Journal of Economics and Sustainable Development
ISSN 2222-1700 (Paper) ISSN 2222-2855 (Online)
Vol.9, No.20, 2018

Land Use Change and Determinants of Agricultural Land Conversion Due to Urbanization: Case of Smallholder Farmers in Njoro Sub-County, Kenya

Price Amanya Muleke* Oscar I. Ayuya Benjamin K. Mutai
Department of Agricultural Economics and Agri-Business Management, Egerton University, P O Box 536-20115, Egerton, Kenya

Abstract
Urbanization process stands out amongst the most imperative drivers of financial, physical and societal change. However, the drivers of agricultural land conversion due to urbanization in Africa specifically, Njoro Sub-County in Kenya are still not clear. This paper looks at the factors impacting decision to convert land used for agricultural purposes and the degree of conversion to non-agricultural purposes. Data for this study was collected from 384 randomly selected smallholder farmers, by the use of semi-structured questionnaires and key witness interviews. The study employed Craggit (Double-Hurdle Model) to examine the drivers of conversion and analyze the amount of land converted. The results from the study show that decision to convert and extent of land conversion were influenced by; age, gender, education, productive farm assets, distance to town, tenure system, risk attitude, soil fertility and land rented out. The study concluded that despite the threat urbanization has on food security, much of peri-urban agricultural land is still being converted to non-agrarian purposes. This study recommends coherent policies that take into account farmer socio-economic and bio-physical characteristics that could stimulate behavioral change towards land conversion. This could be complemented by adopting strategies that align all shareholders from different segments of the economy, provide secure rights to land and incentivize solutions for sustainable agriculture by making agribusiness more competitive.
Keywords: Drivers, urbanization, agricultural land conversion, smallholder, Craggit model

1. Introduction

Urbanization is emphasized as being one of the most imperative drivers of change in the third world countries, particularly those in Africa (Thou, 2013). In this context, urbanization can generally be described as an increased residential population, and growth of non-farm businesses, which transforms an area from a predominantly rural agricultural area to a largely urban non-agricultural area (Li *et al.*, 2013). As the case in different parts of the emerging economies, the urban masses in Africa are projected to twofold in by 2025 (Hall, 2010). As population rises, it depicts a growing demand for land especially for residential housing and other urban uses (Thou, 2013), thus bringing a change in pattern of land use in a particular region.

Aguilar and Ward (2003) pointed out that in various developing countries; growing demand for land is influencing peri-urban surroundings where increased non-agricultural activities are infringing into agricultural land and nearby villages. Urbanization of these peri-urban areas has accrued benefits such as: employment opportunities, improved housing facilities, better social amenities, technological transfer, and provides readily available market for agricultural produce. However, a swell in population strains the limited raw materials, transport and communication network, and shared amenities (Rees, 1992). Urbanization also negatively affects food security in the sense that as population increases; the urban sprawl expands into the surrounding agricultural land. This impinges on food production by crowding out agricultural land thus reducing the capability peri-urban agricultural areas to cater for the rising food demand.

Matuschkle, (2009) observed that urbanization could be a threat to food security due to the urban encroachment on prime agricultural land. An immediate consequence of urban sprawl is change of rural agrarian land to private non-agricultural uses, business premises and modern uses prompting swarming out of peri-urban agriculture. This undermines the sustenance of peri-urban agriculture which is primarily tasked with the responsibility of meeting consumption demands of urbanized regions. As urban communities expand and towns keep growing, more and more food nourishment will be required. This exerts extra strain on the rustic framework, transportation network, equipment and food nourishment which are by now wanting further imperiling sustenance supply (FAO, 2008). Furthermore, increased non-agricultural activities have increased pressure on peri-urban agriculturalists making it even more expensive and hard to practice conventional farming. A Surge in residential population and non-agricultural development activities has therefore compromised the functional capacity of agriculture as a producer of food.

In Kenya, agricultural sector plays an essential role of sustaining the livelihood of individuals and the country at large. The importance of agriculture is further emphasized through the concept of food security as it's still the principal segment charged with the responsibility of bolstering a substantial proportion of the populace (Government of Kenya, 2013). Endeavors to achieve food security must depend on local assets that incorporate

diversification and intensive utilization of available agricultural land to avoid dependence on the supply from abroad. However, in many regions in Kenya, the agricultural sector is facing challenges such as urbanization due to rapid growth of population. This causes change in land use patterns as agricultural land is converted to non agricultural activities which are deemed to be more rewarding and not seasonal in their profitability (Thou, 2013).

In Njoro-Sub-County, population has been progressively increasing over the years bringing with it a progressive change from a traditional rural agricultural area into a more urbanized region. As this trend continues, the once productive land is being converted to non-farm practices which may lead to food insecurity especially among small scale farmers. A plethora of literature exists on urbanization and its implication on peri-urban agriculture (Regmi, 2001; Pretty, 2008; Lu *et al*., 2011; Su *et al*., 2011). However, the socio-economic characteristics, farmer biophysical and land attributes that affect the decision to convert and amount of land converted in Njoro Sub-County have not been clear in empirical literature. Furthermore, previous studies on land conversion have used Tobit estimator. However, the Tobit estimator is limiting as it presupposes 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. It is therefore on this basis that this study is geared towards filling this knowledge gap. The objective of the study is to determine the socio-economic and institutional variables affecting decision and the degree of agricultural land conversion.

This paper contributes to the body of knowledge on urbanization and its implications on peri-urban farming and food security. Descriptive statistics are used to characterize the present land utilization patterns for general comparisons based on those who have and have not converted agricultural land. The Double Hurdle model is then used to determine the impact of socio-economic, land attributes and institutional characteristics on decision to convert land and scale of conversion. Farmer biophysical attributes, socio-economic and land characteristics play an important role in deciding land use practices (Defrancesco, 2008).

This study seeks to provide empirical evidence on the drivers of agricultural land conversion. This paper further adds to literature on how perceived land attributes and individual characteristics influence land use decisions. Findings from this study could be important in informing policy formulation and implementation on sustainable conversion of land used for farming purposes amidst growing urbanization in a bid to preserve agricultural land, enhance sustainable food security as well as improve farmer livelihoods.

Subsequent stages of the paper are structured as follow: the next segment provides a concise description of the methodology which entails an overview of the area of study, research design, sampling process and data management. This is followed by section three which covers the analytical framework of Double Hurdle (Craggit) model to identify factors that significantly influence the decision to convert agricultural land and the amount converted. Section four discusses the estimation results. Finally, section five summarizes the key findings of the study and outlines policy implications.

2. Methodology

2.1 Study area

The study was carried out in Njoro Sub-County, one among eleven Sub-Counties in Nakuru County. Njoro Sub-County was purposively selected because it has been experiencing high threat to overall 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). Therefore using an exploratory research design, the study area will provide insights into strategies that seek to balance the pressure between urban sprawl, preservation of agricultural land and sustainable land conversion while improving livelihood of smallholder farmers. As per 2009 national census, the population projection of Njoro sub-county for 2017 was 221,981 (Kenya National Bureau of Statistics, 2009). This depicts a seventy five per cent increase from the population of 167,778 in 1984. This signifies a steady growth rate of a 3.5 per cent. Consequently, this has exerted pressure on limited land resource. A blend of inadequate arable land, steady population growth and unsustainable agrarian practices has significantly contributed to environmental compromise. Njoro Sub-County covers an area of 702.0 Square Kilometers and is situated between longitudes 35° 28' and 35° 36' East and latitudes 0’ 12” and 1’ 10” South (NCAPD, 2005). It has an annual temperature range of 11°C - 24.5°C (Ogeto *et al.*, 2013). The area receives rainfall of between 950mm and 1500mm per annum, with a bimodal rain pattern. The residents of Njoro Sub-County are mainly subsistence farmers, small traders and civil servants (Kinuthia *et al.*, 2012). Main farm resources include crops, trees and livestock with majority of their livestock being dairy cows, dairy goats, sheep and poultry (Jaetzold and Schmidt, 2010).

2.2 Research Design, Sampling and Data Management

The study employed a social survey technique to gather both subjective and quantitative data. Approach was adopted as it allows economical gathering of a representative sample which gives a good characteristic of the population, enabled collection of relevant cross sectional data and facilitates insightful comprehension of a particular topic of interest (Frankel and Wallen, 2000).

Primary data was obtained through participant observations and face-to-face household survey. Secondary data was sought through review of literature particularly past survey reports and maps showing urbanization trends and land utilization while the specific patterns of land use in the area of study were first identified via casual research, followed by an actual survey. Multistage sampling procedure was used where Njoro Sub-County was purposively selected as it is among the Sub-Counties in Nakuru County, experiencing highest threat to overall ecological integrity due to the rapid conversion of the agricultural lands as informed by exploratory studies and salient reports. Njoro Sub-County was then stratified into 6 wards. Three of the six County assembly wards were selected randomly. Based on information from the agricultural Ministry and Ministry of Lands, one Sub-Location was purposively selected from each ward. Then, 128 respondents were selected from each sub-location proportionate to size using simple random sampling method.

Prior to the actual survey, a pilot assessment of Njoro Sub-County was undertaken where the interview and observation guides were pre-tested to determine their understanding the topic of study. The questionnaires were edited accordingly including language, length and coverage of issues of study in a bid to boost confidence and accuracy of the research findings. The data sought throughout the pilot survey comprised of land use practices, factors influence agricultural land conversion, the extent of agricultural land conversion, and ways of improving farmer livelihoods and achieving food security.

The survey was guided by semi-structured questionnaires administered to 384 smallholder farmers with the assistance of enumerators who were charily selected and trained to equip them with in-depth understanding of topic and empower them with necessary skills to accomplish the study objectives. The information gathered included individual qualities, spatial properties, family unit characteristics socio-economic, institutional factors and land traits impacting agricultural land conversion. The exploration instrument was first pre-tried to assess its proficiency and was corrected according to the recommendations. Households who took part in the reconnaissance study were not included in the actual study. The coded information was managed using statistics and data (Stata Corp 2011) computer program.

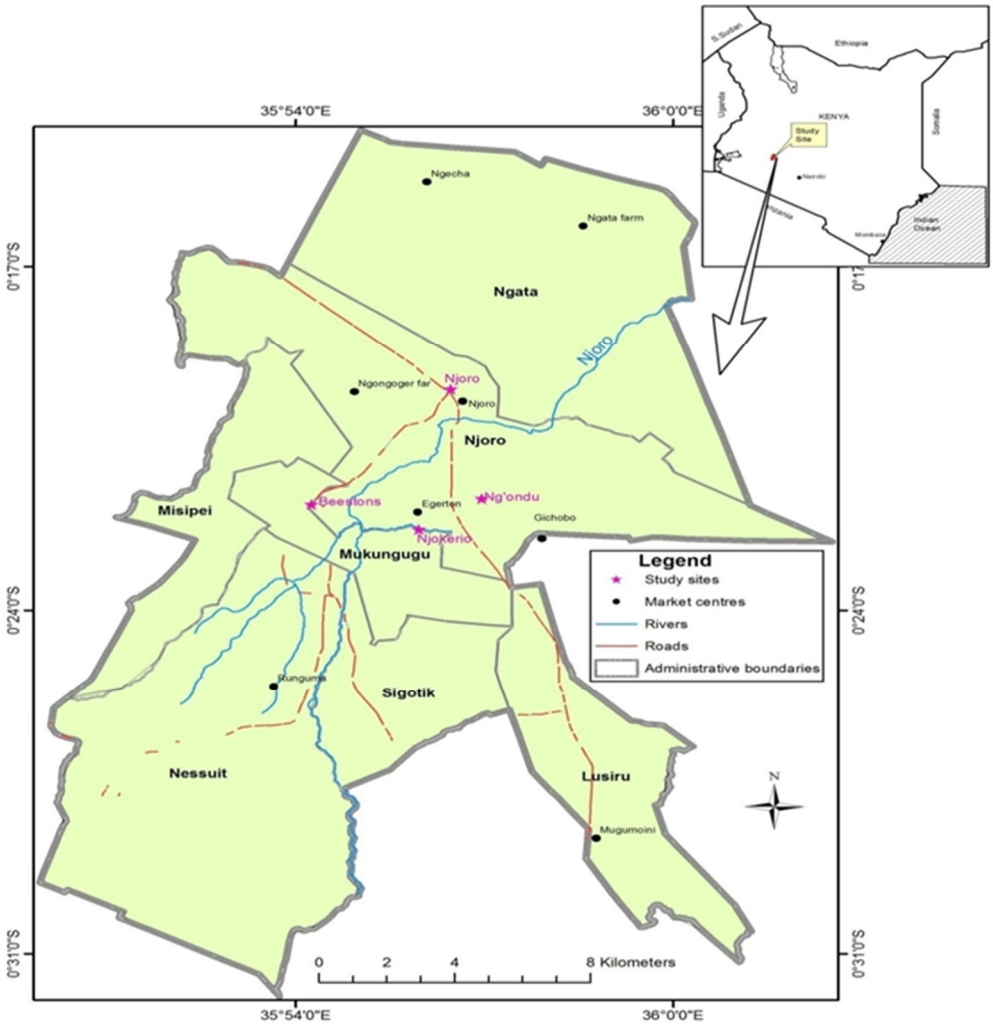

Figure 1: Location of study site in Nakuru County, Kenya.

3. Analytical Framework

3.1 Modeling the factors influencing the decision to convert agricultural land and amount of land converted

Data from the household survey was then analyzed using Craggit model to establish the socio-economic and institutional aspects that significantly influence the decision to convert agricultural land and amount converted. The degree of conversion can be modeled as a two-tier decision involving first, choice of whether or not to convert land, followed by decision on the amount of land to covert. The decision to convert is a discrete choice, expressed as:

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

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

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

Where Y_i^* is a latent variable for Y_i which denotes the amount of agricultural land converted by a household i. x_i and z_i 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.

The Tobit estimator is a common approach to corner solution models. 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 model that takes into account the prospect that the two hurdles (decisions) are dictated separately (Cragg, 1971). After the specification in equations (1) and (2), and with the assumption of independent error terms, the Craggit probability equation is therefore denoted follows (Jones, 1989):

$$L(Y_i|X_i,\theta) = \{\prod_{Y=0}[1 - \Phi(X_i\alpha|\sigma_u)]\Phi(Z_i\beta|\sigma_v)\} \times \left\{\prod_{y>0} \Phi(X_i\alpha|\sigma_u)\, \Phi(Z_i\beta|\sigma_v)\right\} \times \left\{\frac{\phi[Y_i - Z_i\beta/\sigma_v]}{\sigma_v \Phi(Z_i\beta|\sigma_v)}\right\} \tag{3}$$

Where ϕ and Φ denote the probability density and cumulative distribution equations, respectively. σ_v and $\sigma_u$represents standard deviations of U_i and V_i respectively. Equation (3) 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's possible to determine the expected effects individual explanatory variables on decision to convert and amount of conversion.

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

$$P(d_i^* > 0|X_i) = \Phi(X_i\alpha) \tag{4}$$

The conditional expected amount of land converted was estimated as:

$$E(Y_i|Y_i > 0, Z_i) = Z_i\beta + \sigma \times \lambda(Z_i\beta|\sigma) \tag{5}$$

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

$$E(Y_i|X_i, Z_i) = \Phi(X_i\alpha)[Z_i\beta + \sigma \times \lambda(Z_i\beta|\sigma)] \tag{6}$$

The term $\lambda(Z_i\beta|\sigma)$ in the functions (5) and (6) is the inverse Mills ratio expressed as:

$$\lambda(Z_i\beta|\sigma) = \phi(Z_i\beta|\sigma) / \Phi(Z_i\beta|\sigma) \tag{7}$$

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 is 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 (UAE).

Table A.1: Description of socio-economic and institutional variables used in the model

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 household head	Number of years	+
Productive agricultural assets	Value of farm productive assets	Kenya shillings	+
Institutional characteristics			
Location characteristics	Distance to town	Number of kilometers	+
System of tenure	Tenure system of the land	0 = Without tenure 1 = With tenure	+
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	+/-
Farm characteristics			
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	+

4. Empirical Results and Discussion

4.1 Descriptive statistics

The descriptive and summary statistics for smallholder farmers are presented in tables 1 and table 2. The selected sample comprised smallholder farmers in Njoro Sub-county. The results indicate that 57.6% of the respondents had converted agricultural land while 42.4% had not converted land. The results show that those who had converted land had a lower mean age compared to those who had not. Farmers who had converted land had a relatively larger household size compared to those who had not. Also, higher land conversion among households owning high profitable agrarian assets contrasted with those with relatively lower value of productive assets. In general, high proportion of land conversion occurred among male headed households compared to female headed households. On average, conversion was high among households with title deeds converted land compared to those without. With regards to land rented out, out, a high proportion of households who had not converted land leased out land compared to those who those had not leased out land. 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. The results also reveal that majority of smallholder farmers (70.94%) perceive agricultural profitability as average. As such, a high proportion (54.43%) of farmers who perceive agriculture as average had converted land whereas (16.51%) had not.

Table 1: Mean for household characteristics (continuous variables)

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 at 1% level

Table 2: Mean for household and farm characteristics (categorical variables)

Variables	Description	Not converted (%)	Converted land (%)	*Chi* Square
Gender of household head	Female	9.38	16.92	13.8388***
	Male	33.02	40.68	
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 at 1% and 10% level, respectively

4.2 Factors influencing the decision and amount of agricultural land converted

4.2.1 Preliminary diagnostics of the variables used in the Craggit model.

Multicollinearlity is the presence of a linear association between the independent variables (Wooldride, 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, 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 (Wooldrigde, 2015). In an event that the VIF values exceed 10, it can be concluded that the regression coefficients are ineffectively estimated due to collinearity.

Craggit model was employed to evaluate the socio-economic and institutional attributes that significantly influence the decision to convert agricultural land and amount converted in Njoro Sub-County. The first hurdle is a discrete choice in this case decision to convert and the second is a truncated regression that is quantity of agricultural land converted.

The maximum likelihood estimate is revealed to have a chi squared significance of 1%, indicating the model is appropriate for the variables and data. The results of the average partial effects of the independent variable are presented in table 3 on three separate 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 (UAE).

Results indicate that as the household head becomes older, 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 Bollman and Kihmi (1999) that showed that farmers over a particular age will probably "exit" from agricultural farming practices as they age on. Similarly, Katchove and Ahearn (2017) 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 residencies have a tendency to be vested in men, either legitimately or by cultural norms and social standards. Land reform and resettlement 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 (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.

The results also reveal that 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 acquire 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, 2013).

The results further indicate 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 tend to increase with proximity to urban centers thereby positively influencing probability of land conversion. These findings corroborates studies by (Mertens and Lambin, 2000; Westervelt *et al*., 2011) who showed that increased demand for housing due to populations surge around city agglomerations are spatial drivers that positively influence the probability of converting land. 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.

Table 3: Average partial effects for DH model on extent of land conversion

Variable	APE	Std. Error	CAPE	Std. Error	UAE	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	-1.53487*	0.0161	-0.0230	0.0181
Farm characteristics						
Log of land price	-0.0171	0.0588	-2.55104*	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 at 1%, 5% and 10% respectively. Standard errors have been calculated using the delta method.

The results also indicate that 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 conversion of agricultural land 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 the developing countries (Feder *et al*., 2009). Contrary to this, Fenske (2011) reported without clear land titles or different types of insurance, it's expected that that there will be a decline in supply of credit consequently lessening 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 pieces of agricultural land with low fertility to other non-agricultural uses which are more profitable and less prone to risks. According to Polsky and Eaterling (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. Contrary to this Lubowski (2006) reported that lands with low soil productivity are more vulnerable to erosion damage and other undesirable soil attributes, which increases their likelihood of being 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 (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 Unconditional Average Effects (UAE) of decision to convert on extent of agricultural land converted

This section presents the unconditional average effects (UAE) on extent of land conversion. The UAE 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. UAE gives the significant dominant effects of the independent variables.

Results indicate that, older household heads are likely to convert larger proportions of land compared to younger household heads. 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 65years or more) are highly likely to "exit" from agrarian cultivating). 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 amount of agricultural land converted to non-agricultural uses. Perhaps farmers with higher education level have a higher aggressive advantage in the off-farm labour domain and may probably acquire a variety of important skills necessary to thrive in non-farm or corporate environment. This corroborates findings by (Weiss, 1999; Boehlje, 2004) 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 labour markets because it determines farming and in general, individual managerial skills.

The results also indicate that on average, 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; 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 results also reveal that having title deed for a particular parcel of land increased the expected amount of farming land converted. Perhaps parcels of parcels 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 De Soto (2000) 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. Contrary to that, 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.

The results further indicate that risk taking farmers have 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 that 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.

The results also show that there was a significant decrease in the expected amount of agrarian land converted to other non-farm uses 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 (Brasier, 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 agricultural land converted to non agricultural activities on land perceived to have steep slope compared to land perceived to be flat. Topography determines the cost of construction. Steep land requires levelling before construction can commence. This involves use of expensive machinery which perhaps discourages development. This supports findings by Smitt and Jagger (2007) who reported that steeply sloped agricultural lands are unsuitable for urbanization and development. This is because they require extensive stepping, levelling 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.

5. Conclusion and Policy Implications

The study aimed to scrutinize factors influencing the decision to convert agricultural land and the amount of agricultural land converted. The results revealed that there is relatively high agricultural land conversion among younger farmers and households with larger family size. Gender and security of tenure had a significantly positive effect on land conversion. Generally, the results show that much of agricultural land is being encroached and converted to non-agricultural purposes with 57.6% of the farmers having converted land. Such information is important as it justifies an urgent need for policy interventions to ensure controlled and sustainable land conversion in a bid to preserve agricultural land.

The results from Craggit model reveal that the decision to convert agricultural land to non agricultural purposes and the extent of agricultural land converted is influenced by socio-economic factors, institutional and farm characteristics. The results further show that decision to convert land and extent of conversion was positively influenced by risk attitude, contacts with extension agents and soil fertility. Since smallholder farmers are the agents involved in various land use practices, their attitudes towards agricultural land conversion key determinant of the sustainable land conversion, food security and improved livelihoods.

There is need for policies (incentives) that could encourage smallholder farmers to retain their agricultural land, improve and preserve soil fertility, and reduce conversion to other uses. This could be done by establishing good markets for agricultural produce, provision of farm implements at subsidized prices, and agricultural extension services, in order to make agricultural land use more profitable and competitive.

There's need for the establishment of a National Spatial Plan (NSP) to influence the future distribution of land use activities and regulate conversion of agricultural land to other purposes. This could be achieved through strict implementation of comprehensive land use and spatial planning plans. In addition there's need for commitment at all government levels, maintain inter-governmental coordination, a devolved financial mechanism and public support from various stakeholders in order to control agricultural land conversion.

To ensure sustainable agricultural land conversion, public awareness, sensitization and participation by all stakeholders is a must. Civic education and awareness on sustainable agricultural land conversion targeting farmers/land owners is important in an attempt to influence their attitude and behavioural change towards land conversion. Proper and effective means of notifying local residents on agricultural land conversion should be devised as part of agricultural extension services. They should be educated on negative impacts and how to positively contribute towards sustainable development and improved agricultural performance.

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 from urban sprawl.

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