ANALYSIS OF THE MARKETING BEHAVIOUR OF AFRICAN INDIGENOUS LEAFY VEGETABLES AMONG SMALLHOLDER FARMERS IN NYAMIRA COUNTY, KENYA

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DECLARATION AND RECOMMENDATION

Declaration

This thesis is my original work and has not been presented for an award of a degree, diploma or certificate in Egerton University or any other University.

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Recommendation

This work has been prepared under our supervision and has our approval as University supervisors to be submitted to the Graduate School for examination as per Egerton University regulation.

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DEDICATION

To my mother, Anne Kwamboka, who has always imparted in me the inherent price of education and never once gave up on me. I am humbled by your unwavering strength, glowing patience and undying belief in me and all my siblings.

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May God abundantly bless you all.

ABSTRACT

The African Indigenous Leafy Vegetables (AILV) agricultural sub-sector in Kenya has in recent times gained considerable prominence and attention. A diverse number of studies have underpinned the role it can play in improving the economic standing of smallholders, while playing an imperative nutritional role in the diets of many consumers. Stemming from increased awareness on the rise of various lifestyle illnesses and crusaders championing for healthy eating habits, the demand of AILV, as healthier dietary alternatives, has been gradually on the rise. However, the socioeconomic and institutional factors that influence market participation and the effect of choice of market packages on AILV income are still not clear. Therefore, the main objectives of the study were: to characterize the socio-economic attributes of AILV farmers; to determine factors influencing households' market participation behaviour; and to identify the combination of market outlets that deliver the highest payoffs (income) to farmers. The study was based on data collected from a sample of 254 households drawn from Nyamira North Sub-County in Nyamira County. A multistage sampling procedure was used to arrive at the sample, with semi structured questionnaires employed as the research instrument to collect qualitative and quantitative data through face to face interviews. The determinants of market participation behaviour among smallholders was estimated by an ordered probit model, while the combination of market outlets that delivered the highest payoffs (income) to farmers employed a multinomial endogenous switching regression. SPSS and STATA software were used for data analysis and management. Findings revealed that marketing experience, land ownership, households' food self-sufficiency, contractual marketing, access to credit and extension services significantly influenced the regimes in which smallholders participated in markets. Further, using market packages that contained urban market outlets led to higher incomes among smallholders. It is not enough that farmers merely participated in markets, rather they should participate in markets profitably as net sellers. Identifying the specific challenges and requirements that are unique for each market regime (net sellers, autarkic and net buyers) through proper targeting and screening of farmers is necessary. Here, equipping extension workers with the ability to address the specific needs of each group is recommended. Urban markets, in isolation as well as in market packages, were clearly shown to offer higher incomes in actual and counterfactual scenarios. Improving the condition of roads linking urban markets to producers could potentially reduce transportation costs of accessing such urban markets. This could go on to encourage the use of urban markets among farmers, who stand to gain better income and gradually fish themselves out of poverty traps.

TABLE OF CONTENTS

DECLARATION AND RECOMMENDATION ..... **ii**
COPYRIGHT ..... **iii**
DEDICATION ..... **iv**
ACKNOWLEDGEMENT ..... **v**
ABSTRACT ..... **vi**
TABLE OF CONTENTS ..... **vii**
LIST OF TABLES ..... **ix**
LIST OF FIGURES ..... **x**
ACRONYMS AND ABBREVIATIONS ..... **xi**
CHAPTER ONE **1**
INTRODUCTION **1**
1.1 Background information 1
1.2 Statement of the problem 5
1.3 Objectives of the study 5
1.4 Research questions 5
1.5 Justification of the study 5
1.6 Scope and limitations of the study 6
1.7 Operational definition of terms 6
CHAPTER TWO **7**
LITERATURE REVIEW **7**
2.1 Current status and importance of AILV 7
2.2 Determinants of smallholders market participation behaviour 9
2.3 Factors influencing the choice of marketing outlets 13
2.4 Theoretical and conceptual framework 14
2.4.1 Theoretical framework 14
2.4.2 Conceptual framework 17
CHAPTER THREE **19**
METHODOLOGY **19**
3.1 Study area setting 19
3.2 Sampling procedure 19
3.3 Sample size determination and sampling design 21
3.4 Methods of data analysis 22

3.4.1 Specification of market outlets combinations 25
3.4.2 Multinomial adoption selection model 26
3.4.3 Estimation of average treatment effects 28
3.5 Statistical and specification tests 30
CHAPTER FOUR 31
RESULTS AND DISCUSSIONS 31
4.1 Descriptive results 31
4.1.1 Socioeconomic characteristics of different types of AILV farmers 31
4.1.2 Institutional and access characteristics of different types of AILV farmers 35
4.2 Econometric results 39
4.2.1 Determinants of market participation behaviour for AILV 39
4.2.2 Combinations of market outlets with the highest payoffs 44
4.2.3 Average adoption treatment effects for the market packages 52
4.3 Gross margin analysis of individual AILV market outlets 54
CHAPTER FIVE 56
CONCLUSION AND RECOMMENDATIONS 56
5.1 Conclusion 56
5.2 Recommendations and policy implications 56
5.3 Further research 57
REFERENCES 58
APPENDIX A: SURVEY QUESTIONNAIRE 70

LIST OF TABLES

Table 3.1: Proportionate to population size per ward. 21

Table 3.2: Variables used and expected outcomes in the ordered probit model..... 24

Table 3.3: Specification of market outlets combinations..... 26

Table 3.4: Variables used and expected outcomes in the ESR model. 29

Table 4.1: Socioeconomic characteristics of smallholders for continuous explanatory variables (*F*-test). 32

Table 4.2: Socioeconomic characteristics of smallholders for discrete explanatory variables (Chi^2 test). 34

Table 4.3: Institutional and access characteristics for continuous explanatory variables (*F*-test)..... 36

Table 4.4: Institutional characteristics for discrete dummy variables (Chi^2 test). 38

Table 4.5: Variance inflating factor test results for continuous explanatory variables. 40

Table 4.6: Contingency coefficient test results for discrete explanatory variables. 40

Table 4.7: Results of the ordered probit regression for market participation behaviour. 42

Table 4.8: Summary statistics for market outlet combinations..... 44

Table 4.9: The unconditional and conditional probabilities of market packages (%). 44

Table 4.10: Mean values for socioeconomic and institutional characteristics by market package used strategy. 47

Table 4.11: Parameter and marginal effects estimates for the determinants of market packages used strategies by MNL. 48

Table 4.12: Impact of use and non-use of market packages on incomes by ESR. 53

Table 4.13: Gross margin analysis of individual market outlets without combinations..... 54

LIST OF FIGURES

Figure 2.1: Conceptual framework of market participation.....18

Figure 3.1: Map of the study area. 20

ACRONYMS AND ABBREVIATIONS

AILV	African Indigenous Leafy Vegetables.
ATE	Average Treatment Effect.
ATT	Average Treatment Effect on the Treated.
ATU	Average Treatment Effect on the Untreated.
DFID	Department for International Development.
ESR	Endogenous Switching Regression.
GoK	Government of Kenya.
HCDA	Horticultural Crops Development Authority.
HHH	Household head.
KHCP	Kenya Horticultural Crop Performance Report.
Ksh.	Kenyan Shillings.
MNL	Multinomial Logit.
MoA	Ministry of Agriculture.
MT	Metric Tonnes.
R4D	Research for Development.
SPSS	Statistical Package for Social Sciences.
SSA	Sub Saharan Africa.
USAID	United States Agency for International Development.

CHAPTER ONE
INTRODUCTION

1.1 Background information

About 30,000 edible plants are found throughout the world, 7,000 of which are grown or collected as food (Natarajan, 2002). According to Smith and Eyzaguirre (2007), about 3,000 species of these plants have been commercialized with only about 20 consumed on large scale. African Indigenous Leafy Vegetables (AILV) are increasingly recognized as possible contributors of both micronutrients and bioactive compounds to the diets of populations in Africa. The African continent is rich of vegetable species including amaranths which are among the most popular leafy vegetables within the continent (Maundu *et al*., 2009).

The Sub Saharan Africa (SSA) region is a natural habitat to more than 45,000 species of AILV of which, about 1,000 can be eaten as green leafy or fruit vegetables that happen to be the mainstay of traditional diets (Mac-Calla, 1994). AILV subsequently play a significant role in the food security of the underprivileged in both urban and rural settings (Schippers, 2000; Onyango, 2002a). In Kenya, about 200 indigenous plant species are used as leafy vegetables (Maundu *et al*., 1999); of these 200, only a few have been fully domesticated, more are semi-domesticated and majorities are collected from the wild. A study by Maundu *et al*. (1999) reported that the most consumed traditional leafy vegetables in Kenya include the *Amaranthus* species (pig weed), *Vigna unguiculata* (cowpea leaves), *Solanum nigrum* (Black nightshade), *Cleome gynandra* (spider plant) and *Cucurbita* species (pumpkin leaves).

Agriculture remains a key sector for the Kenyan economy. Its commercialization therefore necessitates improving participation of smallholders in markets, translating to improved smallholder incomes, their overall welfare, as well as their livelihoods. Hence, promoting smallholder commercialization through AILV production can be one avenue of such efforts. Here, the main argument for smallholder commercialization through AILV production is that it can allow households to increase their income directly (Okello *et al*., 2012).

According to the 2010-2012 Kenya Horticultural Crop Performance (KHCP) report compiled by the Horticultural Crops Development Authority (HCDA) and the United States Agency for International Development (USAID) for the Ministry of Agriculture (MoA), the preference and hence demand for AILV has been steadily on the rise due to increased awareness, among the masses, on their health and nutritional benefits. The KHCP report labelled the share of AILV on the domestic value for vegetables as 5% in 2012, although the quantity produced was 11% of all the vegetables produced during the same year.

Although large-scale growers dominate commercial horticulture in Kenya, the majority of horticultural growers (about 80%) are small-scale farmers. Virtually all rural households located in arable areas grow fruits and vegetables for home consumption and sale (Agricultural Development Fund, 2012). This is because horticulture has higher returns than most cash crops and is suitable for production on small and marginal farms in varying climatic conditions (Minot and Ngigi, 2003). Like most other agricultural subsectors, producing AILV lies majorly in the hands of smallholders thus providing tremendous opportunities for households to participate in AILV marketing and increase rural incomes. Maundu (2013) reported that demand has increased significantly since Kenyan supermarkets started stocking AILV like nightshade. With supermarkets like Uchumi shelving AILV in Kenya and Uganda, it was just a matter of time before Nakumatt and other major chains took it up, he adds.

Socio-economic surveys in various parts of Africa, especially the SSA, have revealed that indigenous fruits and vegetables provide employment opportunities and generate income for the rural population (Abukutsa-Onyango, 2011). As much as consumers have become increasingly aware of the nutritional and medicinal value of AILV, hence rise in demand especially in major urban centres, the supply of these vegetables has however not matched growing demand. Most farmers are semi-commercially oriented poor farmers, are not organized, and lack inputs and skills to enable them to satisfy the dynamic market requirements (Ngugi and Nyoro, 2011). Further, introduction of exotic vegetables in mainstream agriculture have seen these vegetables only used during famine and by the poor. AILV are especially important to women who are involved in all aspects of the supply chain and dominate both intermediary and retail activities; thus providing them with an important income generating opportunity (Weinberger *et al*., 2011). The AILV market promises to keep growing, and with the rapidly expanding population of Kenya, a consequential increase in demand is projected to take place.

Studies by Barrett (2009) and Kirsten (2010) alluded to market access as one of the critical factors influencing the performance of smallholder agriculture in developing countries. Access to new and better-paying markets for agricultural products is thus vital in enhancing and diversifying the livelihoods of poor subsistence or semi-subsistence farmers (Barrett, 2009). Such markets can be local (including village markets), catering for the local populations, regional markets that serve regional consumers in counties within the country or export markets.

However, most smallholder farmers are engaged in subsistence and semi-subsistence agriculture with low productivity, low marketable surplus (hence low returns) and low investment, a situation described as low equilibrium poverty trap by Barrett and Swallow (2006). Enhancing returns from agricultural production through improved access to markets can therefore be a vital element of poverty alleviation strategies and livelihood improvement. Improved market access results in commercialization of agriculture, which can result in the production of marketable surplus and hence gains in income from agriculture meaning higher revenues, as well as savings translating to investment in productivity enhancing technologies.

Making reference to Omamo (1998), Fafchamps and Hill (2005) and Shiferaw *et al*. (2009), despite the importance of market access in many developing country settings, it remains severely constrained by poor access to agricultural/market information. Poor access to market information results to information-related problems, such as moral hazard and adverse selection, which increase transaction costs, discouraging market participation by some farmers. In Nyamira County, African nightshade, spider plant and giant pig weed, in that order, are the best performing AILV. African nightshade is popular in Kisii and Nyamira counties with 53% of the 22,7991 metric tonnes (MT) marketed nationwide coming from the two counties.

Nyamira County marketed 850.75 MT of leaf amaranth with a value of Ksh. 12.87 million. It was also the leading County in the production of the giant pig weed with 81% of Kenya's total of 3,068 MT valued at Ksh. 201 million. The production of giant pig weed in Nyamira County stood at 2,500 MT with a marketed value of Ksh. 162.50 million. The figures for African nightshade stood at 5,781 MT valued at Ksh. 256.08 million; cowpeas at 1,732.26 MT valued at Ksh. 40.12 million; 88.50 MT of pumpkin leaves valued at Ksh 1.44 million; 4,526 MT of spider plant valued at Ksh. 200.51 million and pumpkin leaves stood at 88 MT worth 2.27 million. A quick summation of these figures reveals a market value of close to Ksh. 675.89 million highlighting the important contribution AILV play in the County and the potential they can have in poverty alleviation among poor households (USAID and HCDA, 2012). These figures are explicit that large volumes of AILV are marketed in the County depicting substantial market participation.

According to Bellemare and Barrett (2006), agricultural households are both consumption and production units. This implies that they can be net buyers of given commodities, autarkic with respect to them or net sellers of them. However households' behaviour and their extent towards market participation is not sufficiently captured in literature, with no recent studies attempting to capture market dynamics of households as either net buyers, autarkic or net

sellers. A study by Jaleta and Gebremedhin (2011) stressed that, the extent in which the participation position in one market affects the other is not well explored in the literature.

The answer to smallholders' market participation by categories, as either autarkic, net sellers or buyers, traces its origins to Adam Smith and David Ricardo. Given a household's desire for a diverse consumption bundle, it can either undertake production of all such goods and services for auto consumption, or it can specialize in production of goods in which it is relatively skilled and holds comparative advantage in production. Thus, it can consume some portion of the good it holds comparative advantage in and trade the surplus for other goods and services it desires but for which it holds no comparative advantage (Barrett, 2007).

According to Bellemare and Barrett (2006), studies that have researched on market participation exist, yet the literature on the subject remains thin, especially in developing country settings where significant fractions make this question most salient. Different studies have researched on market participation decisions (Goetz, 1992; Key *et al*., 2000; Makhura 2001; Holloway *et al*., 2005; Bellemare and Barrett, 2006; Gebremedhin and Hoekstra, 2007; Barrett, 2006; Jaleta and Gardebroek (2008). However, according to Bellemare and Barrett (2006), the question of whether households make marketing decisions either sequentially or simultaneously is not explicit, in the sense that it raises two implicit questions: "First, does the household decide whether to be a net buyer, autarkic, or a net seller, and then decide how much to buy or sell only once it gets to the market and discovers additional market information, conditional on having chosen not to be autarkic?; or second, does the household head make both decisions before leaving for the market?"

A study by Renkow *et al*. (2004) agreed that literature on smallholder market participation fail to capture the net position of smallholders in these markets arguing that households could participate in a given market both as a seller and buyer of a specific commodity at different times in the same production year. The decision to participate in markets or remain autarkic has been postulated to be household-specific rather than commodity-specific (De Janvry *et al*., 1991). Thus, separating the households' decision into a discrete component (whether to participate in markets) and a continuous component (how much to sell or buy, or marketed surplus) for two types of market actors (buyers and sellers) provides further understanding of the underlying factors that govern these processes (Goetz, 1992).

1.2 Statement of the problem

Farmers in Nyamira have ventured into production of AILV due to the high market value associated with it. This is attributable to growing consumer awareness of their nutritional and health benefits. Though farmers engage in the markets, it is unclear why their overall participation as net sellers remains low. It also remains unknown why farmers operating under homogenous conditions, exhibit different market behaviours. Besides empirical literature on market channel choices being thin, little is known on the determinants and effects of using different market outlets in combinations, as opposed to individual channels. This study therefore aimed to fill the existing knowledge gap by giving empirical evidence on the determinants of market participation behaviour and outlet choices among smallholders.

1.3 Objectives of the study

The general objective of this study was to evaluate the marketing behaviour of AILV among smallholder farmers in Nyamira County, Kenya.

The specific objectives of the study were to:

1. Characterize the socioeconomic and institutional attributes of smallholder AILV farmers.
2. Determine the socioeconomic and institutional factors influencing the marketing behaviour of AILV among smallholder farmers.
3. Determine the combination of market outlets that deliver the highest payoffs to smallholder AILV farmers.

1.4 Research questions

1. What are the socioeconomic and institutional attributes of smallholder AILV farmers?
2. What are the socioeconomic and institutional factors influencing the marketing behaviour of AILV among smallholder farmers?
3. What combination of market outlets deliver the highest payoffs to farmers?

1.5 Justification of the study

Smallholder farming is ineludibly potent in various ways, in different countries and for different types of economic activities (Quan, 2011). AILV have both subsistence and commercial value (income generation) for the smallholder poor, without requiring huge capital investments (DFID and R4D, 2010). Therefore, encouraging smallholder farmers to participate in the marketing of AILV to meet available potential and opportunities, by creating conducive market environment for their produce, can be considered as one possible

avenue of improving the welfare and livelihoods of smallholder households. This is possible if studies like this support policy interventions by identifying factors influencing farmers' participation decisions in marketing of AILV. Existing demand patterns can also be identified which farmers can take advantage of and profit from. As well as enriching literature on market participation, this study can also serve as an input for policy makers and researchers who wish to work in this area.

1.6 Scope and limitations of the study

The study was confined to Nyamira County with the scope covering smallholder AILV farmers. The study was conducted in the months of April and May, 2015. Included variables on socio-economic, institutional and marketing factors were only selected variables and do not necessarily mean that all variables were captured. The market participation decisions in AILV were assumed to be separable in terms of autarchies, net sellers and net buyers' positions. The study did not however seek to determine the extent of market participation amongst smallholders in terms of net sales and net purchases.

1.7 Operational definition of terms

***A priori*:** Not supported by a factual study. Proceeds from theoretical deduction rather than from empirical observation or experience.

Autarky: Economic independence or self-sufficiency. Here a household is not affected by outside influences and relies entirely on its resources. For this study, self-sufficient households are those who sell the same amount of AILV as they buy on the markets, either in terms of weight or value.

***Ex-ante*:** Before an event (before-hand). Based on anticipated changes or activity in an economy. In models where there is uncertainty resolved during the course of events, the *ex-ante* values are those that are calculated in advance of the resolution of uncertainty.

Market Packages: Combinations of market outlets.

Net seller: A household which is a net-seller of AILV sells more of it on the market either in weight or in value (quantity times price), than what they buy on the market for a given season or a year.

Net buyer: A household that is a net-buyer of AILV buys more of it (either in weight or value) on the market than they sell for a given season or a year.

CHAPTER TWO
LITERATURE REVIEW

2.1 Current status and importance of AILV

AILV are vegetables indigenous to Africa whose leaves, shoots and flowers are consumed (Schippers, 2000); and have for a long time been described by early writers, researchers and scholars as weeds (FAO, 1988). In Kenya and other parts of East Africa, they have been used by rural and urban communities (Chweya and Eyzaguire, 2000); and include several botanic families like *amaranthaceae, bacellaceae, brassicacea, capparaceae, cucurbitaceae* and *tiliaceae* (Schippers, 2000). In recent years, AILV have grown in prominence as regards to nutritional and economic benefits. This can be attributed to increased awareness on their importance as valuable sources of food, medicine and income for small-scale farmers (Maundu *et al*., 1999; Ouma, 2004). Vegetables rank higher in production than all other crops and they are known to provide 80% of vitamin A in diets (Bosland and Votava, 2000); while they play a very important role in income generation and subsistence (Schippers, 2000).

Although these vegetables have been neglected for a long time, their value and importance cannot be overemphasized. Most have advantages that include high nutritive value, particularly the micronutrients and to some extent the proteins (Chweya, 1997). According to Abukutsa-Onyango (2010), AILV are outstanding sources of micronutrients in the world and this makes them helpful in alleviating micronutrient deficiencies common in Sub Saharan Africa (SSA). Their role in food security and nutrition are yet to be fully exploited though. In tropical Africa where the daily diet is dominated by starchy staples, AILV are the cheapest and most readily available sources of important proteins, vitamins - especially the pro vitamin A - and essential amino acids (Martin and Meitner, 1998). Therefore, they provide vital food security for many subsistence farmers and consumers.

Over two billion people are at risk of vitamin A deficiency globally. In Kenya, levels of micronutrient malnutrition are high with 76% of pre-schoolers manifesting vitamin A deficiency. Leafy vegetables represent quality nutrition for large segments of the population because they supply most of the required vitamins, essential minerals and fibre (Musembi *et al*., 2013). A large number of AILV have long been known and reported to have health protecting properties and uses (Okeno *et al*., 2003); several of which continue to be used for prophylactic and therapeutic purposes (Dalziel, 1937). This indigenous knowledge of the health promoting and protecting attributes of AILV is clearly linked to their nutritional and non-nutrient bioactive properties. *Amaranthus* for example is reported to be grown for its

leaves which are rich in beta-carotene, calcium, iron and vitamin C (James *et al*., 2010). Among the micronutrients that these vegetables have include Vitamin A, calcium, manganese, magnesium and iron (Keding *et al*., 2009).

According to Abukutsa *et al*. (2006) and Mwai *et al*. (2005), AILV possess several agronomic advantages. Unlike the exotic vegetables, they can seed under tropical conditions, have short growth periods and can withstand abiotic and biotic stresses. Aside from their potential for income generation and self-employment, they are also well suited to environment-friendly farming systems like intercropping and organic farming (Chweya and Eyzaguire, 1999). Research indicates that AILV have a high nutritive value, are often grown as intercrops and are less demanding in management since their short growing periods readily lends them favourably to nutrition intervention programs (Onyango, 2003).

There is growing need among farmers in Kenya to diversify agricultural production, especially vegetable production (Mbugua *et al*., 2005). In this case, a shift from over-reliance on exotic vegetables and growing more AILV that include both indigenous and traditional vegetables will suffice. Some of the major problems that hinder optimal production and utilization of these vegetables include poor quality seed and documentation of the priority species in the region (Maundu *et al*., 1999). Studies by Maeda and Salunkhe (1981), Imungi and Potter (1983) and Belitz (1987) reported heavy losses of vitamin C and beta-carotene during storage of AILV. All these problems need rapid, urgent and mitigating interventions in order to unlock the direct economic and the traverse nutritional promise held by AILV.

Before 2000, AILV were found in the back-streets and a few open-air markets. However, AILV are now a common occurrence in most supermarkets, where they are increasing sold. Nairobi and its peri-urban areas are strewn with grocery shops in the main shopping areas, as well as retail kiosks that stock various types of AILV. The study by Schippers (2000) made reference to the importance of AILV to poor households, since their prices are relatively affordable compared to other food items. They also provide very important sources of employment for those outside the formal sector in peri-urban areas because of their generally short, labour-unintensive production systems, low levels of investment and high yield. *Amaranthus* is one of the vegetables for which consumption has greatly increased in the city of Nairobi (Mwangi and Kimathi, 2006). Like other AILV, it used to be sold only in informal markets but it is now commonly sold in supermarkets and greengrocers. However, once harvested, the vegetable has a very short shelf life.

2.2 Determinants of smallholders market participation behaviour

Muricho *et al*. (2015) explained that, in the contemporary period beginning early 1990s, literature on agricultural commercialization (output market participation in particular) has been growing rapidly. Despite the opportunities presented by liberalized markets, concerns on the limited market participation by smallholder farmers necessitated the need for such studies. According to Barrett (2008), studies on market participation were motivated by the need of smallholders to participate in markets and/or respond to market signals, otherwise market based development strategies were bound to fail in facilitating wealth creation and poverty reduction. De Janvry *et al*. (1991) and Fafchamps (1992) are credited with most of the theoretical foundations of agricultural market participation. Despite separately developing formal household models to explain smallholder supply response in the presence of market failures, this was not without empirical analysis challenges. Smallholder market participation analyses had to deal with selection bias that had been addressed using Heckman (1979) approach.

Goetz (1992) used a probit model of households' discrete decision to participate in the market (either as buyers or sellers, without distinction) followed by a second-stage switching regression model of the continuous extent of market participation decision (transaction volume) to correct for the bias caused by unobserved variables. Burke (2009) explained that, the downside of the study by Goetz (1992) is looking only at the influence of fixed transaction costs on households' decision to enter the market while not observing for the role of transaction costs in influencing the quantity transacted. Nevertheless it does show that information is a significant driver of market participation decisions.

On the other hand, using a nationally representative household level data collected from maize (corn) farmers in Mexico, Key *et al*. (2000) advanced on the conceptual framework of Goetz (1992) by identifying the role of transaction costs (fixed and proportional) on market participation. They used an endogenously switching regression that automatically switched households into three different market participation regimes, that is, market participation as sellers, buyers and autarkic. Their focus is not on marketing behaviour but on production behaviour, given the heterogeneity in market participation. Their findings show that both proportional and fixed transaction costs matter in market entry and output decisions.

Bellamere and Barrett (2006) later on developed a two stage econometric method to test whether rural households in northern Kenya and southern Ethiopia make livestock market

participation decision and volume to sale decision simultaneously or sequentially using ordered probit and ordered tobit models. In the first discrete decision making stage where ordered probit model was used, households were put into three categories (net buyers, autarkic and net sellers). In the second stage, determinants of how much to sell or buy conditional on having decided to participate in the market was analyzed using the tobit framework which the authors called "ordered tobit model" due to the analytical approach used in the first stage. Bellemare and Barrett (2006) concluded that articles on household market participation behaviour in developing countries begin from fundamentally different assumptions on the nature of households' market participation choices.

A study by Heltberg and Tarp (2002) found evidence that ownership of a means of transport and proximity to a railway increases both the likelihood of entering the market as a seller and the quantity sold. The break-down of the marginal effect into the entry/exit and quantity components shows that the first effect is substantially larger. This implies that promotion of market access can solicit a greater volume of additional supply from peasants entering the market for the first time than for existing participants. Burke (2009) explained that the study suffers from two inadequacies. Using cross-sectional data, identification of any price effect which limits their ability to compare the effectiveness of price versus non-price factors in increasing market participation and sales is not possible. Second, the proxy used for fixed transaction costs as population density and information dummy are not statistically significant casting doubts on the model identification.

Using a selectivity model and applying a two stage decision making process as done by Bellamere and Barrett (2006), Alene *et al*. (2008) analyzed the role of transaction costs on market participation. They expanded the scope of study to include market participation in both output and input using the maize sub-sector in Kenya. Similarly, on investigating the impact of transaction costs on smallholder agricultural commercialization, Omiti *et al*. (2009) studied factors that influenced market participation intensity in rural and peri-urban areas in Kenya by applying a truncated regression that excluded non-market participants (the lower bound of the truncation). Mathenge *et al*. (2010) used household level panel data to analyze factors influencing market participation and its impacts on income and poverty among poor and marginalized households in Kenya. Using the Double Hurdle model developed by Craigg (1971), Mathenge *et al*. (2010) analyzed household's binary decision to participate in the market and the continuous decision on how much to sell conditional on having decided to participate in the market. Similarly, Mather *et al*. (2011) analyzed the determinants of maize

market participation in selected eastern and southern Africa countries by fitting a double hurdle model on panel data in in a random effects framework. Recently, Macharia *et al*. (2014) used the censored tobit model to analyze the impact of transaction costs on maize market participation in Kenya.

The analytical methodologies adopted in past empirical literature are varied. Majority of the studies used two step selectivity models to analyze the discrete decision of market participation, and the continuous decision of market participation (intensity), conditional on having made the decision to participate (Goetz, 1992; Alene *et al.*, 2008; Mathenge *et al*., 2011). The distinctive focus of these studies is their emphasis on the marketed surplus as opposed to the actual supply. Their intention was to analyze marketing behaviour by estimating the determinants of the quantities bought and/or sold while controlling for the endogenous selection into the respective market participation regime. A key development in market participation by Holloway *et al*. (2005) used a Bayesian double hurdle model to study market participation by distinguishing on non-negligible fixed costs leading to non-zero censoring, as in Key *et al*. (2000), and on the discrete participation decision and the continuous volume marketed decision, as in Goetz (1992). Other studies however focus on just analyzing the continuous decision of market participation intensity (Omiti *et al*., 2009; Macharia *et al*., 2014). Muricho *et al*. (2015) acknowledged that smallholder producers will not benefit by just the mere fact that they are "participating in the market", but instead, they should participate profitably as net sellers.

Empirical literature on market participation in Africa continued throughout the first decade of the 21st century. This could have been driven by the continued dismal participation of smallholder farmers in markets even after liberalization (Muricho *et al*., 2015). Jagwe (2010) used a two-stage Heckman model and revealed that belonging to farmer groups, household size, ownership of transport means and distance to markets meaningfully influenced the extent of farmers' participation in banana markets. Similar findings were reported by Shepherd (2007), suggesting that collective action through farmer groups increases market participation. Njuki *et al*. (2009) asserted that although the formation of farmer groups is essential (for efficient farmer learning, receiving external support and achieving economies of scale), such formation should be accompanied by incentives that encourage market participation. A study by Jaleta *et al*. (2009) established that, market participation is determined by the literacy level of the head of household, nearness to market

place and households' market orientation of making production decisions founded on market signals.

Holden and Binswanger (1998), Eskola (2005) and Jagwe *et al*. (2009) agreed that, factors related to transaction costs, such as geographical location, market information sources, travel time to nearest markets, labour availability, farming experience, gender of household head, off-farm income and household asset base, affect smallholders' likelihood and intensity of participation in markets. Household labour is a powerful but cheaper asset that leads to greater production volumes, positively influencing farmers' market participation (Lerman, 2004).

In their study, Boughton *et al*. (2007) revealed that private household assets especially land, livestock and farm equipment positively affected market participation. A study by Barrett (2007) found that, market participation in staple grains is mainly barred by insufficient land, livestock, capital and improved technologies such as farm equipment required to generate a surplus that influences market participation. According to Pravakar *et al*. (2010), households with larger land holdings per adult member sell larger volumes of their produce as compared to those with smaller land holdings. Moreover, households with ownership of larger livestock herds produced and sold more crop produce since they used manures from the livestock to enhance crop yields.

A study by Jaleta *et al*. (2009) underscored that ownership of livestock by a household negatively affects market participation in the crop market. That is, livestock ownership distracts the farmer from venturing into an alternative source of income. Reinforcing on the economic theory that favourably higher prices induce increased supply, Enete and Igbokwe (2009) and Omiti *et al*. (2009) also affirmed that better output price and market information is crucial to enticing market participation (in form of increased sales through increased supply). By contrast however, the household size and non-farm income significantly reduced the sales of vegetables in the market, hence less market participation.

In their work, Enete and Igbokwe (2009) identified price as an important influencer of the level of farmers' market participation in cassava markets, and that the probability of market participation declined with declining farm size for sellers of cassava but increased with farm sizes for buyers, though not significant in either case. Different studies have pointed to farmers' failure to use improved inputs (that could accordingly result in competitive production), hence less incentives to engage in market oriented production (Ferris *et al*.,

2001; Nkonya and Kato, 2001; Aliguma *et al*., 2007). In his study, Okoboi (2001) revealed that small plots of land and high costs of inputs had limited the potato yields in Uganda limiting the profits of smallholder producers hence low market participation.

2.3 Factors influencing the choice of marketing outlets

Giuliani and Padulosi (2005) emphasized the importance of identification of the factors faced by households in choosing marketing outlets on realizing the millennium development goals. However, as aforementioned, literature on market outlet choices has been thin, especially in developing countries where significant frictions make this question most salient. It is likely that farmers' choice of market outlets is determined by the prices they receive from sale of produce, with the outlets offering higher benefits logically preferred. A study by Zuniga-Aria and Ruben (2007) demonstrated that farm households, including farmers' experience and profitable outlets, attitude toward risk, production systems (farm size and production scale), price attributes and market context (having or not of a written contract, geographical location and distance to urban market) all influenced the choice of market outlets.

According to Montshwe (2006), farm gate sales tend to reduce farmer revenues due to relatively low prices. With farm size a proxy to production scale, large land sizes imply large production scales and vice versa, positively influencing farmers' decisions to sell their produce at market outlets due to economies of scale that lower transaction costs. In an earlier study modelled on infrastructure and market access in Madagascar, Minot (1999) observed that the choice of marketing outlet among traders is negatively related to the distance to the market site. This implies that smallholder farmers tend to sell their outputs at farm gates because there is no transaction cost to be incurred.

A study by Sigei *et al*. (2013) found that farmers' experience, especially for marketing, influenced the choice of marketing outlet, with risk takers willing to transport their farm produces to distant markets while risk averse ones resorted to sell at farm-gates. Further, they found that, price also influences the choice of marketing outlet. Higher prices provide an incentive to preferably use a particular outlet, so as to benefit from the higher prices offered at the point of sale. Contractual arrangements also guarantee farmers ready markets for their produce, with farmers tending to choose outlets that have a ready market. It is therefore conceivable, as these different studies have previously observed, that in most cases, farmers choose prices offered at farm gates because they incur minimal or no transaction cost.

In an attempt to determine smallholder sweet potato farmers' participation in different market options in Vihiga County, Mutai *et al*. (2013) discovered that participation in local town markets rather than village markets was influenced by credit access, total income, transport mode to markets, access to extension services, age, value addition done and the quantity of sweet potatoes supplied. They also found that mode of transport, land size holdings, quantity of sweet potatoes and gender determined participation for the regional outlet option.

2.4 Theoretical and conceptual framework

2.4.1 Theoretical framework

The derivation of this model starts with the (second-stage) market participation decision, and follows a traditional model as in Goetz (1992), Key *et al*. (2000) and Holloway *et al*. (2005), by incorporating transaction costs into a household utility model specified as follows; good *i*, which households consume in amount c_i and produce in amount q_i using inputs x_i. Households also choose the amount of good *i* to market, m_i, at price p_i^m. The household has an exogenous endowment of good *i* in the amount of A_i (which is positive for net sellers and negative for net buyers); with exogenous (non-market) transfers, *T*, representing other sources of income which can be positive or negative, thus completing this constraint. Exogenous household and farm characteristics are represented by z_u and z_q; and *G* (·) represents the household's production function describing the relationship between inputs and outputs through the production technology *G*, considering other supply shifters, accounting for the fact that market-oriented production decision has already been made (hence it is given and known). In absence of transaction costs, the household maximizes the household utility function (Equation 1), subject to Equations 2 through 5:

$$\max u(c; z_u) \quad \text{.....} \quad 1$$

$$\sum_{i=1}^{N} p_i^m m_i + T = 0 \quad \text{.....} \quad 2$$

$$q_i - x_i + A_i - m_i - c_i = 0 \qquad i = 1 \ldots N \quad \text{.....} \quad 3$$

$$G(q, x; \mathbf{Z}_q) = 0 \quad \text{.....} \quad 4$$

$$c_i q_i x_i \geq 0 \quad \text{.....} \quad 5$$

Equations 2-5 represent constraints on maximization of the household utility function. Equation 2 represents the household's budget constraint. Equation 3 states that for each good, the amount consumed, sold, and used as inputs must equal amount bought plus an exogenous endowment of the good. Equation 4 represents the household's agricultural production technology, which is dependent on quantity produced and inputs used in production, given farm characteristics. In Equation 4, z_q is specified as $(z_q = z_q^{cc} z_q^{hi} z_q^{us})$. z_q^{cc} represents supply shifters associated with community characteristics, for example, whether there is a credit access or presence of farmer cooperative. As in previous studies, z_q^{hi} are lagged household investments known to farmers *a priori*; and z_q^{us} are unknown shocks to production, revealed to the farmer after production decisions are made, prior to final marketing decisions.

Characteristically, indirect utility functions that can be derived from the initial optimization, leading to market quantity functions, as in Key *et al.* (2000) will typically arrive at only two decision rules for net buyers and net sellers. However, this study introduced a Lagrange problem to represent how three different market regimes are arrived at. Therefore, proportional transaction costs are incorporated by changing the household budget constraint to the following:

$$\sum_i^N [p_i^m - t_{pi}^s(z_t^s))\delta_i^s + (p_i^m + t_{pi}^b(z_t^b))\delta_i^b]m_i + T = 0 \qquad 6$$

Transaction costs (t_{pi}^s and t_{pi}^b) reduce the price p_i^m the seller receives at the market by unobservable amount t_{pi}^s and increases the price paid by the buyer by unobservable amount t_{pi}^b. Indicator terms δ_i^s and δ_i^b take on the value of 1 if the household is a seller/buyer and zero otherwise. The agent's role in the market is represented by the two indicator functions: δ_i^s is 1 for sellers of good *i* and 0 otherwise while δ_i^b is 1 for buyers of good *i* and 0 otherwise thus adding an important condition $\delta_i^s + \delta_i^b \leq 1$ which establishes the net quantity marketed by stating that a household cannot be both a net buyer and net seller in the same period. This implies that the proportional transaction costs for sellers of good *i*, and fixed transaction costs for sellers of good *i* effectively change the price they receive and thus

their behaviour in the market. Similarly, the proportional transaction costs for buyers of good *i* and fixed transaction costs for buyers of good *i* effectively change the price they pay and thus their behaviour in the market. However, these transaction costs are largely unobserved in survey data, and are thus represented as functions of more readily enumerable factors explaining them. Exogenous factors affecting transaction costs of selling and buying are represented by z_t^s and z_t^b. Transaction costs are an important element in this model for their role in explaining autarkic behaviour of market actors. Once they are partitioned into fixed and proportional transaction costs, Equation 7 is derived:

$$\sum_i^N [p_i^m - t_{pi}^s(z_t^s))\delta_i^s + (p_i^m + t_{pi}^b(z_t^b))\delta_i^b]m_i - t_{fi}^s(z_t^s)\delta_i^s - t_{fi}^b(z_t^b)\delta_i^b + T \quad \text{..... 7}$$

Where the household only pays fixed transaction costs, t_{fi}^s, if it sells good *i* and pays fixed transaction costs, t_{fi}^b, if it buys good *i*; and, t_{pi}^b, if it buys good *i* at proportional transaction costs and, t_{pi}^s, if it sells at proportional transaction costs. Thus, to derive supply and demand equations, the utility function is maximized subject to constraints in Equations 3-5, and the budget constraint reflecting fixed and proportional transaction costs (Equation 7) used to derive Equation 8:

$$L = u(c; z_u) + \sum_i^N \mu(q_{ii} - x_i + A_i - m_i - c_i) + \phi G(q, x; z_q) + \lambda[\sum_i^N [p_i^m - t_{pi}^s(z_t^s))\delta_i^s + (p_i^m + t_{pi}^b(z_t^b))\delta_i^b]m_i - t_{fi}^s(z_t^s)\delta_i^s - t_{fi}^b(z_t^b)\delta_i^b + T \quad \text{..... 8}$$

Lagrange multipliers associated with the resource balance, the technology constraint, and the cash constraint are represented by μ_i, ϕ and λ. The solution to the Lagrangian function is solved in two steps. First, the optimal solution, conditional on the market participation regime, is solved and then the household chooses the optimal participation regime leading to the highest level of utility. First order conditions are then derived as:

$$\frac{du}{dx} = \mu_i = 0 \quad \text{..... 9}$$

$$u_i + \phi\frac{dG}{dqi} = 0 \quad \text{..... 10}$$

$$-\mu_i + \phi \frac{dG}{d\,xi} = 0 \quad \text{..... 11}$$

$$-u_i + \lambda[(p_i^m - t_{pi}^s)\delta_i^s + (p_i^m + t_{pi}^b)\delta_i^b] = 0 \quad \text{..... 12}$$

Based on Equation 12, the market participation decision can be defined as:

$$p_i = \begin{cases} p_i - t_{pi}^s & if \quad seller \\ p_i + t_{pi}^b & if \quad buyer \\ R1 = \dfrac{\mu_i}{\lambda} & if\ autarkic \end{cases}$$

When good *i* is marketed (net sales or net bought), the market participation decision includes variable transaction costs t_{pi}^s or, t_{pi}^b, but when good *i* is not traded the decision price becomes the unobservable shadow price $R1 = \frac{\mu_i}{\lambda}$. Conditions necessary for household market participation can now be established. The maximum utility available to the household is represented by an indirect utility function *V* (*p*,*y*,*z*). For instance considering the case of household's market participation as sellers; using the price for sellers, the indirect utility function of the household is:

$$V = V_i\{(p_i - t_{pi}^s), y_O(p_i - t_{pi}^s) - t_{fi}^s, z_u \quad \text{..... 13}$$

With a corresponding supply function of:

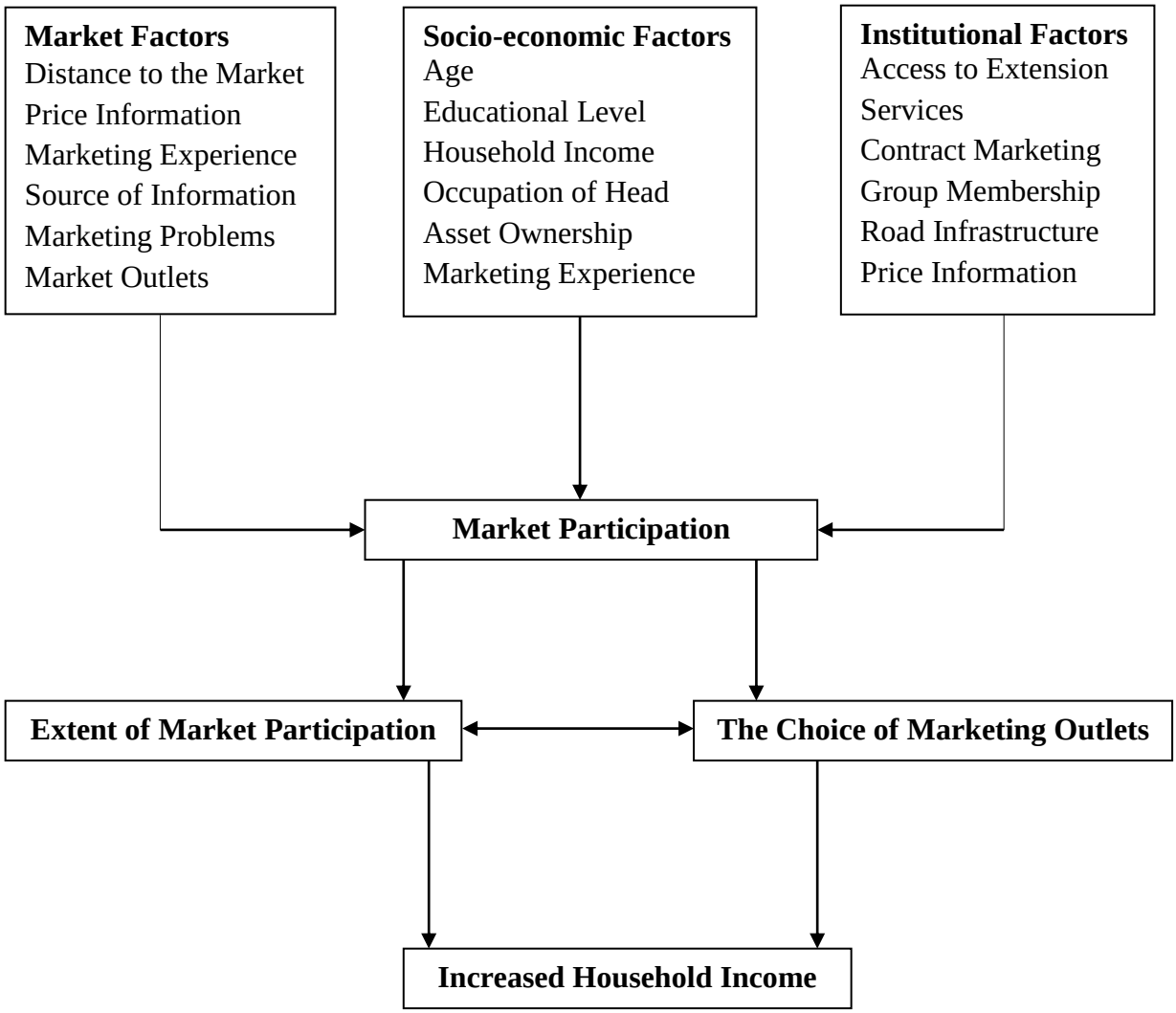
$$q^s = q(p^m - t_p^s, z_q) \quad \text{..... 14}$$

When households are faced with the decision to participate in the market, they evaluate their indirect utility function (Equation 13), which contains both fixed and proportional transaction costs. Once the market participation decision has been made, the household considers its supply function (Equation 14), which contains proportional costs but not fixed costs, to explain the level of market participation. Decreases in transaction costs will lead to greater participation in agricultural markets. Once households are involved in markets, a reduction in proportional transaction costs will increase household involvement in markets.

2.4.2 Conceptual framework

The producing households first decide whether to participate (buying or selling) or remain autarkic; then decide, provided they participate, how much to buy or sell. It is important to first acknowledge that not all households in the study area will be AILV producers. Adding a

third stage of analysis in a three tired market regime to the traditional two-stage market participation model is important as it identifies factors influencing a household's decision on whether or not to commercially produce. Besides, existing models treat participation entirely as an *ex-ante* decision made by the household, while marketing decisions may be, in part, not an *ex-ante* choice but often an artefact of constraints on production and/or a response to stochastic production shocks. Following a similar framework by Burke (2009) but focusing on this case of AILV, the model allows for the market participation variables to be zero because the producing household's optimizing market participation is autarkic. Moreover, for any given household, it predicts the probability that the household is a non-producer and an autarkic producer separately, making it necessary to separate producers from non-producer.



→ Direction of Influence.

Figure 2.1: Conceptual framework of market participation.

Source: Author's conceptualization modified from Burke (2009).

CHAPTER THREE
METHODOLOGY

3.1 Study area setting

The study was conducted in Nyamira County. It covers an area of 899.3 km^2 and lies between latitudes 0º 30' and 0º 45' South and 34º 45' and 35º 00' East. Nyamira County borders the following counties; Bomet to the South East, Narok to the South, Kisii to the West, Homabay to the North and Kericho to the North East. Administratively, the County is divided into Borabu, Manga, Masaba North, Nyamira South and Nyamira North Sub-counties. Politically, the County has four constituencies namely, West Mugirango, North Mugirango, Kitutu Masaba and Borabu. Figure 3.1 highlights the study area setting.

The altitude ranges from 1,250-2,100 metres above sea level. Temperatures range from a mean annual minimum of 10.1°C at night to a mean maximum of 28.7°C during the day, with rainfall amounts of between 1,200 mm and 2,100 mm per annum. Agriculture rests as the main economic activity employing 80% of the population. Major cash crops grown in the area include tea, coffee, sugar cane, bananas and pyrethrum. The main food crops include maize, beans, sweet potatoes, vegetables and sorghum. Dairy farming and livestock rearing for milk, meat and other products is also practiced by many households. Although the County experiences relatively good weather patterns with rainfall occurring regularly throughout the year, opportunities still exist for development of large-scale irrigation schemes.

3.2 Sampling procedure

The target population of the study consisted of smallholder farmers in Nyamira County. The sampling unit was smallholder AILV farmers. Multi-stage sampling procedure was used to arrive at the surveyed sample. First, Nyamira County was purposively selected owing to a large number of smallholder AILV producers and huge volumes of the AILV traded within the County. The implication for this is that there is substantial AILV market participation. Within Nyamira County, Nyamira North Sub-County was purposively selected because it is the leading producer of AILV in the County. Therefore, the study ultimately focused in Nyamira North Sub-County, with all the wards of Itibo, Bomwagamo, Bokeira, Magwagwa and Ekerenyo producing participants for the survey.

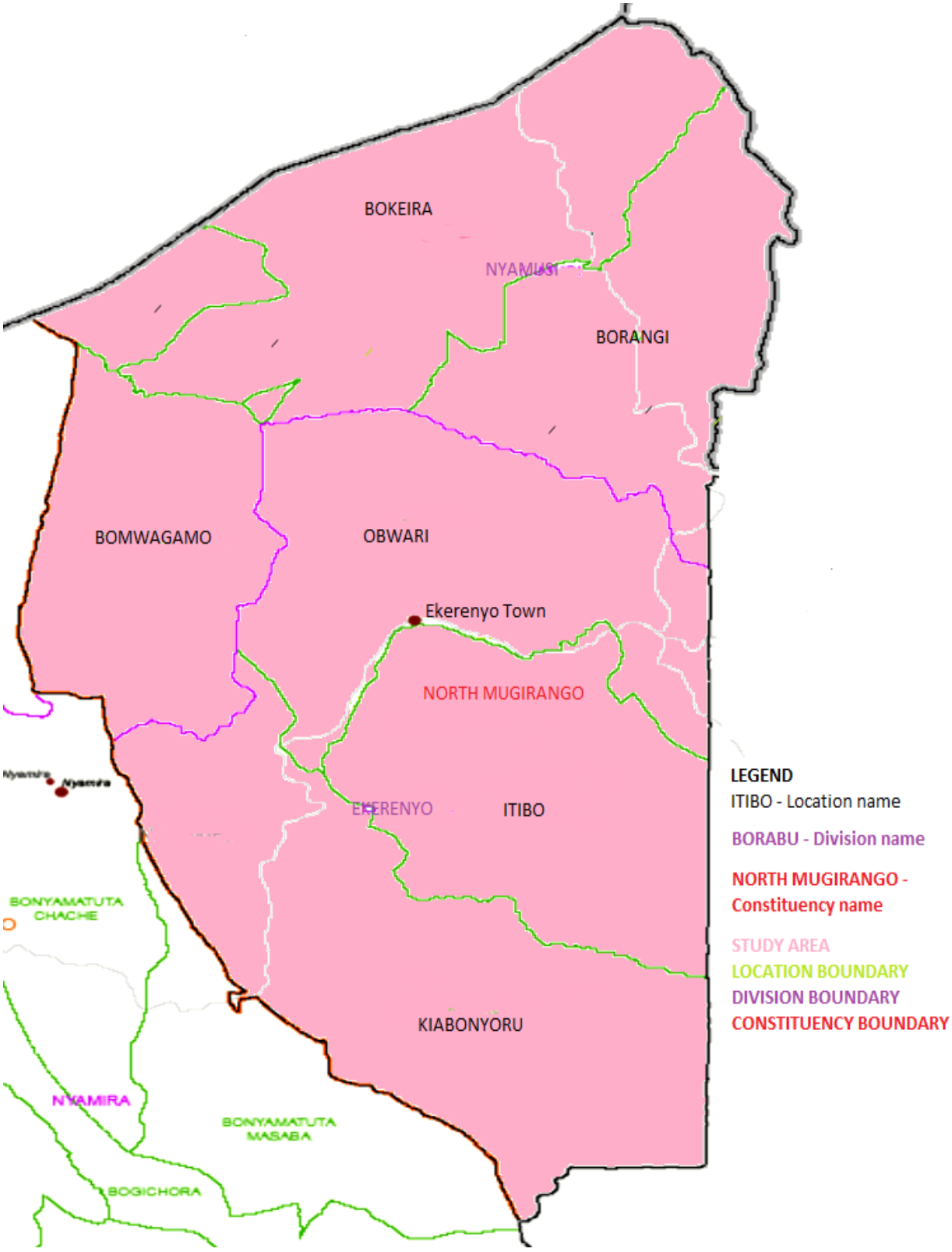


Figure 3.1: Map of the study area.

Source: Kenya National Bureau of Statistics - Cartography GIS Section (2009).

3.3 Sample size determination and sampling design

The determination of the sample size followed a proportionate to size sampling methodology as specified by Anderson *et al*. (2007), written as;

$$n = \frac{pqZ^2}{E^2} \quad \text{.....} \quad 15$$

Where:

n = the sample size;

p = proportion of the population containing the major attribute of interest.

q = 1-p.

Z = confidence level ($\alpha = 0.05$).

E = acceptable/allowable error.

Since the proportion of the population was not known: $p = 0.5$; $q = 1\text{-}0.5 = 0.5$; $z = 1.96$ and $e = 0.0615$. This resulted to a sample size of 254 respondents calculated as;

$$n = \frac{0.5 \times 0.5 \times 1.96^2}{0.0615^2} = 253.9 \approx 254$$

Using the 2009 Kenya Bureau of Statistics (KBS) data on the population of the 5 wards of interest (clusters) as reported by the Kenya Population and Housing Census, a proportionate to population size (PPS) of respondents for each ward was computed to arrive at 254 respondents interviewed proportionately. The probability of selection for each respondent in each of the sampled wards was calculated as;

$$\text{Probability} = \frac{Ward \quad Population}{Total \quad Sub-County \quad Population} \times 100\% \quad \text{.....} \quad 16$$

Table 3.1: Proportionate to population size per ward.

Ward	Population	Cumulative Sum	Prob. (%)	Proportionate Respondents per Cluster (c)
1. Itibo	27,598	27,598	22.60	57.00
2. Bomwagamo	17,252	44,850	14.20	36.00
3. Bokeira	27,489	72,339	22.50	57.00
4. Magwagwa	23,355	95,694	19.10	49.00
5. Ekerenyo	26,659	122,353	21.60	55.00
Total	**122,353**		**100.00**	**254.00**

Source: Author's computation.

A pretested semi-structured questionnaire was administered through face to face interviews to collect primary data (qualitative and quantitative); while reviewing of literature from selected texts, documented book chapters, annual reports, journals, newsletters and other published sources relevant to the study formed the sources of secondary information.

3.4 Methods of data analysis

Based on the objectives of this study, both descriptive statistics and econometric models were employed to analyze qualitative and quantitative data. Collected data was coded, entered and cleaned using SPSS software, while Microsoft Excel complemented this process as back up. A summary of descriptive statistics was subsequently generated from SPSS. Data was then transferred to STATA version 12.0 in which econometric analyses was carried out. In the analysis, the following analytical framework took precedence:

Objective One: Descriptive statistics involving the use of means, percentages, frequencies, standard deviations, *Chi*-square (Chi^2) tests and *F*-tests were employed to describe the socio-economic, marketing and institutional characteristics of AILV farmers.

Objective Two: Following Bellemare and Barrett (2006) and Muricho *et al*. (2015), this section employed the ordered probit model to implement the market participation problem. The motivation for the model comes from the prospective sequencing and jointness (simultaneity) of the household's marketing decisions. In the presence of non-zero censoring points, regions between zero and the censoring points may have zero density, for household's net sales (sales minus purchases) volume. This implies that one can partition the continuous market participation outcome into three distinct categories: net buyer (households whose net sales are negative), autarkic (households whose net sales are equal to zero) and net seller (households whose net sales are positive) households.

According to Tisdell and Svizzero (2001), a large body of literature recognizes that linear regression is inappropriate when the dependent variable is categorical, especially if it is qualitative. Following Greene (2003) and Marenya *et al*. (2015), the appropriate theoretical model in such a situation is the ordered probit model because market participation can be naturally ordered, for this case, into three categories with the lowest category being net buyers of AILV. This model has been widely used as a methodological framework for analyzing ordered data since the pioneering work of McKelvey and Zovoina (1975). The link between the observed categories and the latent outcome index is thus assumed to be of the

ordered probit type and is a nonlinear model, thus the effect of the explanatory variables can be measured in terms of marginal effects. The ordered probit model is conceptualized as;

$$Ordered \quad \text{Pr}obit^{(NB,\quad A,\quad NS)} = \beta_o + \beta_i X_i + u_i$$

Where; Net Buyer (NB) = 0; Autarky (A) = 1; Net Seller (NS) = 2

Explicitly the market participation equation was modelled as follows. The specific regressors (X_i's) are presented in Table 3.2;

$$Y = \beta_o + \beta_1 X_{1i} + \beta_2 X_{2i} + \beta_3 X_{3i} + ... + \beta_n X_{ni} + e_i \quad \text{.....} \quad 17$$

Because these three market categories are logically ordered, and since it is informative to distinguish between net buyers and net sellers rather than just lump them together as market participants, an ordered probit participation decision is estimated. This approach also allows for non-zero censoring points at the first stage, that is, the thresholds below and above which a household will find it worthwhile to be a net buyer or a net seller, respectively, as in Key *et al*. (2000) and Holloway *et al*. (2005). The decision to participate in the AILV market as a net seller, an autarkic or a net buyer is trichotomous in nature. Households are assumed to participate in a market regime that maximizes their expected utility over their planning horizon. Consider the following latent model M^*_{ji} which describes the i^{th} household's behaviour of participating in market regime j (j=0, 1 and 2):

$$M^*_{ji} = \beta_j X_{ji} + \varepsilon_{ji} \quad \text{.....} \quad 18$$

Where M denotes the latent dependent variables which can be represented by the level of expected benefit and/or utility derived from participating in market regime j, Xs are a vector of covariates influencing the j^{th} market participation regime and βs are associated vector of parameters, and ε are the unobserved factors influencing market participation. The household's utility from participating in a given market regime is not observable but the decision to participate is observable. The farmer will choose market regime j if:

$$\begin{cases} 1 & if \quad M^*_{ji} > 0 \\ 0 & otherwise \end{cases}.$$

The parameters β_j were estimated using coefficients of the ordered probit that allows for multiple ordered values (net sellers, autarkic and net buyers).

Table 3.2: Variables used and expected outcomes in the ordered probit model.

Variable(X)	Description	Measurement	Expected Sign
Agehh	Age of the household head	Number of years	±
Edcnhh	Education level of the household head	Number of years	+
Housyz	Household size	Number of members	±
Exprnc	Experience in marketing	Number of years	+
Gendhh	Gender of the household head	0 = Female; 1 = Male	±
Landown	Land ownership (title deed)	0 = No; 1 = Yes	+
Foodsuff	Households' food self sufficiency	0 = No; 1 = Yes	+
Groupmemb	Group membership	0 = No; 1 = Yes	+
Contract	Contractual marketing	0 =No; 1 = Yes	+
Nonfarm	Participation in non-farm activities	0 =No; 1 = Yes	±
Trans	Ownership of transport equipment	0 =No; 1 = Yes	+
Credit	Access to credit	0 =No; 1 = Yes	+
Mrktinfo	Access to market information	0 =No; 1 = Yes	+
Distfrmrkt	Distance from farm to market	Kilometers	-
Farmsyz	Farm size	Acres	+
Extension	Number of extension contacts	Number of visits	+

Objective 3: This was analyzed with two things in mind. First, an analysis of factors motivating the use of a combination of market outlets was carried out. Second, the implication of using various combinations of market outlets on the selected outcome variable (AILV income) was done. The selection bias was controlled for using a multinomial endogenous switching treatment effects approach. This approach emulated a similar framework employed by Teklewold *et al.* (2013). The intention was to determine whether using market outlets in combination provided more economic benefits and earned smallholders better income than using individual outlets (whether farmers should use market outlets in isolation or in combinations). Most previous impact analyses on income (as determined by market outlets) studies have focused on analyses of single market outlets using single equation models (probit or logit). This follows a similar observation that focused on

technology adoption by Gebremedhin and Scott (2003) and Kassie *et al.* (2011). As noted earlier however, farmers are faced with market outlet alternatives that may be used simultaneously as complements, substitutes or supplements to deal with their overlapping constraints such as transaction costs offered by different outlets, distance to reach market outlets, as well as prices offered by different outlets.

Studies by Dorfman (1996), Khanna (2001) and Moyo and Veeman (2004) have all reported this phenomenon on farmers facing adoption decisions of different technology alternatives. Observing from Wu and Babock (1998) and Khanna (2001), earlier studies also ignored that, the possibility of the choice of outlets adopted more recently by farmers may be partly dependent on earlier choices. Adoption and impact analysis of outlets that ignore these inter-relationships may underestimate or overestimate the influence of various factors on the adoption of market outlets and their impacts on incomes that farmers derive. This follows Wu and Babcock (1998). Employing a similar framework by Dorfman (1996) on technology adoption (but focusing on market outlets for this study), modelling of market outlets adoption and impact analysis in a multiple outlet choice framework is important to capture useful economic information contained in interdependent and simultaneous adoption decisions.

3.4.1 Specification of market outlets combinations

The market outlets considered for this study were farm gate, local rural markets and nearest urban markets, providing eight possible combinations. $F_0L_0U_0$ indicates that households did not use any market outlets while $F_1L_1U_1$ indicates that households used all three outlets. Table 3.3 illustrates how this was achieved. Each element in the triplet is a binary variable for market outlets combinations: Selling at farm gate (F), local market (L) or nearest urban market (U). Subscript 1 depicts using of a market outlet and 0, otherwise. After this, the unconditional and conditional probabilities of using different outlets was computed to show the interdependence of various outlets combinations.

In the first stage, farmers' choice of combinations of market outlets was modelled using multinomial logit selection model while recognizing the inter-relationships among the choices. In the second stage of the estimation, the impact of each combination of outlets on the outcome variable (income) was evaluated using ordinary least squares (OLS) with a selectivity correction term from the first stage.

Table 3.3: Specification of market outlets combinations.

Choice (j)	Binary triplet (package)	Farm Gate		Local Rural Markets		Nearest Urban Markets	
		F_1	F_0	L_1	L_0	U_1	U_0
1	$F_0L_0U_0$		✓		✓		✓
2	$F_1L_0U_0$	✓			✓		✓
3	$F_0L_1U_0$		✓	✓			✓
4	$F_0L_0U_1$		✓		✓	✓	
5	$F_1L_1U_0$	✓		✓			✓
6	$F_1L_0U_1$	✓			✓	✓	
7	$F_0L_1U_1$		✓	✓		✓	
8	$F_1L_1U_1$	✓		✓		✓	

3.4.2 Multinomial adoption selection model

Farmers are assumed to aim to maximize their profit, U_i, by comparing the profit provided by m alternative packages. The requirement for farmer i to choose any outlet, j, over any alternative outlet, m, is that $U_{ij} > U_{im}$ and m ≠ j, or equivalently $\Delta U_{im} = U_{ij} - U_{im} > 0$ and m ≠ j. The expected profit, U_{ij}^{*}, that the farmer derives from the use of package j is a latent variable determined by observed household, plot and location characteristics (X_i) and unobserved characteristics (ε_{ij}):

$$U_{ij}^{*} = X_i \beta_j + \varepsilon_{ij} \quad \text{..... 19}$$

Where X_i is observed exogenous variables (household, plot and location characteristics) and ε_{ij} is unobserved characteristics. Let (I) be an index that denotes the farmer's choice of outlets, such that:

$$I = \begin{cases} 1 \; iff \; U_{i1}^{*} > \max\limits_{m \neq j}(U_{im}^{*}) \; or \; \eta_{i1} < 0 \\ \vdots \quad \vdots \quad \vdots \\ J \; iff \; U_{ij}^{*} > \max\limits_{m \neq j}(U_{im}^{*}) \; or \; \eta_{iJ} < 0 \end{cases} \quad for \; all \; m \neq j \quad \text{..... 20}$$

Where $\eta_{iJ} = \max\limits_{m \neq j}(U_{im}^{*} - U_{ij}^{*}) < 0$ (Bourguignon *et al.*, 2007). Equation 20 implies that the i^{th} farmer will use outlet j to maximize his expected profit if j provides greater expected profit than any other package $m \neq j$, that is, $\eta_{iJ} = \max\limits_{m \neq j}(U_{im}^{*} - U_{ij}^{*}) > 0$.

Assuming that ε are identically and independently Gumbel distributed, the probability that farmer *i* with characteristics *X* will choose *j* can be specified by a multinomial logit model (McFadden, 1973):

$$P_{ij} = \Pr(\eta_{ij} < 0 \mid X_i) = \frac{\exp(X_i \beta_j)}{\sum_{m-1}^{J} \exp(X_i \beta_m)} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 21$$

The parameters of the latent variable model can be estimated by maximum likelihood.

In the second stage of multinomial endogenous switching regression (ESR), the relationship between the outcome variables and a set of exogenous variables was estimated for the chosen outlets. In this specification, the base category which is the non-use of any outlet ($F_0L_0U_0$), is denoted as *j* = 1. In the remaining outlets (*j* = 2 … 8), at least one outlet is used. The outcome equation for each possible regime *j* is thus given as:

$$\begin{cases} \text{Regime } 1 \quad Q_{i1} = Z_i \alpha_1 + u_{i1} \quad if \quad I = 1 \\ \quad \vdots \\ \text{Regime } j \quad Q_{iJ} = Z_i \alpha_J + u_{iJ} \quad if \quad I = J \end{cases} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 22$$

Where Q_{ij}'s are the outcome variables of the i^{th} farmer in regime *j*, and the error terms (*u*'s) are distributed with E (u_{ij}|X,Z) = 0 and var (u_{ij}|X,Z) = σ_j^2. Q_{ij} is observed if, and only if, outlet *j* is used, which occurs when $U_{ij}^* > \max_{m \neq j}(U_{im}^*)$. If the *ε*'s and *u*'s are not independent, OLS estimates in Equation 22 will be biased. A consistent estimation of α_j requires inclusion of the selection correction terms of the alternative choices in Equation 22. The model assumes the following linearity assumption:

$$E(U_{ij} \mid \varepsilon_{i1} \cdots \varepsilon_{iJ}) = \sigma_j \sum_{m \neq j}^{J} r_j (\varepsilon_{im} - E(\varepsilon_{im}))$$

With $\sum_{m=1}^{J} r_j = 0$ (by construction, the correlation between *u*'s and *ε*'s sums to zero). Using this assumption, the equation of the multinomial ESR in Equation 21 is specified as:

$$\begin{cases} \text{Regime } 1: \quad Q_{i1} = Z_i \alpha_1 + \alpha_i \lambda_1 + \omega_{i1} \quad if \ I = 1 \\ \quad \vdots \quad \vdots \\ \text{Regime } J: Q_{iJ} = Z_i \alpha_J + \alpha_J \lambda_J + \omega_{iJ} \ if \ I = J \end{cases} \quad \text{.....23}$$

Where σ_j is the covariance between ε's and u's, and λ_j is the inverse Mills ratio computed from the estimated probabilities in Equation 21 as follows:

$$\lambda_j = \sum_{m \neq j}^{J} \rho_j [\frac{P_{im} In(P_{im})}{1 - P_{im}} + In(P_{ij})] \text{.....24}$$

Where ρ is the correlation coefficient of ε's, and u's and ω's are error terms with an expected value of zero. In the multinomial choice setting, there are $J-1$ selection correction terms, one for each alternative package. The standard errors in Equation 23 are bootstrapped to account for the heteroskedasticity arising from the generated regressor (λj).

3.4.3 Estimation of average treatment effects

The above framework can be used to examine the average treatment effects (ATE) by comparing the expected outcomes of various outlets. The challenge of impact evaluation using observational data is to estimate the counterfactual outcome, which is the income the users of a particular outlet could have earned had they not used the outlet (opportunity cost). Following Carter and Milon (2005) and Di Falco and Veronesi (2011), the ATE in the actual and counterfactual scenarios is computed as follows. Actual users of market outlets observed among users in the sample (USERS):

$$\begin{cases} E(Q_{i2} \mid I = 2) = Z_i \alpha_2 + \sigma_2 \lambda_2 \quad (a) \\ \vdots \quad \vdots \\ E(Q_{iJ} \mid I = J) = Z_i \alpha_J + \sigma_J \lambda_J \quad (b) \end{cases} \text{.....25}$$

Users of market outlets had they decided not to use an outlet (counterfactual) (NON-USERS):

$$\begin{cases} E(Q_{i1} \mid I = 2) = Z_i \alpha_1 + \sigma_1 \lambda_1 \quad (a) \\ \vdots \quad \vdots \\ E(Q_{i1} \mid I = J) = Z_i \alpha_J + \sigma_J \lambda_J \quad (b) \end{cases} \text{.....26}$$

These expected values are used to derive unbiased estimates of the ATE. The ATE is defined as the difference between Equations 25a and 26a or Equations 25b and 26b. For instance, the difference between Equations 25a and 26a is given as:

$$ATT = E[Q_{i2} \mid I = 2] - E[Q_{i1} \mid I = 2] = Z_i(\alpha_2 - \alpha_1) + \lambda_i(\sigma_2 - \sigma_1) \quad \text{.....} \quad 27$$

The first term on the right-hand side of Equation 27 represents the expected change in users of market outlets' mean outcome, if users' characteristics had the same return as non-users (had users opted not to market) and if users had the same characteristics as non-users. The second term (λ_j) is the selection term that captures all potential effects of difference in unobserved variables. Specific explanatory variables used in the multinomial endogenous switching regression (ESR) are presented in Table 3.4.

Table 3.4: Variables used and expected outcomes in the ESR model.

Variable	Description	Measurement	Expected Sign
Agehh	Age of the household head	Number of years	±
Edcnhh	Education level of the household head	Number of years	+
Housyz	Household size	Number of members	±
Exprnc	Experience in marketing	Number of years	+
Gendhh	Gender of the household head	0 = Female; 1 = Male	±
Landown	Land ownership (title deed)	0 = No; 1 = Yes	+
Foodsuff	Households' food self sufficiency	0 = No; 1 = Yes	+
Groupmemb	Group membership	0 = No; 1 = Yes	+
Contract	Contractual marketing	0 =No; 1 = Yes	+
Nonfarm	Participation in non-farm activities	0 =No; 1 = Yes	±
Trans	Ownership of transport equipment	0 =No; 1 = Yes	+
Credit	Access to credit	0 =No; 1 = Yes	+
Mrktinfo	Access to market information	0 =No; 1 = Yes	+
Distfrmrkt	Distance from farm to market	Kilometers	-
Farmsyz	Farm size	Acres	+
Extension	Number of extension contacts	Number of visits	+

3.5 Statistical and specification tests

Before performing regressions, all hypothesized explanatory variables were checked for the existence of the statistical multicollinearity problems. Multicollinearity arises due to a linear relationship among explanatory variables and the problem is that, it might cause the estimated regression coefficients to have wrong signs, smaller *t*-ratios for many of the variables in the regression and high *R*-square (R^2) value. Moreover, it causes large variance and standard error with a wide confidence interval hence becoming difficult to estimate accurately the effect of each variable (Gujarati, 2007 and Woodridge, 2002). If collinearity was high, estimation of regression coefficients though possible would have had large standard errors and thus the population values of the coefficients would not have been estimated precisely (Gujarati, 2007). There are different methods suggested to detect the existence of multicollinearity problem between the model regressors. According to Gujarati (2007), the variance inflating factor (VIF) technique is commonly used in an array of literature; and was therefore also preferred in the present study to detect multicollinearity problem among continuous explanatory variables. In Gujarati (2004), the VIF is described as how the variance of an estimator is inflated by the presence of multicollinearity. Mathematically, VIF for an individual explanatory variable (X_i) is computed as: $VIF(X_i) = 1 \big/ (1 - R^2)$, where R^2 is the coefficient of correlation among regressors.

Gujarati (2007) explained that larger values of VIF indicate stronger collinearity among one or more model explanatory variables. As a rule of thumb, if the VIF of a variable exceeds 10, which will happen if a multiple R^2 exceeds 0.90, that variable is said to be highly collinear (Gujarati, 2007). Alternatively, the inverse of VIF (1/VIF), called tolerance (TOL), can be executed to detect multicollinearity. The closer the TOL of one explanatory variable (X_i) is to zero, the greater the degree of collinearity of that variable with the other regressors. On the other hand, the closer the TOL of X_i is to one, the greater the evidence that X_i is not collinear with the other regressors (Gujarati, 2007). The contingency coefficient (CC) method was used to detect the degree of association among discrete explanatory variables following Healy (1984). According to Healy (1984), the discrete/dummy variables are said to be collinear if the value of contingency coefficient (CC) is greater than 0.75. Mathematically, it is computed as: $CC = \sqrt{\frac{X^2}{n + X^2}}$, where CC is the contingency coefficient; *n* is sample size and X^2 is a *Chi*-square (Chi^2) value.

CHAPTER FOUR
RESULTS AND DISCUSSIONS

4.1 Descriptive results

4.1.1 Socioeconomic characteristics of different types of AILV farmers

The different types of producers are net buyers, net sellers and autarkic. The results of the socio-economic characteristics for continuous explanatory variables are presented in Table 4.1. The education level of the household head was significantly different at 10% level of significance. The net sellers and autarkic household heads both had a mean of 10 years of schooling, while the net buyers had a mean of 8 years of schooling. The higher education levels among autarkic and net sellers suggested that, farmers with higher levels of education were more open to new ideas and more likely to be risk takers. They could therefore break away from farm enterprises they previously engaged in and venture into new enterprises (AILV) in pursuant of better income and livelihoods. The educational status of the household head is an important element in smallholder economic activities. Formal education has been found to enhance managerial competence and successful implementation of improved production, processing and marketing practices (Marenya and Barret, 2007). Further, Makhura *et al.* (2001) stated that human capital, represented by the household head's formal education, is posited to increase a household understanding of market dynamics and therefore improve decision about the amount of output sold, *inter alia*.

Intriguingly, Irungu *et al.* (2007) reported that AILV farmers were more educated than other categories of traders, implying that the production of AILV is a field for those endowed with human capital. This might be because one has to acquire knowledge on several aspects of AILV, for instance, their nutritive value and marketing strategies, before embarking on their production. Education helps to unlock the natural talents and inherent enterprising qualities of the farmers, thus making them more skilled and more responsive to risk taking and change than the illiterate farmers (Nwaru, 2004). People with high education level are likely to analyse and interpret information than those who have less education or no education at all (Marther and Adelzadeh, 1998).

The farm size was statistically different at 5% significance level with the net buyers, autarchies and net sellers owning 2.36, 1.52 and 1.98 acres of land respectively. The net buyers had the largest land holdings, possibly because, AILV are a relatively new venture, and so instead of digressing to production of AILV, net buyers stuck to previously produced crops such as maize and beans condemning them to be buyers of AILV.

Table 4.1: Socioeconomic characteristics of smallholders for continuous explanatory variables (*F*-test).

Variable	Overall Mean n = 254	Means of Market Participants by Categories			*F*-Test	Pr. > F
		Net Buyers n = 22	Autarkic n = 17	Net Sellers n = 215		
Age of the HHH	47.51 (10.88)	45.96 (9.99)	47.41 (11.96)	47.67 (10.92)	0.78	0.84
Education of the HHH	9.65 (3.95)	8.46 (2.76)	9.88 (4.27)	9.76 (4.03)	1.60*	0.06
Household size	6.14 (2.04)	6.32 (1.59)	5.88 (1.65)	6.14 (2.11)	0.91	0.55
Farm size	1.98 (1.49)	2.36 (1.77)	1.52 (1.55)	1.98 (1.59)	2.33**	0.03
Income from AILV	16612.52 (29967.15)	2274.76 (2910.74)	3552.65 (3489.42)	19122.86 (31916.21)	0.87	0.76

Note: HHH is for household head; Figures in parentheses are standard deviations; **: significant at 5% level; *: significant at 10% level.

This gave the picture of risk averseness. This finding contradicted that of Machethe *et al*. (2008), who found that land is a critical production asset having a direct bearing on production of a marketable surplus. In supporting the finding by Machethe *et al*. (2008), Branson and Norvell (1983) discovered that, expanding the land under crop production increased the volume of marketable produce.

The results of the socioeconomic characteristics of smallholders for discrete explanatory variables are presented in Table 4.2. The dummy for whether a farmer had a title deed or not was statistically significant at 5% level. About 86.36% of net buyers did not possess title deeds while 13.64% had title deeds. For autarkic households, 88.24% did not own land, while 11.76% had title deeds. Correspondingly, 64.65% of net sellers did not own land, while 35.35% had title deeds. Ownership of title deeds was highest among net sellers and this could explain their ability to develop land (boosting production) or possibly obtain cash loans (to fund marketing operations such as meeting transportation costs), enabling them to become net sellers. The high proportion of no land ownership, by virtue of possessing title deeds, could be explained by: increasing population pressure resulting to land fragmentation, especially in hereditary systems of land sub division among siblings, leaving them with no land titles as the original deeds remain with their parents. Ownership of land influences agriculture productivity, because farmers who do not own land can be reluctant to develop and maintain the land (Randela *et al*., 2000). Furthermore, such farmers may have difficulty in obtaining loans for agricultural purposes because they cannot use the land as collateral.

The ability of households to meet their food needs was statistically different at 5% significance level across the market regimes. For the net buyers, 100% were not self-sufficient in terms of food production; about 88.24% of autarkic households were not self-sufficient in terms of food production, while 11.76% were able to produce enough family food. On the other hand, 26.51% of net sellers were able to produce enough family food, while 73.49% were not able to meet their family food needs. The inability of households to meet their food needs was highest for net buyers. All net buyers were not able to meet their family food needs thus had to buy AILV, explaining their participation in markets as net buyers. The study by Lukanu *et al*. (2004) revealed that household food availability is one among the factors that affects farmers' decision to commercially produce.

Table 4.2: Socioeconomic characteristics of smallholders for discrete explanatory variables (*Chi*^{2} test).

Variable	Description	Overall n = 254	Number of Market Participants by Categories			Pearson *Chi*^{2}	Pr
			Net Buyers n = 22	Autarkic n = 17	Net Sellers n = 215		
Gender of the HHH	Male	184 (72.44)	15 (68.18)	13 (76.47)	156 (72.56)	0.340	0.844
	Female	70 (27.56)	7 (31.82)	4 (23.53)	59 (27.44)		
Land ownership	Yes	81 (31.89)	3 (13.64)	2 (11.76)	76 (35.35)	7.729**	0.021
	No	173 (68.11)	19 (86.36)	15 (88.24)	139 (64.65)		
Food self sufficiency	Yes	59 (23.23)	0 (0.00)	2 (11.76)	57 (26.51)	9.209**	0.010
	No	195 (76.77)	22 (100.00)	15 (88.24)	158 (73.49)		
Non-farm income activities	Yes	107 (42.13)	7 (31.82)	3 (17.65)	97 (45.12)	5.926*	0.052
	No	147 (57.87)	15 (68.18)	14 (82.35)	118 (54.88)		
Transport equipment owned	Yes	60 (23.62)	2 (9.09)	2(11.76)	56 (26.05)	4.600	0.100
	No	194 (76.38)	20 (90.91)	15 (88.24)	159 (73.95)		

Note: HHH stands for household head; Figures in parentheses are percentages; **: significant at 5% level; *: significant at 10% level.

Participation in non-farm income generating activities was statistically significant at 10% level with 45.12%, 17.65% and 31.82% of net sellers, autarchies and net buyers (respectively) participating in non-farm income generating activities. Net sellers had the highest proportion of participants in non-farm income generating activities. This could explain their participation in markets as net sellers, possibly because they finance AILV production and marketing activities through off farm incomes. Rao and Qaim (2011) found that income from off farm activities could be used to finance farm investment required for farmers' participation in high value markets. Alene *et al*. (2008) noted that non-farm income contributes to more marketed output if it is invested in farm technology and other farm improvements.

4.1.2 Institutional and access characteristics of different types of AILV farmers

The results of the institutional and access characteristics of smallholders for continuous explanatory variables are presented in Table 4.3. The distance from smallholders' homes to farms, as well as from farms to markets were statistically different at 1% and 5% significance levels. The net sellers had the shortest distances from homes to farms at 0.51 kilometers, followed by net buyers at 1.20 kilometers and lastly, autarkic households had the longest distance at 3.40 kilometers. The distance from farms to markets was longest for net buyers (3.02km), followed by net sellers (2.70km) and then the autarkic farmers (2.21km). Net buyers had the longest distance separating them from markets. Longer distances translated to high transportation costs therefore justifying their participation in markets as net buyers, instead of incurring transportation costs of AILV to markets.

The distance from the farm to point of sale was found, in a couple of studies, to be a major constraint to the intensity of market participation (Goetz, 1992; Montshwe, 2006; Bahta and Bauer, 2007; Omiti *et al*., 2009). Minot (1999) showed that the choice of marketing outlet among traders is negatively related to the distance to the market site. Ogunleye and Oladeji (2007) found that a greater distance to the market increases transportation costs and marketing costs and this hampers the extent of market participation.

Table 4.3: Institutional and access characteristics for continuous explanatory variables (*F*-test).

Variable	Overall Mean n = 254	Means of Market Participants by Categories			*F*-Test	Pr. > F
		Net Buyers n = 22	Autarkic n = 17	Net Sellers n = 215		
Distance (Home-Farm)	1.00 (3.56)	1.20 (2.30)	3.40 (12.03)	0.51 (1.78)	2.11**	0.03
Distance (Farm-Market)	2.85 (3.90)	3.01 (1.77)	2.21 (1.70)	2.70 (4.27)	3.00***	0.00
Number of extension visits	3.81 (3.25)	2.91 (1.85)	3.82 (3.57)	3.90 (3.34)	1.36	0.20
Marketing experience	7.76 (7.46)	3.10 (4.22)	5.16 (3.26)	8.48 (7.79)	1.72**	0.02

Note: Figures in parentheses are standard deviations; ***: significant at 1% level; **: significant at 5% level.

Experience in marketing AILV was found to significantly vary across participants of the different markets regimes at 5% significant level with net buyers having an average of 3 years of market participation experience, 5 years for autarchies and 8 years for net sellers. Experience was highest among net sellers which implied that farmers with higher number of years of experience had higher participation as net sellers, possibly reflecting their ability to negotiate and achieve better terms of trade. Abay (2007) found an increase in farmers' experience resulted in the increases of tomato being supplied to the market. Further, these farmers will have stronger social networks and will have established credibility within the network (Makhura *et al*., 2001).

The results of the institutional characteristics of smallholders for discrete explanatory variables are presented in Table 4.4. The dummy for contractual marketing was statistically different at 1% significance level with 0% of net buyers under contract, 11.76% and 28.84% of autarkic and net seller (respectively) having contracts. Net sellers had their highest proportions of contracted farmers. Marketing under contract increased market participation because farmers were guaranteed a ready market, plausibly explaining the high proportion of contractual arrangements for net sellers. Habwe *et al*. (2008) recognized the importance of technical support such as market linkages, where contracted farmers of AILV are linked to city supermarkets, informal markets and individual vendors, food processing and preparation joints for sustainable utilization of AILV.

Access to credit was significantly different at 1% significance level with 59.07% of net sellers having access to credit, while 41.18% and 18.18% of autarkic and net buyers having access to credit as well. The proportion of farmers who had access to credit was highest among net sellers. This could explain their ability to invest in production enhancing technologies, hence producing surpluses for markets, as well as funding marketing activities such as searching for information and transporting produce. Mutai *et al*. (2013) postulated that access to credit gives the farmer more cash resources hence it has an effect on their marketing activities. Immink and Alarcon (1993) and Lerman (2004) support the finding of the current study by arguing for agricultural credit as it plays a vital role in the process of smallholder commercialization. Credit facilitates the introduction of innovative technologies and ensures input and output marketing arrangements (Reddy, 1998).

Table 4.4: Institutional characteristics for discrete dummy variables (*Chi*^{2} test).

Variable	Description	Overall n = 254	Number of Market Participants by Categories			Pearson *Chi*^{2}	Pr
			Net Buyers n = 22	Autarkic n = 17	Net Sellers n = 215		
Group membership	Yes	231 (90.94)	21 (95.45)	16 (94.12)	194 (90.23)	0.884	0.643
	No	23 (9.06)	1 (4.55)	1 (5.88)	21 (9.77)		
Contractual marketing	Yes	64 (25.20)	0 (0.00)	2 (11.76)	62 (28.84)	10.550***	0.005
	No	190 (74.80)	22 (100.00)	15 (88.24)	153 (71.16)		
Credit access	Yes	138 (54.33)	4 (18.18)	7 (41.18)	127 (59.07)	14.718***	0.001
	No	116 (45.67)	18 (81.82)	10 (58.82)	88 (40.93)		
Market information	Yes	134 (52.76)	6 (27.27)	10 (58.82)	118 (54.88)	6.374**	0.041
	No	120 (47.24)	16 (72.73)	7 (41.18)	97 (45.12)		

Note: Figures in parentheses are percentages; ***: significant at 1% level; **: significant at 5% level.

Access to market information was statistically significant at 5% level, with autarkic households having the highest proportion (58.82%) of those with access to market information. The proportion of those with market information among net sellers was 54.88% and 27.27% among net buyers. Autarkic and net seller households had higher proportions of farmers who had access to market information compared to net buyers. Access to market information was postulated to reduce the costs of searching for market information as well as addressing the problems of moral hazard and adverse selection. This in turn motivated farmers to move away from lower positions of market participation (net buyers) to higher market positions of autarchies and net buyers, in order to engage profitably in marketing. Studies by Enete and Igbokwe (2009) and Omiti *et al*. (2009) underscored the importance of price and market information in luring smallholders to participate in markets.

4.2 Econometric results

4.2.1 Determinants of market participation behaviour for AILV

An ordered probit model was used to analyze the determinants of market participation among smallholder AILV farmers. However, it is worth mentioning that 22 respondents (8.66%) were net buyers, 17 (6.69%) were autarkic and 215 (84.65%) were net sellers of AILV. Socioeconomic and institutional variables were hypothesized to influence market participation by typology (net seller, net buyer and autarkic regimes). Prior to conducting the regression analysis, both the continuous and discrete explanatory variables were checked for the existence of multicollinearity using the variance inflating factor (VIF) and the contingency coefficient (CC) methods respectively. Accordingly, the test results are presented in Table 4.5 for VIF and Table 4.6 for CC. The results revealed no serious multicollinearity problem. By rule of thumb, there was no strong association among hypothesized explanatory variables (VIF values are less than 10 and CC values are less than 0.75), therefore, all of the proposed potential explanatory variables were included in the ordered probit regression.

Table 4.5: Variance inflating factor test results for continuous explanatory variables.

Variable	VIF	1/VIF
Age of the household head	1.53	0.655
Education level of the household head	1.29	0.773
Marketing experience	1.28	0.784
Number of extension contacts	1.22	0.818
Household size	1.22	0.818
Farm size	1.12	0.892
Distance from the farm to the market	1.07	0.935
Mean VIF	1.25	

Table 4.6: Contingency coefficient test results for discrete explanatory variables.

	Gendhh	Landown	Foodsuff	Groupmemb	Contract	Partnonfrm	Owntrans	Credit	Mrktinfo
Gendhh	1.0000								
Landown	-0.0695	1.0000							
Foodsuff	0.0472	0.1437	1.0000						
Groupmemb	-0.1025	0.0099	0.0111	1.0000					
Contract	0.0129	-0.1442	0.1317	0.1199	1.0000				
Partnonfrm	0.0622	-0.1390	0.1727	-0.0920	0.4782	1.0000			
Owntrans	0.0111	0.0172	0.0014	0.1432	0.3818	0.2201	1.0000		
Credit	0.0713	-0.0171	0.0738	0.2615	0.4047	0.3180	0.2122	1.0000	
Mrktinfo	0.1752	0.0553	-0.0024	0.0861	0.1678	-0.0072	0.3035	0.2089	1.0000

Informed by these test results, the ordered probit model regression was conducted and the results are presented in Table 4.7. The ordered probit model of discrete market participation yielded intuitive results. The non-zero censoring points were of negative signs, with the lower censoring threshold at -2.25 (AILV net purchases) and the upper threshold at -1.79 (AILV net sales), each statistically significantly different from zero. These estimates suggested that purchases or sales of less than 1 kilogram were generally uneconomical, given the monetary and non-monetary costs of market participation in the study area. This, according to Bellemare and Barret (2006), could be explained by people's willingness to enter the market for smaller volume sales than purchases, likely reflecting the fact that sales of AILV are essentially means by which households meet immediate cash needs related to payment of school fees, food purchases and ceremonial or emergency health expenses.

The goodness-of-fit measured by the Prob > Chi^2 = 0.000 showed that the choice of explanatory variables included in the ordered probit model explained the variation in decisions to participate in the market by typology. The likelihood ratio tests indicated that the slope coefficients were significantly different from zero for participation decisions. The pseudo *R*-square of 0.2228 was above the statistical threshold of 20% demonstrating that the explanatory variables described about 22.28% of the covariates considered in the model.

The number of years smallholders participated in AILV marketing (Experience) positively influenced the likelihood of households being net sellers at 5% significance level, *ceteris paribus*. Older household heads could therefore take advantage of their experience to obtain superior yields, hence better income, thus likely moving them towards net sellers' position in the market. In addition to developing strong networks with buyers, the experience a farmer had likely reflected higher bargaining power. Abay (2007) found evidence that an increase in farmers' experience caused an increases in tomatoes supplied to the market in Fogere, South Gonder.

Land ownership positively influenced the likelihood of farmers participating in markets as net sellers, all else held constant. This variable was found to be statistically different at 5% significance level. Possibly, smallholders possessing larger land sizes were more likely to increase the proportion of land under AILV production. This could translate to higher yields, increasing the probability of producing surpluses that are sold off to the market thus moving them towards becoming net sellers. Branson and Norvell (1983) discovered that expanding the land area under crop production increased the volume of marketable produce.

Table 4.7: Results of the ordered probit regression for market participation behaviour.

Variable	Coefficient	Standard Error	z	P > |z|
Age of the HHH	-0.016	0 .013	-1.18	0.240
Education level of the HHH	0.006	0 .035	0.17	0.864
Household size	0.007	0.067	0.10	0.921
Experience in marketing	0 .071**	0.029	2.50	0.013
Gender of the HHH	0 .021	0.264	0.08	0.937
Land ownership	0.810**	0.314	2.58	0.010
Food self sufficiency	1.005**	0.442	2.27	0.023
Group membership	-0.714	0.455	-1.57	0.116
Contractual marketing	1.395**	0.667	2.09	0.036
Access of non-farm income	-0.254	0 .296	-0.86	0.390
Ownership of transport	0 .327	0 .372	0.88	0.379
Access to credit	0 .849***	0 .280	3.04	0.002
Access to market information	-0.248	0 .268	-0.93	0.355
Distance from farm to market	0 .014	0.046	0.31	0.759
Farm size	-0.117	0 .081	-1.45	0.148
Number of extension contacts	-0.133**	0 .062	-2.15	0.032
Ancillary Parameters				
/cut1	-2.248	0.821		
/cut2	-1.789	0 .815		

Number of Observations = 254
LR Chi^2 (16) = 60.43
Prob > Chi^2 = 0.0000
Pseudo R^2 = 0.2228
Log likelihood = -105.4122
z and P > |z| correspond to the test of the underlying coefficient being 0

Note: ***: significant at 1% level; **: significant at 5% level; HHH is for household head.

Households' food self-sufficiency positively influenced the likelihood of households being net sellers at 5% significance level, keeping the effects of other variables constant. The non-zero censoring points of the ordered probit model suggested that it is probable that households engaged in AILV marketing to meet immediate family needs such as food. It could be that smallholders started off as subsistence producers of AILV, but once their

households became food sufficient, they entered AILV markets to sell off remaining portions of produced AILV, likely moving them towards becoming net sellers. Lukanu *et al*. (2004) verified that households' food availability is one among the factors that affects farmers' decision to commercially produce.

Contractual marketing had a positive influence on the likelihood of households participating in markets as net sellers at 5% significance level. In the uncertain world of farming, fluctuating market conditions, especially price and the promise of making sales is a thorny issue to farmers. Contracts between buyers of AILV and producers therefore guarantee smallholders ready markets, thus income. This could further have motivated farmers to perpetually move towards being net sellers, as ready markets guaranteed them income from farming AILV. Jari and Fraser (2009) found an increase in formal market participation made possible by contractual agreements amongst smallholders and emerging farmers in the Kat river valley, South Africa.

Access to credit was positive and significantly different at 1% significance level, *ceteris paribus*. Credit gives smallholders cash resources that they could invest in marketing activities such as value addition to improve incomes, or even invest in transportation to further off lucrative markets which, otherwise, are inaccessible. In the pursuit of better incomes, credit boosts that improve on AILV marketing would likely have pushed farmers towards becoming net sellers. Mutai *et al*. (2013) corroborated that participation in sweet potato markets in Vihiga County, Kenya was influenced by credit access. Credit also facilitates the introduction of innovative technologies and ensures input and output marketing arrangements (Reddy, 1998).

The number of visits by extension workers negatively influenced the likelihood of smallholders being net sellers at 5% significance level. This was intriguing since access to extension service, through extension officers, was expected to play an imperative role in empowering farmers with marketing information and ability, thus increasing the likelihood of households becoming net sellers. It could be that extension officers were more conversant with information relating to traditionally grown crops such as maize and beans and not on AILV. Lack of sufficient information condemns smallholders to become autarkic and net buyers of AILV. AILV have only started receiving attention in the contemporary years as high value nutritional crops, thus fuelling their recent demand. This finding contravenes that

of Mutai *et al*. (2013) who found a positive impact of extension services on market participation.

4.2.2 Combinations of market outlets with the highest payoffs

This section describes the factors that influenced the choice of combination of market outlets (packages), and then quantified the impact of the choice of market packages on the income farmers derived. This was achieved using the multinomial endogenous switching regression (MNL ESR) model. First, the sample unconditional and conditional probabilities were computed to highlight the existence of interdependence across the three individual market outlets (farm gate, local markets and urban markets) before combinations. From Table 4.8, the sample joint and marginal probabilities were deduced. The unconditional probability of observing all three types ($F_1L_1U_1$) at once was at the rate of 3.7% (0.037). The sample unconditional probability of observing only "Farm Gate" was 23.4% (0.234), only "Local Markets" was 21.7% (0.217) and only "Urban Markets" was 2.5% (0.025). Their respective conditional probabilities (Table 4.9) were 72.95%, 71.72% and 11.48%.

Table 4.8: Summary statistics for market outlet combinations.

Choice	Binary Triplet	Frequency	Percent
1	$F_1L_1U_1$	9.00	3.70
2	F_1L_1Uo	106.00	43.44
3	F_1LoU_1	6.00	2.50
4	F_1LoUo	57.00	23.40
5	FoL_1U_1	7.00	2.90
6	FoL_1Uo	53.00	21.70
7	$FoLoU_1$	6.00	2.50
Total		244.00	100.00

Table 4.9: The unconditional and conditional probabilities of market packages (%).

	Farm Gate (F)	Local Markets (L)	Urban Markets (U)
$P(Y_k = 1)$	72.95	71.72	11.48
$P(Y_k = 1\|Y_F = 1)$	100.00	64.61	8.43
$P(Y_k = 1\|Y_L = 1)$	65.71	100.00	9.14
$P(Y_k = 1\|Y_U = 1)$	53.57	57.14	100.00
$P(Y_k = 1\|Y_F = 1, Y_L = 1)$	100.00	100.00	7.83
$P(Y_k = 1\|Y_F = 1, Y_U = 1)$	100.00	60.00	100.00
$P(Y_k = 1\|Y_L = 1, Y_U = 1)$	56.25	100.00	100.00

Y_k is a binary variable that represents choosing an outlet with respect to choice k [k = farm gate (F), local markets (L) or urban markets (U)]. Each element in the binary triplet is a variable which is equal to one (100%) if there was a choice with respect to that type and zero otherwise.

The sample conditional probabilities in Table 4.9 provided fascinating indications of the existence of possible dependence between the three market outlets. Consider for example the case of "Urban Markets". The unconditional probability of "Urban Markets" alone was 11.48%. However, among all outlets with "Farm Gate", the sample probability with "Urban Markets" was 8.43%; among all outlets with "Local Markets", the probability was 9.14%. This meant that the probability of using only "Urban Market" was substantially reduced if there was additional information that another type of market package exists. Marketing information can lead to informed choice of markets with high level of returns. Information aids in acquainting the market participants with the marketing conditions of various outlet combinations. Better utilization of market information may in turn reduce marketing costs and make it more profitable to participate in the market. Jari (2009) stated that, availability of market information boosts confidence of households willing to participate in the market. Poor access to market information results in information-related problems, namely moral hazard and adverse selection, which in turn increases transaction costs discouraging market participation by some farmers (Fafchamps and Hill, 2005; Shiferaw *et al*., 2009).

The conditional and unconditional probabilities highlighted the existence of interdependence across the three outlets and have the following implications. About 72.95% of the observed sample used "Farm Gate", 71.72% used "Local Markets" and 11.48% used "Urban markets" only. The conditional probability that a household used "Local Markets" decreased from 71.72% to 64.61% when farmers used a combination of market outlets as opposed to using an individual outlet of local markets. Similarly, the conditional probability that a household used only urban markets decreased from 11.48% to 8.43% when farmers used combinations of market outlets. These results indicated complementarity among the use of farm gate, local market and urban market outlets. This implied that the market outlets were interdependent of each other, meaning two or more individual market outlets improve on each other's qualities (net returns). The farm gate, local market and urban market outlets exhibited a state of mutual dependence, interrelation and reciprocation where two or more of the market outlets supplemented each other.

Table 4.10 provides a descriptive summary of the users of specific market outlets combinations and that of the pooled sample (Mean and Standard Deviation of All), with the base category of non-users of any channel combination also included. The table compared the means of explanatory variables between each market package and the baseline category ($F_0L_0U_0$) under the assumption of unequal variance. SD is the standard deviation. Afterwards, the MNL model regression was conducted. All the proposed explanatory variables thought to influence the use of market packages were included in the analysis. The multinomial logit model regression was subsequently conducted to obtain parameter (coefficient) estimates and thereafter, the marginal effects of using specific combinations of market outlets were post estimated and the regression results are presented in Table 4.11.

The marginal effects from the MNL model, which measure the expected change in the probability of a particular choice being made with respect to a unit change in an independent variable, are reported and discussed. The marginal effects were used for interpretation since the coefficients had no direct interpretation. They were just values that maximized the likelihood function. The significant values showed whether a change in the independent variable significantly influences the logit at a given market package adoption strategy.

The MNL model fitted the data reasonably well. The *Chi*-square value of -243.085 showed that the likelihood ratio statistics were highly significant ($P < 0.000$). The Wald test that all regression coefficients were jointly equal to zero was rejected [LR χ^2 (112) = 176.08; Prob > χ^2 = 0.000], suggesting that the MNL model had strong explanatory power.

Age of the household head had a negative and significant influence on using combinations $F_1L_1U_0$ (farm gate and local market only), $F_1L_0U_1$ (farm gate and urban market only) and $F_1L_1U_1$ (farm gate, local market and urban market). This implied that, relative to the base category of non-use of any market package ($F_0L_0U_0$), an increase in the farmer's age by 1 year decreased the probability of using $F_1L_1U_0$, $F_1L_0U_1$ and $F_1L_1U_1$ by 0.51%, 0.09% and 2.59e-06 respectively. This could be attributed to the possibility that older household heads had more children and dependents. It is likely that, for the packages that showed significance, the number of dependents was a pseudo characteristic of age. Age can be expected to have a negative association with market participation, as older household heads tend to have more dependents and hence engage more in subsistence production activities (Ehui *et al*., 2009). Alene *et al.* (2007), Barret *et al.* (2006) and Nwaru and Iwuji (2005) also gave evidence of declining market participation that comes with an increase in age of the farmers.

Table 4.10: Mean values for socioeconomic and institutional characteristics by market package used strategy.

Variables	Mean Values for Market Outlets Combinations (Packages)									
	$F_0L_0U_0$	$F_1L_0U_0$	$F_0L_1U_0$	$F_0L_0U_1$	$F_1L_1U_0$	$F_1L_0U_1$	$F_0L_1U_1$	$F_1L_1U_1$	Mean of All	SD of All
Gender	0.60	0.57	0.74	0.67	0.78	0.50	1.00	0.89	0.72	0.45
Age	52.50	49.84	44.61	39.83	47.86	45.33	51.00	44.00	47.51	10.88
Education	7.50	8.91	9.45	10.17	10.31	10.17	10.00	9.33	9.65	3.95
Household size	6.10	6.26	6.02	4.67	6.25	6.67	6.14	5.44	6.14	2.03
Farm size	1.00	1.61	2.12	0.93	1.82	2.17	2.18	1.86	1.80	1.54
Land ownership	0.30	0.32	0.28	0.00	0.32	0.33	0.71	0.44	0.32	0.47
Group membership	0.80	0.93	0.89	0.83	0.94	1.00	1.00	0.67	0.91	0.29
Extension visits	3.10	3.53	3.34	1.00	4.66	3.17	2.00	2.78	3.81	3.25
Food sufficiency	0.10	0.16	0.25	0.33	0.21	0.50	0.71	0.33	0.23	0.42
Distance	2.48	1.28	2.64	1.51	3.54	3.43	4.69	2.36	2.75	3.98
Experience	8.40	5.71	4.62	4.33	10.69	6.33	8.86	5.78	7.76	7.47
Contractual marketing	0.10	0.32	0.04	0.50	0.34	0.33	0.14	0.11	0.25	0.44
Market information	0.10	0.40	0.26	0.50	0.75	0.50	0.71	0.56	0.53	0.50
Transport	0.10	0.09	0.17	0.00	0.40	3.33	0.14	0.00	0.23	0.43

Note: SD stands for standard deviation.

Table 4.11: Parameter and marginal effects estimates for the determinants of market packages used strategies by MNL.

Variable	$F_1L_0U_0$		$F_0L_1U_0$		$F_0L_0U_1$		$F_1L_1U_0$	
	Coeff (S.E)	**dy/dx**	**Coeff (S.E)**	**dy/dx**	**Coeff (S.E)**	**dy/dx**	**Coeff (S.E)**	**dy/dx**
Age	-0.02 (0.03)	-0.0060	-0.05 (0.03)	-0.0000	-0.05 (0.05)	-0.00002	-0.06 (0.03)	-0.0051*
Education	0.01 (0.11)	0.0006	-0.00 (0.11)	-0.0011	0.06 (0.43)	0.00002	0.01 (0.11)	0.0017
Household size	-0.05 (0.22)	-0.0031	-0.02 (0.23)	-0.0072	-0.10 (1.34)	-3.49e-06	-0.09 (0.22)	-0.0137
Experience	-0.17 (0.07)	-0.015**	-0.20 (0.07)	-0.0182***	0.18 (0.13)	0.00018	-0.04 (0.06)	-0.0336
Gender	-0.68 (0.89)	-0.093	0.01 (0.91)	0.0374	0.04 (1.49)	0.0002	-0.09 (0.91)	-0.0808
Land ownership	0.77 (1.08)	0.023	0.71 (1.11)	0.0085	-19.57 (1644.41)	-0.00001	0.61 (1.09)	0.0276
Food sufficiency	1.16 (1.55)	-0.143	2.98 (1.55)	0.1691*	3.65 (2.06)	0.0578	1.98 (1.52)	0.0963
Group membership	1.96 (1.30)	0.124	1.74 (1.27)	0.0898	2.98 (1.96)	0.2121	0.73 (1.30)	0.2058
Contract marketing	1.38 (1.78)	0.198	-2.60 (2.01)	-0.3000	2.38 (3.20)	0.0282	0.54 (1.76)	0.0449
Non-farm income	0.69 (1.00)	0.156	0.45 (1.02)	0.0919	-0.62 (1.22)	-7.16e-06	-0.48 (1.02)	-0.2215
Transport	-2.20 (1.62)	-0.217	0.08 (1.56)	0.1067	-0.80 (1.68)	-0.00002	-0.32 (1.52)	-0.1097
Access to credit	-0.36 (0.95)	-0.1.6	-1.49 (0.99)	-0.3113	-1.84 (1.14))	-1.28e-06	1.00 (0.97)	0.4162
Market information	3.39 (1.45)	0.058**	2.75 (1.47)	0.1580*	-6.20 (3.12)	-0.0002	4.23 (1.43)	0.2982***
Distance	-0.26 (0.28)	-0.082	0.10 (0.25)	0.0120	-2.20 (0.38)	-0.00362	0.33 (0.24)	0.0931
Farm size	1.05 (0.63)	0.002*	1.14 (0.63)	0.0162*	1.47 (0.55)	0.000032	1.03 (0.63)	0.0046*
Extension visits	0.16 (0.22)	0.012	0.43 (0.23)	0.0339*	-0.39 (0.15)	-0.00022	0.20 (0.21)	0.0147

Note: $F_0L_0U_0$ is the reference base category in the MNL; ***: significant at 1% level; **: significant at 5% level; *: significant at 10% level.

Table 4.11: Parameter and marginal effects estimates for the determinants of market packages used strategies by MNL (Continuation).

Variable	$F_1L_0U_1$		$F_0L_1U_1$		$F_1L_1U_1$	
	Coeff (S.E)	**dy/dx**	**Coeff (S.E)**	**dy/dx**	**Coeff (S.E)**	**dy/dx**
Age	-0.12 (0.06)	-0.0009**	-0.08 (0.05)	-0.000	-0.10 (0.05)	-2.59e-06*
Education	0.01 (0.18)	0.0001	-0.36 (0.19)	-0.0012*	-0.17 (0.17)	-9.83e-06
Household size	0.21 (0.32)	0.0035	-0.32 (0.32)	-0.001	-0.36 (0.32)	-0.000
Experience	-0.12 (0.12)	-0.0004	-0.15 (0.11)	-0.0002	-0.07 (0.11)	-9.38e-07
Gender	-1.79 (1.35)	-0.0309	1.26 (1.55)	0.0039	3.25 (2.37)	0.000
Land ownership	0.38 (1.49)	0.0033	1.90 (1.47)	0.0056	1.79 (1.43)	0.000
Food sufficiency	4.15 (1.84)	0.0487**	0.54 (2.00)	0.0368***	2.84 (1.75)	0.000
Group membership	1.98 (2.41)	0.0085	1.64 (2.01)	0.0016	-0.12 (1.58)	-0.000
Contract marketing	2.87 (2.19)	0.0621	-0.06 (2.23)	-0.0014	0.11 (2.15)	0.000
Non-farm income	-2.84 (1.95)	-0.0362	1.94 (1.46)	0.0091	1.12 (1.26)	0.000
Transport	0.46 (1.99)	0.0154	-0.47 (2.00)	-0.0001	-25.73 (148650.6)	-0.0206
Access to credit	0.09 (1.42)	0.0017	1.84 (1.46)	0.0049	-0.04 (1.35)	-0.00001
Market information	2.79 (1.88)	0.0116	3.56 (1.74)	0.0005**	4.70 (1.69)	0.00005***
Distance	0.31 (0.28)	0.0017	0.51 (0.26)	0.0011**	-0.03 (0.35)	-0.000
Farm size	0.90 (0.71)	0.0018	0.86 (0.72)	0.0006	1.32 (0.68)	0.00002*
Extension visits	0.04 (0.32)	0.0024	-0.54 (0.45)	-0.0026	0.24 (0.28)	1.03e-06

Note: $F_0L_0U_0$ is the reference base category in the MNL; ***: significant at 1% level; **: significant at 5% level; *: significant at 10% level.

Education level of the household head was found to be negatively associated with using combination $F_0L_1U_1$ (local market and urban market only). This meant that a 1 year increase in the education level of the household head reduced the likelihood of using $F_0L_1U_1$ by 0.12%, relative to $F_0L_0U_0$ (non-use of any combination). This finding was interesting. Pegged on the ability to understand and interpret information related to improving market outlet choices hence income, education was expected to have a positive influence on using a market package. However, the justification behind this finding could be that; as smallholders became more advanced in terms of education they were better equipped with entrepreneurial skills that enabled them to make informed decisions that improved on marketing. It is therefore likely that the choice of $F_0L_1U_1$ exhibited higher transaction costs, than the other packages which were found to be insignificant for this variable. Therefore educated farmers likely reduced engagements or even opted out of the outlets with higher transaction costs. Chirwa (2009) analyzed the determinants of marketing channels among smallholder maize farmers in Malawi and interestingly found that those who possessed a post primary qualification did not statistically influence the choice of a marketing channel.

The number of years smallholders had prior spent in marketing AILV was negatively associated with using $F_1L_0U_0$ (farm gate only) and $F_0L_1U_0$ (local market only). Therefore, an increase in smallholders' marketing experience by a year resulted to a 1.5% and 1.8% drop in using $F_1L_0U_0$ and $F_0L_1U_0$ respectively, rather than not using any market combination at all ($F_0L_0U_0$). It is likely that the more experienced farmers, based on the market signals picked up through years of experience, made informed decisions. It is also possible the farm gate and local market outlets did not offer as high a price the more experienced farmers anticipated, hence opted for other lucrative ventures at the expense of AILV. This contradicted Abay (2007) who found evidence that an increase in farmers' experience caused an increase in tomatoes supplied to the market in Fogere, South Gonder.

Households' food self-reliance in production positively influenced the likelihood of using $F_0L_1U_0$ (local market only), $F_1L_0U_1$ (farm gate and urban market only) and $F_0L_1U_1$ (local market and urban market only). Households that were self-reliant in food production had higher probabilities of using $F_0L_1U_0$, $F_1L_0U_1$ and $F_1L_0U_1$ (rather than not using any package), by 16.91%, 4.87% and 53.8% respectively. It is plausible that as households became more and more food secure, they were likely to use different market packages to sell excess surplus after meeting subsistence needs. Lukanu *et al*. (2004) postulated that households' food availability, among others factors, determines farmers' decision to commercially produce.

Access to market information was positive and significant in using packages $F_1L_0U_0$, $F_0L_1U_0$ (local market only), $F_1L_1U_0$ (farm gate and local market only), $F_0L_1U_1$ (local and urban market only) and $F_1L_1U_1$ (farm gate, local market and urban market). Relative to the base category of non-use of any market combination, households that had access to market information were more likely to use $F_1L_0U_0$, $F_0L_1U_0$, $F_1L_1U_0$, $F_0L_1U_1$ and $F_1L_1U_1$ by 5.8%, 15.8%, 29.82%, 0.05% and 0.005% respectively. For these market packages, access to market information indicated that farmers were informed on prevailing market condition. This could imply that farmers who used these market packages incurred neither higher transaction nor poor prices than those farmers who used $F_0L_0U_1$ and $F_1L_0U_1$ which were not found to be significant under the variable for access to market information. Jari (2009) stated that availability of market information boosted the confidence of households willing to participate in markets. Poor access to market information results in information-related problem, namely moral hazard and adverse selection which in turn increase transaction costs and hence discourages participation in the market by some farmers (Fafchamps and Hill, 2005; Shiferaw *et al*., 2009).

Distance from the farm to the market was an important factor influencing the use of $F_0L_1U_1$ (local market and urban market only). This finding was alarming since it postulated that an increase in distance by 1 kilometer increased the probability of using $F_0L_1U_1$ (local and urban market only) by 0.11%. It is punitive that this variable was only significant for $F_0L_1U_1$ and insignificant for other packages due to the low transaction costs it offered. For example, minimal information related problems such as moral hazard and adverse selection could have reduced the cost of searching for information. Also, it is likely that $F_0L_1U_1$ had higher gross margins resulting to its use. This contravened the finding by Voors and Haese (2010), that lesser distance to the major markets arguably reduce not only transport costs but also other transaction related costs: information gathering may be easier, negotiation more frequent, and monitoring less costly.

It was also found that farm size positively influenced the use of $F_1L_0U_0$ (farm gate only), $F_0L_1U_0$ (local market only), $F_1L_1U_0$ (farm gate and local market only) and $F_1L_1U_1$ (farm gate, local market and urban market only) This meant that an increase in land size by 1 acre (0.405ha) increased the probability of using $F_1L_0U_0$, $F_0L_1U_0$, $F_1L_1U_0$, and $F_1L_1U_1$ by 0.2%, 1.62%, 0.46% and 0.002% respectively, as opposed to the base category of non-use of any market package. It is likely that households that possessed more land produced more AILV, thus had the higher likelihood of producing surpluses which were sold off to markets using

the significant packages. It is also likely that the use of a particular package may have been dependent on earlier choices, hence increase in farm sizes may not necessarily have influenced the choice of a package, but rather the quantity made available to the market through the consistent use of market packages. Farm size is a proxy to production scale. When the land size is large, the production scale is also large and vice versa. Large production scale positively influences the farmer to sell their produce at market place mainly because of economies of scale which lower transaction cost (Sigei *et al*., 2014).

Finally, the number of contacts with extension service providers positively influenced the use of $F_0L_1U_0$. This meant that, rather than not using any market package ($F_0L_0U_0$), an additional visit from extension workers increased the probability of participating through package $F_0L_1U_0$ by 3.39%. Compared to other market packages, this variable was significant for $F_0L_1U_0$ possibly because; extension information rooted for non-use of farm gates which are known to offer low prices as well as non-cash barter with neighbours as well as the risk of defaulting payment by neighbours. It could also be possible that extension workers discouraged the use of distant markets that increased costs, through transportation costs. Therefore, to get better prices than farm gates and to lower transaction costs to distant markets, the use of package $F_0L_1U_0$ seemed viable. Mwaura *et al*. (2014) asserted that among other technical support services, extension services are necessary if gains at improving AILV gross margins for smallholders are to be realized

4.2.3 Average adoption treatment effects for the market packages

Treatment characteristics are actual net revenues from using a package (Equation 25), while untreated characteristics are counterfactual net revenues if farm households did not use a particular channel (Equation 26). The impact/treatment effect is the difference between the treated and untreated characteristics (Equation 27). An endogenous switching regression was conducted to estimate the actual and counterfactual scenarios for using the 7 market outlets combinations. The results are presented in Table 4.12. In interpretation, a standard approach could be applied to identify the best combination of market outlets with the highest pay offs. Here, a comparison of actual mean net revenues by farm households' package use strategy could be done.

However, based on the ESR results, this naïve comparison would drive to the possible conclusion that farm households that used $F_0L_1U_1$ and $F_1L_0U_1$ outlets were those that earned the most. However, this was not the case. This approach can be misleading, and should be

avoided in evaluating the impact of using market packages on net revenues as it assumes that using an outlet is exogenously determined, while it is potentially an endogenous variable. This problem is addressed by estimating counterfactual net revenues, that is, what farm households would have earned if they had not used a particular market package. Table 4.12 presents net revenues under actual and counterfactual conditions. The expected net revenues under the actual case that the farm household used a particular market combination, and the counterfactual case that it did not are compared. The last column of Table 4.12 presents the impact of each outlet on net revenues, which is the treatment effect, calculated as the difference between columns 2 and 3 (Equation 27).

Table 4.12: Impact of use and non-use of market packages on incomes by ESR.

Package	Treated Characteristics	Untreated Characteristics	Impact/Treatment Effects
$F_1L_0U_0$	15390.15 (1655.64)	16966.19 (894.08)	-1575.85
$F_0L_1U_0$	15865.77 (1662.35)	16809.42 (892.74)	-943.65
$F_0L_0U_1$	37718.50 (5376.49)	16127.30 (784.64)	21591.2
$F_1L_1U_0$	16598.77 (1172.28)	16622.36 (1058.50)	-23.59
$F_1L_0U_1$	21643.96 (7241.02)	16517.70 (789.97)	5126.26
$F_0L_1U_1$	22132.94 (5567.16)	16456.07 (793.20)	5676.87
$F_1L_1U_1$	17948.12 (4385.11)	16628.02 (802.08)	1320.10

Note: Standard errors are in parenthesis.

Unless urban market outlets are individually used, using market outlets in isolation generally led to lower incomes for packages with farm gates and rural markets present. Urban markets offered better prices, thus farmers were more likely to earn better income. Also, the use of market combinations of farm gates and local markets ($F_1L_1U_0$) led to lower incomes due to the monetary and non-monetary transactions associated with the package in remote villages. All outlet combinations with urban markets present in the package projected a positive increase in income from using the combination, with the highest return of Ksh. 5,676.87 exhibited by $F_0L_1U_1$; followed by $F_1L_0U_1$ at Ksh. 5,126.26; and $F_1L_1U_1$ at Ksh. 1,320.10. Alternative to using urban market outlets in isolation, farmers should therefore seek combinations which have urban markets present so as to earn better incomes.

4.3 Gross margin analysis of individual AILV market outlets

The gross margin is defined as gross income net off direct total variable cost. Variable costs are those costs in production, which are specific to the enterprise and vary in proportion to the size of the enterprise. A gross margin usually indicates the income farmers have left for fixed costs and profits. It is formulated as;

$$GM = TR - TVC$$

Where;

GM = Gross Margin;

TR = Total Revenue;

TVC = Total Variable Costs.

The gross margin analysis results as summarized by Table 4.13, show positive orientation. This does not negate the fact that the some individual households had negative gross margins.

Table 4.13: Gross margin analysis of individual market outlets without combinations.

Item	Farm Gate	Local Market	Urban Market
Average bags of AILV sold	20.74	18.10	33.71
Average price of AILV per bag	35.00	50.00	75.00
A. Total revenue	725.97	905.01	2528.45
Transportation costs	0.00	50.00	150.00
Storage costs	15.00	20.00	70.00
Sorting costs	20.00	30.00	100.00
Packaging costs	20.00	30.00	180.00
Search for market information	20.00	50.00	250.00
Value of losses	50.00	80.00	300.00
B. Total variable costs	125.00	260.00	1050.00
C. Gross margin **(A–B)**	600.97	645.01	1478.45
D. Marketing cost as a percentage of gross margin **(B/C)%**	20.80	40.31	71.02
E. Net marketing margin **(C–B)**	475.97	385.01	428.45
F. Marketing efficiency **(E/B*100)%**	380.78	148.08	40.80

Note: 1 bag of AILV is equal to 30 kilograms.

Results showed that farm gates received the lowest gross margin of Ksh. 600.97 while the urban markets received the highest of Ksh. 1,478.45. The local markets received Ksh. 645.01. The low gross margins earned by farmers could have been caused by lack of extension services, relatively low prices and poor access to market information especially on demand and prices. Further, the gross margin for farm gate and local markets were relatively close (more or less equal). It was possible that farmers hired labour and/or equipment to transport AILV to local markets thus incurring costs, reducing their gross margins; however farmers trading at farm gates did not have to incur such transportation costs. It is also possible that the presence of brokers and village traders across the outlets resulted to overfilling bags with AILV, thus contributing to the reduction of the gross margins for the farmers. It seemed that farmers who used urban market outlets received the biggest share of gross margins were well informed about market prices and trends than farmers who opted for the farm gate and local market outlets.

Marketing of AILV was generally profitable, as the analysis in the table shows that 20.80%, 40.31% and 71.02% of the gross marketing margin was spent on marketing cost (for farm gate, local markets and urban markets respectively), with the remaining amount retained as net marketing margin. The implications for this finding is that, while urban markets have higher margins, they are costlier to use than the farm gate and local market outlets. It may also be evident that marketing activities of the users of farm gates and local markets were performed efficiently, with efficiency ratios far in excess of 100%. However, it can be inferred that net marketing margins are not equitably distributed across the market outlets. Constraints such as limited access to credit, high cost of transportation, bad nature of roads linking marketing centers to producing centers and inadequate storage facilities could have therefore impeded the optimal performance of the AILV marketing system.

Investigating the determinants of market outlet choices for mango producers in Costa Rica, Zuniga-Aria and Ruben (2007) showed the significance of four major factors in their analytical framework. The first was related to the farm household characteristics, including farmer's experience, outlet profitability and attitude toward risk. The second factor dealt with production systems such as farm size and the production scale. The third dealt with price attributes; and the last was related to the market context, that is, having or not a written contract, geographical location and distance to urban markets. These factors could potentially have explained the amount of the gross margins for the three individual market outlets. This study however did not seek to quantify the determinants of gross margins for AILV farmers.

CHAPTER FIVE
CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

Alongside characterizing smallholder AILV farmers according to their socioeconomic and institutional attributes, this study examined the factors that influenced smallholders' participation in markets as net sellers, net buyers or autarkic. It further sought to establish the combination of market outlets that offered higher income margins to farmers. Results showed the importance of marketing experience, land ownership, households' food self-sufficiency, contractual marketing, access to credit and extension services in influencing the regimes in which small holders participate in markets. It was also evident that smallholders sold their produce mainly at the farm gate (on farm) and in rural markets packages. The market packages that contained the farm gate and local market options were majorly preferred. A small proportion of farmers sold AILV to the more lucrative (but distant) off farm urban markets. Here market packages containing urban market outlets did not perform well in terms of use by smallholders. These farmers do not participate effectively in the off farm urban markets that offer excellent opportunities for increasing their farm incomes which could haul them out of the poverty trap in which they currently languish.

5.2 Recommendations and policy implications

This study demonstrated the relevance of survey methods in enhancing farmers' involvement in policy making. Besides being influenced by various factors of market participation, the relative proportions of output sold through various outlet combinations could indicate the demand patterns for AILV in rural and urban settings which farmers could exploit, so as to gain higher incomes. High transportation costs hinder farmers from transporting produce to distant urban markets which offer better prices for AILV. To ease movement of AILV and reduce the transportation costs, it is thus necessary to upgrade farm-to-market roads and establish more and better equipped retail market centers in villages, so as to reduce transport costs and encourage rural farmers to produce and trade in the high-value AILV. Policies that reduce transportation costs, through improved transportation, would increase output by both increasing market participation and increasing production, for market participants. In addition, improving rural infrastructure (rural access/feeder roads) would facilitate faster delivery of farm produce (especially perishable commodities such as AILV) to urban consumers at low transportation costs. These interventions that improve market participation as well as quantities transacted would encourage net sales of AILV.

The private sector role in marketing AILV and involvement in the AILV value chain, cannot be overemphasized. Promoting the formation of rural information bureaus that are specifically tailored to deal with AILV is critical. These institutions could enhance farmers' supply response to market dynamics for households in various socioeconomic profiles and village categories. This is a critical step in generating more marketable surplus by facilitating private sector provision of market information via improved information systems. The transaction costs of market participation and quantity of output sold could thus be reduced through improved information and transportation infrastructure, deeper infiltration of trustworthy input merchants, and promotion of institutional innovations, such as AILV production and marketing cooperatives.

Simultaneous improvements in market integration (through institutional reforms) and market access (by building sustainable and predictable linkages to urban markets) in addition to improving infrastructure is critically important. Energies towards this end would entail embracing group marketing arrangements to bring down transaction costs (such as transportation costs, costs of searching for market information) and bargain for better AILV prices. To improve the pricing system of AILV, farmers should form production clusters, through formation of producer groups or cooperatives, in order to improve on their market intelligence and promote organization in marketing. The most common market options for majority of farmers were the farm gate and local village markets, because of their close proximity, making farmers incur lower transportation costs. Accordingly, the prices and incomes derived from these markets are low because of excess supply. Agriculture extension systems should be AILV crop-specific, market driven, decentralized and farmer-led in order to improve productivity and profitability. The development of innovative extension systems by the government is therefore needed. While indeed extension services are present, the nature of information disseminated by officers should not focus on the traditional cash and food crops such as maize and beans. AILV, which have gained attention contemporarily, should be incorporated into the extension services offered by government workers.

5.3 Further research

Although transaction costs are difficult to measure, understanding the impact they have on smallholders' marketing behaviour is crucial, as they can inform policy design aimed at reducing them, thus promote profitability of AILV. This study therefore recommends that further research should be explored on how different types of transaction costs influence marketing decisions and outcomes for AILV producing farm households.

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APPENDIX A: SURVEY QUESTIONNAIRE

ANALYSIS OF SMALLHOLDER MARKETING BEHAVIOUR OF AFRICAN INDIGENOUS LEAFY VEGETABLES IN NYAMIRA COUNTY

Questionnaire Code: _____ Ward: _____

1. Gender of the household head (1=Male; 0=Female): **Sexhh** _____

2. Age of the household head (in years): **Agehh** _____

3. Education level of the household head (in years of schooling): **Edcnhh** _____

4. Education level of the spouse (in years of schooling): **Edcnspz** _____

5. Total number of household members: **Hhsze** _____

6. The number of dependents below 18 years and above 60 years of working age: **Dpndnt __**

7. Is your family labour adequate for farm activities? (1=Yes; 0=No): **Labadq** _____

8. Total land holding size (in acres): **Famsyz** _____

9. Security of tenure (1=Title deed owned; 0=No title deed): **Secten** _____

10. Do you own any livestock? (1=Yes; 0=No): **Lvstck** _____

11. What is the average value of the total livestock owned? **Valstck** _____

12. Do you belong to any groups/cooperative? (1=Yes; 0=No): **Group** _____

13. What is the nature of the group? (1=Formal; 0=Informal): **Ntrgrp** _____

14. What service(s) do you receive from the group? (0=Savings; 1=Credit; 2=Marketing; 3=Training; 4=Others, specify): **Grpsvc** _____ _____

15. Do you have access to credit/loan? (1=Yes; 0=No): **Credit** _____

16. How much worth of credit did you receive in the survey period? **Crdtwrth** _____

17. What was the value of on-farm income in the survey period? **Valon** _____

18. Do you participate in non-farm income generating activities? (1=Yes; 0=No): **Nonfrm __**

19. What was the value of non-farm income in the survey period? **Valoff** _____

20. Information on AILV.

AILV Name *Name*	**Area Cultivated in Acres** *Acres*	**Quantity Produced** *Quantprod*	**Cost of Producing in Ksh.** *Prodcost*	**Quantity Consumed** *Quantcons*	**Quantity** *Quantsold*	**Average Price in Ksh** *Avprcsold*	**Quantity** *Quantbot*	**Average Price in Ksh** *Avprcbot*

1=Chinsaga/ Sageti (Spider plant); 2=Rinagu (African Nighshde); 3=Egesare (Cowpeas); 4=Emboga (Vegetables Amaranths); 5=Omotere (Jute Mallow); 6=Enderema (Vine spinach); 7=Mitoo (Slender leaf); 8=Amato' Omuongo (Pumpkin leaves);

9=Others Specify_____

21. Number of times of receipt of extension services: **Frqextn** _____

22. Do you produce sufficient food for the family for the whole year? (1=Yes; 0=No): **Food**_____

23 Information on distance:

Description of Distance	**Kilometres**	**Condition of the road** (1=Good; 0=Bad) **Cndtn**
Home to the farm (**Hmfrm**)		
Farm to nearest market (**Frmrkt**)		
Home to nearest market (**Hmrkt**)		
Home to nearest town (**Hmtwn**)		
Farm to nearest town (**Fmtwn**)		

24. For how many years have you been selling AILV? **Exper** _____

25. Was there any marketing failure in any of these years? **Mktfail** (1=Yes; 0=No): _____

26. If yes, what are the sources of such failures? **Srcfail** (0=Postharvest losses; 1=Poor roads connecting markets; 2=Unfavourable production conditions (drought, pests and diseases) causing low production for the market; 3=Enough for subsistence consumption only; 4=Low prices; 5=Others, specify): _____

27. If you transport your produce, do you know the nearby town market price from the local market price before transporting your AILV to the nearby town market? (1=Yes, 0=No): **Twnpryc** _____

28. Do you know about other prices available before you sell your AILV? (1=Yes; 0=No): **Othrpryc** _____

29. How and where did you sell your AILV produce?

(0=Directly to the purchaser/traders; 1=Through brokers; 2=Institutions/Groups/Cooperatives; 3=Neighbours; 4=Others, specify). **Outlet**	Location of transaction (0= Farm gate; 1=Local rural market; 2=Urban market). **Where**

30. Is there any problem created by any marketing channel? (1=Yes; 0=No): **Chnlprb** _____

31. What are the problems if any? (1=Weight/scale cheating; 2=Limiting by client; 3=Charge high brokers price; 4=Credit defaulting; 5=Inaccessibility of market; 6=Low price offer; 7=Lack of price information; 8=Others, specify): _____

What channel do you use to sell AILV 1=Direct 2=Brokers 3=Cooperatives/Institutions/Groups 4=Neighbours 5=Others, specify ***Channel***	**Confidence in channel** 1=Yes 0=No ***Cnfdnc***	**What is/are the problem(s)** Use codes in 31 above ***Watprblm***	**Who sets your selling price?** 1=Yourself; 2=Market; 3=Buyers; 4=Negotiations; 5=Other, specify ***Prcsetn***	**Do you have any contracts with this channel?** 1=Yes 0=No ***Cntrct***
Direct				
Brokers				
Cooperatives/Institutions/Groups				
Neighbours				
Others, specify				

32. Do you have access to market information? (1=Yes; 0=No): **Mrktinfo** _____

If yes, from where did you get the market information? **(**1=Local traders; 2=Neighbours; 3=Cooperatives/Groups; 4=Media; 5=Extension officers; 6=Others, specify). ***Srcinfo***	What information did you receive? (1=Price; 2=AILV market location; 3=Time of year to sell; 4=Marketing channel options; 5=Post-harvest handling and value addition; 6=others specify). ***Watinfo***

33. Do own any transport equipment? **Trans** (1=Yes; 0=No): _____

34. If yes, which equipment do you own? **Transeq (**0=Animal carts; 1=Vehicle; 2=Bicycle; 3=Wheelbarrow; 4=Others, specify): _____

35. How do you transport your AILV produce to the market places? **Transmean** (0=N/A; 1=Walking/Carrying; 2=Hired labourer to carry; 3= Public service vehicle/Hired equipment; 4=Own transport vehicle/equipment; 5=Group transportation; 6=Others, specify): _____

36. What are the major costs you incur in selling your AILV? (0=N/A; 1=Transportation cost **(Transcst)**; 2=Packaging cost **(Pckgcst)**; 3=Storage/preservation cost **(Stocst)**; 4=Sorting cost **(Sortcst)**; 5=Search for market information cost **(Schinfo)**; 6=Others, specify):

Cost (Use codes above).	**Value of Cost.**

37. Do you make decision to sell before planting AILV? (1=Yes; 0=No): **Dcsn** _____

38. Did you consider prices offered when you decided to produce AILV? (1=Yes; 0=No): **Prycoffr**_____

39. Do you think AILV, as a farm enterprise, is profitable? (1=Yes; 0=No): **Prcptn** _____

40. Decision making:

Who makes decision on…?	0=Relative; 1=Farm worker; 2=Children; 3=Spouse; 4=Household head.	**Gender of decision maker** 1=Male; 0=Female.
1.Production of AILV (**Dcsnprdc**)		
2.Sale of the AILV (**Dcsnsale**)		
3.Use of money from sales (**Dscnuse**)		