprietorship are imperative however inadequately comprehended features of urban advancement. Land tenure alludes to the right to hold, utilize and own land as described and guaranteed within a lawful framework. There are distinctive frameworks of land tenure in the peri-urban regions. These frameworks dictate the accessibility of land for urban utilization. Payne (2001) noted that the prevailing types of land tenure in a particular region profoundly affect physical urban prototypes and the adaptability of adjusting to the burden of quick urban development. The land tenure influences the land utilization or land possession as well as the manner in which the land exploitation react to increasing urban pressure fashioned as a result of diverse land uses. Much more vital is that different types of tenure frameworks will dictate the measure of control that local authorities can exercise over a given land parcel.

Land ownership in Kenya is usually dictated by legal and social fabrics, and trade happens within the confines of the structure of a formal market and all-inclusive land title registration framework (Gough, 2000). Despite this, there is a casual land market and expansive squatter settlements illicitly set up on private and public land on the outskirts of urban settlements as a result of blended land tenure frameworks and feeble control by authorities who lack imperative human capital to implement land policies. According to Lichfield (2011), frameworks of land tenure exemplify legal, contractual or traditional arrangements, whereby people or associations access social or financial opportunities through land. Land without the component of tenure is a trivial idea.

The pattern and magnitude of urban advancement owes a lot to the idea of original land possession boundaries. The planning of land sales influences the nature of urban advancement. Land tenure gives sovereignty to inhabitants in the public arena since land proprietors may assert extensive impact over urban planning policies particularly if the act in unison. This can be realized through their choice on whether or when to sell land and partake in various types of urban development. Furthermore, land proprietors have impact over the

preparation and implementation of land use strategies. Thus, land tenure is a basic component of both national and regional economic aspects and it tends to be viewed as a constituent of the connection between the production and consumption sector (Webster, 2009).

In Njoro Sub-County Kenya, like many developing areas in Kenya, there exists a concrete legal and social right for inhabitants, organizations and other private companies to possess land. These rights are well protected, although they are seldom absolute frequently compelled by an assortment of state enactments. In general, private property rights might be constrained by the prohibition of certain social groups from possession, limitations on the utilization and fragmentation of land as indicated by planning or zoning laws, land taxation, its gainful exploitation and confiscation by the state (Kimiriny, 2017).

In the peri-urban peripheries of Njoro town, pressure for land for development is phenomenal however development of land is characterized by land fragmentation. The greater part of the land use choices are basically local bringing about spontaneous land use changes and development activities. There is little proof that there exist compelling organizations to manage the vast land use planning and management requirements of peri-urban zones. A unique attribute of the peri-urban periphery is that land is usually under a lot of pressure because of various patterns of land exploitation, conversion and extensive commercialization (Kleemann *et al*., 2017). This leads to the loss of farming area because of the physical extension of the urban territory, speculative land fragmentations and land use changes instigated by emergence of industries, improved infrastructure and social amenities for example; schools, clinics and sewerage transfer work. *Per se*, the peri-urban fringes of Njoro town are progressively being tainted by an assortment of various advancements comprising; private settlements combined with vacant land (frequently held for speculative reasons) and agrarian land conversion from subsistence to non-farm business ventures.

2.6 Land use amid urbanization in Kenya

According to Kombe (2005), urban venture into the peri-urban regions of towns and urban centers can prompt imperfect development of land use in the absence of suitable land utilization mechanism. Indications of problematic land use include; huge tracts of unused land which are unavailable for other land uses, low density residential locales, and extensive distances between local locations and destinations of work. Turok and McGanahan (2013) also contend that neglecting to anticipate the premise of populace projections is most

damaging to the possibilities of the poorest urban occupants. When situated on the peripheries of urban centers far from financial chances, casual settlements may not only lack fundamental water and sanitation provisions, but also ensnare communities in spots where the possibilities of upward trajectory are isolated.

Land shortage may by as a result of either prohibitive control or influential developers sufficiently powerful to oppose pressures to convey housing necessities thus pushing up rents for poorer occupants. When the alternatives for residential housing are constrained to unlawful settlements, this can compel individuals to settle in zones that are either deficient of basic human services or might be more prone to calamities. High rents evidently reduce disposable income for the deprived further limiting what they can spend on other services and amenities (Magigi, 2010).

In peri-urban regions, diverse attributes in land tenure, planning and administration can make it difficult to achieve a valuable urbanization process. Peri-urban regions, at the border of provincial regions and developing urban centers are generally zones of rapid transformation, marred by different land uses and tenure plans with overlapping and fragmented land organization and administration frameworks. They are regularly land development hotspots where land markets are liable to aggressive stress as urban areas grow, speculation is rampant, property relations are predisposed to exceptional contestation, and access to affluence and authority is experiencing fast change (Simon *et al*., 2004; Ubink, 2016).

Peri-urban fringes experience numerous changes in land exploitation, supported by rivalry for land from various non agricultural sectors, usually mirrored in sharp ascents in land values and change in land use. Land is essential for farming communities and it is critical for peri-urban agriculturalists who act in response to request from urban communities. Due to the closeness of peri-urban fringes to urban areas, production and supply perishable foodstuffs is common including horticultural and livestock products (Kuusaana, 2015). At the same time, a noteworthy interest for peri-urban land is for private and commercial residential housing. This interest originates from both middle-income workers in search of land for bigger houses than would be conceivable in urban centers, and low-earning families unfit to bear the cost of housing in urban areas in the midst of rising land costs.

Manufacturing industries additionally look for land for modern practices, either in light of the fact that assets are available (quarries, water), since land is less expensive than in urban areas, or on the grounds that there is more scope to release waste from industrial processes. This progress prompts growth in land markets and land becomes progressively commoditized.

This growing demand increases the cost of land in peri-urban territories, which prompts an alteration in insight from seeing land fundamentally as an asset with minimal money value towards considering it to be a product that can be developed for monetary profit (Appiah *et al*., 2014). In regions where land was accessible to families at low costs, vicinity to an extending urban center frequently goads present land owners to rent it out at higher rates to developers, or charge higher rent rates. For instance, in Njoro Sub-County Kenya, heightened land demands have compelled majority of land owners to convert rural land to residential areas and other non-agricultural ventures. Therefore, land transactions in Njoro Sub-County Kenya turn out to be more widespread, and pressure mounts to fragment parcels into smaller subdivisions in an attempt to increase land supply and financial returns.

2.7 Urban planning and management structure

The land legal framework in Kenya comprises of The Constitution of Kenya of 2010, The Land Act of 2012, The Land Registration Act of 2012, The Land Commission Act of 2012 and The Physical Planning Act of 1998 later revised in 2012. The Physical Planning Act of 2012 oversees management at national and county levels. Likewise, it necessitates a coordinated advancement planning system to upgrade linkages between strategies, physical planning and available resources. The motivation behind The Land Act of 2012 is to facilitate tenable organization and management of land in Kenya by characterizing the land frameworks in Kenya as freehold, leasehold and conventional land holding, and outlining ways of securing land. The Land Registration Act of 2012 merges and supports the listing of land titles in Kenya and provides impact to the doctrine of delegated government in Kenya.

The rationale underlying the National Land Commission Act of 2012 is to facilitate further clarifications with regards to the role of National Land Commission, credentials and appointment procedure to the Commission. Additionally, it gives effect to the substance and ideology of delegated government in organization and planning of land use. The Physical Planning Act of 1998 (later reviewed in 2012) facilitates the statutory system for structuring and organization of all physical land improvement and advancements in the nation. The Act

accommodates the planning and execution of local and national physical development designs. The Act confers the task of designing and implementing development control in the particular local zones. The Local Government Act of 2010 enables every local authority to design and enforce organized development of all land under its control (Government of Kenya, 2012).

Planning and administration of urban areas have been inefficient and have failed to tame the expanding urban rot and ecological turmoil. Frail institutional structures, contradicting interests and insufficient human capital are significant drawbacks. Physical expansion blueprints given by the Physical Planning Department are typically at the mercy of individual impulses of particular local jurisdictions to execute, through their development control power. Nonetheless, local jurisdictions fall short of adequate human capabilities in terms of skilled personnel and facilities to actualize these plans (Mbogua, 1994).

Kenya's planning of physical development is wanting. The nation does not have the ability to viably design and guarantee deliberate improvement of the urban locales. Both the Director of Physical Planning and the Local Jurisdictions are deficient in the imperative human capital and valuable planning information. The Directorate of Physical Planning has shortage of work force to execute the massive duty of physical administration and improvement control in both rustic and urban territories. Also, the local Jurisdictions need budgetary assets to set up and sustain successful urban administration offices (Chipungu, 2013).

It is difficult to exercise appropriate physical arranging of the urban focuses without proper planning information (Hall, 2010). Both the Director of Physical Planning and Local Authorities lack sufficient cash assets to procure and refresh planning information. Accordingly, most urban focuses are either spontaneous or do not conform to the proposed expansion designs. In essence, urban development has taken place without growth designs, which has fundamentally undermined the artistic significance of Kenya's urban focuses. Furthermore, urban administration organizations as currently comprised cannot give the premise to proficient urban management and growth control (Bhatta *et al*., 2010).

Ineptitude has conversely incited poor and problematic foundation improvement and urban utilities exemplified by the fast advancement of informal settlement, with their incalculable issues like degraded sewer structures and other important public utilities. A high urbanization

rate in Kenya against fragile human and financial assets has made it difficult to tame heightened enthusiasm for transport and communication systems, and other general necessities. The costs of these troubles are regularly reflected in the emerging nature of the ecological and human welfare (Hope, 2013).

Proficient infrastructure and other public utilities are contingent upon viable institutional system. The nation has throughout the years neglected to sufficiently develop institutional system for the improvement of urban infrastructure and other public requirements. The quick development of informal settlements in key urban centers of the republic is an expression of frail and inept institutional framework. Additionally, derisory human and economic assets have added to the deprived infrastructure and general living conditions. Local Kenyan development specialists have limited income base and insufficient human capital work in dominant urban zones to oversee and manage human settlements and general urban development (Chesoto, 2013).

2.8 Agricultural land resource impacts in the context of food security and urbanization

As indicated by the Food and Agriculture Organization of the United Nations (FAO), food security is attained when everyone constantly has physical and financial access to adequate, harmless and nourishment to satisfy their nutritional needs and food inclinations for a vibrant and healthy life (Pinstrup, 2009). This definition involves four measurements of food security: readily available, constancy, safety and accessibility. The first measurement alludes to the general availability of adequate quantity of food. Later on, agriculture will be challenged to satisfy the food demands of the populace that is anticipated to increase tremendously and become quickly urbanized (Mendez *et al.,* 2004). As such, the future food availability in every developing city is already facing turmoil.

An instantaneous result of rapid urban sprawl is the edging out of peri-urban agriculture which assumes a key responsibility in steady supply of perishable consumables to urban areas. Furthermore, the ownership contracts which are by now undermined, may be challenged and agricultural production may be transferred to less productive regions which could lead to low productivity. Food constancy conversely necessitates that food is consistently available for access by people from all backgrounds. Food safety is connected to the nature and standards of food and consistency. This will exert extra strain on rustic framework, innovative advancements and food supply since these provisions and services

tend to be inadequate in cities and peri-urban fringe in developing nations. This implies that the future consistency of food supply may be in jeopardy (Swinnen, 2012).

These challenges are vividly manifested in the context of Njoro Sub-County, Kenya taking into consideration transportation cost, the population pressure and the consequent food requirements. It is not satisfactory that there is adequate amount of food, if it cannot be eaten without putting the health of devourers in danger (food safety). Many studies concluded that urbanization usually decreases infant malnutrition and augments nutritional diversity (Ruel and Garret, 2004). However, food in urban centers is progressively being consumed outside the house confinements. Armar-Klemesu (2000) in an assessment of households in urban regions in Sub-Saharan Africa established that more than 32% of their food budget was used on fast foods. This proportion was bigger in areas with poorer inhabitants. Urbanization hence tends to increase the physical risk of urban zone particularly with poorer populace. The last dimension, food accessibility is connected to the assets that a person or family unit owns to acquire rood necessary for healthy diet (Tubiello, 2007). Having adequate assets to acquire healthy diet is the most vital measurement of food security in urban regions. In numerous urban areas of developing nations, people purchase more than 90% of their foodstuffs (Armar-Klemesu, 2000; Tubiello, 2007). Food is as a result not open to urban inhabitants particularly the poor who depend on minimal pay. Food costs in these urban places are constantly on the rise and tend to deny a portion of the dwellers the much required food supplies.

2.9 Theoretical and conceptual framework

2.9.1 Utility maximization theory

This is a premise utilized in economics that embraces the claim that when people settle on a choice to buy a product or undertake a business venture, they endeavor to acquire the most measure of significant worth conceivable, while simultaneously spending as little amount of money as they can. Altogether, the individual seeks to determine the best measure of significant worth from their accessible assets (Milgrom, 2002).

The utility maximization theory was developed from a noteworthy scholarly legislative body that commenced amid the nineteenth century. The utilitarian theorists were inclined towards finding an objective principle for the art of governance. They contended that if strategies and choices were to be determined contingent on achieving the good of the majority, there was

need for a utility catalog that could indicate the gauge of how useful various strategies were to a variety of individuals (Levin *et al*., 2003).

Rational decisions form the foundation of virtually all individual choices. In this context, a rational decision is described as the process of figuring out the accessible alternatives and selecting the most ideal in terms of maximizing utility. This section describes how persons formulate rational choices reliant on the utility maximizing theory. The use of utility augmentation approach to determine decision making process has been utilized to investigate not just family unit decisions about conventional monetary issues like utilization and reserve funds, but also and business choices about investment , exit entry and so on (Rani, 2014).

The utility maximization theory is an entrenched precept founded on the postulation that individuals are logical agents. The rational persons will dependably desire the choice that takes full advantage of their utility preferences contingent on them being furnished with sufficient information regarding their alternative available choices (Poolman, 2012). The utility maximizing individuals approach decision making with the objective of attaining the most ideal choice. According to Schwartz (2006), so as to achieve this, they will be involved in a comprehensive inquiry of all conceivable alternatives, putting considerable time and exertion in the choice process.

In Njoro Sub-County for instance, small scale farmers who are viewed as rational and seeking to maximize utility (financial) have a choice to make between converting agricultural land to non-farm purposes or continue with farming activities among other available alternatives. In the light of better financial profits from the non-farm activities, small scale farmers in Njoro Sub-County have found themselves gravitating towards choosing to convert land to non-agrarian uses as compared to using land for agricultural purposes. This is because non-farm ventures in Njoro Sub-County are increasingly becoming more profitable and offer the best outcome compared to practicing agriculture which is plagued by seasonality in revenue, produce and dependence on rainfall. As such, this has led to wide spread conversion of agricultural land to non-farm uses in Njoro Sub-County.

2.9.2 Conceptual framework

In Figure 1, it is conceptualized that land conversion is directly influenced by farmers' socio-economic attributes, institutional and land characteristics. These characteristics are chosen

based on other similar studies (Azadi *et al*., 2011; Huang *et al*., 2015; Qiu *et al*., 2015; Sroka *et al*., 2018) and the author's perception. Farmer socio-economic characteristics include; age, gender, attitude towards risk, education level, house hold size, off farm activities, and off farm-income. Household size for instance affects sustainable land conversion in that; a household with many family members has labor readily available. This implies land will not be readily converted compared to a small family size with large tracks of land in an urbanizing area. Institutional characteristics include; distance to nearest market, nature of the roads and the value of productive agricultural assets.

Land characteristics include; soil quality, expected agricultural land value, land quality, plot size, location of agricultural land. Urbanization effect is assumed to be a moderating variable as it determines conversion and the intensity of conversion. Urbanization also influences the different land prices in an area by potentially to changing agricultural land prices because of increased expected value of land due to anticipated changes in land use. The probable increased agricultural land price differentials leads to agricultural land conversion and loss of potentially fertile lands to non-agricultural purposes.

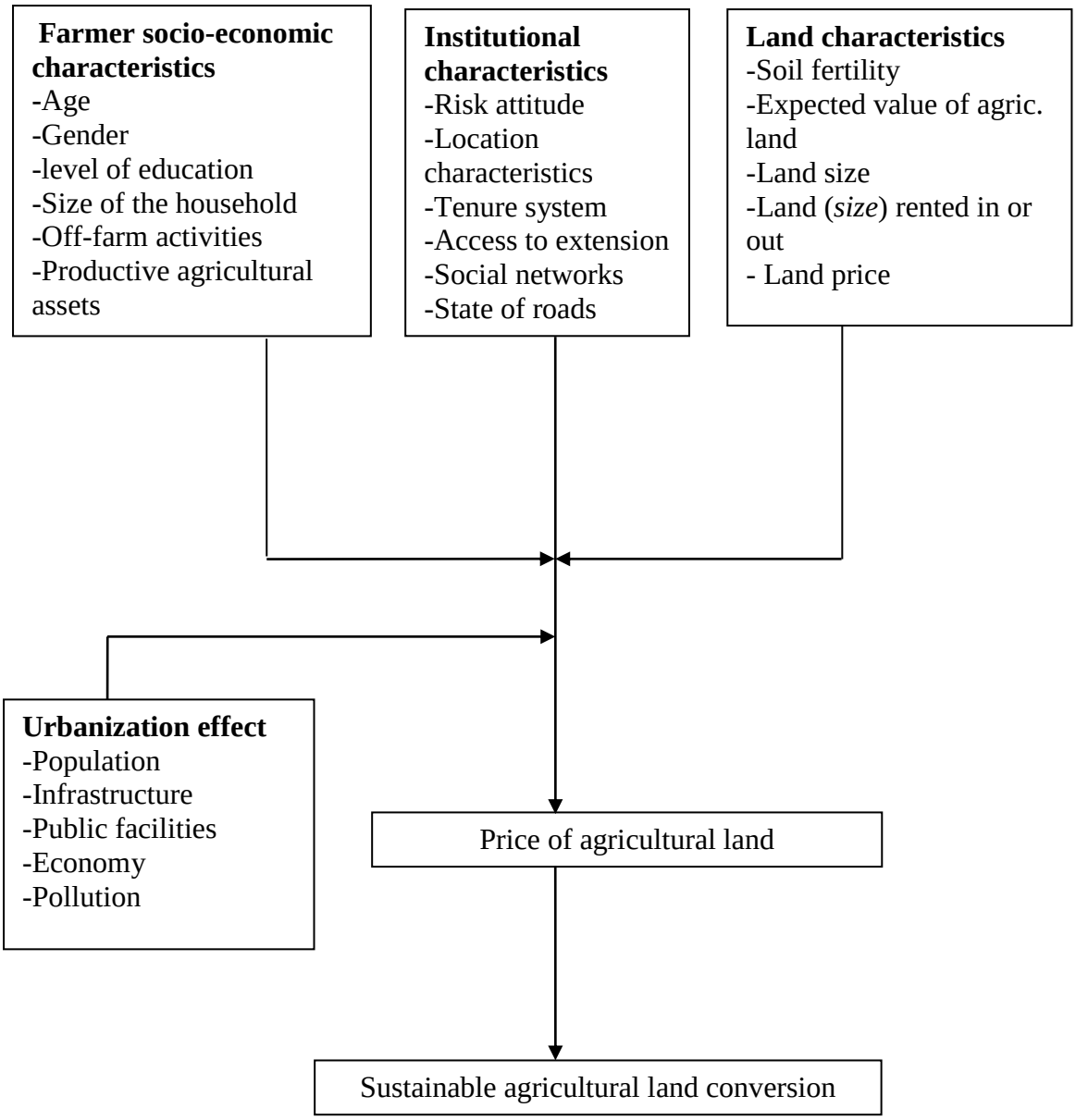

Figure 1: Conceptual framework of sustainable land conversion

CHAPTER THREE
METHODOLOGY

3.1 Introduction

This section presents the depiction of the research process. It provides information on the participants, that is, the criteria for consideration in the study, who the respondents were and how they were sampled. It portrays the research design that was chosen for the purposes of this study and the justification for its choice. It additionally describes the different stages of the research, which incorporates the number of sampled participants, kinds of data gathered, the data collection process and the methods used in data analysis. The chapter further outlines the discourse of legitimacy and dependability in qualitative research and describes the manner by which these two prerequisites were met. This section ends by outlining the various variables utilized in the study.

3.2 Study area

The study was undertaken in Njoro Sub-County. Reminiscent of other extensive urban areas, in addition to its remarkable economic development is Njoro Sub-County's swift growth and change from a primarily rustic area to a predominantly urban region. The study area was selected because it has been experiencing significant threat to general ecological integrity due to the rapid conversion of peri-urban agricultural land to other non-farm uses such as residential housing, industries, schools and public social facilities (Government of Kenya, 2013). Njoro Sub-County covers an area of 713 Square Kilometers and is located in Nakuru County which lies within the Great Rift Valley (Government of Kenya, 2013). Njoro Sub-County comprises six wards namely Mau-Narok, Mauche, Kihingo, Nesuit, Lare and Njoro (Figure 2).

There is a wide variation in altitude with Mauche lying within 2100 - 2500 meters Above Sea Level (A.S.L.), Mau Narok 1700-2850 meters A.S.L. and Lare 1650-2200 meters A.S.L. The Sub-county is situated between longitudes 35° 28′ and 35° 36′ East and latitudes 0' 12" and 1' 10" South (KNBS, 2017). Njoro Sub-County has an elaborate drainage and relief system with its major river being river Njoro, which drains into Lake Nakuru. Soils in the area are mainly latosolic whose productivity ranges from moderate to high (Government of Kenya, 2013).

The annual temperature range in Njoro Sub-County is between 11°C - 24.5°C (Ogeto *et al.*, 2013). The area receives rainfall of between 950 mm and 1500 mm per annum which is characterized as bimodal with short rains experienced between October and December whilst the long rains fall between March and May (Government of Kenya, 2013). As per Kenya National Bureau of Statistics population projections, Njoro Sub-County's population was estimated to reach 243,251 in 2018 (KNBS, 2017). This depicts a seventy five per cent increase from the population of 167,778 in 1984 and portrays a steady growth rate of a 3.5 per cent. This overshadows the regional and countywide populace incremental rates of 2.6 per cent and 2.7 per cent respectively. The residents of Njoro Sub-County are mainly small-scale farmers, small traders and civil servants (Kinuthia *et al.*, 2012). Main farm resources include crops, trees and livestock. Farm families constitute 12.17 per cent of the population as per 2009 census, with majority of their livestock being dairy cows, dairy goats, sheep and poultry (Jaetzold and Schmidt, 2010).

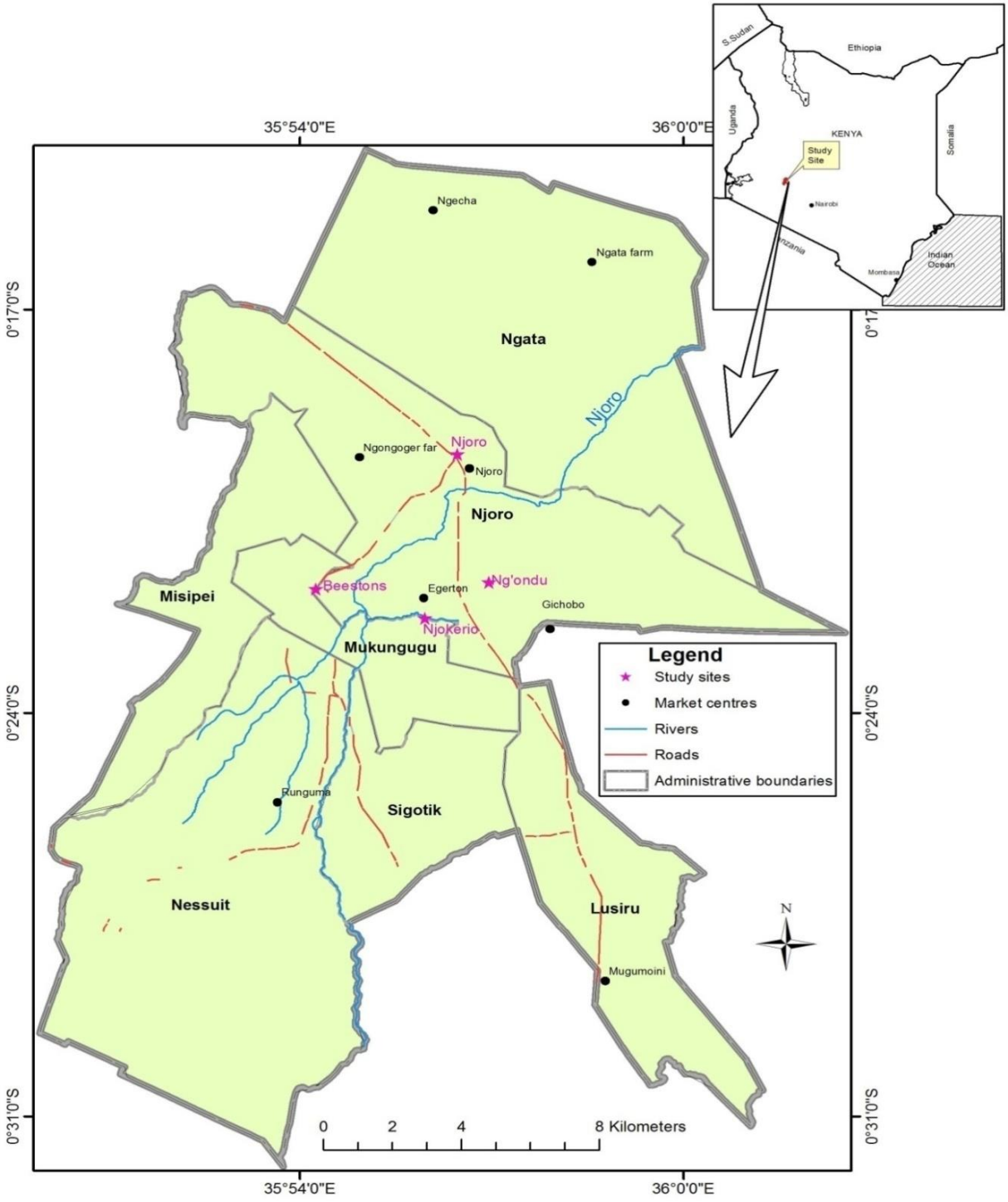

Figure 2: Map of Njoro Sub-County

3.3 Research design

The study employed a survey research design where qualitative and quantitative data was sought to achieve objectives of the research. The design enabled collection of relevant cross sectional data from different subsistence farmers within the study area. This allowed collection of a representative sample of data from the population which gave a good characteristic of the population (Frankel *et al.*, 2000). The social survey approach was used as it allows for profound understanding of a particular topic of interest and makes it possible for one to discern cases endowed with relevant information.

3.4 Sampling procedure

The target populace of this study was smallholder farmers (less than 10 acres) who have lived in Njoro Sub-County for the last 20 years. Multistage sampling technique was employed. In the initial stage Njoro Sub-County was intentionally chosen as it is among the eleven Sub-Counties in Nakuru County where agricultural land is rapidly being converted due to urbanization effect. In the second stage Njoro Sub-County was stratified into 6 wards (Mau-Narok, Mauche, Kihingo, Nesuit, Lare and Njoro). In the third stage, one ward (Njoro ward) was purposively selected based on the information obtained from the ward Ministry of Agriculture and the Ministry of Lands, housing and urban development. Respondents were then selected from the ward using simple random sampling method.

3.5 Determination of sample size

The desired size of the sample was determined using outlined by Kothari (2004) as shown below.

$$n = \frac{pqZ^2}{E^2} \quad (1)$$

Where n was the desired sample size, Z is confidence level ($\alpha \leq 0.05$); p was the proportion of intended populace having of interest (*small scale farmers in the study area*). q was the weighting variable computed as (1 - p) and E was the level of precision (allowable error). p was 0.5 because statistically, a proportion of 0.5 yields a sufficient and reliable sample size especially when the population proportion is not known with certainty. This implied that q was 0.5 from q = (1 - p). An error of less than 10% is usually acceptable according to Kothari (2004). Thus an error of 0.5 was used to approximate a sample size of 384 small farmers.

$$n = \frac{0.05 \times 0.05(1.96)^2}{0.05^2} = 384 \text{ farmers} \quad (2)$$

3.6 Data collection and analysis

3.6.1 Primary data

Primary data was gathered through observations and interview methods. The semi-structured questionnaires addressed the type and characteristics of changes in land utilization, their ramifications on agrarian land and future insights for preserving prime agricultural areas from infringement by urban non-farm uses. The questionnaire included closed ended as well as open ended questions and was administered on target population to capture information on the land conversion due to urbanization, the extent, impact and factors influencing agricultural land conversion within Njoro Sub-County.

3.6.2 Secondary data

Secondary data was sought through the review of literature, which included referenced books and journals, newspapers and internet articles. Other sources of secondary data were from institutional surveys on documents from Njoro Sub-County urban development offices, statistical references of Njoro Sub-County showing urban development trends due to growth in urban population, in the last ten years, the Kenya National Bureau of Statistics, County Planning and Development department, Lands Commission (LC), the Land Valuation Board (LVB), and the Ministry of Agriculture, Livestock and Fisheries (MOALF). For instance, According to Kenya National Bureau of Statistics population projections, urban population in Njoro Sub-County was estimated at 23,551 in 2009, and was projected to reach 30,990 and 35,011 in the years 2018 and 2022 respectively (KNBS, 2017). This urban growth was mainly attributed to natural and artificial population increase. In addition urban population was anticipated to grow at a rate of 3.1 per cent which overshadows countywide populace incremental rates of 2.7 per cent. As such, this exemplifies Njoro Sub-County as one of the regions in Nakuru County experiencing rapid urbanization. These provided information on the trend of urban sprawl, patterns of land use, value of land and how agricultural lands have been affected in the area over time so as to enable analysis of the extent by which agricultural lands have been affected by urbanization.

Any particular measurement must encompass validity and dependability. Validity alludes to the importance or competence of the measuring instrument in estimating what is supposed to assess (Kimberlin *et al*., 2008). Dependability also called reliability infers the technique of measurement is not influenced by probability. To guarantee legitimacy, multiple sources of collecting data were obtained such as, documents, accounts of local community feelings, interviews and direct observation. Reliability was achieved by carrying out a pilot study with the questionnaires in Njoro Sub-County. In addition the interview and observation guides were pre-tested to understand how well they can be used to collect the data and were edited accordingly in terms of language, length and coverage of issues for study.

The process of data management involved cleaning the questionnaires for errors and coding quantitative data from the household interviews and then entry was made in the Statistical package for social sciences (SSPS) computer program (SPSS, 2015). Descriptive statistics were used to make cross tabulations and mean comparisons. The coded information was then managed using Stata computer program (StataCorp, 2011).

3.7 Analytical framework

3.7.1 Objective one: To characterize the current land use practices by small scale farmers in Njoro Sub-County

Descriptive statistics in the form of calculated means and measures of association using Stata computer program, were used to characterize the current land use practices due to urbanization.

3.7.2 Objective two: To identify socio-economic, land attributes and institutional drivers of agricultural land conversion Njoro Sub-County

Craggit estimator was employed to identify the socio-economic, land attributes and institutional drivers of agricultural land conversion. A Heckman selection technique may appear suitable owing to the fact that a certain percentage of the sampled households indicate no conversion at all (*zero amount of agricultural land converted*). Nonetheless, Heckman approach is intended for incidental truncation where the zeros are considered unobserved values (Wooldridge, 2002). For this scenario, a corner solution is more appropriate to apply contrast to a choice model as zero values are in fact observed. It may very well be assumed that households that choose not to convert land, do so intentionally, such that the unobserved values signify rational decisions (*deliberate zeros*) as opposed to omitted zeros. The Tobit

estimator is frequently used to estimate corner solution models. However, the Tobit estimator is limiting in this case as it would presuppose that the decision to convert land and the degree of land to convert are dictated by the same procedure. Yet, smallholder farmers differ in their background, individual attributes and land utilization choices. Craggit estimator models agricultural land conversion as a two stage decision. In the first hurdle, households chose whether to convert agricultural land or not. Contingent to them converting land, they decide on amount (extent) of land to convert in the second tier.

The decision to convert is a discrete choice, expressed as:

$$d_i^* = \alpha x_i + \mu_i;\ \mu_i \sim N(0,1) \quad \text{and } d_i = \begin{cases} 1 \text{ if } d_i^* > 0 \\ 0 \text{ otherwise} \end{cases} \tag{3}$$

Where the subscript *i* alludes the i^{th} household. d_i^* is an observable variable for d_i when $d_i = 1$, the household converts land, while $d_i = 0$ indicates no land converted by the household. The decision on the quantity of land to convert is represented as:

$$Y_i^* = \beta Z_i + V_i;\ V_i \sim N(0,\sigma^2) \text{ and } Y_i = \begin{cases} Y_i^* \text{ if } Y_i^* > 0 \text{ and } d_i = 1 \\ 0 \text{ otherwise} \end{cases} \tag{4}$$

Where Y_i^* is a latent variable for Y_i which denotes the proportion of agricultural land converted by a household i. X_i and Z_i in equation (3) and (4) respectively are vectors of explanatory variables and may not comprise the same variables. α and β are vectors of parameters to be approximated, while μ_i and V_i are random error terms.

A more flexible technique is the two-stage Craggit estimator used for estimating the Cragg's (1971) Double Hurdle Model that takes into account the prospect that the two hurdles (decisions) are dictated separately (Cragg, 1971). After the specification in equations (3) and (4), and with the assumption of independent error terms, the Craggit probability equation is therefore denoted follows (Jones, 1989):

$$L(Y_i|X_i,\theta) = \left\{\prod_{Y=0}\left[1-\Phi\left(X_i\alpha\middle|\sigma_\mu\right)\right]\Phi(Z_i\beta|\sigma_v)\right\} \times \left\{\prod_{y>0}\Phi\left(X_i\alpha\middle|\sigma_\mu\right)\Phi(Z_i\beta|\sigma_v)\right\} \times$$

$$\left\{\frac{\phi[Y_i - Z_i\beta/\sigma_v]}{\sigma_v\Phi(Z_i\beta|\sigma_v)}\right\} \tag{5}$$

Where ϕ and Φ denote the probability density and cumulative distribution equations, respectively. $\sigma_v$and $\sigma_\mu$represents standard deviations of μ_i and V_i (from equations 3 and 4) respectively. Equation (5) can be solved for α, β and σ^2 through maximum likelihood estimation. Bearing in mind that Tobit is nested in the Double-hurdle model; we can ascertain

which of the two is best suited in a particular situation based on likelihood ratio (LR) test. The log-likelihood of the double hurdle model constitutes the sum of log probabilities of Probit and truncated regressions. Upon estimation of DH model, it is possible to determine the expected effects individual explanatory variables on decision to convert and amount of conversion.

At first, the probability of converting land for each individual observation i was estimated as:

$$P\left(d_i^* > 0 \mid X_i\right) = \Phi\left(X_i \alpha\right) \tag{6}$$

The conditional expected amount of land converted was estimated as:

$$E\left(Y_i \mid Y_i > 0, Z_i\right) = Z_i\beta + \sigma \times \lambda\left(Z_i\beta/\sigma\right) \tag{7}$$

Similarly, the unconditional expected amount of agricultural land converted was estimated as:

$$E(Y_i|X_i,Z_i) = \Phi(X_i\alpha)[Z_i\beta + \sigma \times \lambda(Z_i\beta|\sigma)] \tag{8}$$

The term $\lambda(Z_i\beta|\sigma)$ in the functions (7) and (8) is the inverse Mills ratio expressed as:

$$\lambda(Z_i\beta|\sigma) = \phi(Z_i\beta|\sigma)/\Phi(Z_i\beta|\sigma) \tag{9}$$

The marginal impact for each predictor variables was evaluated in accordance with techniques outlined by Burke (2009). The standard effects were obtained by averaging all *i* observations. In addition to the expected effects of each explanatory variable in the first stage that are based on Probit estimates, it was differentiated between the marginal effect of an independent variable X_i on the expected value of Y given that Y > 0; conditional average partial effect (CAPE), and the marginal effects of the independent variables on the unconditional expected value of Y; unconditional average partial effects (UAPE).

Table 1: Description of socio-economic characteristics, land attributes and institutional variables used in objective two

Variable	Description	Measurement	Expected sign
Socio-economic factors			
Age	Age of the household head	Number of years	+
Gender	Gender of the household head	0 = Female	-
		1 = Male	
Household size	Size of the Household	Numbers	+
Education level	Level of education of household head	Number of years	+
Productive agricultural assets	Value of farm productive assets	Kenya shillings	+
Institutional characteristics			
Location characteristics	Distance to town (Nakuru)	Number of kilometers	+
System of tenure	Tenure system of the land	0 = Without title deed	+
		1 = With title deed	
Attitude towards risk	Willingness to take risk	1 = Risk averse	
		2 = Risk neutral	+
		3 = Risk taker	
Agricultural Extension	Contacts with extension agents(*past three years*)	Numbers	+/-
Land attributes			
Land price	Price of agricultural land	Kenya shillings	+
Soil fertility	Perception on soil fertility	0 = Very low	
		1 = Fairly high	-
		2 = Very fertile	
Topography	Perception on slope of land	0 = Flat	-
		1 = Gentle slope	
		2 = Steep	
Future price of agric. land	Perception on future value of agricultural land	0 = Decrease	
		1 = Constant	+
		2 = Increase	
Land rented out	Lend rented out (0 = No, 1 = Yes)	0 = No	+
		1 = Yes	
Initial land size	Size of land before conversion	Acres	+

3.7.3 Objective three: To determine the socio-economic characteristics, institutional factors and land attributes that influence agricultural land price differentials in Njoro Sub-County

Hedonic pricing model was used to identify the socio-economic characteristics, institutional factors and land attributes significantly influencing agricultural land prices in Njoro Sub-County. Farmers are conversant with the different characteristics of the land they use for farming purposes and have no inducement to distort the value of their agricultural land. The study was directed by competent interviewers sharpened by the author and who were capable of controlling the exactness of farmers' responses. Past literature imply that self-detailed farm reports can be utilized as apposite instruments for market observations (Merry *et al*., 2008; Ali *et al*., 2018). This study therefore used self-reported values per acre. Self-reported values produce an estimate of the allure of a specific parcel of land and reveal which attributes are most desired by farmers. In addition, utilizing self-reported land values allows us to discern whether farmers incorporate probable ecological debasement in land valuation.

A hedonic pricing model disintegrates the price of a particular item into its constituent segments that determine its cost (Garmendia, 2010). Agricultural land is a composite good comprising an assortment of attributes. Goods are set apart from each other, both through their internal and external attributes. The empirical determination of various marginal embedded prices therefore needs evaluation using hedonic price model, because it computes the embedded marginal prices of these diverse attributes from the general cost $P_i(X)$ of the good by regressing the prices of good on their constituent different attributes.

According to O'Donoghue *et al*. (2015), products are viewed as sets of traits and the significance consumers attach to each feature elucidates the disparity in prices of products. Ekeland *et al*. (2004) presented a market-based methodology for developing a hedonic price function, where utility maximizing sellers and buyers collaborate to determine a market value for a particular characteristic. A differentiated item can in this manner be depicted using a vector of equitably measured qualities such that the cost is a composition of the coefficients of the different qualities. This method can be exploited to relate the different prices of land to its various attributes. In light of this, this study adopted the hedonic pricing analysis to identify the socio-economic characteristics, institutional factors and land attributes that influence the different prices of agricultural land in Njoro Sub-County.

The analysis expressed price as a function of various attributes as shown below:

$$P_i(X) = Q^i (X_1, X_2, \ldots\ldots X_n Z) + \varepsilon_i \quad (10)$$

Where: P_i is the price of agricultural land; $X_1, X_2, \ldots\ldots X_n$ are land attributes and $Z=1$. The variable Z can be removed from the equation if farmers are homogenous.

The function (10) above then adopts the empirical multiple regression models' form derived in short form as:

$$\ln P_i = \alpha + \beta_1 X_2 + \beta_2 X_2 \ldots\ldots \beta_n X_n + \eta Z + \varepsilon_i \quad (11)$$

Where: P_i is the logged market price of agricultural land, X's are the land attributes and Z's are the farmer characteristics. α is the constant effect and ε_i is the homoscedastic error term with a mean of zero. The natural log was adopted on all non-binary countable variables to enable variation in implicit prices of characteristics depending on the level of the feature. To obtain the parameters, the model was estimated using Stata (2011) computer software (StataCorp, 2011).

Table 2: Description of socio-economic characteristics, institutional factors and land attributes used objective three

Variable	Description	Measurement	Expected sign
Socio-economic factors			
Age	Age of the household head	Number of years	+
Gender	Gender of the household head	0 = Female 1 = Male	+
Household size	Size of the household	Numbers	+
Education level	Years of education of the household	Number of years	+
Off-farm employment	Participation in off-farm employment	0 = No 1 = Yes	+
Productive agricultural assets	Value of productive farm assets	Kenya shillings	+
Institutional characteristics			
Location characteristics	Distance to town (CBD) Distance to social amenities Distance to market	Number of kilometers	-
System of tenure	Tenure system of the land	0 = Without title deed 1 = With title deed	+
Attitude towards risk	Willingness to take risk	1 = Risk averse 2 = Risk neutral 3 = Risk taker	+
Agricultural Extension	Contacts with extension agents *(past three years)*	Numbers	+
Credit accessed	Amount of credit *(past three years)*	Kenya shillings	+/-
Social capital	Membership to agricultural group	0 = No 1 = Yes	+/-
Nature of the roads	State of the roads	0 = Bad 1 = Fair 2 = Good	+
Electricity	Access to electricity	0 = No 1 = Yes	+
Land attributes			
Soil fertility	Perception on soil fertility	0 = Very low 1 = Fairly high 2 = Very fertile	+
Topography	Perception on slope of land	0 = Flat 1 = Gentle slope 2 = Steep	+
Initial land size	Initial size of land owned	Number of acres	+/-
Future price of agric. land	Perception on future value of agricultural land	0 = Decrease 1 = Constant 2 = Increase	+

Land rented out	Lend rented out *(0 = No, 1 = Yes)*	0 = No 1 = Yes	+/-

3.8 Preliminary diagnostics of the variables used in the regression models

Multicollinearlity is the presence of a linear association between the independent variables (Wooldridge, 2015). It is a major problem to both proper specification and to the successful estimation of basic relationships sought via regression methods. Mutlicollinearity was assessed by use of Contingency coefficient test results for categorical independent variables and variance inflation factor (VIF) for continuous variables. VIF estimates how much the variance of a regression coefficient is increased due to collinearlity. This is possibly caused by related predictors (Kurtner *et al*., 2004). It quantifies the severity to which multicollinearity debases the accuracy of an estimate. By the rule of thumb, a VIF estimation of between 5 and 10 implies high correlation among regressor variables (Wooldridge, 2015). In an event that the VIF values exceed 10, it can be concluded that the regression coefficients are ineffectively estimated due to collinearity. In accordance with the VIF rule of thumb there was no significant correlation among the independent variables as the VIF values were less than 10. As such, all the proposed explanatory variables were used in the regression analysis.

Table 3: Results of Variance Inflation Factor (VIF) test for continuous variables

Variable	**VIF**	**1/VIF**
Age of the household head	1.91	0.5224
Household size	2.45	0.4086
Household head's years of education	2.01	0.4968
Log of amount of credit in the past three years	1.99	0.5015
Initial size of land owned	2.11	0.4739
Number of contacts with extension agents in the past three years	1.17	0.8545
Distance to nearest social amenity	1.95	0.5139
Distance to market	2.74	0.3653
Distance to Central business district (CBD)	1.58	0.6323
Log of value of productive assets	1.47	0.6824
Mean VIF (Variance Inflation Factor)	1.94	

The results for Pearson's correlation coefficient test for discrete variables are presented in Table 4. Pearson's correlation is a measure of the strength and association that exists between two variables (Campbell and Machin, 1999). To test for multicollinearlity among discrete

independent variables, contingent coefficient cutoffs of less than 0.5 indicate low multicollinearlity while contingent coefficient cutoffs of more than 0.5 indicate strong multicollinearlity. The results in Table 4 show that Pearson's correlation coefficients are less than 0.5. This implies there is no strong collinearlity between the proposed variables hence all were used in the regression analysis. Negative correlation coefficients depict the extent to that two variables move in opposite direction. For example, with two variables X and Y, an increase in X is associated with a decrease in Y. Positive correlation coefficients imply that as the value of one variable increases the value of the other variable also increases.

Table 4: Pearson's correlation coefficient test results for categorical explanatory variables.

	HHgen	Nonfrm	Stenr	Rdst	ElectrAcc	Memgrp	RntO	Attrsk	Sfrt	Slpln	Fvgric
HHgen	1.0000										
Nonfrm	0.0341	1.0000									
Stenr	-0.1155	-0.0967	1.0000								
Rdst	-0.1010	0.1898	-0.0178	1.0000							
ElectrAcc	-0.0305	-0.0172	0.0064	0.0238	1.0000						
Memgrp	0.0305	0.0172	-0.0064	-0.0238	0.0026	1.0000					
RntO	0.0116	-0.1781	-0.0308	0.0294	-0.0828	-0.0316	1.0000				
Attrsk	0.1253	0.1308	0.0517	0.0712	0.0528	0.0357	-0.1031	1.0000			
Sfrt	-0.0096	-0.1624	0.0293	0.0611	0.0119	0.1307	0.2465	-0.1395	1.0000		
Slpln	-0.0146	-0.0479	-0.0659	-0.1063	-0.0309	-0.0844	-0.0338	-0.0211	-0.1708	1.0000	
Fvgric	-0.0305	-0.0172	0.0064	0.1229	-0.0026	0.0026	0.0316	0.0528	0.0119	0.0844	1.0000

CHAPTER FOUR
RESULTS AND DISCUSSION

4.1 Introduction

The empirical results of the study are presented in this section. First, the descriptive findings for characteristics of current land use practices based on farmers who have converted land from agricultural to non-agricultural activities. Section two presents Craggit estimation results to identify the socio-economic and institutional factors influencing the extent of agricultural land conversion. Section three presents' hedonic model results to identify socio-economic and land attributes influencing agricultural land prices.

4.2 Descriptive statistics for extent of agricultural land conversion

Table 5 presents the results for the extent to which agricultural land (acres) had been converted as a proportion of the initial size of agricultural land owned. The results indicate that 67% of the total initial current agricultural land size owned by the household had been converted to non-agricultural purposes. The results also show that 33% of the initial size of agricultural land was still being utilized for agricultural purposes. The steady agricultural land conversion could probably be due to the low profitability and seasonality in agricultural produce that makes non-agricultural ventures more enticing as they may not be dependent on rainfall. Also, population increase, surge in non-agricultural enterprises (shopping centers) and growing demand for residential housing may result in an amplified demand for agricultural land for non-agrarian purposes. According to Mazzocchi *et al*. (2013), weaknesses in agriculture resulting from fluctuation of farm revenue and flawed farm structures such as rampant land fragmentation, may lead to land being first, being neglected then converted to non-agricultural purposes. Additionally, Wastfelt (2016) noted that with high land rents in the rapidly urbanizing areas, small-scale farmers are unable to increase either the area or scale of production and may result to converting to urban land uses that fetch higher economic rents.

The results for the extent to which agricultural land had been converted are displayed in Table 5. The average size of agricultural land among small scale farmers was 1.68 acres. Furthermore, the average size of agricultural land converted to non-agricultural purposes was 1.12 acres. The results also reveal that an average of 0.56 acres of land was still being used for farming.

Table 5: Extent of agricultural land conversion

Land conversion (%)	Mean (%)	Standard deviation
Average initial land size *(acres)*	1.00	0.00
Current average size of agricultural land *(acres)*	0.33	0.30
Average size of agricultural land converted *(acres)*	0.67	0.35
Land conversion (acres)		
Average initial land size *(acres)*	1.68	1.47
Current average size of agricultural land *(acres)*	0.56	0.43
Average size of agricultural land converted *(acres)*	1.12	1.05

4.2.1 Socio-economic characteristics of smallholder farmers

Findings for household head mean age, household size, and value of agricultural assets owned based on those who have converted land and those who have not are revealed in Table 6. The results indicate that household heads who had not converted land had a mean age of 48.52 years as compared to 53.41 years for those who had converted land. There is a significant difference in the mean age of farmers by land conversion ($p<0.01$). Maybe this is because decisions regarding land succession and exit from farming are significantly determined by the farmer's age. After entry into agriculture, farmers who have just ventured into farming particularly youthful agriculturalists, extensively expand the proportion of their farming enterprise in the initial decade of undertaking their business as opposed to converting right away. Lobley (2016) contend that the farmer life-cycle harmonizes with farm life-cycle. This implies that as the farmer ages, the opportunity cost of devoting resources to the farm or as far as retraining and acquire an off-farm occupation rises. In addition, young agriculturalists that have as off late made substantial investments in their farms are probably the most constrained financially, and are hence least likely to convert agricultural land. This examination affirms the life-cycle prototypes previously established in the literature.

Households who had not converted land had an average of 5 members compared to 6 members for those who had converted and was significantly different ($p<0.01$). Higher conversion for larger households may be due to the increased need for alternative financial resources to cater for many family members. Large household size implies increased demand for food and other social requirements; hence the need for an alternative source of income as agriculture is crippled with seasonality in its profits and output (Irwin and Geoghegan, 2001).

Table 6: Mean for socio-economic characteristics of small scale farmers

Variables	Converted land	Mean	Std Err	*t-stat*
Age of household head	Yes	53.4094	0.4452	-5.3040***
	No	48.5232	0.7481	
Household size	Yes	5.8322	0.1297	-2.9531***
	No	5.0349	0.2246	
Value of agricultural assets	Yes	7.2135	0.0312	-5.0191***
	No	4.8794	0.0605	

***=Significant ($p<0.01$)

The mean value of agricultural assets owned by households was lower at 4.88 million Kenya shillings for those who had not converted compared 7.21 million Kenya shillings for those who had converted. This is probably because wealthier farmers have a high proportion of fixed inputs (land, cereal warehouses, own labor, equipment) and other major farm resources. Wealthier farmers can therefore gain from profitable agricultural production resulting from advanced mechanized farming and enhanced crop-livestock combination which allows them to diversify their investments. According to Wadley *et al*. (2005), wealthier family units with agricultural surplus are keen on investing in other more rewarding non-agricultural ventures. This not only diversifies their sources of income but also choice of investment opportunities. Income diversification not only influences how households utilize agricultural land but also land use decisions in general.

4.2.2 Descriptive results for farmer socio-economic characteristics and land attributes

Table 7 summarizes findings of household head's gender, security of tenure of the land, whether the household has rented land out, size of land rented out and future value of agricultural land. In general, 57.60% of the respondents had converted their agricultural land to non-agricultural practices while 42.40% had not. A more detailed breakdown reveals that, 9.38% of those who did not convert were female and 33.02% were male. For those who had converted agricultural land, 40.68% were male and 16.92% were female. Land ownership and right of use have a tendency to be vested in men either legitimately or as dictated by the society. Land re-organization and relocation have been inclined to fortify this predisposition against women. Compared to men, women cultivate lesser, more scattered land parcels and have a lower probability of holding land titles, secure ownership or equal right to use,

develop or sell land as men (World Bank, 2011). According to Nightingale (2006), even where official titles are offered equally to the family unit, the female partner may be deprived of her basic decision making right over her former domains on and off farm as the so called household 'heads' assume an exclusive task of managing and deciding on land use practices of the household land.

Table 7: Mean for farmer socio-economic characteristics and land attributes (%)

Variables	**Description**	**Not converted (%)**	**Converted land (%)**	***Chi* Square**
Socio-economic characteristic				
Gender of household head	Female	9.38	16.92	13.8388***
	Male	33.02	40.68	
Land attributes				
Tenure system	Without title deed	1.04	0.52	6.8734 ***
	With title deed	21.35	77.08	
Land rented out	Yes	19.54	52.86	12.1685***
	No	2.86	24.74	
Perception on agricultural profitability	Fairly low	2.60	3.91	
	Average	16.51	54.43	7.3607 *
	Fairly high	3.39	15.89	
	Very high	0.26	3.39	
Future Value of agricultural land	Decrease	0.00	0.00	
	Constant	0.26	0.00	3.4742 *
	Increase	22.13	77.60	

***, *=significant ($p<0.01$) and ($p<0.1$) respectively

There was a significant relationship between security of tenure of the land and conversion of agricultural land $p<0.01$. The results show that 77.08% of farmers with title deeds had converted their land while 21.35% had not. Only 0.52% of farmers without title deeds had converted their agricultural land compared to 1.04% who had not. A possible explanation

could be that freehold ownership enables the proprietor to utilize land as deemed fit, for sale, rent or as collateral to acquire loan, whilst traditional tenure is liable to norms and traditional social practices. Land designation gives enhanced land security, which implies land rights are enforced and unrivalled. This empowers the land owner to utilize the land as a guarantee to acquire monetary credit in form of loans, since borrowers can verify free and comprehensible ownership, and banks are effortlessly capable of recovering the land on account of default. Given this increase in off-farm income, it is asserted that households will diversify not only their investment decisions but also affect land use patterns (Jiang, 2013). This implies that the additional income can be re-invested in other non-agricultural ventures and facilitate land conversion.

In terms of land rented out, 24.74% of farmers who had rented land out had converted land while only 2.86% had not. The results also indicate that 52.86% of the farmers who had not rented out land had converted land and 19.54% had not. A reason for this observation could be perhaps farmers who have rented out land drastically reduce amount of land available for use either in agricultural production or non-agricultural purposes. Brueckner *et al.* (2008) found that the probability of conversion decreases with the size of the parcel. Renting out land reduces available land for agricultural production and other land uses. If lesser parcels of land are rented out, more land is available to be utilized for alternative non-agrarian purposes e.g. recreation parks, social amenities (Wasilewski, 2004).

Majority of farmers who expect future value of agricultural land to increase had converted land with 77.60% having converted compared to 22.13% who had not. This is a contrast to the farmers who expected future value of agricultural land to remain constant, where 0.26% had not converted and none (0.00) had converted land. The dismal returns from agricultural production compared to the substantial monetary rewards arising from demand for land for urban residential uses prompts an increased interest to sell land for non-agricultural purposes. Furthermore, wages that accrue from farms through agrarian activities are not enough to meet the fundamental requirements for the farmers' families. Other benefits that come with urban sprawl such as improvement of technical infrastructure, possibilities of additional employment, improvement of activities of local society also play a role in agricultural land conversion (Ryszkowski, 1994).

The results in Table 7 also show that 2.60% of farmers who perceive profitability of agriculture as fairly low had not converted land compared to 3.91% who had converted. The results further indicate that 16.15% of the farmers that perceive agricultural profitability as average had not converted their land while 54.43% had converted. The results also show that 3.39% of farmers who perceive profit from agriculture as fairly high had converted not converted land compared to 15.89% who had converted. It can also be observed that 0.26% of farmers who perceive agricultural profitability as very high had not converted land and 3.39% had converted land. Perhaps over time, farmers have acquired experience, and can accurately predict trends of agricultural output and profit. Due to seasonality in agricultural output and dependence on weather, many farmers have found themselves incurring losses after making huge investments in agriculture. According to Schilling *et al*. (2014), this recurring phenomenon of making losses has made farmers develop an "impermanence syndrome". This has made farmers shun away from practicing agriculture and instead seek alternative non-agricultural investment opportunities. With prospect of quick returns on their investments, limited risks, and a promise of steady flow of income at their grasp, most of farmers who view agricultural profitability as average, are converting land to non-farm activities which have much higher returns.

4.3 Socio-economic factors, land attributes and institutional drivers of agricultural land conversion

The Craggit estimator was used to identify the socio-economic factors, land attributes and institutional drivers of agricultural land conversion in Njoro Sub-County. Craggit estimator is a two hurdle estimation procedure: the first hurdle is discrete choice in this case decision to convert land and the second a truncated regression that is amount converted (Burke, 2009). The Tobit estimator could seem suitable. However, the Tobit estimator is limiting as it presupposes that the decision to convert and the degree of land to convert dictated by the same process. A more supple technique is the two-stage Craggit estimator that takes into account the prospect that the two hurdles (decisions) are dictated separately (Cragg, 1971). The assumption of conditional independence is upheld as a basic assumption when using a Craggit estimator to determine both decisions to convert and amount of land converted. The maximum likelihood estimate is revealed to have a chi squared significance of 1%, implying that the Craggit is a suitable estimator.

The results of the average partial effects of the independent variables are presented in Table 8 on three different quantities of interest: the probability that a household converts agricultural land (APE), the expected amount of land converted by a household given that the household converts land (CAPE), and the expected amount of land converted by a household (UAPE). Results indicate that as the age of the household head progresses, probability of converting agricultural land to non-agricultural purposes increases. This is probably because of relative immobility and a decline in the ability to perform physical tasks among elderly farmers. This finding corroborates reports by Kimhi and Bollman (1999) that showed that farmers over a particular age will probably "exit" from agricultural farming practices as they age on. Similarly, Breustedt (2007) pointed out that after establishing themselves in agribusiness, young farmers' particularly youthful agriculturists swiftly increase the dimensions of farm operations and cultivating ventures in the first decade of operation as opposed to exiting.

Male headed households have higher probability of converting agricultural land compared to female headed households. A possible explanation is land title and rights of use have a tendency to be vested in men, either legitimately or by cultural norms and social standards. Land reorganization and reallocation have further fortified the inclination against women. This infers the society often sidelines women from the benefits of land organization, administration and improvement plans. Rocheleau *et al*. (1996) noted that in most contemporary societies, women still have limited proprietorship rights than men. Without secure land ownership rights, female agriculturalists have restricted access to credit which could facilitate investments in other non-agricultural sectors. In addition, female household heads often have a particular predisposition when it comes to accessing land, water and other natural resources (FAO, 2011).

Table 8: Average partial effects for Double Hurdle model on probability and extent of land conversion

Variable	APE	Std. Error	CAPE	Std. Error	UAPE	Std. Error
Socio-economic factors						
Age	0.0117*	0.0038	4.7358*	0.0078	1.1497*	0.0112
Gender	0.0722**	0.0276	35.9694*	0.0798	0.1352	0.0947
Household size	0.0025	0.0073	0.3832*	0.0120	0.0054	0.0142
Years of education of household head	0.0091**	0.0037	4.0192*	0.0099	0.0200***	0.0120
Log of value of farm productive assets	0.0277	0.0206	-6.6991*	0.0433	-0.1110**	0.0489
Preference of receiving money (1*week or 1month*)	0.0060	0.0272	-15.5573*	0.0272	-0.1333*	0.0267
Institutional characteristics						
Distance to town	-0.0214*	0.0073	-10.6011*	0.0186	-0.0291	0.0235
System of tenure	0.3037*	0.1004	100.3309*	0.2581	1.5355*	0.2518
Attitude towards risk	0.0118	0.0091	-24.8042*	0.0421	-0.2227*	0.0406
Contacts with extension agents(*past three years*)	0.0080	0.0080	-1.5349*	0.0161	-0.0230*	0.0181
Farm characteristics						
Log of land price	-0.0171	0.0588	-2.5510*	0.1309	0.02683	0.1455
Perception on soil fertility	0.0852**	0.0359	-36.2251*	0.0929	-0.4866*	0.0848
Perception on slope of land	-0.0171	0.0226	-55.4708*	0.0967	-0.4068*	0.1027
Perception on future value of agricultural land	0.0210	0.1619	-36.6608*	0.9514	-0.3412	0.9671
Lend rented out *(0 = No, 1 = Yes)*	0.1200*	0.0381	51.9598*	0.0907	0.1554	0.1181
Observations =	384					
Wald Chi^2=	44.1900					
Prob> Chi^2 =	0.0001					

Note: ***, **, * Significant (p<0.01), (p<0.05) and (p<0.1) respectively. Standard errors have been calculated using the delta method.

APE: Average Partial Effect CAPE: Conditional Average Partial Effect

UAPE: Unconditional Average Partial Effect

According to findings of this study, more educated household heads were likely to convert agricultural land than the less educated heads. Formal education could have enhanced knowledge of alternative more profitable non-agricultural investment opportunities and positively influenced their capabilities to adopt new technologies. This finding is consistent with Jiang (2009) who reported that higher education level among farmers improves chances for new employment opportunities in non-agricultural sector and acquisition of better farming technologies. This increases their off-farm income as well as on-farm income from non-agricultural salary and efficient production technology. Education enhances personal skills and diversification which has a positive influence on income, farm income and investment opportunities (Liu *et al*., 2013).

Furthermore, the results divulge that as distance from the nearest town increases, the probability of converting agricultural land to non-agricultural purposes decreases. This is perhaps because increase in urban population around urban centers leads to increased demand for housing and other non-agricultural purposes such as recreation parks, industries, social amenities and shopping malls. Furthermore, land rents also increase as the distance from urban centers decreases there by positively influencing probability of land conversion. These findings corroborates studies by (Mertens (2000) and Haarsma (2014) who showed that increased demand for housing due to populations surge around city agglomerations are spatial drivers that positively influence probability of agricultural land conversion. Levia (1998) showed that distance from urban centers is among the core determinants of land rents. It follows that parcels near urban fringes are suitable for development and are the most valuable
.

Moreover, parcels with title deeds had a higher probability of being converted to non-agricultural purposes compared to parcels without title deeds. Perhaps farmers having parcels of land with title deeds can use land as collateral security to obtain loans from financial institutions. This can be used to facilitate agricultural land conversion and investment in non-agricultural enterprises. Land with clear legal title and well defined property rights is the most commonly accepted collateral for farm loans in developing countries (Feder, 2009). Fenske (2011) reported that in the absence of clear land titles or other forms of collateral, it is expected that there will be a decline in supply of credit thereby reducing access to finance for rural borrowers.

Agricultural land perceived to have high soil fertility had a lower probability of being converted to non-agricultural purposes compared to parcels with low soil fertility. The low soil fertility negatively affects agricultural yields and returns from selling agricultural produce. This could have influenced farmers to convert less fertile parcels of land to other non-agricultural uses which are more profitable and less prone to risks. According to Polsky and Easterling (2001), subject to soil fertility the choice of land use for a parcel of agricultural land will be allocated to the use that earns the highest profit or returns. Lubowski *et al*. (2006) reported that lands with low soil productivity are more vulnerable to erosion damage and other undesirable soil attributes, which makes them more likely to be converted to other more rewarding non-agricultural uses.

In terms of land rented out, farmers who had leased out land were more likely to convert agricultural land in contrast to those who had not rented out their land. Income from agricultural land rented out probably contributed positively to the farmer's income. This ground rent supplements farmer income and may facilitate acquisition of efficient advanced technology. This technology could further contribute positively to farm revenue by increasing agricultural output and hence sales from farm produce. This makes it possible to undertake other non-agricultural investments. This is in line with findings by Woldehanna *et al*. (2000) who reported that earnings from off-farm activities could augment smallholder commercialization if exploited as a liquidity source for farm investment, that will improve efficiency and accumulation of considerably attractive overflow revenue which may prompt an increase in household's demand for non-agricultural ventures

4.3.1 Unconditional Average Partial Effects (UAPE) of decision to convert on extent of agricultural land converted

This section presents the unconditional average Partial effects (UAPE) on extent of land conversion. The UAPE are the most significant deductions, as they permit explanations about the effect (if any) of a farmer having converted land on the extent of land converted taking into account both hurdles. UAPE gives the significant dominant effects of the independent variables. Results indicate that the expected quantity of agricultural land converted increases with age. A possible explanation is that farmers' mobility and other physical capabilities deteriorate as they get older. This could have negatively impacted their ability to perform physical and mental duties of managing a farm hence they may opt for a different economic activity. This explanation is in line with findings by Kimhi and Bollman (1999) who found

that farmers especially over a particular age (above 65 years or more) are highly likely to "exit" from agrarian cultivation. Similarly, Foltz (2004) in his study on dynamics underlying farmer decision to exit dairy production in Maine showed that farmers' age among other demographic characteristics positively impact the decision to exit agricultural and farming practices.

On average, an increase in the number of years of formal schooling of the household head increased the expected quantity of agricultural land converted to non-agricultural uses. Perhaps farmers with higher education level have a higher aggressive advantage in the off-farm labor domain and may probably acquire a variety of important skills necessary to thrive in non-farm or corporate environment. This corroborates findings by (Boehlje, (2004) and Mishra *et al*. (2010) who reported that level of education may positively enhance the earning capabilities of a farm operator in the non-agrarian realm, subsequently reducing the likelihood of farm survival especially if the farm operator decides to fully commit labor input outside the farm. Similarly Rizov (2005) found that, higher individual skills, talent and ability can be linked to better opportunities in the off-farm labor markets because it determines farming and in general, individual managerial skills.

With regards to productive agricultural assets, the more productive assets (value) a household has, the lower the expected amount of agricultural land converted. Maybe, the productive assets contributed positively to both on-farm income and non-farm income of the farmer which made it possible to acquire better farming technologies that improved production efficiency. This promotes farm growth and enhances farm productivity. This is in line with findings by Riethmuller (2003), Ellis and Freeman (2004) and Kristjanson *et al.* (2004) who reported that accumulation of land and other productive assets can boost incomes of rural household farmers, enhance further growth in the productivity and returns to assets which ensures the sustainability of profitable agriculture. Contrary to this, Dercon (2002) reported that constraint on accumulation of productive assets limits additional income and the ability of farmers to sustain profitable agriculture.

The possession of a title deed for a particular parcel of land increased the expected quantity of agricultural land converted to non-agricultural purposes. Perhaps parcels of land with title deeds can be used as security to obtain loans from financial institutions. This extra income can be used to facilitate agricultural land conversion and investment in non-agricultural

enterprises. This explanation is supported by Simbizi *et al.* (2011) who reported that freehold residency and formal title deeds have prompted several advantages that have boosted economic development, including improved access to and exploitation of formal credit secured by land mortgages. Abdulai (2006) reported that in the absence of clear land titles or other forms of collateral, it is expected that there will be a decline in supply of credit thereby reducing access to finance for rural borrowers.

Farmer attitudes towards risk played a key role in influencing the expected amount of land converted in that; risk taking farmers had a higher expected amount of agricultural land converted compared to risk-averse farmers. A possible explanation is that risk taking farmers tend to diversify their investments and may therefore reap handsome financial rewards from their investments. This boosts their financial capability enabling them to invest in other non-agricultural ventures. This is consistent with findings by Adebusuyi (2004) who showed risk averse smallholder farmers are less likely to embark on investments that have a higher expected return, but bear the possibility of failure or huge losses. As such, risk averse farmers may be unwilling to venture into non-farm activities which may be considered risky but have higher expected returns.

There was a significant decrease in the expected amount of agricultural land converted to non-agricultural purposes on parcels perceived to be very fertile compared to those perceived to have low soil fertility. This finding is not surprising as parcels with fertile soils are generally considered prime farmlands which produce highest yields with minimal inputs and economic resources. Cultivating such land results in least damage to the environment. This probably reduced their likelihood of being converted to non-agricultural purposes. This corroborates findings by Brazier (2007) who reported that prime farmlands possess a combination of physical characteristics considered optimal for crop production and is regarded by farmers as a high-value asset, least likely to be converted to other uses.

There was a decrease in expected amount of agricultural land converted to non-agricultural purposes on land perceived to have steep slope compared to land perceived to be flat. Topography determines the cost of construction. Steep land requires leveling before construction can commence. This involves use of expensive machinery which perhaps discourages development. This supports findings by Smitt *et al*. (2016) who reported that steeply sloped agricultural lands are unsuitable for urbanization and development. This is

because they require extensive stepping, leveling and fill operations. Furthermore, land in such areas might be dangerous to the working personnel which make them least likely to be converted to non-agricultural purposes.

4.4 Socio-economic characteristics, institutional factors and land attributes influencing prices of agricultural land

To identify the farmer socio-economic characteristics, institutional factors and land attributes that significantly affect prices of agricultural land Hedonic price analysis model was applied. Hedonic price model breaks down the price of an item into distinctive constituents that determine its cost (Sirmans *et al*., 2005). According to Ekeland *et al*. (2002), the observed market price of a differentiated product is a composite of the coefficients of its embedded characteristics but the characteristics of buyers and sellers are excluded. Nonetheless, several surveys have established that prices of goods are likewise interrelated to the attributes of sellers or buyers (Bett *et al*., 2011; Alemu *et al*., 2015; Pambo *et al*., 2015). This study therefore theorizes that farmer socio-economic and land attributes explain the variations in prices of agricultural land.

4.4.1 Socio-economic characteristics, institutional factors and land attributes of the household influencing land prices

Hedonic model results are presented in Table 9. Adjusted R^2 is used to determine the goodness of fit of the model while *p-value* indicates the significance of the model. According to the adjusted R^2, the independent variables explain 44.61% of the variance of the log of the price. The F test value was significant at 1% for the model implying that the independent variables as a set significantly affect the dependent variable. This shows that OLS regression model fits the data well and is therefore suitable for estimating the variables.

Results indicate that the household size negatively influenced agricultural land prices ($p<0.05$). This means that the larger the household size, agricultural land prices are significantly low and vice versa. This is probably because households with many family members primarily use land for cultivation to meet food requirements, rearing livestock and other family needs. This implies that the anticipated potential of converting agricultural land to non-agricultural use is low. The expectation of developing agricultural land for other lucrative and more rewarding non-farm activities begets an anticipation that is positively capitalized into prices of agricultural land. According to Plantinga and Miller (2001), high

probability of converting agricultural land to other non-agrarian purposes creates an anticipation that is often incorporated into the overall land price by the sellers. Similarly Shi *et al*. (1997) found that the anticipated higher rents from future development will be capitalized into the current price of agricultural land. They further observed that among the key determinants of increase in agricultural land prices, is the high likelihood of conversion to residential or commercial use.

In terms of distance to the nearest commercial town, there was a negative and significant effect on price of agricultural land ($p<0.01$). This implies that the price of land reduces as we move further away from commercial towns. This is probably because the likelihood of converting land to other uses such as residential housing, non-agricultural enterprise is high near urban areas. Such investments have high returns and less risky compared to agriculture. As demand for urban housing around urban towns' increases, the steady decline financial gains from agricultural production has forced farmers, who are at liberty to make land conversion decisions, to be inclined towards sale of agricultural land for non-farm purposes (Haider and Miller, 2000).

The distance to the nearest market has a significantly negative impact on the value of agricultural land ($p<0.01$). A possible explanation is that nearness to main markets makes it easy for farmers to purchase inputs as well as sell their output. This helps in saving time and reducing travelling costs. The time saved and reduced transportation cost adds up the cost of land.

Table 9: Regression results for determinants of agricultural land prices

Variables	Coefficients	Standard Error	*p-value*
Socio-economic factors			
Age	-0.0009	0.0015	0.5250
Household size	-0.0131**	0.0059	0.0250
Gender	-0.0148	0.0204	0.4680
Years of education of household head	0.0013	0.0029	0.6570
Participation in off-farm employment	-0.0022	0.0369	0.9530
Log of value of farm productive assets	-0.0033	0.0183	0.8570
Institutional characteristics			
Distance to town	-0.0160***	0.0049	0.0010
Distance to social amenity (schools, hospitals etc)	-0.0026*	0.0016	0.0990
Distance to market	-0.0075***	0.0019	0.0000
Group membership	-0.4604***	0.1675	0.0060
Attitude towards risk	0.0163**	0.0075	0.0300
Contacts with extension agents in the past three years	0.0140**	0.0066	0.0360
State of the road	-0.0212	0.0169	0.2110
Access to electricity	-0.0904	0.1598	0.5720
Log of amount of credit in the past three years	-0.0027	0.0037	0.4730
Land characteristics			
Perception on soil fertility	0.0728***	0.0247	0.0030
Perception on future value of agricultural land	0.2513	0.1635	0.1250
Perception on slope of land	0.0141	0.0189	0.4570
System of tenure	0.0518	0.0677	0.4450
Lend rented out *(0 = No, 1 = Yes)*	-0.0272	0.0214	0.2050
Initial size of land	-0.0045	0.0059	0.4430
Goodness-of-fit (Adjusted R^2) = 44.61%			
Prob> F = 0.0000			

***, **, * Significant (p<0.01), (p<0.05) and (p<0.1) respectively.

According to Anderson *et al*. (2006), public infrastructure which often determines market accessibility coupled with high demand for urban residential land around metropolitan areas have a positive impact on agricultural land prices. Nearness to urban centers can enhance the ease of access of inhabitants to market places and urban centers. This encourages business and employment opportunities in various parts of the metropolis as well as increasing cost of land parcels.

The distance to social amenities e.g. schools, financial institution etc is observed to have a negative influence on agricultural land prices in this study ($p<0.1$). A possible explanation could be the value of land is positively affected by proximity to facilities such as shopping areas, medical facilities, schools, financial institutions, playgrounds, police stations, and other basic human basic needs. This is especially important in cases of emergencies such as medical, fire, theft and other human requirements. Proximity to these amenities increases the value of land parcels by complementing the environmental quality and enhancing land use efficiency. Brasington (2005) showed that, parcels close to public schools, health facilities, and other man-made facilities have a high potential for land exploitation, variety of high quality resources and are valued at high prices.

Membership to an agricultural group is observed from the results to have negative influence on agricultural land prices ($p<0.01$). This implies that farmers in the same agricultural group are likely to sell land at a higher price to non-group members compared to group members. This could probably be due to the positive role played by social capital as a platform for sharing beneficial information, a tool for facilitating cohesion as well as promoting the likelihood of transaction between individuals with rich closely knit networks. Winder (2015) noted that if a buyer and a seller include socio-emotional goods in their transactions, the likelihood of them finding a mutually agreed price and exchanging increases. On the contrary, with exclusion of socio-emotional good, the same exchange may be relatively challenging. Robinson (2001) also show that social capital provides an incentive to share reliable information that will benefit ones social networks, aid trading partners to find agreeable terms and complete necessary documentation to establish evidence of agreement.

The results also show that attitude towards risk has positive influence on price of land ($p<0.05$). This implies that a risk-averse farmer will value or sell land at a lower price compared to risk-taker. This is probably because risk perception influences the investment

decisions and the profit earned. Risk taking farmers are likely to be more diverse in their investment ventures. As a result, they get higher profit margins and are able to purchase agricultural assets which are positively capitalized in agricultural land prices. This is in agreement with Riley *et al.* (1992) who showed that high risk taking individuals are more likely to invest in other non-agricultural enterprises compared to risk-averse individuals.

The number of contacts a family unit has had with agricultural extension agents has a positive impact on agricultural land prices. This implies that agricultural land prices are likely to increase as the number of contacts with agricultural extension officers increases. Probably this is because extension helps farmers identify appropriate technology suitable for their agro ecological and resource circumstances. These technologies offer low-cost means of raising productivity. This facilitates additional investment, higher returns and great profit margins which positively influence agricultural land prices. According to Anderson and Feder (2003), extension promotes access to scientific advancements designed to trounce the drawbacks brought about by conventional practices and technology, and hence improving productivity. Nonetheless, to understand their impending impact, the science-based technologies must be tailored to the local agricultural environment and socio-economic attributes of the areas of interest (Rivera *et al*., 2002).

The results further reveal that farmer perception on soil fertility positively affected the value of agricultural land ($p<0.01$). This implies that parcels perceived to have high soil fertility have a higher value compared to those perceived to have low soil fertility. Fertile land is often considered to be agricultural prime farmland which is characterized by high productivity and high agricultural returns with minimal input. Perhaps this makes it a valuable asset which is likely to attract higher prices in contrast to parcels considered to have low soil fertility. This is in line with observations by Clouser (2005) who reported that parcels considered to be prime agricultural farmlands with high agricultural returns are considered valuable assets and their land value is high. Similarly, Brasier (2005) reported that prime farmlands possess a combination of physical characteristics considered optimal for crop production and is regarded by farmers as a high-value asset likely to be sold at a high price.

CHAPTER FIVE
CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

Three conclusions emerge from the analyses of the three objectives:

i. The results indicate that more than half (57.60%) of respondents had converted agricultural land. Also, an average of 1.12 acres (*0.67% of initial agricultural land*) had been encroached and converted to non-agricultural purposes.

ii. Socio-economic characteristics, institutional factors and land attributes such as household age, gender, years of education, land tenure, contacts with extension services, tenure system and soil fertility are significant drivers influencing probability and rate of agricultural land conversion.

iii. Farmer socio-economic characteristics, institutional factors and land attributes such as; household size, distance to nearest town, membership to an agricultural group, contacts with extension services and soil fertility are significant in influencing the variations in market prices for agricultural land.

5.2 Recommendations

i. Protection of prime agricultural areas

Since conversion of agricultural land characterizes much of the current land use practices among small scale farmers, there is need to enforce policies that strictly protect agricultural prime lands and control conversion to non-agricultural purposes. This could be achieved through zoning of agricultural areas can be used to protect agricultural land by designating zones of prime agricultural land for exclusive farming purposes.

ii. Productive and sustainable land use

In light of socio-economic characteristics, institutional factors and land attributes being significant drivers of agricultural land conversion, there's need to for coherent policies that take into account farmer socio-economic and bio-physical attributes that could stimulate behavioural change towards agricultural land conversion. For instance, the government could utilize extension as a tool for educating farmers on financial, technological and other resources (seeds etc) tailored for farmers and how they can attain them. This could help farmers in crop selection, pest detection, soil health and utilize farmer loans and subsidies not being fully utilized. Also, allocation and issuance of title deeds should be done in accordance with approved physical plans and local area zoning regulations.

iii. Make agriculture more profitable

Taking into consideration the role of farmer socio-economic characteristics, institutional factors and land attributes in influencing different prices of agricultural land and their ultimate sale, the government should put in place policies to encourage farmers to retain their agricultural land. This can be achieved by augmenting financial returns from agriculture in a bid to improve its competitiveness against non-agrarian ventures. For example, local authorities can directly connect local farmer groups to viable markets thus eliminating exploitative middlemen. Furthermore, soil sampling campaign, evaluating soil production potentials and development of infrastructure can be pursued as strategies for improving agricultural profitability and productivity.

5.3 Areas of further research

This study was restricted to primary data gathered from the field in Njoro Sub-County. Similar studies can be carried in other Sub-Counties in Nakuru County and comparisons can be made for use in future development plans. Since this study was limited to interviewing farming community, future research could incorporate views from the business community who are mostly responsible for urban sprawl. Furthermore, variables like farmer income levels, employment status, agricultural enterprises and individual reasons of converting should be incorporated and analysed as drivers of agricultural land conversion.

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APPENDICES

Appendix 1: Farmer survey questionnaire

Dear sir/ madam,

HALLO, my name is _____ and I am part of a team from Egerton University, who are studying aspects to do with land conversion with emphasis on characteristics of current land use practices, factors influencing extent of land conversion and different agricultural land prices. Your participation in answering these questions is highly appreciated. Your responses will be **COMPLETELY CONFIDENTIAL** and used solely for research purposes. If you indicate your voluntary consent by participating in this interview, may we begin? If you have any questions or comments about this survey, you may contact survey supervisor through the following address: **Muleke Price Amanya Department of Agricultural Economics and Agribusiness Management, Egerton University, P.O. Box 536, Egerton.** Email address: priseam28@gmail.com

Ward: _____ Location: _____

Sub location: _____ Date: _____

1. Name of enumerator ……
2. Name of respondent (Mr. / Mrs. /Miss) ……

SECTION A: FARMER'S CHARACTERISTICS.

Please tick (√) the appropriate choice

1. What is the age in years of the household head? (**HHage**)…….
2. Gender of the household head: (**HHgen**) ……

   1=Male [ ] 0= Female [ ]
3. What is highest level of education of the household head? (**HHeduc**) ……..

   0=No formal schooling [ ] 1=Primary [ ] 2=secondary [ ] 3=College/University [ ]
4. How many years of schooling did the household attend? (Including university if applicable) (**Yrofsch**)……
5. What is the size of your household? (**Hsize**)……...
6. From the total size of the household, how many are involved in income generating activities? (**HszInc**) ……..
7. How long have you been practicing agriculture? (**Pagri**)……...
8. Are you involved in any other non-farm activities? (**Nonfrm**) …….

   1=Yes [ ] 0=No [

SECTION B: INSTITUTIONAL CHARACTERISTICS

1. What is the average distance (walking time in minutes) from your farm to the main market? (**Dmkt**) **.....**
2. What is the average distance in km from your farm to the major town (CBD)? (**Dtown**) …….
3. What is the distance (walking time in minutes) to the nearest social amenity? (**Damnty**)(E.g. school, market, hospital etc.) …….
4. Do you have access to agricultural extension services? (**Accext**) …….

   1=Yes [ ] 0= No [ ]
5. If YES, what is number of contacts you had with extension service provider in the past 1 year? (**Ncont**) ……...
6. Do you have access to credit? (**Accred**) ……

   1=Yes [ ] 0=No [ ]
7. If YES, what amount of credit did you get in the last three years? (In ksh) (**Amcred**) ……..
8. In the last 3 years, did you have any farm activities that require credit? (**Fmcred**) …… 1=Yes [ ] 0=No [ ]
9. If YES, did you apply? (**Apcred**) …….

   1=Yes [ ] 0=No [ ]
10. Was the money given enough to meet your farming needs? (**Flynd**) ……

    1=Yes [ ] 0=No [ ]
11. What is the security of tenure of the land you currently own? (**Stenr**) …….

    1= With title deed [ ] 2=Without title deed [ ]
12. What is the state of the roads in this area? (**Rdst**) ……

    0=Bad [ ] 1=Fair [ ] 2=Good [ ]
13. Do you have access to electricity? (**electrAcc**) ……..

    1=Yes [ ] 0=No [ ]
14. What is your source of agricultural information? *(consider possibility of multiple responses)* (**Agrinfo**) …….

1=Extension	[ ]	2=Researchers	[ ]
3=Internet	[ ]	4=Farmer to Farmer	[ ]
5=Radio	[ ]	6=Television	[ ]
7=Farm magazines	[ ]	8=Other (specify)	[ ]

    ……
15. Are you a member of any agricultural related group? (**Memgrp**) …….

    1=Yes [ ] 0=No [ ]

16. If YES, please fill in the details of the main group in which the main household head belongs.

Group name	Year started	Group activities	No. of scheduled Meetings per 6 month	No. of meetings attended per 6 month	No. of members in the household belonging to the group	No. of days household members claim they have worked for the group in one year	From a scale of 0-10 how would you rank your participation in decision making in the group	From a scale of 0-10 how would you rank the level of trust to the members of the group?

Group activities: ***(1****=Crop farming* ***2****. Livestock rearing* ***3****=mixed farming 4=Business* ***5****=Education****6****=Sanitation and safe drinking water program* ***7****= Other (specify) _____)*

Continuation;

Group name	Please describe the characteristics of members in each of the groups **(0=No, 1=Yes).** Enumerator: **Ask if the members of the groups have/from the same;**							
	Neighborhood	Occupation	Kin group	Economic status	Religion	Residence (rural/urban)	Age	Level of education

14. Please indicate the agricultural assets currently owned by the household and their current value. (**Agrval**)

Item	**Number**	**Average value per unit**	**Item**	**Number**	**Average value per unit**
Land			Farm store		
Jembe			Milk bucket		
Panga			Cows		
Spade			Goats		
Ox-plough			Sheep		
Harrow			Donkey		
Disc plough			Rabbit		
Rake			Pigs		
Harrow			Bicycle		
Hand sprayer pump			Vehicles		
Wheelbarrow			Combine harvester		
Seed planter			Tractor		
Watering Can			Motorbike		
Boom sprayer			Milking machine		
Water troughs			Trees (timber plantation)		
Feed troughs			Cattle plunge dip		
Sickle			Saw		
Green house			Fruit trees		
Sugar cane			Poultry		
Watering Pipes			Water Pumps		

SECTION C: FARM CHARACTERISTICS INFLUENCING THE EXTENT OF LAND CONVERSION

1. What motivated you to own land/ reside in this area? (**motlive**)
    1) Water supply [ ]
    2) Climate [ ]
    3) Security [ ]
    4) Social amenities [ ]
    5) Soil fertility [ ]
    6) Employment [ ]
    7) Quality of life [ ]
    8) Other (specify) [ ] ……
2. When did you acquire land? (**Wacql**) …….
3. What was the initial size of agricultural land when you first acquired it? (In acres) (**Siln**) …….
4. How did you acquire the land?(**Hacql**)
    1) Allocation [ ]
    2) Purchase [ ]
    3) Will [ ]
    4) Gift [ ]
    5) Succession [ ]
    6) Occupation [ ]
    7) Other (specify) [ ] …… ……
5. What is the size of agricultural land that you have sold out or converted to non-agricultural practices? (In acres)(**Sicl**) ……
6. When did you last (*the year*) convert land from agriculture to non-agricultural practices? (**Lstcn**) ……
7. What is the average price per acre of land in your area? (**Avprce**) …….
8. In the past one year, have you rented out any piece of land in this area? (**RntO**)

    1=Yes [ ] 0= No [ ]
9. If YES, what size of land have you rented out? (**Srnto**) ……..
10. In the past one year, have you rented in any piece of land in this area? (**RntI**)

    1=Yes [ ] 0= No [ ]

11. If YES, what size of land have you rented in? (**Srnti**) ……..

12. . Please fill the following table on attitude towards risk as indicated. **Attrsk**)

Guidelines;

i. *The participant can only choose once which gamble he wants to play from alternatives 1 – 5.*

ii. *Toss a coin with 50% probability of winning or losing.*

iii. *If the heads come up they will receive low pay off and if the heads come up they would receive highs payoff corresponding to their respective field of choice.*

iv. *Please fill in the table the appropriate choice that each participant has selected.*

***(1 – 2)** = [Risk Averse]; **(3)** = [Risk Neutral]; **(4 – 5)** = [Risk Taker]*

Alternatives	Heads (low payoff)	Tails (high payoff)	Choice
1	50,000	50,000	
2	40,000	100,000	
3	25,000	150,000	
4	15,000	170,000	
5	0	200,000	

13. This question is about your preference for receiving money in one week or in one month. Please remember that it is just a question. Would you prefer to receive in one week or would you prefer to receive in one month: (**Tmepfr**)

	Bid	Tick where switching occurs
1.	580 KSH in one week or 600 KSH in one month	
2.	560 KSH in one week or 600 KSH in one month	
3.	520 KSH in one week or 600 KSH in one month	
4.	480 KSH in one week or 600 KSH in one month	
5.	420 KSH in one week or 600 KSH in one month	
6.	340 KSH in one week or 600 KSH in one month	
7.	260 KSH in one week or 600 KSH in one month	

14. Farmer innovativeness. (**frinvt**)

		Response	**Indicate choice**
1	I am very curious about how things work.	1=Strongly disagree 2= Disagree 3= Neutral 4= agree 5= Strongly agree	
2	I like to experiment with new ways of doing things.	1=Strongly disagree 2= Disagree 3= Neutral 4= agree 5= Strongly agree	
3	I like to take chance with new technologies.	1=Strongly disagree 2= Disagree 3= Neutral 4= agree 5= Strongly agree	
4	I like to be around unconventional people who dare to try new things.	1=Strongly disagree 2= Disagree 3= Neutral 4= agree 5= Strongly agree	
5	I often seek out information about new agricultural technologies.	1=Strongly disagree 2= Disagree 3= Neutral 4= agree 5= Strongly agree	

SECTION D: PERCEPTION FACTORS INFLUENCING DIFFERENT AGRICULTURAL LAND PRICES

1. What is the condition of soil fertility in this area? (*main plot*) (**Sfrt**) ……

   0=Low fertility [ ] 1=fairly fertile [ ] 2=Very Fertile [ ]

2. What is your perception on the profitability of agriculture in your land? (**Agriprof**)

   1) Very low [ ]

   2) Fairly low [ ]

   3) Average [ ]

   4) Fairly high [ ]

   5) Very high [ ]

3. What is the general slope of land?(*main plot*) (**Slpln**)…….

   0=Flat [ ] 1= Gentle slope [ ] 2=Steep [ ]

4. What do you expect the future value of agricultural land to be? (**Fvgric**)…….

   0=Decrease [ ] 1=Constant [ ] 2=Increase [ ]

5. Progress out of poverty indicator (**Pgpvty**)

	Response	
How many members does your household have?	1= Nine or more 2= Seven or eight 3= Six 4= Five 5=Four 6= Three 7= One or two	
What is the highest school grade that the female head or spouse has completed?	1= None or pre-school, 2= Primary standards 1 to 6, 3= Primary standard 7, 4= Primary standard 8 or secondary forms 1 to 3, 5= No female head/spouse, 6= Secondary form 4 or higher	
What kind of work is the main occupation of the male head/ spouse?	1= Does not work 2= No male head/spouse 3= Agriculture, hunting, forestry, fishing, mining, or quarrying 4=Any other	
How many habitable rooms does this household occupy?	1= One 2= Two 3= Three 4= Four or more	
What material is the floor of the house made of?	1= Wood, earth or other 2= Cement or tiles	
What is the main fuel used for lighting?	1= Collected firewood, purchased firewood, grass, or dry cell (torch) 2= paraffin, candles, biogas, or other 3= Electricity, solar, or gas	
Does your household own any electric or charcoal irons?	Yes/No	
How many mosquito nets does your household own?	1= None 2=One 3= Two or more	
How many frying pans does your household own?	1= None 2=One 3= Two or more	

Appendix 2: Pair wise correlation Stata output

```
. pwcorr  HHgen Nonfrm Stenr Accext  Rdst  ElectrAcc Memgrp RntO  Attrsk Sfrt Agriprof Slpln Fvgric
```

	HHgen	Nonfrm	Stenr	Accext	Rdst	Electr~c	Memgrp
HHgen	1.0000						
Nonfrm	0.0341	1.0000					
Stenr	-0.1155	-0.0967	1.0000				
Accext	0.0678	0.1662	-0.1534	1.0000			
Rdst	-0.1010	0.1898	-0.0178	-0.0229	1.0000		
ElectrAcc	-0.0305	-0.0172	0.0064	-0.0064	0.0238	1.0000	
Memgrp	0.0305	0.0172	-0.0064	0.0064	-0.0238	0.0026	1.0000
RntO	0.0116	-0.1781	-0.0308	-0.0631	0.0294	-0.0828	-0.0316
Attrsk	0.1253	0.1308	0.0517	-0.0153	0.0712	0.0528	0.0357
Sfrt	-0.0096	-0.1624	0.0293	-0.1465	0.0611	0.0119	0.1307
Agriprof	0.0712	-0.0884	-0.0071	-0.1671	0.0298	0.0170	0.0678
Slpln	-0.0146	-0.0479	-0.0659	0.0185	-0.1063	-0.0309	-0.0844
Fvgric	-0.0305	-0.0172	0.0064	-0.0064	0.1229	-0.0026	0.0026

	RntO	Attrsk	Sfrt	Agriprof	Slpln	Fvgric
RntO	1.0000					
Attrsk	-0.1031	1.0000				
Sfrt	0.2465	-0.1395	1.0000			
Agriprof	0.2101	-0.0593	0.6940	1.0000		
Slpln	-0.0338	-0.0211	-0.1708	-0.1106	1.0000	
Fvgric	0.0316	0.0528	0.0119	-0.0678	0.0844	1.0000

Appendix 3: Variance inflation factor Stata output

```
. reg Sicl  HHage Hsize Yrofsch lnCredit Siln Ncont Damnty Dmkt Dtown  lnasset
```

Source	SS	df	MS		
Model	337.296234	10	33.7296234	Number of obs	= 384
Residual	5502.83728	373	14.752915	F(10, 373)	= 2.29
				Prob > F	= 0.0131
Total	5840.13352	383	15.2483904	R-squared	= 0.0578
				Adj R-squared	= 0.0325
				Root MSE	= 3.841

Sicl	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
HHage	.0752122	.0348693	2.16	0.032	.0066471	.1437773
Hsize	-.0054065	.1378116	-0.04	0.969	-.2763916	.2655787
Yrofsch	.0730918	.0653616	1.12	0.264	-.0554316	.2016152
lnCredit	-.0118483	.0817497	-0.14	0.885	-.1725963	.1488998
Siln	.2530292	.1420627	1.78	0.076	-.026315	.5323734
Ncont	-.0669218	.156773	-0.43	0.670	-.3751914	.2413479
Damnty	-.0292436	.0376907	-0.78	0.438	-.1033564	.0448693
Dmkt	-.0044298	.0448445	-0.10	0.921	-.0926094	.0837499
Dtown	.0102963	.1167746	0.09	0.930	-.2193227	.2399153
lnasset	.3455661	.4236513	0.82	0.415	-.4874782	1.17861
_cons	-9.894257	6.949654	-1.42	0.155	-23.55967	3.771156

```
. estat vif
```

Variable	VIF	1/VIF
Dmkt	2.74	0.365258
Hsize	2.45	0.408638
Siln	2.11	0.473946
Yrofsch	2.01	0.496775
lnCredit	1.99	0.501527
Damnty	1.95	0.513894
HHage	1.91	0.522352
Dtown	1.58	0.632267
lnasset	1.47	0.682409
Ncont	1.17	0.854467
Mean VIF	1.94	

Appendix 4: Craggit estimator Stata output

```
. craggit convert HHage HHgen Yrofsch Hsize Dtown Ncont RntO Attrsk Sfrt  Stenr  Slpln  Fvgric Tmepr  lnasset lnPric
> e, second ( Conversion HHage HHgen Yrofsch Hsize Dtown Ncont RntO Attrsk Sfrt  Stenr  Slpln  Fvgric Tmepr  lnasset
>  lnPrice) iterate(316)

Estimating Cragg's tobit alternative
Assumes conditional independence

initial:       log likelihood =     -<inf>  (could not be evaluated)
feasible:      log likelihood = -3082.8517
rescale:       log likelihood = -1011.6932
rescale eq:    log likelihood = -530.88227
Iteration 0:   log likelihood = -530.88227  (not concave)
Iteration 1:   log likelihood = -437.86522  (not concave)
Iteration 2:   log likelihood = -395.46103  (not concave)
Iteration 3:   log likelihood = -365.51614  (not concave)
Iteration 4:   log likelihood = -348.47718  (not concave)
Iteration 5:   log likelihood = -338.44113  (not concave)
Iteration 6:   log likelihood = -329.98112  (not concave)
Iteration 7:   log likelihood = -322.65138  (not concave)
Iteration 8:   log likelihood = -317.60813  (not concave)
Iteration 9:   log likelihood = -314.09921  (not concave)
```

Appendix 5: Craggit estimator Stata output (*continued*)

```
                                                Number of obs   =        384
                                                Wald chi2(15)   =      44.19
Log likelihood = -269.99197                     Prob > chi2     =     0.0001
```

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
Tier1						
HHage	.0450896	.0144895	3.11	0.002	.0166907	.0734886
HHgen	.2780554	.1794526	1.55	0.121	-.0736653	.629776
Yrofsch	.0349369	.0251008	1.39	0.164	-.0142598	.0841336
Hsize	.0096741	.0582456	0.17	0.868	-.1044852	.1238334
Dtown	-.0824061	.0444783	-1.85	0.064	-.1695819	.0047697
Ncont	.0307263	.06207	0.50	0.621	-.0909287	.1523812
RntO	.4623075	.2188039	2.11	0.035	.0334597	.8911553
Attrsk	.0455354	.0694055	0.66	0.512	-.0904969	.1815678
Sfrt	.3281162	.2442071	1.34	0.179	-.1505209	.8067532
Stenr	-1.169849	.5956106	-1.96	0.050	-2.337225	-.0024742
Slpln	-.066045	.177756	-0.37	0.710	-.4144404	.2823504
Fvgric	.0809237	1.294117	0.06	0.950	-2.455499	2.617346
Tmepr	.0230153	.047979	0.48	0.631	-.0710218	.1170525
lnasset	.1065342	.1577397	0.68	0.499	-.2026299	.4156983
lnPrice	-.0657994	.468904	-0.14	0.888	-.9848343	.8532355
_cons	-.6318471	8.139974	-0.08	0.938	-16.5859	15.32221
Tier2						
HHage	4.732988	2.196562	2.15	0.031	.4278058	9.03817
HHgen	36.93409	33.8757	1.09	0.276	-29.46106	103.3292
Yrofsch	5.00512	3.679961	1.36	0.174	-2.207471	12.21771
Hsize	1.369976	6.553552	0.21	0.834	-11.47475	14.2147
Dtown	-9.611785	6.740441	-1.43	0.154	-22.82281	3.599236
Ncont	-.5480392	8.889663	-0.06	0.951	-17.97146	16.87538
RntO	52.93635	30.49343	1.74	0.083	-6.829687	112.7024
Attrsk	-23.8132	13.9699	-1.70	0.088	-51.1937	3.567307
Sfrt	-35.2332	39.93762	-0.88	0.378	-113.5095	43.0431
Stenr	101.2745	131.3132	0.77	0.441	-156.0946	358.6435
Slpln	-54.47463	31.33088	-1.74	0.082	-115.882	6.932764
Fvgric	-35.66481	530.1568	-0.07	0.946	-1074.753	1003.423
Tmepr	-14.56829	9.261814	-1.57	0.116	-32.72111	3.584532
lnasset	-5.710264	24.37689	-0.23	0.815	-53.4881	42.06757
lnPrice	-1.564265	71.57567	-0.02	0.983	-141.85	138.7215
_cons	-75.32962	.	.	.	.	.
sigma						
_cons	9.604523	2.220748	4.32	0.000	5.251937	13.95711

Appendix 6: Hedonic price model Stata output for determinants of agricultural land price

```
. reg  lnPrice HHage HHgen Hsize Yrofsch  Nonfrm lnasset  Dtown Damnty Dmkt Memgrp Attrsk Ncont Rdst ElectrAcc lnCre
> dit Sfrt Fvgric Slpln Stenr RntO Siln
```

Source	SS	df	MS		
Model	8.11855591	21	.386597901	Number of obs =	384
Residual	8.92125929	362	.024644363	F(21, 362) =	15.69
				Prob > F =	0.0000
Total	17.0398152	383	.044490379	R-squared =	0.4764
				Adj R-squared =	0.4461
				Root MSE =	.15699

lnPrice	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
HHage	-.0009433	.0014822	-0.64	0.525	-.0038582	.0019716
HHgen	-.0148165	.0203891	-0.73	0.468	-.0549125	.0252794
Hsize	-.0131329	.0058541	-2.24	0.025	-.0246451	-.0016206
Yrofsch	.0012709	.0028627	0.44	0.657	-.0043587	.0069006
Nonfrm	-.0021727	.0368995	-0.06	0.953	-.0747369	.0703915
lnasset	-.003306	.0182993	-0.18	0.857	-.0392922	.0326802
Dtown	-.0159821	.0048498	-3.30	0.001	-.0255194	-.0064449
Damnty	-.0026231	.0015842	-1.66	0.099	-.0057384	.0004922
Dmkt	-.0074603	.001909	-3.91	0.000	-.0112144	-.0037063
Memgrp	-.4604352	.1675063	-2.75	0.006	-.7898429	-.1310275
Attrsk	.0162902	.0074774	2.18	0.030	.0015856	.0309949
Ncont	.0139966	.0066361	2.11	0.036	.0009466	.0270467
Rdst	-.0211888	.0169174	-1.25	0.211	-.0544575	.0120798
ElectrAcc	-.0904397	.1597676	-0.57	0.572	-.4046289	.2237496
lnCredit	-.0026504	.0036931	-0.72	0.473	-.009913	.0046123
Sfrt	-.0727528	.0247196	-2.94	0.003	-.1213649	-.0241408
Fvgric	.2512823	.1634587	1.54	0.125	-.0701655	.5727301
Slpln	.0141023	.0189265	0.75	0.457	-.0231173	.051322
Stenr	.0517864	.0676778	0.77	0.445	-.0813047	.1848774
RntO	-.0272349	.0214403	-1.27	0.205	-.0693982	.0149283
Siln	-.0045495	.005923	-0.77	0.443	-.0161973	.0070984
_cons	15.37054	.4707726	32.65	0.000	14.44475	16.29633

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