AN ANALYSIS OF FACTORS INFLUENCING FARMERS' CHOICE OF GREENGRAM MARKETING CHANNELS IN MBEERE SOUTH SUB-COUNTY, KENYA

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Declaration and Approval

Declaration

This thesis is my original work and has not been presented for examination in any other University.

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Dedication

This thesis is dedicated to my husband Ken and my two daughters, Helen and Hadassah, for their invaluable support, love and encouragement. And to my friends Grace and Phillis for many hours invested in editing this work.

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Abstract

Smallholder farmers in Mbeere South sub-County face crop production and marketing constraints that trap them in a vicious cycle of poverty. Mainstream marketing research and development efforts often focus on the major staples such as maize, rice and wheat, neglecting the traditional crops of high value such as green grams, cowpeas, and sorghum. Most of the traditional crops of high value are produced in the arid and semi-arid lands (ASALs) where they experience many challenges. This study attempted to provide a better understanding of market dynamics of green grams, a traditional crop grown by a resource-poor community, by assessing the factors affecting farmers' preference for alternative green gram marketing channels. The study addressed two objectives: first, it characterized the existing green gram marketing channels in Mbeere South sub-County in terms of price and marketed volumes. Secondly, it evaluated the factors that influence the choice of the marketing channel in Mbeere South sub-County. To achieve the first objective, descriptive statistics were used to characterize the marketing channels using data collected using a semi-structured questionnaire and focus group discussions. The second objective was achieved by employing a multinomial logit model on survey data involving 266 household in Mbeere South sub-County. The results showed that about 70 percent of farmers in Mbeere South sub-County grew green grams at the time of the survey. On average, each household had 1 to 2 acres of land under green grams production each year, with an average yield of four bags per acre. Farmers used three marketing channels; i.e., rural retailers, wholesalers and assemblers. About 58.2 percent of the farmers sold to rural retailers, 26.9 percent to assemblers and 14.9 percent to wholesalers. Rural retailers offered farmers the highest price at KES 4500 per bag of 90 kg; assemblers KES 4400 and wholesalers KES 4162 for the same bag. The results of multinomial logit showed that farmer's age (P=0.06), access to credit (p=0.065), price of green grams (p=0.079), and selling as individuals

(p=0.000) positively influenced farmers' choice of rural assembler marketing channel. The cost of production (p=0.006) and access to marketing information through mobile phones (p=0.001) negatively but significantly influenced the probability of choosing rural assemblers relative to wholesaler channel. Farmers with a higher cost of production could not make a mark-up from selling to assemblers who offered the lowest margins. The rural assembler channel was preferred by older farmers who did not use mobile phones to access market information. Transport costs negatively influenced the choice probability of rural retailer relative to wholesale marketing channels (p=0.000). The gender of the household head (p=0.001), production cost (p=0.000) and use of mobile phone to access marketing information (p=0.019) positively influenced the probability of choosing rural retailer over wholesaler marketing channel. The rural retailer marketing channel was preferred by men and farmers who had access to credit, sold individually, and had higher production cost. This could be because men control the decision on income from agricultural produce and hence would like to sell to channels which give the highest margins. In addition, farmers who sold through this channel received the highest margins making it the most preferred channel. In conclusion, farmers' choice of marketing channel was determined by the socio-economic, institutional, and farm level factors. Farmers preferred marketing channels where they incurred low transport cost and that offered higher prices plausibly to maximize profits. The study recommends interventions to aim at enhancing market-based signals such as price support by the government. In addition, interventions that lower production cost, e.g., use of improved seed to enhance farm productivity are called for.

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Abbreviations and acronyms

ASALs	Arid and Semi-Arid Lands
GOK	Government of Kenya
IIA	Independence of Irrelevant Alternatives
IID	Identically and Independently Distributed
KALRO	Kenya Agricultural and Livestock Research Institute
KARI	Kenya Agricultural Research Institute
KNBS	Kenya National Bureau of Statistics
LM	Lower Midland
MLE	Maximum likelihood estimation
MNL	Multinomial logit
MoA	Ministry of Agriculture
MSSC	Mbeere South Sub-County
OLS	Ordinary Least Squares
SPSS	Statistical Package for Social Sciences
SSA	Sub-Saharan Africa

CHAPTER ONE: INTRODUCTION

1.1 Background

Agricultural commercialization is an important pathway towards economic growth and development for most developing countries that rely on agriculture (Timmer, 1997; Pingali and Rosegrant, 1995; von Braun, 1995). The process of agricultural transformation involves a shift from subsistence farming to high-value commercial agriculture (Timmer, 1997). These changes, in turn, trigger sweeping structural changes that ripple through the broader economy, leading to a more liberalised marketing system (Indaba Agricultural Policy Research Institute [IAPRI], 2012). The latter provides investment opportunities for farmers engaged in agriculture and fuels agricultural comercalisation.

Since the adoption of neo-liberal economic reforms in most developing countries in the 1980s and 1990s, there has been a notable move by governments to liberalize their markets. Subsequently, liberalization has opened up a window of opportunity for smallholder producers to grow diverse products and supply surpluses to markets (Harvey, 2005). Although liberalization may present unfair competition to smallholder farmers from large-scale, subsidized farmers in developed world, it offers all farmers an opportunity to compete at the world market. The removal of trade barriers and increased competition has opened up some flexibility for smallholder farmers to choose buyers for their products and suppliers of key inputs (Fafchamps, 2004). Access to market is an important pathway in achieving agricultural commercialization. This is an important development because smallholder farmers remain critical to the agri-food systems of many sub-Sahara African (SSA) communities (Maina *et al.,* 2010). There is consensus from research and policy makers that the future of food security and poverty eradication in developing countries is

hinged on the commercialization of smallholder agricultural production (Jaleta *et al.*, 2009), which is an import aspect in achieving agricultural development.

Smallholder agriculture is practiced by more than half of the population in the developing countries (World Bank, 2008b). An estimated 2.5 billion households are involved in agriculture, of which 1.5 billion households are in smallholder farming (World Bank, 2008a). Agriculture is a source of livelihood for an estimated 86 percent of the rural people both directly and indirectly (World Bank, 2008b). This makes agricultural development a key objective for developing countries and a key priority for poverty reduction.

In Kenya, smallholder farmers operate farms of less than one hectare (Government of Kenya [GoK], 2010). Food production in the country is dominated by smallholders who account for 75 percent of the total agricultural output and 70 percent of marketed agricultural produce (GoK, 2010). Of the 75 percent of agricultural output produced by smallholder farmers, 25 percent comes from the arid and semi-arid lands (ASALs) (GoK, 2010). This represents 3.3 percent of total gross domestic product (GDP), and one quarter of national agricultural production (USAID, 2013). Approximately 16 percent of Kenya's landmass is classified as having high to medium agricultural potential, while the remaining 84 percent is ASAL (GoK, 2010). The ASALs are exposed to recurrent drought leading uncertainties in food supply and frequent reliance on food relief. Increasing and stabilizing food production in ASALs is essential for their food and nutrition security. This can be achieved through promotion of drought tolerant crop varieties, water harvesting and use of good agronomic practices (Maina *et al.*, 2010).

Initiatives by the GoK to promote integrated approaches to sustainable development and food security have given rise to various programmes such as "Promotion of High Value Traditional

Crops" implemented by the then Kenya Agricultural Research Institute (KARI), which has since been renamed the Kenya Agricultural and Livestock Research Organization (KALRO), in Mbeere South for three years between 2010 and 2012. The Ministry of Agriculture (MoA) and its sector partners developed strategies to promote the adoption of drought-tolerant crop varieties and livestock breeds in the ASALs in order to minimize shocks in food supply. The main drought tolerant crop varieties promoted under the programme included green grams, pigeon peas, and sorghum (Maina, 2010). The programme's strategy was to promote indigenous crops that can do well across a range of agro-ecological zones including ASALs (Maina, 2010).

An integral part of the programme was a project entitled "Making Agri-food Systems Work for the Rural Poor" in which KARI promoted the adoption of green grams (*Vigna radiate*) in Mbeere South sub-County, Kirinyaga West sub-County and Nyandarua North sub-County (Maina, 2010). The aim of the project was to increase green gram production in project areas through use of improved seed, better farm management, and utilisation of water-harvesting techniques.

Green gram is one of the most popular pulses consumed in Kenya. It is mainly consumed as grain; however, in some instances, it is ground into flour and mixed with other cereals and made into porridge. Green grams have high protein content and constitute a rich source of essential amino-acids (WHO, 2007). In Kenya, pulses contribute about 20 percent of crop-based proteins (FAO, 2010). Low and middle income countries such as Kenya derive most of their protein from crop-based sources rather than livestock (FAO, 2010). The consumption of green grams in both the rural and urban areas in Kenya is constrained by bottlenecks in production with a surplus during harvest season and a deficit during the rainy season (Tegemeo, 2012).

There has been an increase in green gram production in Kenya over the last decade. Table 1.1 shows green gram production trends in Kenya between 2008 and 2012. Green gram production rose 343 percent from 296,808 bags in 2008 to 1,020,270 bags in 2012 (GoK, 2013). The increase in green gram volume can be attributed to capacity building of farmers on better agronomic practices, expanded markets due to increased demand, improved seed and subsidized inputs from the government (Tegemeo, 2012). The price per bag has also increased from KES 5,000 in 2008 to KES 7,644 in 2012. The price increase is attributed to the global food price increase driven by high cost of inputs such as fertilizer and energy; weather variability and increased labor costs (Ackello-Ogutu, 2011).

Table 1.1: Volume and value of green gram production in Kenya (2008-2012)

Year	2008	2009	2010	2011	2012
Area (Ha)	91,452	112,997	147,352	159,910	188,416
Production (90 Kg Bags)	296,808	470,372	680,528	780,283	1,020,270
Yield (Bags/Ha)	3.2	4.2	0.5	4.9	5.4
Unit Price Bag (KES)	5,000	6,149	7,050	8,619	7,644

Source: GoK (2013)

Mbeere South sub-county in Embu County has a suitable climate and available arable land for green gram production. It is predominantly a semi-arid area located in the Eastern region in Kenya. The region is characterized by frequent drought and erratic rainfall that ranges between 700mm and 900mm (GoK, 2010). As a result, 59.9 percent of the population is food poor (KNBS, 2009). Over the last decade, the MoA and KALRO have been promoting green gram production in Mbeere South sub-County, to help farmers cope with erratic rainfall. The main interventions have been the issuance of free improved green gram seed and provision extension services on good

agronomic practises (GoK, 2010). Farmers in Mbeere South sub-County have taken up green gram production seriously making it the third best ranked enterprise in terms of monetary value after maize and beans in Embu County (Figure 1.1).

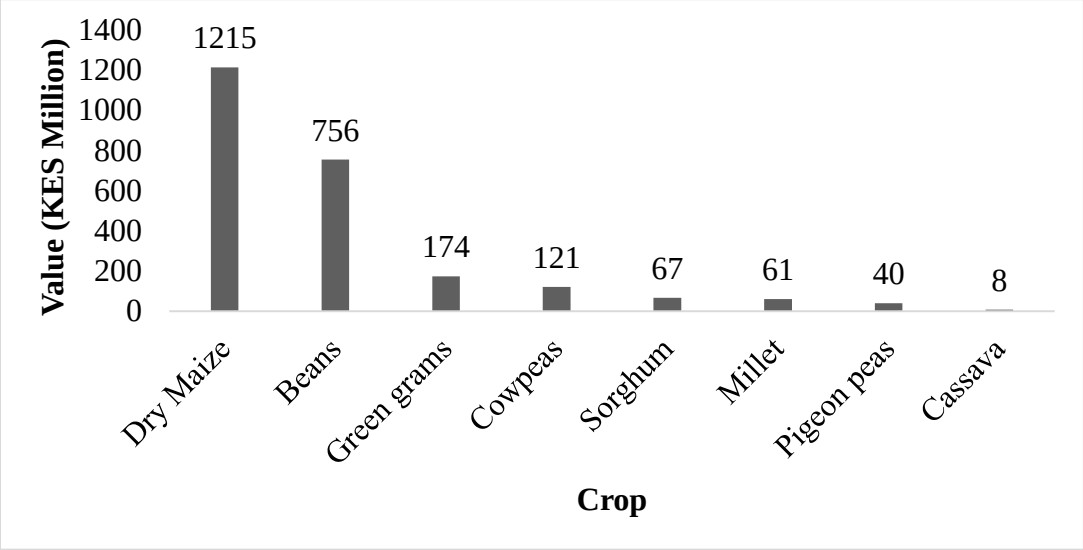

Figure 1.1: Value of crops in Embu County 2012

Source**:** Economic Review of Agriculture (2012)

Over the same period, Mbeere South sub-County recorded an average yield of 4 bags per acre up from 1-2 bags per acre in 2010 (Tegemeo, 2012). Despite increased production, green gram marketing is not well organized. Without farmers' linkage to efficient output markets, initiatives seeking to promote the adoption of productivity-enhancing technologies by smallholder producers in SSA are likely to have limited success (Dorward *et al*., 2005). This is because, access to market enhances productivity and strategizes production geared towards increasing profitability and competitiveness. This study aimed to characterize the marketing channels that farmers use in selling green grams and to assess the factors influencing their choice of green gram marketing channels in the sub-County. The findings of this study will provide insights for policy makers and

other stakeholders on the design of interventions aimed at increasing farmers' access to markets. Farmers could also use the information to make more informed decisions on the choice of marketing channels.

1.2 Statement of the problem

Since the inception of the KARI green gram project in 2010, farmers in the target sub-counties have increased green gram production (Tegemeo, 2012). For example, before the inception of the project, the average green gram production was 1-2 bag per acre (GoK, 2009). The low production was attributed to poor agronomic practices and lack of improved seed. This production increased to 4bags per acre during the project period. Available evidence indicates that sustaining success in productivity-based agricultural growth critically depends on expansion of market opportunities (Diao and Hezel, 2004). It also requires thinking beyond productivity to incorporate profitability and competitiveness (Kaplinsky, 2000). It is now increasingly evident that smallholder farmers' key concern is not only agricultural productivity and household food self-sufficiency, but also better market access (IFPRI, 2002). To overcome market barriers, farmers need to use marketing channels which maximize margins at lowest cost. Marketing channels in SSA vary in incentives and conditions such as prices offered, marketing costs, quantity requirements and mode of payment (Shiferaw, 2006). As such, farmers are motivated by various factors in choice of their preferred channels.

Although several studies have been undertaken on green gram productivity and value chain analysis (see Tegemeo, 2012), there are no studies that characterize green gram marketing channels and farmers' choice of marketing channels in Mbeere South sub-County. In addition, it is not known which marketing channels that green-gram farmers prefer and the factors driving that

preference. Lack of this knowledge hinders informed choice of marketing channels by farmers. To increase farmers' access to markets, researchers and development practitioners need to understand the bottlenecks that prevent green gram market channels operating more efficiently and equitably, knowledge of the factors that influence farmers' choice of green gram markets is important for farmers, the government and development agents in guiding them on the most competitive and profitable channels. This study addressed this knowledge gap by providing empirical evidence on farmers' choice of green gram marketing channels as well as the drivers of that choice in Mbeere South sub-County.

1.3 Purpose and Objectives

The purpose of this study was to assess the factors influencing farmers' choice of green gram marketing channels in Mbeere South sub-County. The specific objectives were:

1. To characterize the existing green gram marketing channels in Mbeere South sub-County in terms of players, price and marketed volumes.
2. To identify the factors influencing farmers' choice of green gram marketing channels in Mbeere South sub-County.

1.4 Hypotheses tested

The following hypotheses were tested in this study:

1. That there is no difference in gross margins among farmers using different green gram marketing channels in Mbeere South sub-County.
2. That farm, marketing channels, socio-economic, demographic and institutional factors taken singly have no effect on farmers' choice of green gram marketing channels in Mbeere South sub-County.

1.5 Justification

This study sought to assess the market dynamics of a traditional crop within a resource-poor producer community. Green gram is a traditional crop whose value chain is not well developed compared to those for mainstream crops. As such, poor farmers stand to be exploited by other actors in the marketing channel. Further, farmers may be at a disadvantage in meeting the requirements for engaging in various marketing channels. An analysis of the factors that hinder or enhance farmers' choice of the various marketing channels is important to decision makers such as KALRO in devising appropriate innovations aimed at linking resource-poor farmers to markets.

These results provide insights for policy makers and other stakeholders on the design of interventions aimed at increasing farmers' access to markets. Value chain actors are expected to benefit from the findings of this study by understanding the key factors that attract farmers to certain marketing channels. This can be exploited for the design of marketing strategies to attract specific farmers to specific marketing channels. Additionally, the findings of this study are beneficial to farmers through the documentation of the profitability of various marketing channels and the unique factors that characterize each channel. This information can be used to make more informed decisions on the choice of marketing channels.

The study contributes to the literature on factors affecting farmers' choice of marketing channels in Mbeere South sub-County where no such information currently exists. It also provides information on available marketing channels for green grams in Mbeere South sub-County. Such information will serve as a benchmark for similar studies in future.

1.6 Organization of the thesis

Chapter one provides the general overview of the role of agriculture in Kenya, mainly legumes and in particular green grams, and its importance to smallholder farmers. It also details the problem statement, objectives and justification of the study. Chapter Two is a review of the literature on smallholder farmers' market integration, theoretical review and a review of previous studies on choice of marketing channels. Chapter Three presents the methodology including the conceptual framework, theoretical framework, sampling procedure, study area and data needs. Chapter Four provides the results while Chapter Five presents the summary, conclusions and recommendations of the study and highlights key areas for further research.

CHAPTER TWO: LITERATURE REVIEW

2.1 Integration of smallholder farmers into agricultural markets

Reducing poverty and enhancing food security require greater smallholder integration into markets and more inclusive value chains. This is because if farmers are not well integrated into markets the adoption of new technologies to drive productivity growth would be limited (Dorosh and Haggblade, 2003). However, markets and value chains are not static as they change with the growing importance of the formal sector transforming the agri-food system surplus (Kydd *et al.*, 1998). The spread of supermarkets both in the rural and urban centers in Kenya has expanded the agricultural market and incomes to farmers (Rao & Qaim, 2011). However, with more formal marketing structures, quality standards, higher value products, traceability and contracts are becoming part of the ever-demanding environment that smallholders need to adapt to even in their local markets (FAO, 2013). These new agri-food system demands create both barriers and opportunities to smallholder farmer especially in SSA to integrate into formal markets (FAO, 2013). The barriers are experienced by the less endowed, less informed farmers who are not able to meet the market standards. However, for farmers who are able to meet the standards, this translates into higher incomes and improved welfare (Rao and Qaim, 2011).

In the past, much focus on agricultural development in SSA was mainly on supply-side constraints without sufficient attention paid to how the farmer would market the surplus (Kydd *et al.*, 1998). The basis of this focus was to increase productivity; for instance, the Green Revolution (Parayil, 1992). Just as smallholders are a heterogeneous group, the markets in which they participate are also diverse in terms of their size, geographic location, connectivity to other markets, power relations between market players and institutional settings (Rosset, 1999). Smallholder farmer

participation in food markets in SSA is therefore typically characterized by a constrained choice, and this choice is critically dependent upon their ability and willingness to participate in input and output markets, and on the functionality of those markets that they are able to access surplus (Barrett, 2008). Smallholder farmers in SSA are likely to increase their engagement in markets when well-functioning ones give those appropriate incentives, when they have access to, and the ability to use their assets productively, and where efficient infrastructure allows them to transport their produce to market at reasonable cost (Dorosh and Haggblade, 2003). However, if one component of the marketing structure is missing, farmers cannot, or will not be willing, to participate in the market. This suggests that markets must have the capacity to remain profitable and accessible to farmers in the long term to enhance farmer's inclusion in the market (Kydd *et al.*, 1998).

Despite the fact that smallholder farmers in SSA face difficulties in marketing, they continue to produce and survive in the face of unfavorable conditions (Maina, 2010). Smallholder farmers in SSA fulfill numerous important functions in the agricultural economy, including contributing towards food security (Rosset, 1999), employment and creation of linkages for economic growth (Dorosh and Haggblade, 2003). Dorosh and Haggblade (2003) and Rosset (1999) explain that smallholder farmers in SSA have the advantage of flexible family labor resources, which allow them to allocate their labor to activities with higher marginal returns. Ngqangweni (2000), using Schultz's hypothesis of small but efficient farms, shows evidence of efficient resource use among smallholder farmers in SSA. Smallholder farmers, therefore, have the ability to produce surplus for the market.

Studies show that smallholder farmers' access to liberalized markets in SSA is hampered by producers' and traders' costs (Jayne *et al.,* 2010; Barrett, 2008). Their success in market liberalization depends on their ability in conveying market information, coordinating marketing functions, defining property rights and enforcing contracts (Jari, 2009). Through coordination of marketing activities, farmers could facilitate access to better markets, reduce marketing costs, and synchronize buying and selling practices to seasonal price conditions (Reardon *et al*., 2009). Transaction costs, entry barriers and other market bottlenecks, have increasingly hindered the participation of rural smallholder producers in SSA in the formal marketing system (Key *et al.*, 2000).

An important integrative part of farmers in SSA is the marketing channel. According to FAO (2013), a marketing channel is an institutional arrangement through which goods and services are marketed. Marketing channels give place and time utilities to consumers (Crawford, 1997). In order to provide these and other services, marketing channels charge a margin, with longer channels charging higher ones (*ibid*). According to Jham. (2011), marketing channels are defined as "a set of interdependent organizations involved in the process of making available a product or service for use or consumption" (p.162). Each marketing channel member depends on others to develop its function efficiently, which makes the product available in an efficient way (*ibid*). This study adopted the first definition and sought to assess the factors that enhance farmers' choice of a particular marketing channel.

2.2 Theoretical review

2.2.1 Theories anchoring farmers' choice of marketing channels

Traditional consumer theory posits that a typical consumer derives utility from a good or service by maximizing utility subject to a budget constraint (Greene, 2003). This theory assumes that individuals have full information and that they are rational decision makers, with well-defined preferences (Thaler, 1990). However, Lancaster (1966) notes that it is the attributes of the good or service from which such utility is derived. Therefore, consumers' prefer options where they derive the highest utility. The process of choice making can be analyzed under the random utility theory or model (RUM). According to Greene (2003), RUM posits that an individual will choose the alternative from a choice set that will provide the highest utility. Thus, an individual, *I*, will only choose a particular alternative, *j*, if and only if the utility, U_{ij}, he/she derives from this alternative is greater than that from another alternative, *k*, in the choice set (*ibid*.). That is;

$$u_{ij} > u_{ik} \qquad \forall j \neq k \tag{2.1}$$

The utility derived from alternative *j* (U_{ij}) is composed of a deterministic component (V_{ij}) and a random part (ε_{ij}) such that the total utility is a sum of the two components (Gujarati, 2007):

$$U_{ij=V_{ij}} + \varepsilon_{ij} \tag{2.2}$$

The deterministic component, (V_{ij}), comprises the measured attributes of the alternatives in the choice set, and the attributes of the chooser (Maddala, 1983). The random component (ε_{ij}) includes a stochastic component representing unobserved attributes affecting choice, inter-individual differences in utilities depending upon heterogeneity in tastes; measurement errors and functional misspecifications (Manski, 1977). The stochastic term (ε_{ij}) shaping the true and latent utility in equation (2.2) introduces uncertainty regarding the choice. Hence, choice probabilities are

invoked. Because utility is unobservable, and the decision maker has incomplete information about the choice, uncertainty has to be accounted for. The utility is then modelled as a random variable. If the decision maker selects alternative *k*, then U_{ij} is the maximum among *k* utilities. The RUM model is then derived from the probability that choice *j* is made:

$$prob\left(u_{ij} > u_{ik}\right) \quad \forall j \neq k \tag{2.3}$$

RUM is anchored on the following axioms of choice (Greene, 2003): (a) ordering – i.e., the alternatives can be put in an unambiguous order of preference; (b) transitivity – i.e., if situation A is more preferred to situation B and B to situation C, then A is more preferred to C; and (c) dominance – i.e., if situation A is as good as B in every respect and A is better than B in at least one respect. Therefore, utility can be compared across individuals.

2.2.2 Methods used to operationalise RUM

Discrete choice models have been widely used to determine consumer behavior. The criteria for choosing a particular model are well documented (Maddala, 1983; Greene, 1997). Where the outcome being studied is binary, then a binary choice model is used in its estimation (Greene, 1997). If the dependent variable is categorical and mutually exclusive, then the dependent variable is assumed to have a multinomial distribution (*ibid*).

The models for analyzing choice with a multinomial distribution depend on whether the categories are ordered or unordered and whether the specific repressors vary across the alternative categories (Maddala, 1983). For ordered outcomes, the models of interest could be either the ordered probit or logit (Gujarati, 2007). Either model is used when evaluating outcomes whose order of choice reflects an underlying latent motivation (*ibid*.). For unordered outcomes, the models of interest

include multinomial logit (MNL), conditional logit (CL), nested logit and multinomial probit (Greene, 2003). The CL is used for estimating the probability of choice of a new alternative while the MNL is used to estimate the probability that a new chooser will choose a specific alternative in the choice set (Maddala, 1983). The nested logit and multinomial probit allow the relaxation of the independence of irrelevant alternatives (IIA) assumption (*ibid*.).

Since McFadden (1974), the MNL has been widely used to evaluate unordered choice outcomes (see Jari, 2009; Chomba, 2004). The main advantages of the MNL include that (a) the logit model is easy to compute (Sheikh *et al.,* 2003), (b) the β-coefficients are easier to interpret, (c) the probabilities are bound between 0 and 1, and (d) the choice probabilities and their derivatives take a simple closed-form so that the likelihood for the MNL can be quickly constructed and easily maximized (Louviere *et al.,* 2000). One of the major disadvantages associated with use of the MNL is the IIA problem (Greene, 2003). IIA implies that the relative probability of choosing one alternative instead of another does not depend on whether other alternatives are also available (*ibid*.). The presence of IIA hinders the assumption of homogeneity in unobservable components of utility resulting in inconsistent parameter estimation if the existence of heterogeneity is omitted (Hsiao, 1986). One way to overcome the IIA problem is to use the mixed logit or the random parameters logit model (RPM) (Train, 2003). The mixed logit accounts for heterogeneity in preferences hence it inherently overcomes the IIA problem (Louviere *et al.,* 2000). Another alternative in overcoming IIA is the varying choice set logit (VCL) model leading to a RPM. This model relaxes the IIA assumption by allowing the individual random utility function to directly depend on choice set type (Greene, 2003). The VCL can be applied to a variety of data in which some individuals can only choose from a subset of the theoretically possible responses (Yamamoto, 2011).

The current study used the MNL to assess the factors that influence the choice of green gram marketing channels in Mbeere South sub-County. The choice of MNL was based on multiple response categories in the dependent variable. Unlike the probit or logit models which are limited to a maximum of two choice categories, MNL can be applied on multiple choice responses (Maddala, 1983; Woodridge, 2002).

2.3 Empirical review

Following the pioneering work of McFadden (1974), numerous empirical studies have been conducted using MNL to examine various aspects of human behavior including coalition government formation in the United States of America (USA) (Martin and Stevenson, 2001), public opinion on policy issues in the USA (Branton and Brandford, 2005), and marketing channels in South Africa (Jari, 2009).

Dijkstra *et al*. (2001) used MNL to assess the application of marketing channel theory on horticultural marketing channels in Kenya. The results showed that the probability of encountering a more disintegrated horticultural marketing channel increases when the market center has more inhabitants, when the center is more densely populated, and when the transport to the center takes more time. The study only used population variables and market variables and omitted all socio-economic variables the current study uses both the market variables, product attributes and institutional arrangement variables to asses all the factors that may influence the choice of marketing channels.

Mburu *et al*. (2007) assessed farmers' choice of milk marketing channels in central Kenya using a logit model. The study found that land, average milk price, total number of cow milked and farm acreage negatively influenced farmers' adoption of milk marketing through the dairy cooperative

channel. Upper midlands, lower highlands, hired permanent labor, whether or not a household head worked off-farm, and average milk production per cow dairy cooperative as a source of animal production information, and availability of credit services had positive influence. The study grouped the traders into two categories; cooperatives and itinerant traders (hawkers, neighbors and hotels). The difference between Mburu *et al*. (2007) and the current study is that their study collapsed all the market alternatives in to a binary outcome while the current study does not. The current study extended Mburu's study and assessed the choice of green grams marketing channels using the MNL capturing each marketing channels independently.

Kwakwa *et al.* (2013) used a logit model to identify the determinants of fuel type choice in Ghana. The analysis was done by running regression for each energy type that is; electricity, firewood, charcoal, LPG and Kerosene. Each dependent variable was treated as having binary outcome only for each variable and therefore estimated five logit models. The study did not observe model parsimony since it used more variables in each of the models as compared to using one model. A parsimonious model accomplishes a desired level of explanation or prediction with as few predictor variables as possible. The difference between this study and the current study is that the dependent variable was defined as a multiple outcome and hence the MNL was estimated.

Chalwe (2010) used the multinomial probit to assess the factors influencing bean producers' decision to sell as well as their choice of a marketing channel in Zambia. The results showed that farmers' choice of marketing channels was positively influenced by the price of beans, scale of operation (as measured by the quantity of beans harvested, and quantity sold), distance to the market, farming mechanization used and livestock ownership. Use of a multinomial probit

assumes a normal distribution of the dependent variable. In the current study, a logistic distribution is assumed since the dependent variable has a logistic distribution.

Jari (2009) used a MNL to assess the institutional and technical factors influencing agricultural marketing channel choices of green gram among smallholder and emerging farmers in the Kat River Valley in South Africa. The study found that access to market information, expertise on grades and standards, availability of contractual agreements, existence of extensive social capital, and availability of good market infrastructure, group participation and reliance on tradition were positively related to the choice of marketing channels. Jari's study was beneficial to the current study in helping to determine the institutional variables to use. The current study seeks to extend the definition of independent variables to capture institutional, economic and product attributes which influence choice of green gram marketing channels.

2.4 Summary

The litrature reviewed in the foregoing sections shows that methodologies used in asessing choice of marketing channels depend on the objectives of the study and the research questions to be answered. The litrature also is thin on studies on factors incfuencing farmers' choice of green gram markets in Mbeere South sub-County, hence necessitating this study. The study is based on discrete choice. The process of choice making can be analyzed under the RUM which posits that an individual will choose the alternative from a choice set that will provide the highest utility. This study used the MNL to assess the factors that affect the choice of green gram marketing channels in Mbeere South sub-County. MNL was chosen because the dependent variable was categorical, mutually exclusive and unordered.

CHAPTER THREE: METHODOLOGY

3.1 Conceptual framework

The performance of the marketing system of any commodity depends on the organization of its marketing channels. In particular, the number of actors involved and the degree of coordination and information sharing within the channel will determine the marketing costs and margins (Coughlan and Coughlan, 2002). As shown in Figure 3.1, the choice of marketing channels is influenced by the farmer's socio-economic attributes, farm level factors product attributes, and institutional arrangements. In addition, existing policies and interventions by research organizations and non-governmental organizations (NGOs) moderate the choice of the marketing channel.

Product attributes such as price, variety, cost of production and amount harvested influence the amount of the commodity produced and enterprise mix. Farmer's socio-economic and personal attributes influence his/her risk attitude, resource endowment and other tastes and preferences (Jari, 2009). These attributes influence the production objective as well as access to a variety of production and marketing resources needed to achieve a self-determined welfare objective (Dorosh and Haggblade 2003). Farmer specific attributes include age, education, occupation; income, wealth category, household size, risk preference and asset portfolio (e.g., land size, herd size, etc). Institutional factors generally influence farmer's ability to access and participate in the market (Jari, 2009). These factors include cost of transport, mode of accessing market information, access to credit and marketing arrangements. Figure (3.1) shows that the collection of socio-economic factors, product attributes and institutional arrangements and moderated by existing policies and institutions of research organizations and NGOs contribute to frame choice of marketing channel.

Therefore, the type of marketing channel chosen is an outcome of individual attributes, farm attributes, resource endowment, socio-economic attributes and institutional attributes.

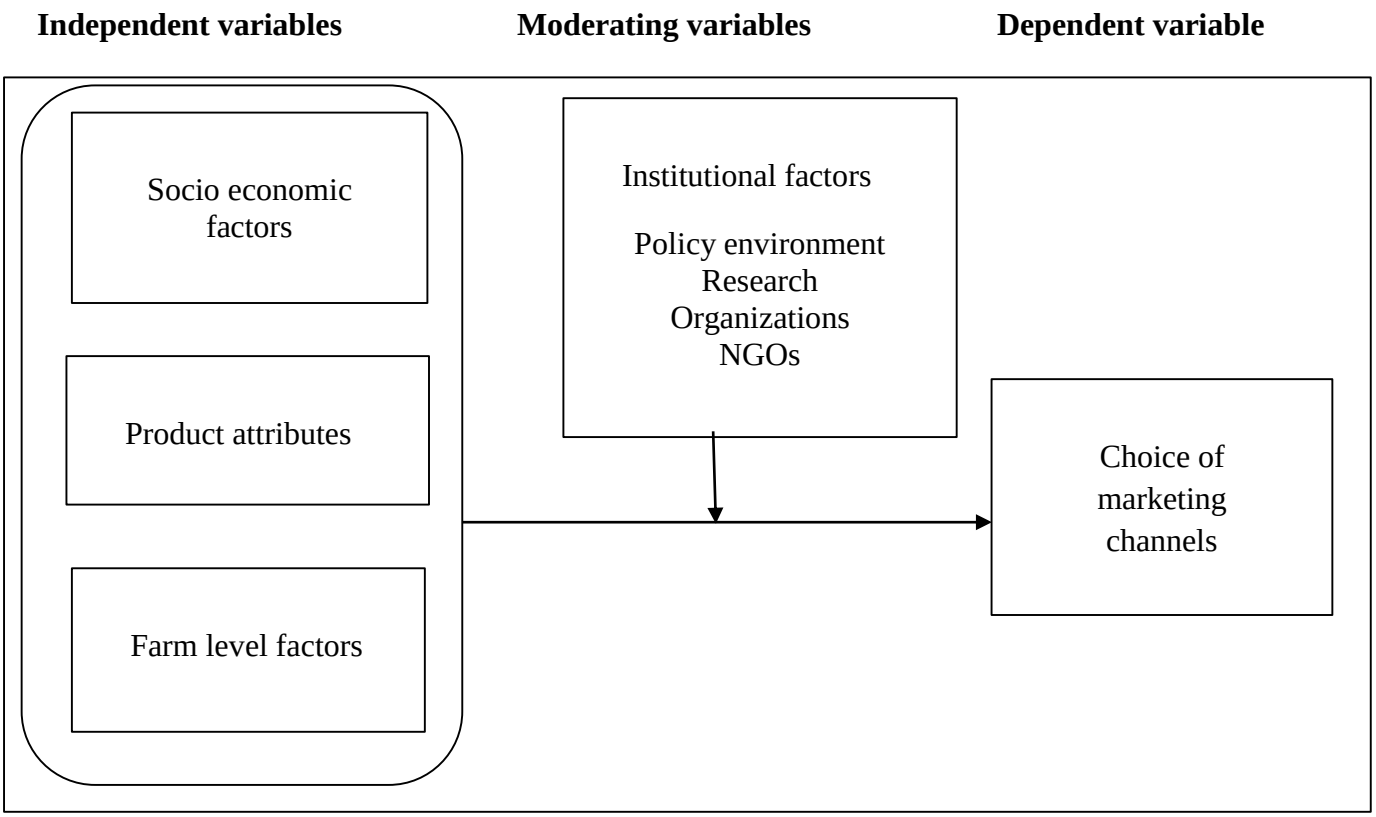

Figure 3-1: Conceptualization of choice of marketing channels

Source: Author

3.2 Theoretical framework

This study is anchored on the random utility model (RUM). RUM assumes that the decision maker has perfect discrimination capability to choose an alternative with the highest utility from choice set (Greene, 2003). It postulates that a consumer will make a rational choice to maximize utility subject to a set of constraints (*ibid*.). Therefore, if the costs associated with using a particular alternative are greater than the benefits, households will be discouraged from using it and shift to another option that maximizes their utility. In real life, however, the decision maker seldom has

perfect information implying that uncertainty has to be taken into account. Consequently, utility is modeled as a random variable in order to account for this uncertainty. Let (U_{ij}) denote utility of individual *i* for using marketing channel, *j*. According to Gujarati (2007), U_{ij} is composed of a deterministic component (V_{ij}) and a random part (ε_{ij}) such that:

$$U_{ij=V_{ij}} + \varepsilon_{ij} \qquad (3.1)$$

Following Greene (2003), suppose *Y* represents a choice set of marketing channels (*Y* ranges from 1 to *c*) available to farmer *i* (ranging from 1 to *n*). Let X_k represent a vector of attributes (ranging from attribute 1 to *m*) which influence choice of marketing channel, and U_i represent the utility derived from channel (*c*) chosen by the i^{th} farmer. Then, farmer *i*'s choice of a marketing channel (i.e., c_i) is a function of channel attributes, farmer's attributes, institutional and other factors (Greene, 2003). That is:

$$c_i = c_i\,(x_k) + \mathcal{E}_{ij} \qquad (3.2)$$

Following Greene (2003), the probability that a farmer chooses marketing channel *z* instead of another channel *j* is assumed to depend on the additional utility derived from channel *z* relative to that derived from channel *j* in the choice set. *Y* is therefore given by;

$$P(Z_i|Y_i=) = P(E(U_{iz}) - P(E(U_{ij}) \text{ for all } z \neq j. \qquad (3.3)$$

The difference in utility is because *z* has a higher utility compared to choice *j*. From equation (3.3), y_i can take multiple choices such that the dependent variable becomes a qualitative multiple choice response (Gujarati, 2009). Estimating the probability of channel choice using Ordinary Least

Squares (OLS) yields inconsistent parameter estimates because the OLS technique does not limit the choice probability to the 0-1 bound (Gujarati and Sangeetha, 2007; Wooldridge, 2000). On the other hand, although both binary choice models such as logit and probit restrict the choice probability within the 0-1 bound, they are only appropriate for two rather than multiple responses (Greene, 2003). The multinomial logit (MNL) is the model of choice for multiple discrete choice responses (*ibid*.).

Gujarati (2009) argues that in cases where the dependent variable is an unordered categorical variable the MNL is most appropriate, unless it violates the assumption of independence from irrelevant alternatives (IIA) (Louviere *et al.,* 2000). Violation of the IIA assumption implies that the estimated probabilities are correlated with those of choices not included in the analysis thereby leading to inconsistent estimates (Smalls and Hsiao, 1985). One way to address the IIA problem is first to test for it and if present use other models such as the random parameter logit (Gujarati, 2009).

According to Greene (2003), the MNL models the probability of choosing from a multiple choice set. It assumes that the error term is extreme-value distributed. Based on this assumption, the probability of farmer *i* choosing a particular marketing channel, *z*, is given as a logistic function:

$$P(c_i = Y|X_{i1},\ X_{i2} \ldots, X_{im}) = \frac{e^{\beta X_{ik}}}{\sum_{k=1}^{m} e^{\beta X_{ik}}} \text{ for } Y=1, 2, \ldots, c \text{ and } i=1, 2 \ldots\ldots n \qquad (3.4)$$

where β is a vector of parameters to be estimated; X_{ik} denotes the vector of explanatory variables that influence the choice of marketing channel by farmer *i*. Taking logs on equation 3.4 and given

that farmer *i*'s choice set of marketing channels is denoted by *Y = 1, 2...j, z, c,* then then log likelihood function of the MNL is given by (Greene, 2003):

$$\boldsymbol{l = \prod_{Y=1}^{C} \prod_{Y=1}^{C} prob(Yi = Z) = \quad \beta_0 \; + \; \beta_1 x_{i1} \ldots\ldots\ldots + \quad \beta_C x_{im}} \qquad (3.5)$$

Equation 3.5 is estimated using the maximum likelihood estimation (MLE) method. According to Wooldridge (2000), the MLE for random samples implies that, under general conditions, the MLE is consistent, asymptotically normal, and efficient. In estimating equation 3.5, a baseline alternative that corresponds to the status quo is chosen (Greene, 2003). In this study, the wholesaler marketing channel was used as a reference.

3.3 Empirical framework

3.3.1 Empirical model

The following MNL was fitted into the data:

$$\text{Channel choice}_{ij} = B_0 + \beta_1 \text{HHsize} + \beta_2 \text{EDUC} + \beta_3 \text{AGE} + \beta 4 \text{FARM\_LAND} + \beta_5 \text{COST\_PRDN\_ACTIVITY} + \beta_6 \text{UNIT\_TRANSCOST} + \beta_7 \text{FREQ\_TO\_MKT} + \beta_8 \text{GENDER} + \beta_9 \text{CREDIT\_ACCESS} + \beta_{10} \text{INDIV\_SELLING} + \beta_{11} \text{COOP\_SELLING} + \beta_{12} \text{MIDDLECLASS} + \beta_{13} \text{RICH} + \beta_{14} \text{PRICE} + \beta_{15} \text{GGVARIETY} + B_{16} \text{MOBILE\_MKT\_INFO} + \beta_{17} \text{OFFINCOME} + \varepsilon_{ij} \qquad (3.6)$$

Table 3.1 shows the definition of variables included in the model, their measurement and their hypothesized signs.

Table 3.1: Definition of variables included in the empirical model and their hypothesized signs

Variables	Variable description	Measurement	Expected Sign
CHOICE	Dependent variable indicating the various marketing channels 1= Rural assemblers, 2 =Wholesalers and 3= Rural retailers	Discrete multiple choice dependent variable	None
EDUC	Education of the household head in years	Number of years spent in formal education (years)	+
AGE	Age of the household head in years	Continuous variable capturing age in years (years)	+
FARM_LAND	Total cultivated by the household in acres	Continuous variable of total cultivated land in acres (acres)	+
COST_PRDN_ACTIVITY	Aggregate cost for all activities in green gram production in KES	Continuous variable capturing total cost of production activities (KES)	-
UNIT_TRANSCOST	Unit cost of transport to the nearest market	Continuous variable capturing cost of transport in (KES)	-
FREQ_TO_MKT	Frequency of the respondent to the market	Categorical variable capturing frequency to market 1= Once a week, 2=Once a month 3= Once every three months	+
GENDER	Gender of the Household head	Dummy variable for sex of household head 1= Male; 0= Female	+
CREDIT_ACCESS	Whether the respondent has access to credit	Dummy variable: 1 = Yes 0 = No	+
INDIV_SELLING	Whether the respondent sold green grams individually	Dummy variable: 1 = Yes 0 = No	+
COOP_SELLING	Whether the respondent sold green grams in a cooperative	Dummy variable: 1 = Yes 0 = No	+
MIDDLECLASS	Middle class wealth category of the respondent	Dummy variable: 1 = Yes 0 = No	+
RICH	Rich wealth category of respondents	Dummy variable: 1 = Yes 0 = No	+
UNIT PRICE	Selling price of green grams per kg	Continuous variable capturing the unit selling price of green gram per kg (KES)	+
GREENGRAM VARIETY	Green gram variety farmers sold	Dummy variable: 0= Local variety; 1= Improved variety (N26)	+
MOBILE_MKT_INFO	Use of mobile phone to access market information	Dummy variable 1= Yes; 0= Otherwise	+
OFFINCOME	Total annual off farm income in the household	Continuous variable capturing annual off-farm income in (KES)	+

Source: Author

3.3.2 Justification for inclusion of various variables in the empirical model

Education level of the household head (**EDU)**

EDU was a continuous variable measuring number of years the household head spent in formal education. A positive sign was hypothesized with more educated farmers being more likely to sell to more complex marketing channels. According to Girma and Abebaw (2012), years of formal education is linked to the critical thinking capacity of the farmer where he makes critical decisions to sell at the highest price while minimizing his/her costs. Elsewhere, education has been found to have a significant positive influence on choice of marketing channels (Emmanuel and Charles, 2012). Marenya and Barrett (2006) show that if a farmer attained formal education of any level, they are more likely to take up innovations both in production and marketing. This is supported by Bongiwe and Micah (2013).

Age of the household head (AGE)

AGE was a continuous variable measuring the age of the household head in years. It was expected to have a positive effect on farmer's choice of a marketing channel. Older people are expected to have accumulated more knowledge than younger ones on marketing trends and opportunities hence they have forged trust with buyers and know which buyers give good margins (Girma and Abebaw, 2012). Nyaupane *et al*. (2010) found the age of the household head to significantly affect the choice of marketing channels in Louisiana Crawfish Industry. Hobbs (1997) found that the age of the household head significantly influenced farmers' channel choice in livestock marketing in the United Kingdom. Chomba (2004) found that older farmers had a lower probability of choosing formal marketing channel compared to younger farmers in Zambia.

Area under farming (FARM_LAND)

FARM_LAND measured the size of cultivated land by the household in acres. It was hypothesized to have a positive relationship with farmer's choice of marketing channels in Mbeere South sub-County. Size of cultivated land can influence agriculture productivity and marketing. Farmers with larger proportions of cultivated land may have higher production leading to greater market activities to offtake the surplus. Tsourgiannis (2002) found the size of cultivated land to be highly significant in determining milk marketing channel choice in East Mercedonia, Greece. The study noted that farmers with larger cultivated farms marketed their milk to big national/regional dairy firms. Mathenge *et al*. (2010) found that larger cultivated land increases the potential for the household to have marketable surplus, benefiting from economies of scale which translate into lower transaction cost and increased probability of choice of marketing channels.

Cost of production activity (COST_ACTIVITY)

COST_ACTIVITY was measured as a continuous variable representing the total cost of production activities. The production cost was aggregated to get the total cost. It was hypothesized to have a negative relationship with the choice of marketing channel. This is because high costs of production could discourage farmers from producing and hence participating in the market (Girma and Abebaw, 2012). Higher production costs lower the profit margins, which has a bearing on the choice of marketing channels (Tsourgiannis, 2008).

Unit transport cost (TRANS _COST)

TRANS _COST was measured as a continuous variable capturing the one-way transportation cost per unit of green grams transported to the market. The study hypothesized transport cost to have a

negative relationship with choice of marketing channels. Transport cost varies with mode of transport used and amount of produce being transported to the market. Hobbs (1997) noted that transaction costs (including transport cost) affect the choice of marketing channels with farmers preferring channels that attract lower transport cost. Other studies also show transport cost to have a significant negative relationship with choice of marketing channels. For example, Ogunleye and Oladeji (2007) found that cocoa farmers in Nigeria preferred channels with lower transportation cost to maximize their profit margins.

Frequency of selling at the market (FREQ_TO_MKT)

FREQ_TO_MKT was coded as a categorical variable. It represented the number of times the farmer travelled to the market to sell his/her produce over the past 12 months. The values 1, 2 and 3 denoted access the market weekly, once a monthly and every three months respectively. The study hypothesized the variable to be positively associated with the choice of the marketing channel. Repeated transactions embody trust between the parties and reputation of the buyer through repeated interaction over a period of time (Maina, 2010). Hobbs (1997) found that long-standing relationship between market actors had a positive influence on choice of livestock marketing channels in the United Kingdom. Frequency to the market embodies trust influencing repeated transaction with the trader.

Gender of the household head (GENDER)

GENDER was coded as a dummy variable representing the gender of the household with 1 denoting male household head and zero otherwise. Being male was expected to have a positive relationship with the choice of marketing channel. Men have a higher decision making capability within the household shaped by the norms and roles set out for men in the African culture. Nyaupane *et al*. (2010) found that the choice of marketing channel for crawfish in Lousiana was positively influenced by the gender of the household head with women preferring shorter channels compared to men. Male household heads were found to have a better tendency in searching market outlets for their potatoes compared to their female counterparts in Ethiopia (Girma and Abebaw, 2012). Therefore, the gender of the household head plays an important role in determining the households' production and marketing choices in Mbeere South sub-County.

Credit Access (CREDIT_ACCESS)

CREDIT_ACCESS was coded as a dummy variable measuring whether or not the farmer had access to credit during the previous season. A value of 1 denoted that the household had had access to credit in the last season and zero otherwise. The study hypothesized a positive relationship between credit access and choice of marketing channel. Mburu *et al*. (2007) found that availability of credit services had a positive influence in choosing cooperatives as the most viable marketing channel for selling milk in central Kenya. Jari (2009) also found that farmers who had access to credit preferred more formal marketing channels.

Selling as an individual (INDIV_SELLING)

INDIV_SELLING was coded as a dummy variable. The variable measured whether the respondent sold individually. This variable was a proxy for market arrangement to show the mode of sale farmers used while selling their green grams with a value of 1 denoting yes and 0 otherwise. The study hypothesized a positive relationship between marketing arrangement and choice of marketing channel. The cost of peer monitoring may be higher than the benefits of selling in a group (Stockbridge *et al*., 2003). Farmers who sell individually benefit from quick decision making and flexibility in choice of marketing channels (Fafchamps, 2004).

COOP_SELLING was coded as a dummy variable. The variable measured whether the respondent sold green gram in a cooperative. This variable was a proxy for market arrangement to show the mode of sale farmers used while selling their green grams with a value of 1 denoting "selling in a cooperative" and 0 otherwise. The study hypothesized a positive relationship between decision to sell in a cooperative and choice of marketing channel. This is because selling in a group reduces marketing costs and increases farmer's bargaining power. Githaiga (2007) found that farmers that sold in a group had a higher bargaining power than farmers who sold individually because they were able to sell in markets where they get higher margins while individual farmers are likely to sell to markets closer to their farms where they incurred less marketing costs. Jari (2009) also noted that availability of contractual agreements and existence of extensive social capital had a positive influence in choice of formal marketing channels in South Africa. Mathenge *et al*. (2010) found that producer groups were good platforms for social capital formation through which farmers obtained market information at a lower cost hence lowering the fixed transaction marketing costs in Kenya.

WEALTH_CATEGORY

This was derived from a household asset index as described in Ahuja *et al*. (2003). Filmer and Pritchett (2001) popularized the use of principle component analysis (PCA) for estimating wealth levels using asset indicators to replace income or consumption data. In this study, the status of wealth of survey households was derived as follows: First, eigen values were computed for the following variables: income, roof material, floor material, wall material, type of toilet, main water source during the main season, main water source during the short rains season and cultivated land. Second, discriminant factors based on eigen values were obtained by retaining only factors with a minimum eigen value of 1. These factors were then rotated based on the maximum variance method and only factors with a score greater than 0.4 were retained. The retained factors obtained above were used to determine which assets could be used to discriminate between survey households. All assets with meaningful loading on two or more factors were excluded. Factor scores from PCA were used as weights or coefficients on each asset. They were then used to compute the asset index using this formula (Ahuja *et al.*, 2003):

$$A_i = \sum_k f_k \frac{a_{ik} - a_k}{s_k} \qquad (3.7)$$

where:

A_i = value of asset index for the *i*th household

f_k = factor score coefficient for the *k*th asset obtained from PCA

a_{ik} = value of the *k*th asset for the *i*th household

a_k = the mean of the *k*th asset over all households

s_k = the standard deviation of the *k*th asset over all households

If the asset index for a particular household was less than the mean for all households, that household was designated as "poor"; if the index was between the sum of the mean plus one standard deviation, the household was designated as "middle class." All households with an index greater than the mean plus one standard deviation were deemed "rich" (Ahuja *et al.,* 2003).

Two dummy variables, one for middleclass and the other for rich, were defined while the "poor" category was left out to avoid the dummy variable trap. **MIDDLECLASS** was coded as a dummy variable with a 1 depicting respondents categorized in the middleclass category and 0= otherwise. Likewise, **RICH** was also coded as a dummy variable with a 1 depicting respondents categorized in the rich category and 0= otherwise both variables were hypothesized to have a positive influence on the choice of green gram marketing channels. This is because, more wealthy farmers were expected to have the resources needed to take their produce to distant markets. In addition, wealthier farmers were expected to more likely meet transaction costs, e.g., transport, to access the market. Fafchamps and Hill (2005) found that wealthy coffee farmers in Uganda with large quantities of coffee for sale were more likely to sell it to distant markets because they were able to pay for transport.

Green gram selling price (UNIT_PRICE)

UNIT_PRICE was captured as a continuous variable capturing green gram selling price per kg in KES. A positive sign was hypothesized with farmers likely to choose a channel which offered a higher price. Pricing plays a critical role while farmers are making decisions on which marketing channel to use. Dejo *et al.* (2011) in Nigeria examined the marketing channel and pricing system

of cashewnuts in the eastern part of Kogi State. The results showed that price had a positive relationship with choice of marketing channels. Mburu *et al*. (2007) found that more farmers in central Kenya chose the channel that offered a higher price for milk. Staal *et al.* (2006) also found a positive relationship between the price offered for milk and marketing channel choice in Gujarat. Msabeni *et al*. (2010) however found a negative relationship price of mangoes and choice of marketing channels in eastern Kenya. This is because farmers in the rural areas where markets were located were far away from farms and majority of farmers lacked means of transport and information on the said markets. Although farmers may be interested in selling to channels offering the highest prices, their socio-economic and institutional environment may not enable them to exploit the opportunity (Msabeni *et al.*, 2010).

Green gram variety sold (GREENGRAM_VARIETY)

GREENGRAM_VARIETY was coded as a dummy variable variable with 1 representing the improved green gram variety (N26) and zero otherwise. This variable was hypothesized to have a positive association with farmers' choice of green gram marketing channels. Improved varieties are more resistant to disease and drought and hence have higher yield, which could encourage farmers to sell the surplus (Nyaupane *et al.,* 2010). Wojciech *et al.* (2003) found that improved fruit variety positively influenced farmers' choice of peach marketing channels in Georgia, USA.

Use of Mobile phone to access market information (MOBILE_MKTINFO)

MOBILE_MKTINFO was coded as a dummy variable capturing the use of mobile phone to access marketing formation. The value of 1 denoted use of mobile phone and zero otherwise. The use of mobile phone was hypothesized to have a positive relationship with farmers' choice of green gram marketing channels in Mbeere South sub-County. Mobile phones ease the cost of information

access by reducing the transport cost and time that a farmer would use to go to the market (Gong *et al*., 2007). Hobbs (1996) argues that economic agents face costs in the search for information about products, prices, inputs and buyers or sellers. The cost of obtaining price information depends on the extent to which there is readily available information on market prices (Hobbs, 1997). Martey *et al*. (2012) used mobile phone as a proxy for access to market information by yam farmers in Ghana. The study found that farmers who used mobile phones to access market information were more likely to sell to the rural market.

OFFARM income (OFFINCOME)

OFFINCOME was measured as a continuous variable capturing household off-farm income in KES. Off-farm income was computed by summing all off-farm income sources obtained by the household. Because marketing requires some initial capital, it was expected that off-farm income would have a positive effect on the choice of green gram marketing channel in Mbeere South sub-County. This is because it enabled the farmer to access the initial capital to market and search information on available marketing options. Shiferaw *et al*. (2006) found that cash-strapped farmers in eastern Kenya were not able to wait for delayed payments; they sold to buyers who paid promptly on cash in order to satisfy immediate household financial needs. Ngqangweni (2000) in South Africa found that farmers with higher off-farm incomes engaged more in formal marketing channels compared to those with lower incomes. Higher off-farm incomes were found to enable the farmer to purchase necessary inputs to meet quality requirements in western Kenya (Marenya *et al*., 2006). These studies therefore support the hypothesis that off-farm income increases farmers' availability to cater for marketing costs hence positively influence farmers' choice of green gram marketing channels in Mbeere South sub-County.

3.4 Diagnostic tests

3.4.1 Testing for multicollinearity

Multicollinearity occurs when the independent variables are highly correlated or have a perfect linear relationship among them (Wooldridge, 2000). Where multicollinearity is present, the β-coefficients have very high standard errors leading to low *t*-values (*ibid*). This leads to drawing the wrong inference about the effect of the hypothesized variables on the dependent variable or committing type I error, which involves rejecting the null hypothesis when it is true (Gujarati and Sangeetha, 2007).

Multicollinearity was examined by inspection of the *p*-values and magnitude of parameter estimates in the model through a pairwise correlation matrix. According to Kennedy (1995), a statistically significant values of 0.8 or above in one of the correlation coefficients shows a high correlation between two independent variables. In this study, the Pearson correlation was used to detect multicollinearity. The results in Appendix I show no variables with a value higher than 0.5 and statistically significant at 95 percent confidence level. Hence, there was no correlation in among the independent variables.

In order to confirm absence of multicollinearity, the variance inflation factor (VIF) method was used. According to Maddala (2001), if VIF for any regressor is equal or greater than 5, then there is a problem of multicollinearity. Based on the results presented in (Appendix II), all variables had a VIF of below 5. Hence, multicollinearity was ruled out from the data.

3.4.2 Testing for heteroscedasticity

Heteroscedasticity exists when the variance of the disturbance term is not constant, implying lack of homoscedasticity (Greene, 2003). One of the OLS assumptions is that all error terms have the same variance and are not correlated with each other (*ibid*.). Hence, presence of heteroscedasticity means variance of error term is different across observations leading to inefficient estimators. Assuming homoscedasticity when it does not exist results in type I error of failing to reject a null hypothesis when it should be rejected (Gujarati, 2007). Presence of heteroscedasticity was tested using the Levene's test (Levene, 1960). The test was used to assess if *k* samples in the data have equal variances under the ROBVAR command in STATA. The null hypothesis was that variables have an equal variance. The results in Appendix III indicate absence of evidence of heteroscedasticity in the data as none of the *p*-values was significant (Levene, 1960).

3.4.3 Test for Independence of Irrelevant Alternatives (IIA) STOP

As indicated elsewhere, the MNL suffers from the problem of IIA (Louviere *et al.*, 2000). Presence of the IIA problem makes estimated probabilities to be correlated with those of choices not included in the analysis leading to inconsistent parameter estimates (Small and Hsiao, 1985). This study used the Hausman and Small-Hsiao test to assess for the possible violation of the IIA assumption. The null hypothesis was that the odds (outcome-*J* vs outcome-*K*) were independent of other alternatives against the alternative that (outcome-*J* vs outcome-*K*) are not independent of other alternatives. A significant test gives evidence against Ho if the chi-square is less than 0. This implies that the estimated model is independent of irrelevant alternatives (Small and Hsiao, 1985). The Hausman and Small-Hsiao test were undertaken using the MLOGTEST, IIA command in

STATA. Based on the results presented in Appendix IV, the null hypothesis could not be rejected meaning that the outcomes were independent of other alternatives.

In addition to the Hausman and Small-Hsiao tests, a "combination" test was undertaken to check if the alternatives could be combined. The null hypothesis was that a coefficients except intercepts associated with a given pair of alternatives were 0 (i.e., alternatives can be combined) against the alternative that all coefficients except intercept were not zero (Small and Hsiao, 1985). The command MLOGTEST, COMBINE was used. The results in Appendix V show that the test was significant at 1 percent level for all alternatives. Therefore, the null hypothesis could not be rejected, implying that the alternatives could not be combined.

3.4.4 Test for goodness-of-fit

Model fit was assessed using the likelihood ratio (LR) test under the LRTEST command in STATA. The LR test involves estimating two models and comparing them. The LR test compares the log likelihood of two models and assesses whether this difference is statistically significant. If the difference is statistically significant, then the less restrictive model (the one with more variables) is said to fit the data significantly better than the more restrictive model. As shown in Appendix VI, the chi-square value for the LR with 32 degrees of freedom was 95.20 and was statistically significant (p=0.0000). This means that the unrestricted model is fitted the data better than the restricted model.

3.4.5 Testing for Endogeneity

Endogeneity is observed when the error terms of independent variables are correlated with the error terms of the dependent variable i.e., $E[X'\varepsilon] \neq 0$ (Wooldridge, 2007). Whenever there is endogeneity, OLS estimates of the β's will no longer be unbiased. Endogeneity could result from

specification error, simultaneity or model misspecification (omitted variables) (*ibid*). Since use of mobile phones to access marketing information by itself is an outcome variable that may depend on households' socio-economic conditions, it could be correlated with the error term of the dependent variable. To check the robustness of the estimates, endogeneity test was undertaken on the variable "use of mobile phone to access marketing information" Using the two-stage endogeneity test (Tadesse and Bahigwa, 2015). Three instrumental variables were selected based on strong suspicion of having an influence of the use of mobile phone to access marketing information but without a significant effect on the outcome. Basic numeric, reading, and writing literacy is an important precondition for a household to own and use mobile phone to access market information (*ibid*). Education level of the household head and that of the spouse were used as instruments. In addition, cattle ownership was used as a proxy to wealth. In the absence of endogeneity, performing IV estimation inflates the asymptotic variance of the estimators (Wooldridge, 2003). From the first-stage estimation, a generalized residual was predicted, as an inverse Mill's ratio of the predicted value of using a mobile phone to access market information. Then, the generalized residual was included in the second-stage estimation that estimated the outcome variables. Endogeneity was detected based on whether the generalized residual was statistically significant in the second stage regression. The Wu-Hausman test for endogeneity was used under the Stata command ESTAT ENDOG command. The null hypothesis was that the suspected variables are exogenous. The results in Appendix VII show that the null hypothesis of lack of endogeneity could not be rejected.

3.5 Study area

This study was conducted in Mbeere South sub-County in former Eastern Province of Kenya. It consists of six administrative Locations namely, Kiritiri, Gachoka, Mwea, Makim, Siakago and Muringari (Figure 3.2). Mbeere South sub-County is located in a low-potential dry zone (GoK, 2009). It is covered by three agro-ecological zones; the marginal cotton zone (LM4); the lower midland livestock-millet zone (LM5); and the lowland livestock millet zone (L5) (GoK, 2009).

The altitude of Mbeere South sub-County is 800 meters above sea level with an average rainfall of 700 to 900 mm. Mean annual temperature ranges between 21.7^{o}C to 22.5^{o}C. The soil type is ferralsols (Jaetzold *et al.,* 2007). The total population in the sub-County was 202,929 individuals in 2009 of which 55.9 percent were food poor (KNBS, 2009). The main crops grown in the area are green grams, cowpeas, bananas and sorghum, which play the dual role of being both food and cash crops. Smallholder farmers in the county depend on the production and marketing of green grams, with about 70 percent producing green grams (Tegemeo, 2012).

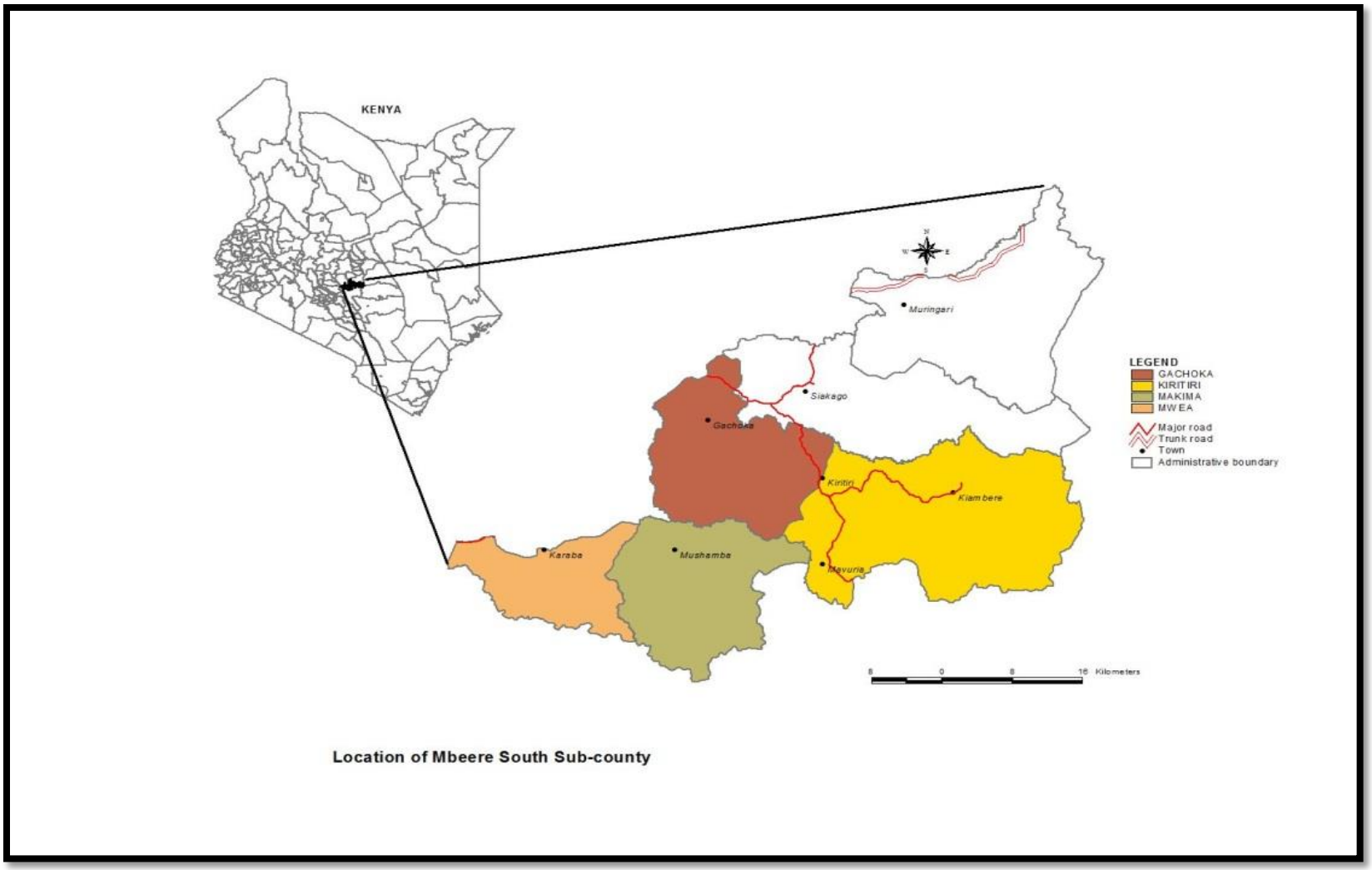

Figure 3-2: Map of Mbeere South sub-County

Source: GoK (2010)

3.6 Sampling procedure and sample size

3.6.1 Sampling procedure

The study was carried out under the now completed project "Making Agri-food Systems Work for the Rural Poor", implemented by the then KARI now KALRO. Random sampling was used to select the sample. Names of household heads were compiled by the help of village guides and Ward Agricultural Officers who listed all farmers in Kiambere, Kindaruma, Mutuobare and Gacabari locations who were growing green grams at the time of the survey in 2012. This constituted the population.

3.6.2 Sample size determination and sampling procedure

The sample size was determined using Yamane (1967)'s formula, which is used when the population size is known:

$$n = \frac{N}{1+N(e^2)} \quad (3.8)$$

Where n= sample size, N= population size and e = confidence level. A 95 percent confidence level and a value of 0.05 were assumed based on Mugenda and Mugenda (2003). From a population of 800 households, a sample size of 266 respondents was obtained using the sample size formula. Random sampling was used, from the sampling frame of 800 respondents random numbers were assigned to each household and using the random number generator 266 respondents were selected. Respondents were then identified using the help of village elders and Ward agricultural officers.

3.6.3 Data needs

This study used both primary and secondary data. First a focus group discussion (FGD) was conducted involving 6 women and 7 men to identify the green gram marketing channels in

Kiambere Location. The FGD was attended by representative farmers from all the sampled sub-locations. A FGD guide was used in this regard (see Appendix VIII). A schematic drawing of the marketing channel was made on flip charts with the help of farmers indicating the various options that they had in marketing their produce. On each node of the channel, the average price that they obtained for their produce was recorded.

Quantitative data were collected by administering a semi-structured household questionnaire (see Appendix IX) to 266 randomly selected households. The target of the questionnaire survey was the household head or the spouse in households that grew green grams and were part of farmer groups in the project. The questionnaire gathered information on age, gender, education, production and marketing of green grams in Kiritiri, Gachoka, Mwea, Makim, Siakago and Muringari locations.

Secondary data were collected from the Ministry of Agriculture, KALRO and the KNBS on the quantity of green grams produced in the project area and the market structure. The objective was to assess the production levels and trends in the study areas compared to the national average.

3.6.4 Data collection

Prior to administering the actual survey, the questionnaire was pretested by administering 10 questionnaires to respondents in Mutobare location which was outside the study area. This was done by the researcher and four research assistants as part of their training. The researcher was interested in establishing whether the respondents had the same understanding of the questions in order to collect the required information.

The data collection procedures involved the following steps: First, the researcher sought research permit to conduct the study in writing from the sub-County Agricultural Officers. After the permission was granted, four research assistants were recruited and trained on how to administer the questionnaire. The researcher, together with the research assistants, visited the sampled households in Mbeere South sub-County under the guide of the Ward Agricultural Officer. The questionnaire was administered to selected heads of households by the researcher and research assistants and any clarification from them concerning the research questions was provided. To schedule for interviews, appointments were made with the help of the village guide. Each research assistant and researcher administered three questionnaires per day over a period of three weeks. The questionnaires were administered in Kimbeere or Swahili but recorded in English. Most of the respondents were conversant with the Swahili language.

On completion of all the household interviews, the researcher collected data from the market actors, i.e., rural retailers, wholesalers and assemblers in Mutobare, Kiritiri and Embu markets. These were the three main markets accessed by farmers in Mbeere South sub-County. An interview guide was used (see Appendix X). The main data collected were on source(s) of the produce, buying price, selling price and monthly marketed volume. A transect walk was done in each market and every third trader was interviewed in the categories above. In total, 8 assemblers, 10 rural retailers and 6 wholesalers were interviewed.

3.7 Data analysis

The data were captured in the Statistical Package for Social Sciences (SPSS) software version 21. Descriptive statistics were used to characterize the existing green gram marketing channels in MSSC pursuant with objective 1 of this study. The descriptive statistics included means,

percentages and frequencies. Analysis of variance (ANOVA) was conducted across the marketing channels. The second objective was achieved by fitting a MNL to the data using STATA version 13 to assess the factors influencing farmers' choice of alternative marketing channels in Mbeere South sub-County. Results were presented in MS Word using tables and graphs.

CHAPTER FOUR: RESULTS AND DISCUSSION

4.1 Characterization of green grams marketing channels

4.1.1 Socio-economic characteristics for green grams producers

Out of the sampled 266 households, 262 respondents were interviewed; the remaining 4 households were not available during the data collection exercise. In addition, only 230 households actually grew green grams at the time of the survey of whom 194 were involved in green gram marketing. Majority (58.2%) of the households preferred the rural retailers marketing channel, followed by assemblers marketing channel at 26.9 percent and wholesalers at 14.9 percent respectively (Table 4.1).

Table 4.1: Distribution of survey households by marketing channel in Mbeere South Sub-County

Marketing channel	**Number of households using the channel**	**Percentage**
Direct sales to rural retailers	113	58.2
Direct sales to rural assemblers	52	26.9
Direct sales to wholesalers	29	14.9
Total	**194**	**100**

Source: Author

Table 4.2 presents the frequencies of socio-economic characteristics of the survey households in Mbeere South sub-County. Majority (87%) of the households were headed by males. More male-headed households participated in the three marketing channels compared to their female counterparts. The results were significant at p=0.04. These results are consistent with (Girma and

Abebaw, 2012) who found that male-headed households were more likely to engage in choice of potato marketing channels in Ethiopia as compared to women. Quisumbing (2000) noted that men and women have different roles in the household. Women take up more productive roles, e.g. provision of farm labour while men take up more decision making role, e.g., decision to sell *(ibid.).*

Majority (67.7%) of the household heads had attained primary level of education and only one respondent had no formal education (Table 4.2). When grouped according to the marketing channel, the majority of those with primary and secondary education sold their green grams through the rural retail outlets while half of post-secondary education holders preferred rural assemblers. The literacy levels are well within the range of the national adult literacy level of 87.4 percent (World Bank, 2012).

Out of 194 farmers who marketed their green grams, 28 percent had accessed some credit within the last 12 months prior to the study. When grouped according to the marketing channel, the majority (55%) of those who accessed credit sold through the rural retailer marketing channel, followed by 35 percent selling through the assemblers marketing channel and the remaining 10 percent sold through the wholesaler marketing channel. There was no statistical difference across the marketing channels on number of people who accessed credit.

Table 4.2: Frequencies of socio-economic characteristics across green gram marketing channels in Mbeere South sub-County

	Marketing channel				
Characteristic	**Rural assembler**	**Rural retailer**	**Wholesaler**	**Total**	**Chi Statistic**
Gender of household head					
Male	45	103	21	169	6.26(2)**
Female	7	10	8	25	
Literacy level of household head					
No Education	0	1	0	1	
Primary Education	33	73	24	130	
Secondary Education	14	35	4	53	6.71(2)
Post-secondary Education	4	3	1	8	
Credit access					
Yes	19	30	5	54	3.67 (2)
No	33	84	23	140	
Use of mobile phone in marketing					
Yes	13	49	12	74	5.2(2)*
No	39	64	17	120	
Green grams variety					
N26	40	83	16	139	
Local	12	30	13	55	5.02(2)**
Wealth category					
Rich	13	25	8	46	2.79(4)
Poor	36	72	18	126	
Middle class	3	16	3	22	
Marketing frequency					
Once a week	6	18	4	28	3.19
Once a month	15	30	4	49	
Once every three months	31	65	21	117	

Source: Author

Even though 72 percent of the households had a mobile phone, only 38 percent used it to access marketing information. Of these, 66.5 percent were farmers who used sold green grams through rural retailers marketing channel; 17.5 percent sold through assemblers and 16.0 percent through the wholesalers respectively. Use of mobile phones in marketing was statistically different between rural assemblers and rural retailers; it was also significantly different between rural retailers and wholesalers ($p=0.07$). A frequency correlation between uses of mobile phones to access marketing information against education level showed that there was no significant difference among mobile phone users across education levels ($p=0.3$). However, 72 percent of the respondents owned a mobile phone. This is above the national average mobile phone penetration of 64.2 per 100 in habitants during the study period (Communication Commission of Kenya, 2011).

Most (90.2%) of the households sold their produce individually (Table 4.2). Another 5 percent in either cooperatives or collectively. However, the number of households using different marketing arrangements was not statistically different across the three marketing channels. It could be farmers enjoy higher flexibility and independence while marketing as individuals. Also it could be the farmers have not explored the value of collective marketing. Hobbs and young (2009) observed that farmers who sold individually avoid the cost of peer monitoring compared to the benefits of marketing in a group.

Most (71%) farmers grew the improved green gram variety, N26. The variety is both drought tolerant and disease tolerant relative to the local variety (Tegemeo, 2012). It also has a better taste and is more preferred by consumers compared to the local variety (*ibid*.). The majority (59.7%) of

households who grew N26 sold their produce through rural assemblers. Another 28.8 and 11.5 percent sold through assemblers and wholesalers respectively (Table 4.2). Accordingly, the number of households who grew different green gram varieties was statistically different across the three marketing channels (p=0.05). The improved green gram variety (N26) was more preferred by traders who sold directly to consumers since it had a shiny appearance and was more preferred by customers. This is in line with Tegemeo (2012) who found that the Improved variety (N26) was more preferred for trade while the local variety was more preferred for own consumption and use as seed.

With regard to wealth classification, the majority (64.9%) were "poor"; 11.3 and 23.7 percent were "middle" and "rich" categories respectively (Table 4.2). Most of the "rich" category chose the rural retailer marketing channel (54.3%); while 28.4% and 17.3% chose rural assembler and wholesaler respectively. Majority of the "middle class" chose the rural retailer marketing channel (72.8%); while 13.6% chose rural assemblers and wholesalers each. There was a slightly higher percentage of people who chose the rural assembler (28.4%) among the "poor" category while (54.2%) chose rural retailer marketing channel and 14.3 percent chose the wholesaler marketing channel. There was no statistical difference in the number of households in each wealth category across the marketing channels (p=0.59). The common trend is most farmers in each category chose to sell to rural retailers although they were distant from farmers' households. However, a higher proportion of the poor category chose to sell to the assembler marketing channel. This is in line with Fafchamps and Hill (2005) who found that coffee farmers in Uganda were more likely to sell it to channels where they received the highest margins.

Table 4.3 presents the means of various socio-economic characteristics of survey households in Mbeere south sub-County. The mean age of the household head was 39.2 years (range= 22-77 year). There was no significant difference in age across the three marketing channels. The farmers in Mbeere South were younger relative to the national average of between 45-65 years for smallholder farmers (GoK, 2010c). Due to luck of many livelihood options young people start farming early. In addition, green gram is seen as a cash crop in Mbeere hence most young people are keen to engage in this enterprise (Tegemeo, 2012).

The mean household size was five members (range = 2-12). There was no statistical difference in household size across the marketing channels in Mbeere South sub-County. The observed household size in Mbeere South sub-County was higher than the national average of 4.4 persons per household (KNBS, 2009). The mean cultivated land was 2.95 acres (range = 0.01-12). The observed land holding was above the national average of 2.5 acres per household (FAO, 2012). This implies that farmers in Mbeere South sub-County have a higher leverage in production potential, compared to other farmers in the country.

The average production cost per acre was KES 1027 (range = 100-8000). The cost of production activities was significantly different between rural retailer and wholesaler (p=0.01) marketing channels. Farmers who sold to rural retailers had the highest production cost at KES 1,234.65 per acre. The farmers who sold via wholesalers had the highest harvested amount (Table 4.3). These findings are consistent with Fafchamps and Hill (2005) who found that coffee farmers in Uganda with large quantity of coffee for sale were more likely to sell it to a distant market because they were able to pay for transport.

Table 4.3: Means of socio-economic characteristics of survey households across different marketing channels in Mbeere South sub-County

Characteristic		Marketing channel			
		Rural assemblers	Rural retailers	Wholesalers	Pooled
Formal education (Years)	Mean	8.84	8.50	8.86	8.64
	SD	2.90	2.81	5.35	3.31
Age of household head (Years)	Mean	40.67	39.25	36.58	39.23
	SD	11.49	10.86	7.89	10.6
Household size (Number)	Mean	5.09	5.00	4.96	5.02
	SD.	1.92	2.05	1.88	1.98
Yield (Kg)	Mean	65.42	81.56	88.66	77.8
	SD	107	78.12	100.21	97.04
Size of cultivated land (Ha)	Mean	2.78	3.04	2.91	2.95
	SD	1.98	1.94	2.10	1.97
Cost of Production (KES)	Mean	775.72	1262.65 ^{a**}	642.31 ^{c*}	1027
	SD	1101.97	1365.08	583.21	1227.90
Transport cost (KES)	Mean	120.27^{a**}	91.17	136.63^{c***}	103.78
	SD	67.30	46.14	65.21	58.38
Price (KES)	Mean	48.5	50	46.5^{c*}	48
	SD	8.6	9.6	8.0	8.5
Off farm Income (KES)	Mean	81,678	80,886.55	73,737	78,655
	Se	86,652	84,577	94,451	86,230

Source: Author

Significant groups: [a]Rural retailers' vs Assemblers; [c]Wholesalers vs Rural retailers

***, ** and * denote statistical significance at 1%, 5% and 10% levels respectively

The average transport cost was KES 103.78 (range=6-300) and was significantly different across rural retailers and wholesalers (p=0.00) and rural retailers and assemblers at (p=0.01). Transport cost was highest among farmers who sold to wholesalers. Wholesalers were located further from the farmers' homesteads and hence the cost of transport was higher compared to the other channels. Rural assemblers were mainly located at local markets whose main mode of transport was motorbikes. This mode of transport was slightly more expensive compared to public transport. There was public transport to distant market. This mode of transport was comparatively cheaper than motorbikes, which are the main mode of transportation from farms located in the interior of the local markets. These results are consistent with Artukoglu *et al.* (2008) who found that higher transaction cost incurred by dairy farmers, reduce farmers' interest of participating in formal marketing channel in Turkey.

The mean price for green grams per kilo was KES 48 (range= 35-68) (Table 4.3). The mean price was significantly lower for farmers who sold to wholesalers compared to those who sold to rural retailers (p=0.06). The rural retailers offered higher prices probably because this was the shortest channel (Figure 4.1). This finding is consistent with that of Tegemeo (2012) who found that retailers offered higher margins compared to other traders. The mean off-farm income was KES 80,016.75 per annum per household (range =8400-660,000). There was no significant difference in incomes across the green gram marketing channels. Farmers in rural assembler marketing channel had slightly higher income at KES 81,678 compared to those who sold through the other marketing channels. This could be because the study was conducted across project farmers in the same region and the livelihood options are not very different in the study sites. This is consistent

with Delgado and Minot (2000) who noted that the initial distribution of land and other productive assets will clearly affect the size of household income and distribution in a population.

4.1.2 Map of green grams marketing channels in Mbeere South sub-County

Figure 4.1 presents the map of green gram marketing channels in Mbeere South sub-County. The even broken arrows indicate the farmer-assembler marketing channel. In this channel, farmers sold directly to the rural assemblers who bought small volumes, bulked the produce and resold in larger volumes to other traders such as rural retailers, wholesalers and exporters. Assemblers sold an average of 40 (90kg) bags per month during the peak season and 10 (90kg) bags during the low season.

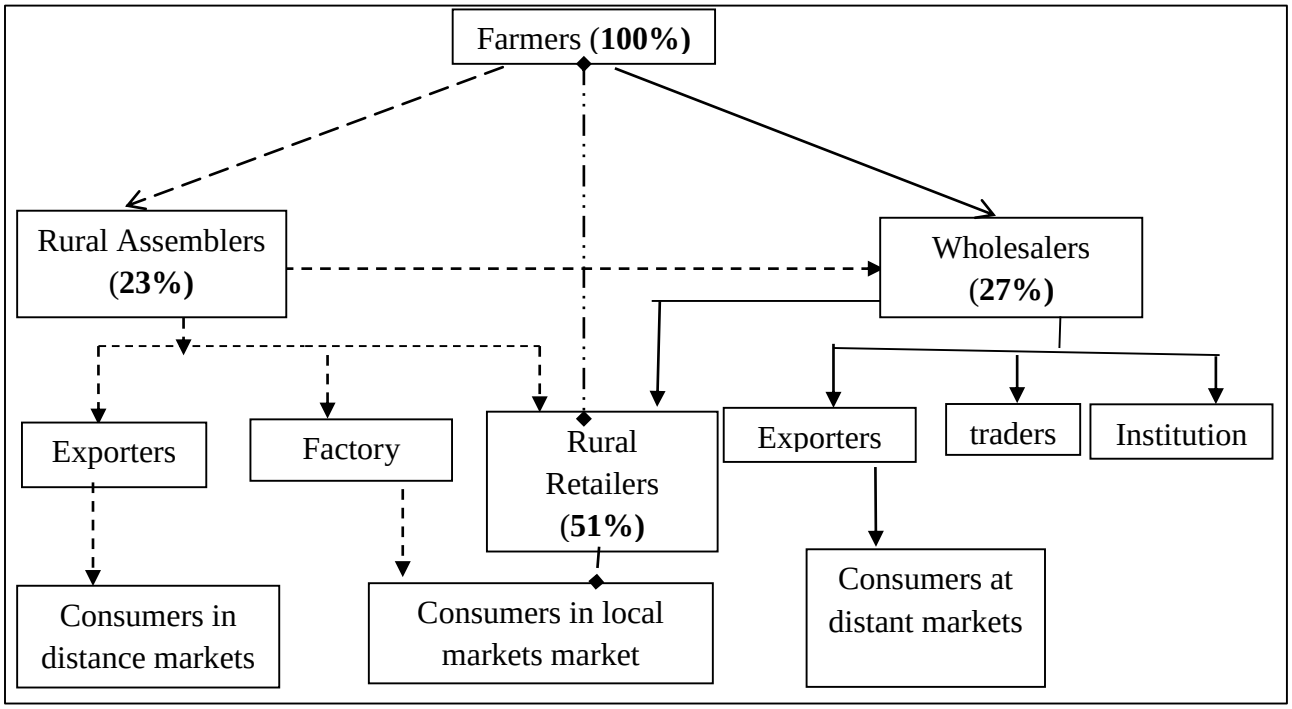

Figure 4.1: Map of green gram marketing channels in Mbeere South sub-County
Source: Author

Numbers in brackets represent % volumes of green grams per marketing channel

Key: Assemblers ---------► Rural Retailers —··—··—◆Wholesalers ——————►

Farmer-rural assembler channel was the longest of the three as it had the most intermediaries (Figure 4.1). These included rural retailers and wholesalers. The rural assemblers were mainly found at the local market at Mutuobare in Kiambeere Location. They bought small quantities of green grams from as little as 5kg to a 90-kg bag. They would then bulk the produce and sell to other traders. The rural assemblers also sorted the various varieties of green grams before bulking. They often rejected any produce that was mixed other green gram varieties. Rural retailers and wholesalers operated in both the local and distant markets including Kiritiri, Embu, Thika, Sagana, Kutus and Nairobi. The rural assemblers also sold their green gram stocks to exporters, e.g., Mavuria Women Nutria Business Group, and to the packaging factory, where green grams were sorted, polished and packaged before export or distribution to local supermarkets.

The stared arrows represent farmer to rural retailer channel which was the shortest among the three. In this channel, farmers sold their produce directly to rural retailers who later sold to consumers. Rural retailers also obtained their green grams supplies from rural assemblers and wholesalers. In the farmer-rural retailer channel, the retailers bought the produce from the local market at Mutuobare in Embu County during market days on Tuesdays and Fridays. They then sold their stock to consumers in both local and distance markets such as Kiritiri, Kutus, Sagana and Embu. This marketing channel did not have very many intermediaries and it offered farmers slightly better margins. During peak seasons, rural retailers had the highest volumes, selling up to 100 bags per month and approximately 12 bags during the low season.

The continuous arrows denote sales to green grams wholesalers. The latter bought the produce from farmers in large volumes. Wholesalers later sold their stock to retailers, institutions and exporters. The later mainly sold green grams to Asia. The main customers of wholesalers were traders from distant markets (e.g., from Embu, Karatina and Nairobi) who came to source for the produce during the harvesting season. In this channel, farmers with large quantities of green grams sold directly to wholesalers because they could bargain for higher prices. Typically, the farmer transported the produce to the wholesaler in Kiritiri in Embu County the wholesalers then sold their stock to exporters, distant traders, rural retailers or institution such as schools, hospitals and colleges. The wholesalers sold an average of 43 (90kg) bags per month during the peak season and an average of 16 (90kg) bags during the low season.

4.1.3 Price differentials in various green grams marketing channels

The rural retailers bought farmers' produce at the highest mean price of KES 4,500 per 90 kg bag. The rural assemblers bought the same bag at KES 4,400 while wholesalers obtained it at the lowest price of KES 4,162. These prices were not statistically significant; rural retailers offered the best price because they sold directly to the consumer, and this was the shortest marketing channel.

The mean selling price of a 90 kg bag of green grams was KES 5,640, KES 5,237 and KES 4,866 for rural retailers, wholesalers and rural assemblers respectively (Figure 4.2). This translates into a price margin of KES 1,140, 1,075 and 466 for rural retailers, wholesalers and rural assemblers respectively which was significant at (p=0.000). Thus, rural assemblers obtained the lowest margin this could be attributed to the fact that this marketing channel has the most intermediaries (see Figure 4.1). Many intermediaries could push the prices lower since each trader will need a

margin from the same commodity. Coughlan and Coughlan (2002) suggest that the longer the channel the more margins are added. In addition, wholesalers traded in higher volumes, even when making small mark-up per kilogram of green gram they traded in bulk. This is in line with Chalwe (2005) who noted that farmers who sold in bulk preferred selling beans to private traders.

According to the survey respondents, rural retailers purchase green grams from farmers for as low as KES 45 per kilogram during the harvesting season. They sold the same to farmers for as high as KES 120 during periods of food scarcity or during the planting season. This is consistent with Tegemeo (2012) who showed a significant price differential during harvesting and the rainy season. During harvest periods the prices of green grams are lower since there is higher supply compared to demand pushing the prices lower. During planting season there is limited supply and higher demand of green grams both for consumption and seed (*ibid*).

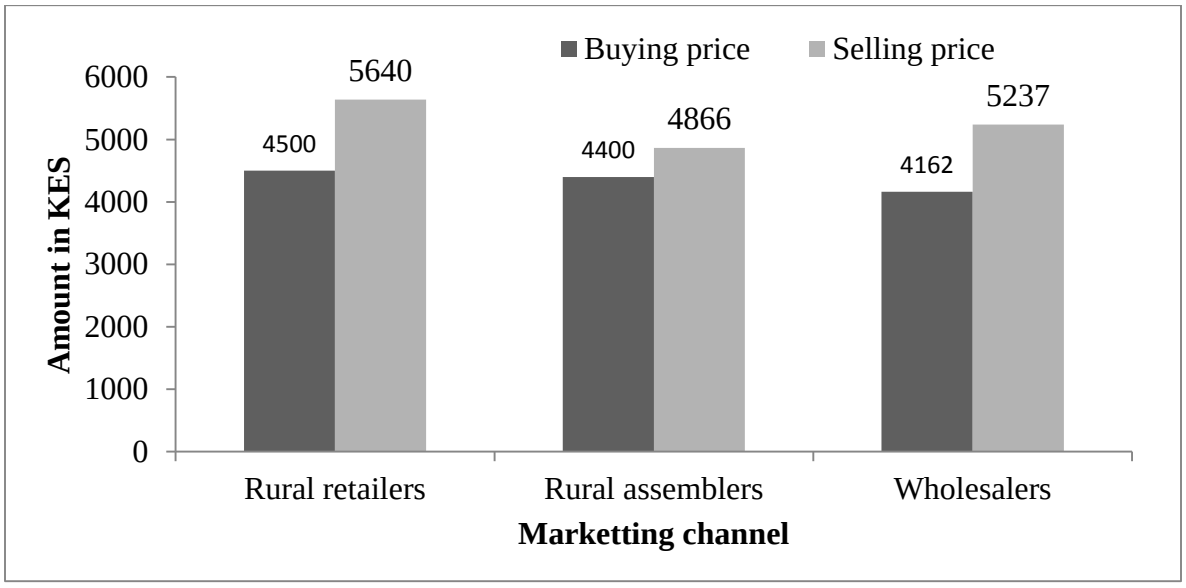

Figure 4.2: Green grams price differentials across the three marketing channels in Mbeere South sub-County

Source: Author

4.2 Factors influencing farmers' choice of green grams marketing channels in Mbeere South sub-County

Table 4.4 presents the results of the multinomial logit on the factors influencing farmers' choice of marketing channels in Mbeere South sub-County. The likelihood function testing the hypothesis that all the slope coefficients were simultaneously equal to zero was 95.20 (df = 32; p=0.000), pseudo R^2 = 0.431 indicating that the response variables explained 41% of the variation in the model. A likelihood ratio index of between 0.2 and 0.4 is acceptable for cross-sectional data (Jarvis, 1990 quoted by Mbata, 1997) indicating a good fit of the estimated model.

Out of the 17 variables included in the model, four variables significantly influenced choice of rural retailer marketing channel relative to wholesaler marketing channels. Age of household head and price of green gram positively influenced choice of rural assembler marketing channel relative to wholesaler marketing channel. Cost of transport and use of mobile phones to access marketing information had a negative and significant association in the probability of choosing rural assemblers relative to wholesaler marketing channel in Mbeere South sub-County.

Production cost, green gram selling price and gender of household head had a positive and significant effect on choice of rural retailer marketing channel relative to wholesaler marketing channel. While, transport cost negatively and significantly influenced the probability of choosing rural retailer marketing channel relative to wholesaler marketing channel in Mbeere South sub-County.

Table 4.4: Maximum likelihood estimates of factors influencing farmers' choice of green grams marketing channels in MSD

	Marketing channel					
	Rural assemblers			Rural Retailers		
Variables	**β-Coefficient**	**Std Error**	**Z-value**	**β-Coefficient**	**Std Error**	**Z-value**
HHSIZE	-0.040	0.265	-0.150	-0.162	0.222	-0.730
HHH_EDUC	0.013	0.103	0.130	-0.089	0.096	-0.930
HHH_AGE	**0.113***	0.060	1.890	0.080	0.053	1.510
COST_PRDN_ACTIVITY	-0.000	0.001	-0.330	**0.002***	0.001	-1.940
UNIT_TRANSCOST	**-0.024****	0.010	-2.380	**-0.037*****	0.010	-3.720
FREQ_TO_MKT	-0.954	0.943	-1.010	-1.426	0.896	-1.590
GENDER_HHH						
Male	0.806	1.559	0.520	**4.053*****	1.422	2.850
CREDIT_ACCESS						
Yes	1.713	1.176	1.460	0.585	1.087	0.540
INDIVIDUAL_SELLING						
Yes	16.106	1347.449	0.010	2.064	1.566	1.320
COOPERATIVE_SELLING						
Yes	18.930	1347.4	0.010	**4.640***	2.598	1.790
MIDDLECLASS						
Yes	0.144	1.144	0.130	-0.362	1.006	-0.360
RICH						
Yes	0.029	2.045	0.010	1.137	1.675	0.680
SALE_PRICE	**0.100****	0.040	2.480	**0.086****	0.038	2.280
GREENGRAM_VARIETY						
Improved N26	-0.984	1.156	-0.850	-0.535	0.989	-0.540
MOBILE_MKT_INFO						
Yes	**-3.900*****	1.327	-2.940	-0.669	0.878	-0.760
ANNUAL_INCOME	0.000	0.000	-1.180	0.000	0.000	-1.620
FARM_LAND	-0.101	0.257	-0.390	-0.229	0.224	-1.020
Constant	-18.464	1347.454	-0.010	-1.745	3.929	-0.440

Source: Author. †Farmer-wholesaler market channel was used as a reference.

n = 118; Log likelihood = -62.06; Pseudo R^2 = 0.431; LR Chi^2 (32) =95.20 Prob> Chi^2 = 0.0000***, ** and * denote statistical significance at 1%, 5% and 10% levels respectively

Table 4.5: Marginal effects of factors influencing choice of green grams marketing channels in Mbeere South sub-County

Variable	Marketing channel					
	Rural assemblers			Rural Retailers		
	dy/dx	Std Error	Z-value	dy/dx	Std Error	Z-value
HHSIZE	0.011	0.021	0.510	-0.018	0.022	-0.790
HHH_EDUC	0.009	0.009	0.960	-0.016	0.011	-1.430
HHH_AGE	**0.007***	0.004	1.860	0.001	0.004	0.330
COST_PRDN_ACTIVITY	**-0.000****	0.000	-2.490	**0.000*****	0.000	-3.430
UNIT_TRANSCOST	0.001	0.001	0.810	**-0.003*****	0.001	-3.980
FREQ_TO_MKT	0.021	0.057	0.370	-0.108	0.069	-1.570
GENDER_HHH						
Male	-0.198	0.122	-1.620	**0.460*****	0.084	5.450
CREDIT_ACCESS						
Yes	**0.143***	0.079	1.820	-0.075	0.086	-0.870
INDIVIDUAL_SELLING						
Yes	**0.248*****	0.033	7.540	-0.009	0.163	-0.060
COOPERATIVE_SELLING						
Yes	0.735	2.852	0.260	-0.541	2.852	-0.190
MIDDLECLASS						
Yes	0.053	0.084	0.630	-0.058	0.089	-0.650
RICH						
Yes	-0.091	0.126	-0.720	0.150	0.146	1.030
SALE_PRICE	**0.004***	0.002	1.780	0.004	0.002	1.430
GREENGRAM_VARIETY						
Improved N-26	-0.057	0.087	-0.660	0.008	0.091	0.090
MOBILE_MKT_INFO						
Yes	**-0.277*****	0.055	-5.030	**0.171****	0.073	2.350
ANNUAL_INCOME	0.000	0.000	-0.280	0.000	0.000	-0.750
FARM_LAND	0.008	0.020	0.390	-0.022	0.022	-1.030

Source: Author's Analysis
†Farmer-wholesaler market channel was used as a reference.
n = 118;***, ** and * denote statistical significance at 1%, 5% and 10% levels respectively

The coefficients from multinomial logit can be difficult to interpret because they are interpreted relative to the base outcome. To better evaluate the effect of a unit change in covariates on the dependent variable, the marginal effects are examined (Greene, 2003). Table 4.5 presents the marginal effects of factors influencing the choice of green grams marketing channels in Mbeere South sub-County.

The age of the household head (AGE) was positively and significantly related to choice of assembler marketing channel (p=0.06). This is in line with *a priori* expectation that age has a positive influence on choice of marketing channel. Older farmers preferred the assembler marketing channel with a one year increase in age associated with a 0.7 percent increase in the probability of choosing rural assemblers' relative to wholesale marketing channel, *ceteris paribus*. Older farmers have stronger networks with rural assemblers as compared to the younger farmers, due to many years of trade and repeated visits creating trust. This finding tallies with that of Adegbola and Gardebroek (2007) who reported that older farmers in Benin did not trust wholesalers. Instead, they preferred rural assemblers because they had developed a long term relationship. In Lousiana, USA, Nyaupane *et al*. (2010) found that older farmers had accumulated knowledge on market opportunities and trends, which positively influenced their choice of crawfish marketing channels. Older farmers in Mbeere South sub-County had fostered stronger relationships with rural assemblers due to repeated visits and knowledge of the opportunities and trends based on previous interactions.

As expected *a priori*, the production cost of green grams (COST_PRDN_ACTIVITY) was negatively but significantly associated with the probability of a farmer choosing rural assemblers

to wholesaler marketing channel (p=0.006). Accordingly, a unit increase in green gram production cost elicited a 0.01 percent decrease in the probability of a farmer choosing rural assemblers relative to wholesalers, *ceteris paribus*. Increased cost of production hinders production and consequently reduces the marketable surplus. This finding was consistent with Alene *et al*. (2007) who found that smallholders in Africa often face high costs in production and marketing of agricultural products. Increase in production cost reduces farmers' margins and hence there is no marketable surplus, resulting to a negative effect on the choice of assembler marketing channel.

Access to credit (CREDIT_ACCESS) was positively related to the probability of choosing rural assemblers relative to wholesale marketing channel as expected *a priori* (p=0.065). Access to credit increases farmers' access to resources needed for production and to cover marketing costs. A change from no access to credit access increased the choice probability by 14.3 percent, *ceteris paribus*. Farmers with credit access preferred selling to rural assembler relative to wholesaler marketing channel because credit access enabled them to meet production and marketing costs. Credit access allows farmers to purchase inputs, e.g., improved seed, fertilizers, which increase production increasing the marketable surplus. Randela *et al*. (2008) found that availability of credit allowed South African farmers to meet transaction and input costs.

Farmers' decision to sell individually rather than collectively through farmer groups (INDIVIDUAL_SELLING) was positively and significantly associated with the probability of choosing rural assembler instead of wholesale marketing channel (p=0.000) as expected *a priori*. Accordingly, the decision to sell individually rather than collectively increased the choice probability of selling to rural assemblers relative to wholesalers by 24.8 percent, *ceteris paribus*.

Individual selling allows flexibility and a direct relationship between the seller and the buyer. Rural assemblers were the closest traders to farmers hence were able to form a direct relationship with the farmers. The majority of the farmers market their produce as individuals, which is a clear sign that there is little collective action among farmers in marketing produce. Another possible explanation is that most traders usually deal with individual farmers. Most supply contracts are entered into between the market and an individual for the sake of accountability. This is consistent with Zivenge and Karavina (2012) who found that individual farmers in Zimbabwe preferred formal marketing channels since they were able to get into enforceable agreements with the traders.

Contrary to *a priori* expectations, the use of mobile phone to access market information (MOBILE_MKT_INFO) was negatively but significantly related to the probability of choosing rural assemblers over wholesale marketing channel in Mbeere South sub-County (p=0.001) *ceteris paribus*, a change from not using mobile phone to access market information decreased the probability of choosing rural assemblers as opposed to wholesaler marketing channel by 27.7 percent. This could be the adoption of mobile phones as a source of marketing information was not taken up in the study site at the time of the survey. Availability of marketing information about rural assemblers may be unavailable on the mobile platform as opposed to wholesaler channels. This is consistent with Urquieta (2009), who noted that cell phones increase access to price information. Thus, farmers with cell phones go to further markets, where prices are expected to be higher than local markets.

As expected *a priori* the price of green grams (PRICE) was positively and significantly related to the probability of choosing rural assemblers relative to wholesale marketing channel (p=0.079).

All else being equal, a unit increase in the price of green grams led to a 0.4 percent increase in the choice of assembler marketing channel relative to wholesaler marketing channel. Rural assemblers offered farmers a higher buying price compared to rural wholesalers at KES 48.5 and 46.5 respectively. High farm output prices increase farmer's income and farmers prefer channels where they make higher margins. This finding is consistent with (Staal *et al*., 2006), who reported that higher prices act as a motivation to produce more and get more income. In addition, Mburu *et al*. (2010) reported a positive relationship between price and choice of cooperative marketing channels among dairy farmers in the central highlands of Kenya.

As expected, use of mobile phone to access marketing information was positively and significantly related to the probability of choosing rural retailers relative to wholesaler marketing channel (p=0.019). *Ceteris paribus*, a change from not using to use of mobile phone increased the probability of choosing rural retailers as opposed to wholesaler marketing channel by 17.1 percent. Farmers who sold to retailer marketing channels had a wider range of traders to sell to. The more the traders the higher the variation in buying prices, and volumes among traders. Use of mobile phone to access information on prices and volumes traded would then lower the transaction costs. This finding is consistent with Jensen (2007) who reported that use of cell phones to access market information for fishermen in India made them choose more formal marketing channels and increased their profits by 8 percent.

With regard to the choice of rural retailer marketing channel, the unit production cost of green grams (COST_PRDN_ACTIVITY) was positively associated with choice probability (p=0.000) contrary to *a priori*. This could be because the rural retailer marketing channel was offering the farmers the highest price among the three marketing channels, which could have offset their production cost. A unit increase in green grams production cost could increase in the probability of choosing the rural retailer over the wholesaler marketing channel by 0.01 percent, *ceteris paribus*. From Figure 4.2, rural retailers and wholesaler offered KES 1140 and KES 1070 respectively, per 90kg bag. Thus, this could have influenced their likelihood to sell to the rural retailers as compared to wholesalers. Even with increased costs, Kakaty and Borah (2011) found that farmers in Asam chose channels with higher margins to be able to cater for their costs. In the current study, farmers in Mbeere South sub-County could have chosen the rural retailer marketing channel even though they incurred higher production cost since this channel offered higher green grams prices rather than wholesale channel.

A negative and significant relationship was found between transport costs (UNIT_TRANSCOST) and the probability of choosing rural retailer marketing channel as opposed to wholesalers (p=0.000) as expected *a priori*. Higher transport costs reduce the marketing margins hence farmers would not prefer channels that attract high transport costs. A unit increase in transport cost was associated with a 0.3 percent decrease in the probability that the farmer will choose rural retailer marketing channel relative to wholesalers, *ceteris paribus*. This finding is consistent with Jari (2009) who reported that farmers in South Africa preferred channels with least transaction costs including transport cost. In Turkey, Artukoglu *et al*. (2008) found that farmers with higher

transport costs preferred to sell to brokers where they could negotiate for higher prices. In this study, high transport cost would favor wholesalers than rural retailers since wholesalers bought high volumes, which could enable farmers to cover the higher transport costs.

The gender of the household head (GENDER) was positively associated with the probability of choosing the rural retailer as opposed to wholesale marketing channel ($p=0.001$). Accordingly, being male increased the probability of choosing rural retailer over wholesale marketing channel by 46 percent, *ceteris paribus*. Men control the decision on income from agricultural produce and hence would like to sell to channels which give the highest margins. In addition, male-headed households possess more marketing networks due to interaction capabilities with more buyers unlike women who are in most cases restricted to household chores. The rural retailer had the highest margin of KES 1,075 compared to the wholesale channel's KES 466. This is consistent with finding by the FAO (2002) that men in Latin America control the income generated from the marketing of the agricultural products and will choose marketing channels with the highest margins.

CHAPTER FIVE: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary

This study was carried out in Mbeere South sub-County. The sub-County is classified as semi-arid with low and erratic rainfall. It is therefore mainly suitable for drought-tolerant crops such as green grams, cowpeas, millet and sorghum. Mbeere South sub-County was selected as a study area because it is a major producer of green grams in Kenya, with 70 percent of the households growing them for sale. Thus, green grams act as a major cash crop in the study area. Since 2010, there has been an increase in green gram production in Mbeere South sub-County following the inception of the KALRO project that aimed at enhancing green gram productivity through distribution of improved seed and training on good agronomic practices. To sustain this increased productivity, there was need to link farmers with efficient marketing systems. However, at the time of the study it was not known which marketing channels that green gram farmers would prefer and the factors driving that preference. As such, farmers lacked an informed way to discriminate between existing marketing channels to sell their produce. This study addressed this knowledge gap by providing empirical information on factors influencing farmers' choice of green gram marketing channels in Mbeere South sub-County.

The study had two objectives: the first one involved the characterization of existing green gram marketing channels while the second one identified the factors influencing farmers' choice of green gram marketing channels in Mbeere South sub-County. Two hundred and sixty two households were randomly selected from a sampling frame involving 800 hundred farmers in four divisions of Mbeere South sub-County. A focus group discussion (FGD) was held with both men and women to understand the green grams market structure and the type of marketing channels

that farmers used to market their produce. A household survey was undertaken in 2012 using a structured questionnaire. The target households were those which marketed their green grams in the season prior to the survey.

Data were captured in SPSS software and analysed in Stata version 13. Descriptive statistics were computed to compare respondents' socio-economic characteristics across the marketing channels. A MNL was estimated to assess factors influencing farmers' choice of green gram marketing channels. In instances where farmers sold to more than 1 channel, farmers were asked to state the main green gram marketing channel in terms of volumes, price and convenience to them. The study found three main green gram marketing channels in Mbeere sub-County. These were (a) direct sales to wholesalers, (b) direct sales to rural retailers, and (c) direct sales to rural assemblers. Most farmers (58.2%) preferred rural retailer marketing channel; another (26.9 %) preferred rural assemblers while (14.9%) preferred wholesaler channel. The number of respondents preferring different marketing channels was statistically significant across the three channels ($p=0.053$).

On average, the mean age for farmers in the study site was 39.23 years with an average 9 years of education. Most (60.9%) male-headed households sold their green grams through the retailer channel. On the other hand, most (40%) female-headed households sold through the retailer marketing channel. Farmers selling to rural retailer marketing channel received the highest sales prices at KES 4,500 per 90 kg bag, compared to KES 4,400 and KES 4,162 for rural assembler and wholesalers respectively. Selling to rural retailers gave the highest margins at KES 1,140. The margins for selling through rural assemblers and wholesalers were KES, 466 and 1,075, respectively. Farmers selling through wholesaler marketing channel incurred the highest transport cost at KES 136 compared to KES 12.27 and 91.17 for rural assemblers and retailers respectively.

The results of the multinomial logit showed that farmer's age, access to credit, price of green grams, and selling as individuals positively influenced the choice of rural assemblers over wholesalers marketing channel. Older farmers preferred assembler marketing channel which was closer to farmers' homes. The price of green grams positively influenced the choice of rural assembler over wholesaler marketing channel. The cost of production and use of mobile phones to access marketing information negatively but significantly influenced the probability of choosing rural assemblers relative to wholesaler channel. This means activities that increased costs negatively influenced choice of assembler marketing channel. This could be due to the fact that increased costs lowered farmers' marketing margins.

The probability of choosing rural retailer relative to wholesaler channel was positively influenced by production costs, gender of the household head and use of mobile phone to access marketing information. Rural retailers offered the highest margins therefore use of mobile phones could ease the cost of searching for marketing information to know which trader offered higher prices. Being male increased the probability of choosing rural retailer marketing channels relative to wholesaler marketing channel. This could be because men control the decision on income from agricultural produce and hence would like to sell to channels which give the highest margins. On the other hand, the same probability was negatively influenced by transport cost. Increased costs lower farmers margins. In addition, rural retailers bought smaller quantities of green grams compared to wholesalers; therefore, it could be difficult for farmers to cover the higher transport cost needed to sell to wholesalers.

5.2 Conclusion

Understanding marketing channels is important for achieving marketing integration and inclusion for smallholder farmers. Farmers are attracted to a particular marketing channel based on a mix of personal and socio-economic attributes and other marketing-enabling factors. Farmers in the arid and semi-arid areas of Kenya not only face market penetration barriers but are also faced by other factors like access, poverty, inefficient production systems, and fragile ecosystems. Therefore, interventions aimed at enhancing farmers' market access should consider these varied dimensions.

The results of this study show that the main determinants of farmers' choice of rural assembler over the wholesaler marketing channel in Mbeere South sub-County were (1) production cost, with farmers preferring channels with lower costs, (2) market arrangement where farmers who sold individually preferred selling to assemblers, (3) unit price of green grams - farmers' preferred rural assemblers over wholesalers because they offered higher prices; (4) age of the household head where older farmers preferred rural assemblers over wholesaler marketing channels, and (5) access to credit. Access to credit increased the probability of choosing rural assemblers over wholesaler marketing channel because farmers were able to cover both production and marketing costs.

The main determinants for farmers' choice of rural retailer over wholesale marketing channel in Mbeere South sub-County were (1) gender of the household head with being a man influencing the likelihood of choosing rural retailer marketing channel over wholesaler marketing channel, (2) transport cost, with farmers choosing wholesaler channel over rural retailer marketing channel because of lower transport costs, (3) use of mobile phone to access marketing information. Mobile phone ownership increased the probability of choosing rural retailer marketing channel over wholesaler marketing channel, and (4) production cost where higher production cost led to the

choice of rural retailer over wholesaler marketing channel probably because farmers were able to cover their production costs when they sold to rural retailers since they offered the highest margins.

The study concludes that market-based signals such as price are important determinants of choice of marketing channels. In addition, high production cost and transport also negatively influence the choice of marketing channels. The study also show significant gender differences in choice of marketing channels with being male oriented to more profitable (retailer) channels while being female oriented to more bulk-oriented (wholesaler) channels.

5.3 Recommendations

The study found that price of green grams had a positive and significant effect on choice of both the rural assembler and rural retailer marketing channels. Based on this findings, the study recommends that special attention should be paid by the government in ensuring that there is stability in green grams pricing by controlling green gram imports from cheaper producers and promoting the consumption of green grams to increase demand, which further increases the price. The county government of Embu should also enhance cross county trade where green grams from Mbeere South sub-County can be easily bulked and transported to other regions which do not produce green gram, this will increase demand and further improve the price of green grams.

The study also found that use of mobile phone to access marketing information was positively and statistically significant in choice of rural retailer vs. wholesaler marketing channel. The government should invest in platforms for accessing market information in terms of green grams price, volumes and varieties needed via the mobile phone. This however, could be an opportunity for private sector to invest in availing the information to farmers through mobile phone at a small

fee. In addition, farmers should invest in mobile phones which they can use to access marketing information, this would lower their transaction costs and increase their marketing options.

The gender of the household head was positive and significant with being male having a positive association with the probability of choosing rural retailer vs. wholesaler marketing channel. Therefore women sold more to the wholesalers. The study recommends affirmative action for women through non-governmental organizations and Ministry of Agriculture, Livestock and Fisheries officials. Where women will be trained on how best to access and cost various marketing channels and the possible ways they could combine various options.

5.4 Areas of further research

The following areas need further research:

- Effect of the new county arrangement on choice of green gram marketing channels to show whether there is any policy change with devolved government structure. Knowledge of these effects will enhance inter-county green gram trade.

- Future studies should consider using time series data to capture how sequential change in a household influence choice of marketing channels. This is based on the growing concern that to appropriately determine what influences choice of market channels, there is need to use time series data whereas this study only used cross sectional data.

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APPENDICES

Appendix I: Pearson correlation matrix for all the variables in the model

variables	Main_B~r	HHSize	HHH_Educ	HHH_Age	Cost_Prdn_Activty	Unit_TransCost	Freq_to_Mkt	HHH_Sex	Credit_Acess	Individual_Selling	Cooperative selling	Middle class	Rich	Sale Price	Green gram Variety	Mobile Mkt info	Annu Inco	Farm land
Main_Buyer	1																	
HHSize	-0.0227	1																
HHH_Educ	-0.04	-0.08	1.00															
HHH_Age	-0.12	0.39	-0.08	1.00														
Cost_Prdn_Activty	-0.01	-0.05	0.02	0.04	1.00													
Unit_TransCost	0.02	0.00	0.03	0.05	0.22	1.00												
Freq_to_Mkt	0.03	-0.14	0.02	-0.06	-0.12	-0.13	1.00											
HHH_Sex	-0.08	0.08	0.08	-0.07	0.08	0.07	0.13	1.00										
Credit_Acess	-0.14	0.05	0.03	-0.01	-0.04	-0.07	-0.18	0.08	1.00									
Individual_Selling	0.05	0.17	-0.05	0.07	-0.03	-0.10	0.16	0.07	-0.03	1.00								
cooperative _selling	-0.10	-0.11	0.04	0.01	-0.07	0.14	-0.08	-0.04	-0.09	-0.51	1.00							
Middleclass	0.01	-0.03	0.05	-0.06	0.06	-0.17	0.05	0.01	-0.10	0.02	-0.02	1.00						
Rich	0.07	0.05	0.05	0.04	0.13	0.18	-0.09	0.10	0.07	-0.05	0.06	-0.20	1.00					
Sale_Price	-0.12	0.01	0.09	0.01	0.24	0.05	-0.03	0.08	0.08	0.07	-0.02	-0.09	-0.08	1.00				
greengram_Variety	-0.14	0.13	-0.01	0.17	0.14	0.03	-0.15	0.11	0.00	-0.09	0.04	0.00	0.04	0.07	1.00			
Mobile_Mkt info	0.13	-0.07	0.12	0.02	0.03	0.02	-0.07	-0.08	-0.08	0.04	-0.09	-0.06	0.15	-0.03	-0.02	1.00		
Annual_Income	-0.03	0.09	0.11	0.10	0.26	0.10	-0.13	0.14	0.26	0.04	-0.06	-0.05	0.37	0.13	-0.07	0.11	1.00	
Farm_land	0.03	0.20	0.03	0.16	0.33	0.25	-0.11	0.20	0.07	0.04	0.01	0.07	0.11	-0.02	0.14	0.06	0.31	1.00

Source: Author

Appendix II: VIF results for testing multi-correlation

Variable	VIF	1/VIF
Individual selling	2.65	0.377692
Cooperative selling	2.52	0.396448
Annual Income	1.61	0.619494
HHH Age	1.55	0.645811
HH Size	1.53	0.652253
Farm land	1.52	0.65779
Rich Dummy	1.47	0.678797
Cost of production activity	1.46	0.686274
Green gram variety	1.32	0.756286
Unit transport cost	1.29	0.773732
HHH Education level	1.28	0.780397
HHH Sex	1.25	0.799257
Credit Access	1.24	0.80464
Sale Price	1.24	0.808969
Frequency to the market	1.21	0.823867
Middleclass Dummy	1.17	0.855042
Mobile market information	1.16	0.858548
Mean VIF	**1.5**	

Source: Author

Appendix III: Results for testing of heteroskedasticity of variances

Robust equal-variance test results Variable	P value
Individual selling	0.135
Cooperative selling	0.238
Annual Income	0.992
HHH Age	0.218
HH Size	0.998
Farm land	0.400
Rich Dummy	0.285
Cost of production activity	0.152
Greengrams variety	0.192
Unit transport cost	0.121
HHH Education level	0.321
HHH Sex	0.043
Credit Access	0.146
Sale Price	0.294
Frequency to the market	0.467
Middleclass Dummy	0.438
Mobile market information	0.173

*probability value less or equal to 10 percent indicates the presence of heterokedasticity

Source: Author

Appendix IV: Results of Suest-based Hausman test for Independent of Irrelevant Alternatives

Ho: Odds (Outcome-J vs Outcome-K) are independent of other alternatives

Marketing Channels	chi2	df	P>chi2
Assembler	13.9	17	0.66
Rural retailer	15.05	17	0.326
Wholesaler	13.07	17	0.66

Note: A significant test is evidence against Ho.
Source: Author

Appendix V: Results combination test

Ho: All coefficients except intercepts associated with a given pair of alternatives are 0 (i.e., alternatives can be combined

Marketing Channels	**chi2**	**Df**	**P>chi2**
Assembler & Rural Retailer	47.50	18	0.000
Assembler & Wholesaler	49.97	18	0.000
Rural retailer & Wholesaler	67.17	18	0.000

Note: A significant test is evidence against Ho.

Source: Author

Appendix VI: Goodness fit results

Log likelihood test		
Likelihood-ratio test	LR chi2(32) =	95.33
(Assumption: m1 nested in m2)	Prob > chi2 =	0.0000

Source: Author

Appendix VII: Endogeneity test results

Test for endogeneity Ho: Variables are exogenous		
Durbin (score) chi2(1)	chi2(1)=0.843244	P=0.3585
Wu-Hausman F(1,96)	F(1,96)= 0.715392	P= 0.3998

Source: Author

Appendix VIII: Focus Group Discussion Guide

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Focus group discussion on Famers' choice of greengrams marketing channels in MSSC.

Facilitator_____ Date_____

Participants' demographic information

Key questions:

1. Are you involved in greengrams marketing
2. What are the main markets where you sell your produce
3. Who are the main buyers
4. What are the main marketing nodes for each channel
5. What are the prices offered by each buyer at each node
6. What are the main advantages from each buyer
7. What are the main constraints faced for each buyer

Appendix IX: Household questionnaire

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Factors affecting choice of greengrams marketing channels questionnaire

Introduction
This questionnaire aimed to capture information of household, socioeconomic and institutional factors that affect the choice of farmer's choice of marketing channels

IDENTIFICATION

Household No. **HHID: _____**Questionnaire Serial Number_____.
Date :(dd mm yy): _____
Supervisor: _____
Enumerator's name: _____
District: _____
Division: _____
Location: _____
Sub-Location: _____
Village: _____
Name of farmers' group: _____

A. DEMOGRAPHIC AND SOCIO-ECONOMIC CHARACTERISTICS

1. Name of Respondent: _____
2. Marital status of respondent: _____
   Codes: 1=Married; 2=Separated; 3=Widowed; 4=Single; 5=Divorced
3. Year of birth of respondent: _____
4. Relationship of the respondent to the household head: _____
   Codes: 1=House hold head; 2=Spouse; 3=Son; 4=Daughter; 5=Grandson; 6=Granddaughter; 7=Parent; 9= Employee
5. Household profile

S/No	Name	Sex M=1 F=2	Year of birth	Level of Education	Main Occupation
Parents					
1: Household head					
2: Spouse					
Children					
3					
4					
5					
6					

Codes:

Main occupation	Education levels		
1=salaried employee 2=farmer 3=self-employment 4=casual labourer 5=student 6 = unemployed 7 =others (specify)	0= Pre school 1=std 1 2=std 2 3=std 3 4=Std 4 5=Std 5 6=std 6 7=Std 7	8=Std 8 9=Form 1 10= Form 2 11= Form 312=Form 4 13= Form 5 14= Form 6 15= College Yr 1 16= College Yr 2	17= College Yr 3 18= College Yr 4 19= Univ yr 1 20= Univ yr 2 21= Univ yr 3 22= Univ yr 4 23= Univ yr 5 and above

Wealth information

6. What is your average household off farm income per month? [KES] _____

7. Did you receive remittances or pensions in the last 12 months? 1. Yes [ ] 2.No [ ]

8. If yes, how much do you receive per month?[KES] _____

9. What is your main source of drinking water during the wet season? _____

1 =Tap 2 =Borehole (protected) 3=Borehole (not protected) 3=River 4= Well (not protected) 5= Well (protected) 6 = spring 7 =rain water 8= Other (specify)……

10. What is your main source of drinking water during the dry season? _____

1 =Tap 2 =Borehole (protected) 3=Borehole (not protected) 3=River 4= Well (not protected) 5= Well (protected) 6 = spring 7 =rain water 8=Other (specify)..

11. What kind of toilet facility does your household have? _____

1= Flush toilet 2=Traditional pit latrine 3 = Ventilated improved latrine

4 = None/Bush/Field 5 = Digging a hole 7=other (specify).....

12. Do you own cattle 1=yes 0=no
13. What types of materials make the walls, roof and floor of the main house? (Make observation as much as possible)

Walls	Roof	Floor
Codes: 1=Mud; 2=Wood; 3= Iron sheets; 4=Bricks 5=Stone; 6=Others (specify)_____	Codes: 1= Grass thatch; 2= Iron sheets; 3= Tiles; 4= Others (specify)_____	Codes: 1=Mud; 2=Wood; 3=Concrete; 4=Other (specify)_____

B. PRODUCTION INFORMATION

How many **pieces of land holding** do you **use**? _____

1. How many **acres** in **total land holding** do your household **own**? _____
2. How much land do you farm on? _____
3. Please indicate the type of tenure for each piece of land used.

Land Pieces	**Type of tenure**	**Codes**
Piece 1		1=Owned with title deed; 2=Owned without title deed; 3=Rented; 4=Owned by parent/ relative; 5=Government/Communal/Co-operative
Piece 2		
Piece 3		
Piece 4		
Piece 5		

4. If you planted any of the following crops in the last season kindly fill in the table below

Crop/ Varieties	**Area planted (Acres)**	**Watering system** 1.Rain fed 2. Irrigated	**Land preparation type** 1.Manual 2.Oxen 3.Tractor	**Seed Type** 1.Purchased new hybrid 2.Retained hybrid 3.OPV (Local variety) 5.Improved local variety 6. Improved vines	**Harvest Quantity**		**Sales Quantity**		**Price of sales**		**Amount given away**		**Amount Consumed**		**Amount of loss during storage**		**Total (Kgs)**
					Qty	**Unit**	**Qty**	**Unit**	**Qty**	**Unit**	**Qty**	**Unit**	**Qty**	**Unit**	**Qty**	**Unit**	
Greengrams																	
1=N26 (Nylon)																	
2=Local																	
					Quantities: 1=kg; 2=Gorogoro 3=Sack; 4=Debe													

5. Please fill in the table below.

Crop/Varieties	Why do you prefer this particular variety of the crop? (Choose as many codes as is applicable from below)	Cost of seed for the crop in the last season		Year when you started to grow the crop	Mode of production 1= Contracted 2= Not contracted
		Unit	KShs		
Greengrams					
1=N26 (Nylon)					

2=Local					

Codes: 1=Early maturing; 2=Fetches a higher price; 3= Resistant to drought; 4=Lower tillering capacity; 5= Has a better taste; 6= Others (please specify)

6. What are the benefits of being contracted?

   a) _____
   _____

   b) _____
   _____

7. What were the costs of production you incurred in the last season for the following crops? Please indicate the total_____

Crops	Ploughing	Furrowing	Planting	Fertiliser	Top	Weeding	Cost of	Spraying	Harvesting	Shelling	Irrigation
Greengrams											
Cost											
Gender of who does the work 1=Male; 2=Female											
Gender of who does the work 1=Male; 2=Female											

C. MARKETING INFORMATION

1. To whom did you sell the following crops in the last season?

Crop/Varieties	Main Buyers	Codes defined
		1= Assemblers – The person who collects from various farmers at farm gate and sells to the local market **2= Rural retailers** – Is the person who buys in larger quantities from local traders and also from farmers and sells in small quantities to the final consumers e.g. the local cereal store **3= Wholesalers** – The person who sells in bulk to other traders usually in the larger towns
Maize		
Greengrams		
1=N26 (Nylon)		
2=Local		

2. Through which means do you access market information?

Ranks	Means of accessing marketing information	Main advantage of this mode of communication
Rank 1		
Rank 2		
Rank 3		
Rank 4		
Rank 5		

Codes: 1= Radio; 2= TV; 3= Buyer; 4=Neighbour; 5=Extension officer; 6= Farmer group; 7=Cooperative; 8= Church; 9= Ministry of agriculture offices; 10=Newspaper; 11= Others (please specify)

a) _____

b) _____

c) _____

3. Do you own a mobile phone? 1=Yes [ ] 2=No [ ]_____
4. Do you use it to get marketing information? 1=Yes [ ] 2=No [ ]_____
5. In addition to being a member of your farmer group, how many other groups do you belong to? _____

6. If any other, please indicate the kind(s) of groups they are?

Type of groups	**1=Yes; 2=No**	Main advantage of this type of group membership
Church group		
Marketing groups		
Community Based Organization		
Others, specify		

7. Please fill in the table below to show your yields over the last three seasons and your mode of sale

Crop/Varieties	Quantity sold			Mode of sale
	Short rains 2012	Long rains 2011	Short rains 2011	1=Cooperative; 2=Individual;3=Collective
Maize				
Greengrams				
1=N26 (Nylon)				
2=Local				

8. Give the benefits of the marketing arrangement you use.

Benefits of the different modes of crop sales		
Cooperative	Individual	Collective marketing

9. In which market do you sell the following crops?

Crop/Varieties	Market centre 1	Market centre 2	Market centre 3	Who sells 1=Male spouse 2=Female spouse 3=Hired labour	If hired labour, at how much?	Who makes the decision of the proceeds of the sales made 1=Male spouse 2=Female spouse 3=Joint decision-making of both spouses
Maize						
Greengrams						
1=N26 (Nylon)						
2=Local						

10. Are you aware of any alternative markets? 1= Yes [ ] 2= No [ ]

11. If yes name them

    a) _____

    b) _____

    c) _____

12. How far are the alternative markets from your farm? _____

13. Please describe the marketing channel for your crop produce as you know it?

Node 1 _____»Node 2_____ Node 3»_____Node 4»_____ Node 5»_____ Node 6»_____Node 7»_____Node 8»_____

14. How much of the following crops did you sell over the following period?

Crop/Varieties			
Key LR2011= HH Units 1=kg;	Long rain 2012 (April-July)	Short rains 2011 (Oct. - Dec.)	Long rains2011 (April-July)
Maize			
Greengrams			
1=N26 (Nylon)			
2=Local			

15. Do buyers of these crops offer any other services? 1. Yes [ ] 2.No [ ]

16. If yes, which service?

Service	**Frequency**	**How reliable is this service**
	1=Always 2=Sometimes 3=Never	1=Very unreliable 2=Moderately unreliable 3=Neutral 4=Moderately reliable 5=Very reliable
Marketing information		
Transport		
Credit		
Others		

17. How do you transport your crops to the markets?

Crops	Mode of transport Codes: 1=Bicycle; 2=Motor bike; 3=Donkey cart; 4=Pick up; 5=Saloon car; 6=Lorry; 7=Human potters	Unit transported per trip	Cost of transport per unit	Distance to market in km	Time taken to reach the market (in hrs)	How often do you go to the market to sell 1=Once a week 2=Once a month 3=Once every three months 3=Others, Specify
Greengrams						

18. Distance from homestead to various amenities

Distance from your homestead	
1 What is the distance from your homestead to where you buy fertilizer	
2 What is the distance from your homestead to where you buy seed	
3 What is the distance from your homestead to where you get extension advice	
4 What is the type of road from homestead to the nearest market place **Codes:** 1= Tarmac 2= Murram/ all weather road 3. Dry weather	

19. What varieties of the crops are most preferred by your buyers?

Crop/Varieties	Most preferred varieties	The reason for preference of the crop by the buyer 1=Colour 2=Foreign matter composition 3=Taste preference of consumers 4=Pure varieties 5=Free from pest and disease
Greengrams		
1=N26 (Nylon)		
2=Local		

20. Do you undertake the following activities?

Activity	**1.Yes** **2. No**	**If yes, Why?** 1=Fetch better prices 2=Required to do so 3=Others, specify	**Cost per Kg/bag(90 kg)**
Sorting			
Cleaning			
Grading			
Splitting			

21. Do you store crops in order to sell later and for how long?

Crops	Storage 1=Yes; 2=No	Length of storage in months	Type of store 1= Traditional granary 2= Wooden store 3= Brick store 4= Other, specify	When was it constructed?	Cost of building	**Depreciation**	**Cost of storing one bag of crop**
Greengrams							
Cowpeas							
Sorghum							
Dolichos							
Sweet potato							

22. If you **do not store**, what is the main reason why you do not store?

_____

a) Have no storage facility [ ]
b) I sell on harvest [ ]
c) Not enough surplus to store []
d) Fear of loss of produce
e) Theft [ ]

f) =Others (please specify)_____

23. Have you experienced rejection of any of your produce at the market? 1=Yes; 2=No

Crops	Rejection 1=Yes; 2=No	Main reason for rejection 1=Splits 2=Mixed varieties 3=Foreign matter composition 4=Others, specify	Proportion rejected	What alternative markets rejected portion of crops
Greengrams				

CREDIT AND RISK FACTORS

1. Did you access any form of credit in the last season? 1. Yes [ ] 2. No [ ]

2. If yes, from whom

Source of credit	**1. Yes 2. No**	**Type** 1.Cash 2.Kind	**Repayment period**	**Requirements**
Credit institution				
Family				
Neighbour/ friend				
Shylock				
Micro finance institution				
Farmer group				
Merry go round				

3. If no, what makes you not access such credit facilities?

a) _____
_____

b) _____
_____

c) _____
_____

d) _____
_____

4. Did you sell on credit in the last season? 1= Yes [ ] 2= No [ ]

5. If yes, what were the conditions of such credit sale?

a) _____
_____

b) _____
_____

c) _____
_____

6. What are the terms of payment for credit sales? …1=Cash [ ]; 2= Kind [ ]

a) _____
_____

b) _____
_____

c) _____
_____

Appendix X: Market actors' questionnaire

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Questionnaire for market actors for the Famers' choice of greengrams marketing channels in MSSC study.

Enumerator_____ Date_____

Basic information

1. Name of the respondent_____
2. Age of the respondent_____
3. Education level of the respondent_____
4. Market name where the respondent is operating_____

   1= Muobare 2=kiritiri 3=Embu

Marketing information

5. What type of trader are you _____

   1= broker 2=assembler 3=rural retailer 4 =wholesaler

6. What is the main source of your produce_____

   1=farmer 2=assembler 3=rural retailer 4=broker 5=wholesaler

7. How much produce to you buy per month in KES per month peak season _____

   low season_____

8. What is your buying price in KES per bag peak season _____low season_____
9. How much produce do you sell per month in bags peak season _____low season_____
10. What is your selling price in KES per bag peak season _____low season_____
11. Who are your main buyers_____

1=consumers 2=rural retailers 3=assemblers 4=wholesalers.

12. What other costs do you face in KES

    Council levies_____ rent_____ License_____ others_____

13. What are your main advantages_____

14. What are your main disadvantages_____