

**DETERMINANTS OF PARTICIPATION OF SMALL HOLDER FARMERS
IN MARKETING OF GRAIN AMARANTH: A CASE OF KAMULI
DISTRICT, UGANDA**

BY

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DECLARATION

I Stella Namazzi, certify that the work presented in thesis is from my own research and has not been submitted to any other University for the award of a degree. Where other sources of information have been used, they have been rightly acknowledged.

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This thesis has been submitted for examination with our approval as University supervisors.

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DEDICATION

To dedicated to my family for being supportive during the entire period of the study.
Especially to my mother, daughter Tahia and Andrew.

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LIST OF ACRONYMS

NGOs	Non-Governmental Organizations
VEDCO	Volunteer Efforts for Development Concerns
OLS	Ordinary Least Squares
VSLA	Village Savings and Loans Association
SACCOs	Savings and Credit Cooperatives
NAADS	National Agricultural Advisory Services
BRAC	Bangladesh Rural Advancement Committee
HIV	Human Immunodeficiency Virus

ABSTRACT

As a vegetable crop, grain amaranth plays an important role in improving household nutritional and economic status. Grain amaranth is still a new crop in Uganda's farming system, after being introduced by VEDCO in 2005 to curb malnutrition in Kamuli district. Production and consumption of the crop is still limited mainly due to lack of market, this has limited the purpose of production to domestic consumption with no incentive of producing a marketable surplus. A cross sectional study was conducted in Kamuli district to assess the determinants of small holder participation in grain amaranth marketing. A total of 150 grain amaranth farmers obtained through a multistage sampling technique, constituted the study sample. Findings revealed that grain amaranth production and marketing in Kamuli district is dominated by male headed households with land sizes allocated to grain amaranth production averaging 0.08 hectares.

The decision to participate in grain amaranth marketing was positively influenced by; Gender of household head, Education levels of the household head, Grain amaranth yield, grain amaranth selling price, membership in a farmer group while farm size decreased the likelihood of selling grain amaranth. The results further reveal that the education status of the household head and yield positively influenced households to sell more grain amaranth with farmers who had participated more in field days as a promotion activity marketing less grain amaranth.

Yield improvements are critical if increased market participation is to be realized. Therefore, research efforts should be directed towards generation and dissemination of grain amaranth varieties that are superior in production, consumption and nutrition attributes in order to stimulate massive production of the crop that will lead to higher production surpluses being realized.

CHAPTER ONE

INTRODUCTION

1.1 Background

Grain amaranth (*Amaranthus spp*) is an industrial crop and an important food crop in many parts of the world; it is also used in the production of many healthy food stuffs all over the world (National Research Council, 1984). The major producing countries are china, India, Ethiopia, Nepal and Kenya (Pandey, 2009). Though currently there are limited production and trade statistics for grain amaranth, several thousands of hectares of grain were reported in china, Argentina with about 2000 hectares reported in the United States of America. Estimates for India and Nepal are up to 4000 hectares and for Peru over 1000 hectares have been estimated, The United States imports large quantities of grain amaranth from Mexico (Brink and Belay, 2006). On farm trials have shown that yields of grain amaranth crop are 1800 kg of seed per hectare in Pennsylvania, 3000 kg of grain per hectare were reported at four locations in hills of Himachal Pradesh and Uttar Pradesh in India from local land (National Research Council, 1984) and about 1000kg per hectare have been reported in Kenya and in pure stands it yields the same (Twesige, 2010). In Uganda up to 3 tonnes per hectare have been reported on farmers' fields (Muyonga et al., 2008).

Grain amaranth is an upcoming new crop in Uganda, following its introduction in the country by researchers (Twesige, 2010). This implies that production and consumption of the amaranth is relatively new in Uganda and therefore still limited to a few areas around the Lake Victoria basin including Nakasongola, Bududa, Iganga and Kamuli districts. In Kamuli district however, there are deliberate efforts by VEDCO, a non-governmental organization to promote the production and consumption of the Grain Amaranth crop through its Food and Nutrition Security Programme. Promotion of grain amaranth production in Kamuli district by VEDCO stems from the fact that it is one of the districts in Uganda with high levels of malnutrition Sseguya (2007). Malnutrition results from factors related to poverty, food insecurity, and lack of knowledge. This therefore prompted VEDCO to massively promote grain amaranth production and consumption due to its high dense nutrient content. With a protein content of about 16 percent, amaranth protein content

is higher than that of other commercial cereals. Its' important to note too that the protein contained in amaranth seeds is well balanced in amino acids to meet the optimum balance requirement in human diet when compared to other plant proteins (National Research Council, 1984). Grain amaranth can also be used as a substitute for milk, particularly during child-weaning (Nabakabya and Nakimbugwe, 2007).

In order to promote grain amaranth production and consumption for household food and nutrition security among the small and medium holder farmers and groups of disadvantaged people VEDCO instituted promotional strategies such training extension workers and establishment of demonstration and multiplication gardens. The extension workers were trained on aspects of production, nutrition value addition, preparation and processing methods and were later charged with the responsibility of introducing grain amaranth to communities in Kamuli district. On the other hand the demonstration and multiplication gardens were established to provide a source of seeds for farmers interested in producing and consuming the crop. More still the demonstration and multiplication gardens acted as training grounds where farmers were trained on aspects of seed production, selection and management.

However, despite massive promotion campaigns by VEDCO and other NGO's such as PLAN-UGANDA, production and consumption of grain amaranth is still very low among farming households in Kamuli district and production still remains within the areas where the crop was introduced. The crop is grown mainly for nutrition purposes and so the sole purpose of production is mainly food security and not income generation but however some families have taken up the initiative of marketing the surplus either in the form of flour or un processed grains (Nabakabya and Nakimbugwe, 2007).

1.2 Problem Statement

In Uganda production and consumption of amaranth has been limited to the leafy types and not grain types. The grain amaranth industry gained prominence in 2005 following efforts by researchers to curb food insecurity and bring about economic empowerment (Twesige, 2010).As a vegetable crop grain amaranth plays an

important role in improving household nutritional and economic status (Muyonga *et al.* 2008) of vulnerable populations. Worldwide, there has been increasing interest in the production of grain amaranth due to the growing health food markets in China, Russia, Europe, South America and the United States of America. With a protein content of about 16% the crop compares well with other conventional cereals (National Research Council, 1984). Hence, there is potential for growth in the grain amaranth industry owing to an increasing proportion of the population living in urban centers which require more nutritious foods available at all times. According to Twesige (2010) grain amaranth is a super grain crop because of its amazing properties that are both nutritional and medicinal where for example it can readily be utilized in most of foods and hence find its way into many market outlets including the now flourishing supermarkets.

However, in Uganda, production and consumption has been limited to the leafy amaranth types and not the grain amaranth types which can be processed and utilized into a number of products. production and consumption of the crop is still constrained mainly due to limited marketing Muyonga *et al.*(2008) this has limited the purpose of production to food security and hence there is no incentive to produce a marketable surplus. The limited marketing for the crop could be due to thin markets or market imperfections that give rise to high transaction costs and so households are better off self-sufficient de Janvry and Sadoulet (2006) than depending on the market.

Un locking market opportunities for the crop creates dual benefits for facilitating commercialization among small holder farmers and supplying nutritional product to consumers. Currently, there is insufficient empirical evidence to determine factors that would effectively engage farmers in the production of grain amaranth for the market and others not to. Hence there is need to understand the factors associated with market participation for important nutritional crops such as grain amaranth. An understanding of these factors will help in identifying interventions to unlock and release benefits associated with marketing agricultural produce such as grain amaranth.

1.3 Objectives of the study

The main objective of the study was to establish the determinants for participation of small holder farmers in grain amaranth marketing and suggest strategies to enhance promotion of the crop. The specific objectives of the study were;

1. To characterize grain amaranth farmers in Kamuli district.
2. To identify factors that influence small holder farmers' decision to participate in grain amaranth marketing.
3. To identify factors which influence the level of participation in grain amaranth marketing.

1.4 Hypothesis

1. Socio-economic factors such as gender, family size, education, and access to credit among others influence small holder farmers' decision to participate in grain amaranth marketing.
2. Socio-economic factors such as gender, family size, education, and access to credit among influence the level of farmers' participation in grain amaranth marketing.

1.5 Significance of the study

Grain amaranth is of high importance to both consumers and producers .given its nutritional benefits and economic potential (Muyonga *et al.* 2008). Therefore understanding the determinants of farmers' participation in the market will generate important information for those institutions currently supporting its production and marketing to come up with promotion strategies for encouraging both production and consumption resulting into improved farmers' livelihood.

Being a new crop studies so far conducted in Uganda so far are focused on nutritional aspects, however efforts are in place to enrich economic studies. This study can therefore enrich the existing but limited t stock of knowledge and literature whose focal point is encouraging market participation and hence commercialization of the

crop by small farmers in Kamuli district. It will therefore serve as a reference material for policy makers, academicians and researchers.

Further still this study can give a better insight into the role of market participation in enhancing welfare situation and reducing poverty of small holder farmers who have taken up grain amaranth as a commercial crop.

1.6 Organization of thesis

This study attempts to analyze the determinants of market participation of small holder grain amaranth farmers in Uganda. Analysis was based on data collected from individual grain amaranth farmers in Kamuli district. The survey was conducted in the year 2011 between October to December. This study is composed of five chapters. The first chapter gives an overview on grain amaranth production; the second chapter is all about the presentation of relevant literatures, theoretical framework methodologies adapted in relation to market participation of small holder farmers. Presentation of the research methodology including description of the study area is the subject of the third chapter. The fourth chapter is where the findings from the household survey questionnaire and key informant interviewees using focus groups are presented and discussed both descriptively and using econometric tools. Finally, the fifth chapter incorporates the summary, conclusion and policy recommendations based on the major findings of the study.

CHAPTER TWO

LITERATURE REVIEW

2.1 Definition of Basic Marketing concepts

2.2 Market and marketing

A market is a point, or a place or sphere within which price-making force operates and in which exchanges of title tend to be accompanied by the actual movement of the goods affected (Backman and Davidson, 1962). The concept of exchange and relationships lead to the concept of market. It is the set of the actual and potential buyers of a product (Kotler and Armstrong, 2003). Abbott and Makeham (1979), defined market as an area in which exchange can take place. The market can be categorized into a local market or an international market. Local market refers to a set of actual and potential buyers who are within the same geographical boundary as the seller. With the target boundary being a village, district, town, county, country or specific region. The international market refers to a set of actual and potential customers beyond the geographical boundaries and outside country borders in most cases. Cross -border issues for instance, tariffs, custom procedures, trade agreements are taken into account (Kotler, 2003).

The definition of marketing as a process by which individuals and groups obtain what they need and want by creating and exchanging products and values with others involves work. Marketing means different things to different people: to the house wife it means shopping for food; to the farmer it means the sale of his produce; to the fertilizer distributor it means the selling to the farmer (Abbot and Makeham, 1981). Kotler and Armstrong (2003), defines marketing as managing markets to bring about profitable exchange relationships by creating value and satisfying needs and wants. Marketing is essentially a process like farming, manufacturing, mining or construction (Backman and Davidson, 1962). As such basically functional in character, marketing may be defined, as the performance of all activities with the necessary ability.

involving effecting transfer of ownership of products, providing for their physical distribution, and facilitating the entire process.

In addition to those definitions, Lele and Jain (1997) defined the marketing concept, as philosophy of business, which states that the customer want satisfaction, is the economic and social justification for a firm's existence. Consequently all the firms' activities must be devoted to finding out what the customers want, and then satisfying those wants while still making a profit over the long run. Mendoza (1995) also defined marketing as a system because marketing usually comprises several interrelated structures along the production, distribution and consumption units underpinning the economic process. Kotler (2003) defines marketing as a social process by which individuals and groups obtain what they need and want through creating, offering, and freely exchanging products and services of value with others.

2.3 Market Participation

Various definitions of market participation have been suggested by different authors. Market participation is defined as any market related activity which promotes the sale of produce (Holloway and Ehui, 2002; Lapar *et al.*, 2002; Key *et al.*, 2000) However Latt and Nieuwoudt (1988) argue that market participation is simply commercialization. It can also be described as an individual's or household economic transaction with others both in cash and in kind (Von Braun *et al.*, 1991). The extent of market participation will to a certain extent depend on the proportions that are exchanged in the market, with limited market participation attributed to low proportions of products exchanged in the market. Based on the three states of buying, selling or not trading, Goetz (1992) defines market participation using household's purchases and sales, with volumes of produce traded determining market participation.

In an agricultural market economy, market participation is viewed as a transition from subsistence to profit orientation by farmers, and is defined as earnings from the market activities (Makhura *et al.*, 2001). Ana *et al.* (2008) defined market participation in terms of sales as a fraction of total output, for the sum of all agricultural crop production in the household; this includes annuals and perennials, locally-processed and industrial crops, fruits and agro-forestry. This "sales index" would be zero for a

household that sells nothing, and could be greater than unity for households that add value to their crop production via further processing and/or storage. The measure is intended to measure market orientation or commercialization in a scale-neutral manner, independently of the household's wealth or productivity. Market participation is such an important aspect for small holder farmers in that it is both a cause and a consequence of economic development in that it results into economic growth and poverty reduction (Reardon and Timmer, 2005). Markets offer households the opportunity to specialize according to comparative advantage and thereby enjoy welfare gains from trade. Recognition of the potential of markets as engines of economic development and structural transformation gave rise to a market-led paradigm of agricultural development during the 1980s.

Reardon and Timmer (2005) further explains that as households' disposable income increases, so does demand for variety of goods and services, thereby inducing increased demand-side market participation, which further increases the demand for cash and thus supply-side market participation. The various market participation definitions do not rule out quantity or produce sold or sales volumes. In this study, both the presence of sales and the volume of sales will be used as a measure of market participation. This is because market participation for small holder farmers is largely linked to generation of a marketable surplus, which in turn depends on productivity levels.

2.5 Determinants of market participation

A study on the determinants of cereal market participation by sub Saharan Africa small holder farmers Siziba *et al.*, (2011) showed that household characteristics, ownership of private assets and access to public assets significantly influenced the intensity of participating in cereal markets conditional on the probability of participating. Household units which had more access to public assets such as extension training, price information and participation in research programs were more involved in participating in cereals markets, due to the fact that they were able to reduce barriers associated with accessing better markets. .. However, the effect of household demographic characteristics in influencing the quantities of cereals traded was less pronounced with only one factor group membership emerging as the only

factor influencing volumes of cereal marketed. On the other hand ownership of private assets such as radio and livestock positively increased the volumes of cereals marketed hence increased participation in cereal markets.

These findings are in agreement with those of Green *et al.*, (2006) that private household assets including land, livestock, equipment, labor are strongly positively associated with market participation. Hence household units which have adequate access to assets and infrastructure coupled with appropriate incentives to participate in the markets are more obliged to participate more in output markets, with households which lack one or more of those pre-requisites less likely to participate in the output markets. Barret (2008) emphasizes that there are strong associations between household asset holdings and geographical factors such as market access and agro ecological zones and household market participation. Where by wealthier households and those cultivating in higher potential agro ecological zones are more likely to sell to markets than other households. In addition the study reveals that transaction costs associated with weak institutional and physical infrastructure are substantial and appear to distort production and marketing behaviors significantly, muting the effects of price policy and causing significant social inefficiency.

A household's production technology choices affect its market participation choices by affecting its productivity (Barret, 2008). Households operating rudimentally agricultural technologies may participate in markets only because they use commodity markets as a means to resolve pent up demand for financial services for which they do not have access to. Hence there is need to promote technological advance as a means to induce broader based market participation.

Distance from the farm to points of sale has been shown to be major constraint to the intensity of market participation by a number of studies (Holloway and Ehui, 2002; Ohajiana and Ugochukwu, 2010)

2.6 Modeling of market participation

Previous Economic studies on market participation have adopted Tobit model, Heckman selection model and double hurdle models. When sample selection is a problem, Heckman (1976) should be followed; Heckman's model first uses a probit

analysis with all available data to estimate the probability of market participation. Then the inverse Mills ratio, computed from the probit regression, is used with other explanatory variables to help explain variation in the continuous, non-zero dependent variable (normally sales volumes). The heckman model has been used in a number of market participation studies including; (Makhura *et al.*, 2001; Gebremedhin *et al.*, 2009; Ouma *et al.*, 2010 ; Siziba *et al.*, 2011;)

Makhura *et al.* (2001) in his study transaction costs and small holder farmer participation in maize markets in the Northern Province of South Africa used a heckman model to determine factors influencing the decision to participate in maize marketing and those which lead to increased level of participation in agricultural output markets. The results showed that the decision to participate in maize marketing was positively associated with size of arable land and negatively associated with family size, with households with a larger area of arable land having a greater opportunity for surplus production and hence marketing of the surplus, on the other hand households with larger household sizes are less likely to participate in output markets due to household subsistence needs. In conclusion transaction costs influence the decision to participate and level of participation in maize markets, hence there is need to reduce these transaction costs through policy and institutional reforms in increasing access to markets and other productive assets such as land.

Siziba *et al.* (2011) in their study of the determinants of cereal market participation by SSA small holder farmers found out that the probability to participate in the cereal market as a seller was positively influenced by total area cultivated by household, use of animal manure in production, market access information, national road density and national information communication technology index. Similarly the decision to participate in cereal markets was negatively influenced by household size and experience. On the other hand the quantity of grain sold was positively associated with ownership of assets such as radio and livestock and ability of households to generate incomes from off farm activities. Similarly access to public assets including extension training, price information, and participation in research programs were positively associated with large cereal volumes.

In conclusion the study indeed justifies the importance of both private and public assets in explaining increased level of farmers' participation in cereal markets.

therefore there is need for increased investment in public assets such as research and agricultural extension training by government since these are public goods with the government having an upper hand in terms of finances to fund such activities.

A study by Ouma *et al.*, (2010) about small holder farmer's participation in the banana markets in Central Africa employed a lee heckman model. The results show that the decision to participate in banana markets as a seller is positively influenced by access to market information since farmers can easily decide on which markets to sell given their differences in prices. However the results further show that ownership of transport assets such as bicycle and cars negatively influenced banana market participation decisions were rather surprising and contradict findings by other studies such as Siziba *et al.*, (2010) that access to transport assets such as bicycle and cars positively influence participation in markets .The results further show that decision to participate in banana markets was most influenced by fixed transaction cost factors such as proximity to market place, ease of access to market, means of transport, source of information and geographical location of the household. Therefore in order to encourage increased farmer participation in markets, favorable policies geared towards improving physical access to market places, availing market information would yield best results.

The Tobit model contrasts the double-hurdle model as a single mechanism determines the choice between positive and zero sales, and the amount of sales given market participation. Tobit models assume that zero values traded are because of rational choice, although it may be prohibitive entry barriers that are limiting market entry. The Tobit model imposes the restriction that the same factors have the same effects upon the decisions to participate in the market as they do on the quantity sold. Studies that have used Tobit model to model market participation include; (Komarek, 2010; Gani and Adeoti, 2011). Gani and Adeoti (2011) in their study of market participation in Nigeria, found out that access to extension service, farm size, high transportation costs and dependency ratio, positively influenced market participation whereas distance to markets, household size, age, access to infrastructure and farming experience negatively influenced level of market participation.

Similarly findings from a study by Komarek(2010)about market participation in banana markets in Uganda revealed that land used, yield, banana price, membership

in a producer group, use of hired labour, size of banana garden positively influenced market participation while distance to market and off farm income earned negatively influenced market participation.

The double hurdle model is a variant of the heckman model when the data has been drawn from a random sample. The model has been used mainly in adoption studies Olwande *et al.*, (2009) and consumption expenditure (Zang *et al.*, 2008; Yimer, 2011). However it is gaining importance in market participation studies because it eliminates selection bias created by truncation of the variables. The double hurdle model has been used in market participation studies such as (Holloway and Ehui, 2000; Komarek, 2010). Komarek (2010) studied determinants of banana commercialization in Western Uganda where he found out that yield of a given crop, price information positively influenced market participation while distance to markets negatively influenced market participation.

Similarly, Holloway and Ehui (2000) used a double hurdle model in their study on expanding market participation among small holder livestock producers in the Ethiopian highlands where they found out that those farmers with lower transaction cost participated more in markets and sold more because they were likely to recover their production and marketing costs. In this way, farmers living closer to roads, markets or towns with means of transportation or more labour were found to participate and sell more livestock products.

CHAPTER THREE

METHODOLOGY

3.1 Description of the study area

Kamuli district is located in southeastern Uganda and lies at an elevation of 1,100m above sea level. It borders the districts of Iganga in the East, Jinja in the south, Kayunga in the west, Soroti in the north and Pallisa in the north-east. It is estimated that as of 2010, the population of Kamuli District has grown to about 554,100 people (www.en.wikipedia.org/wiki/kamuli_District).

The study was purposively conducted in Kamuli district because it is one of the pioneer districts for growing grain amaranth following the introduction of the crop by VEDCO. VEDCO is a non-governmental organization which implements a food and nutrition security in the area with their focus for the introduction of the crop being to curb malnutrition in the area and boost immune systems of expectant mothers and HIV/AIDS patients.

3.2 Sampling Procedure

A multi- stage sampling procedure involving purposive and simple random sampling methods were used. Only 3 out of the 13 sub counties were covered in the survey since these were the major areas that were producing grain amaranth as a result of massive promotion campaigns mainly by two non- governmental organizations and hence it was ascertained that there was a high concentration of farmers who were at different stages of production and marketing. In the first stage a purposive sampling procedure was employed to identify the district of interest which is Kamuli district since it is one of the pioneer districts for producing grain amaranth and hence it was ascertained that there is a high concentration of farmers who are who market grain amaranth and those who do not. In the second stage the district was purposively stratified into 2 strata's that is VEDCO and PLAN-UGANDA since these are the two organizations which are promoting production of the crop.

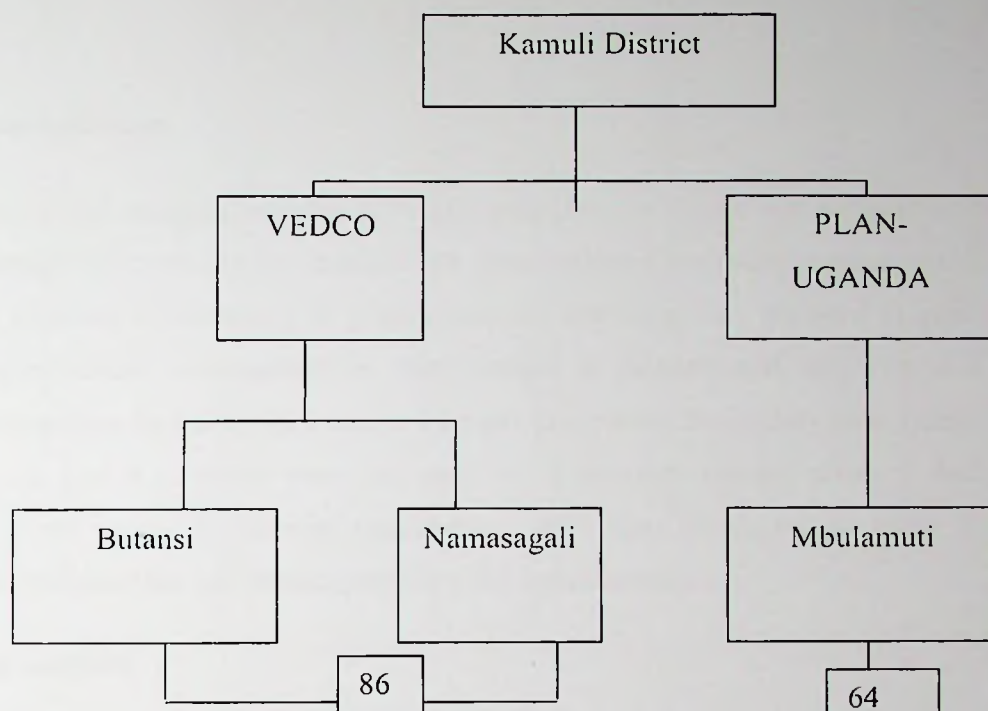


Figure 1: Sampling Procedure used in the study

However, though Kamuli district has about 13 sub counties, 2 sub counties that is Butansi and Namasagali were purposively selected from VEDCO stratum since from the time the NGO started promoting production of grain amaranth in 2005 it was operating in only two sub counties. Similarly from the PLAN-UGANDA stratum only one sub county Mbulamuti was selected since the NGO was only operating in one sub county since the inception of its' grain amaranth promotion activities in 2010.

In the third stage using a sampling frame provided by community development agents for both grain amaranth marketing farmers and non- market participants 64 respondents were randomly selected from Mbulamuti sub county, 45 from Butansi and 41 from Namasagali sub county making a total of 150 respondents. The target of the study was to have equal number of farmers in each stratum but this however differed from what was earlier proposed due to the concentration of grain amaranth farmers in some sub-counties resulting from the time difference when the promoting organizations started promoting the crop and hence it was ascertained that in some sub counties where grain amaranth was promoted earlier there were more market participants than non- market participants.

3.3 Data collection

Data was collected using a structured pretested questionnaire which was administered directly through interviews to the respondents. Data collected included; characteristics of farmers involved in marketing of grain amaranth, resources that are used in grain amaranth production, information on participation in promotional activities and market, information on asset ownership and access to services. Secondary data mainly from journals and text books was also used to supplement on the primary data collected. Focus group discussions (qualitative) were also conducted in order to validate the findings that had been captured by the questionnaire.

3.4 Data analysis

Data collected was entered using SPSS (statistical package for social scientist) for management of the data after which STATA was used to analyze the data. In this study both descriptive statistical analysis and econometric analysis were used to analyze the primary data collected from the small holder farmers.

3.5 Descriptive statistical analysis

Descriptive statistics such as means, frequencies, percentages and t-tests were used to describe and analyze grain amaranth farmers' characteristics in Kamuli district. (Achieve objective 1). Means were generated on household size, land size, land allocated to grain amaranth, average yearly production, distance to services including markets, roads, district headquarters, extension services. In addition, t-tests were used to test whether there was a significant difference between the means of the variables described above of farmers who sell grain amaranth and those who do not. Furthermore, descriptive statistics including frequencies, percentages were generated for categorical variables. These were used to describe data for variables such as sex, membership in farmer group, credit access, extension access, participation in promotional activities. In addition a chi-square test was performed to see whether there is an association between these categorical variables and being a seller of grain amaranth or not.

3.6 Econometric Analysis

When analyzing the probability of selling Probit or Logit models would be adequate techniques for addressing it. But if one is interested to know factors that influence the level of sales, at the same time, there is a need for a model that is a hybrid between the Logit or Probit and the OLS. The appropriate tool for such is the Tobit model that uses maximum likelihood regression estimation. Similarly, to look at factors that increase the level of participation in the market ideally, the OLS model is applicable when all households participate in the market. In reality however, all households may not participate. Some households may not prefer to participate in a particular market in favor of another; while others may be excluded by market. If the OLS regression is estimated excluding the non-participants from the analysis, the model would have sample selectivity bias problem (Gujarati, 2003).

According to Heckman (1979), sample selection bias may arise in practice for two reasons; first there may be self-selection by an individual or data units being investigated. Second sample selection decision by analysts or data processors in much the same fashion as self-selection. The Heckman's correction, a two-step statistical approach, offers a means of correcting for non-randomly selected samples. The first stage formulates a model for the probability of participation used to predict the probability for each individual and then in the second stage, removing the part of the error term correlated with the explanatory variables and avoiding the bias.

Scott (1995) explained that if majorities (95%) the sampled households are market Participant's i.e. potential supplier, then it is advisable to apply OLS model. For this study, therefore since out of 150 grain amaranth producers, 47% of the sampled households did not participate in the grain amaranth marketing, employing the Heckman's two stage model was more appropriate. Therefore, the Heckman's two stage model was used to model both the decision for farmers 'participation in grain amaranth markets and to determine factors which influence increased level of participation in these markets.

3.7 Conceptual framework

Following Singh *et al.*, (1986) the rural farming household can be viewed as a group of people living together and carrying out production and consumption activities together in a rural environment. For the purpose of this study, the farming household is assumed to maximize a utility function:

$$U = f(X_a, X_m, X_l) \dots\dots\dots (1).$$

Where the commodities are own produced staples (X_a), a market-purchased good (X_m) and leisure (X_l). Utility is maximized subject to a cash income constraint:

$$P_m X_m = P_a (Q - X_a) - w (L - F) \dots\dots\dots (2)$$

Where P_m and P_a are the prices of the market purchased commodities and the staple respectively, Q is the household output of the staples (such that $Q - X_a$ is its marketed surplus), w is the market wage, L is total labour input, and F is family labour input (such that if $L - F$, is positive, labour is hired and if negative, off farm labour is supplied) (Singh et al., 1986).

The farming household also faces some other constraints. It cannot possibly allocate more time to leisure, on-farm production, or off-farm employment than to the total time available to the household:

$$X_l + F = T \dots\dots\dots (3)$$

Where T , is the total stock of household time The household also faces a production constraint or production technology that depicts the relation between inputs and outputs:

$$Q = Q(L, A) \dots\dots\dots (4)$$

Where A , is the household fixed quantity of land here, various complexities that could arise from inclusion of other variable inputs such as fertilizer and pesticide have been ignored. It is also assumed that only one crop is being produced and that family labour and hired labour is perfect substitutes and can be added directly. In addition, it is also assumed that the three prices in the model (P_a , P_m and w) are not affected by various

actions of the household. That is the, household is assumed to be price-taker in the three markets. Apart from income constraint, land and time available for production are also constraints. These three constraints (i.e. income, land and time) can be collapsed into a single constraint. Substituting the production constraint for Q and the time constraint into the cash income constraints in for F in equation 2, we have a single constraint of the form:

$$P_m X_m + P_a X_a + w X_l - w.T = P \dots\dots\dots (5)$$

Where:

$$P = P_a Q (L, A) - wL \dots\dots\dots (6)$$

The expression in equation 6 is a measure of farm profits (P). From equation 5, the left hand side shows total household “expenditure” on three items (the market-purchased commodity, the household’s purchase of its own time output, and the household’s purchase of its own time in the form of leisure). The right hand side is a development of Becker’s concept of full income in which the value of the stock of time (wT) owned by the household is exclusively recorded. The extension for agricultural household includes a measure of farm profits ($P_a Q - wL$) with all labour valued at the market wage as a result of the assumption of price-taking behavior of households in the labour market.

Equation (5) can therefore be written in another form:

$$P_m X_m + P_a X_a + w X_l = Y^* \dots\dots\dots (7)$$

Where Y^* is the value of full income associated with the profit maximizing behavior of the household.

Maximizing utility subject to this new version of constraint requires a first order condition. Since household members have to make choice among goals competing for limited resources, the concept of “market” becomes very important in the analysis of the household production, exchange activities and consumption (Alene *et al.*, 2008). Thus, equations 1 and 7 will form the basis for the study of grain amaranth farmers.

3.8 Heckman selection model

The Heckman (1979) two-step procedure was used to achieve both the 2nd and 3rd objective. First, the factors that influence the decision to participate in marketing of grain amaranth are estimated. Second, the factors that affect the amount of sales are identified, using results from the first stage. The decision to participate in the market (the selection equation) is specified in equation (8). The selection variable Z^* is not observed but rather the sign of participating or not.

$$Z^* = \gamma'W_i + \mu_i \dots\dots\dots (8)$$

Where $\mu \sim N(0,1)$ and, $Z_i = 1$ if $Z^* > 0$, $Z_i = 0$ if $Z^* \leq 0$

Equation (1) was estimated by maximum likelihood as an independent probit model from the entire sample of market participants and non-participants; w is a vector of factors influencing the decision. The sample selection bias, what Heckman (1979) refers to as the inverse Mill's ratio (λ) equation 2, is computed from the parameter estimates of the selection equation for each observation in the selected sample (Greene, 2000), and is represented by: $\lambda_i = \frac{\phi(\alpha'W_i)}{\Phi(\alpha'W_i)}$ where ϕ and Φ are the probability density function and cumulative distribution function respectively. The level of sales, y , specified in equation (3), is observed only if $\gamma'W_i + \mu_i > 0$ and is estimated by ordinary least squares, where the vector of inverse Mill's ratios is included as an additional regressor.

$$y_i = \beta'X_i + \theta\lambda_i + \varepsilon_i \dots\dots\dots (9)$$

Where $\varepsilon \sim N(0,\sigma)$

The error terms of the market participation and the sales equation are correlated, as the Heckman procedure assumes that the decisions pertaining to market participation and the amount of sales are interdependent. The correlation coefficient for the error terms μ_i and ε_i is represented by ρ , where μ_i and ε_i are bivariate and normally distributed (Greene, 2000).

$$corr = (\mu_i, \varepsilon_i) = \rho \dots\dots\dots (10)$$

By incorporating the inverse Mill's ratio as an additional explanatory variable in the sales equation, the second stage of the Heckman procedure corrects the sample selection bias. W and X are the vectors of factors affecting participation and sales, respectively, and $w \subset x$.

3.9 Empirical model specification

The Probit model was used to achieve the 2nd objective i.e. identify factors that influence the decision to participate in grain amaranth marketing. The Probit model is specified as

$$\text{Pr (Grain mkt)} = \alpha + \beta_1 \text{HHGENDER} + \beta_2 \text{FARMSIZE} + \beta_3 \text{PRICE} + \beta_4 \text{BICYCLE} + \beta_5 \text{YIELD} + \beta_6 \text{EDUC} + \beta_7 \text{PROMOACT} + \beta_8 \text{EXP} + \beta_9 \text{FARMERGRP} + \beta_{10} \text{MBULAMUTI} + \beta_{11} \text{NAMASAGALI} + \varepsilon_i \dots\dots\dots (11)$$

Where

Pr (Grain mkt) = probability of Grain amaranth marketing decision (with marketing decision = 1 if a farmer participates in marketing and 0 otherwise.)

Explanatory variables;

HHGENDER	=	Gender of household head
FARMSIZ	=	Amount of land owned
EDUC	=	Number of years spent in school by household head
YIELD	=	Average amount of grain amaranth produced in a year 2011
PRICE	=	Grain amaranth selling price
BICYCLE		Dummy for ownership of bicycle
EXP	=	Years spent in grain amaranth production
PROMACT	=	Participation in promotion activities in the year 2010
FARMGRP	=	Dummy for membership in a farmer group
MBULAMUTI	=	Dummy for being located in Mbulamuti sub county
NAMASAGALI	=	Dummy for being located in Namasagali sub county

After estimating the probit model in the first stage and obtaining the inverse mills ratio, the inverse mills ratio was added in the OLS equation as an explanatory variable. Equation 12 was used to identify significant factors which influence level of grain amaranth sales.

The explanatory variables are as defined above in the probit model;

Dependent variable, Proportion of grain amaranth sales=percentage of grain amaranth sold

$$\text{Proportion sold} = \alpha + \beta_1 \text{HHGENDER} + \beta_2 \text{FARMSIZE} + \beta_3 \text{PRICE} + \beta_4 \text{BICYCLE} + \beta_5 \text{YIELD} + \beta_6 \text{EDUC} + \beta_7 \text{PROMOACT} + \beta_8 \text{EXP} + \beta_9 \text{FARMERGRP} + \beta_{10} \text{MBULAMUTI} + \beta_{11} \text{NAMASAGALI} + \beta_{12} \lambda + \varepsilon_i \dots\dots\dots (12)$$

3.10 Description of variables used in the model

The hypothesized determinants of grain amaranth market participation decision and marketable surplus are presented in table 1 and are discussed in the preceding sections.

Table 1: Description of Variables Used in the Heckman Model

Description	Type	Values	Participation decision (apriori sign)	participation level (apriori sign)
Gender of household head	Dummy	1=Male, Female	+	+
Land owned by the household	continuous	Hectares	+	+
Average grains harvested in a year	continous	kg	+	+
Possesitionof bicycle as a transport assets	Dummy	1=yes,0 otherwise	+	+
Education of the household head	continous	Years	-	-
Frequency of participation in field days in year 2010	continous	Number of times	+	+
Membership in farmer group	Dummy	1=yes,0 otherwise	+	+
Grain amaranth price	continous	Ugandan shillings	+	+

Before estimating the heckman two stage model, normality tests using Kernel density were performed to check whether continuous variables followed a normal distribution. Similarly the continuous variables were checked for multicollinearity using variance inflation factor Appendix (3). Basing on the results all variables used in the model had VIF values of less than 3 indicating no signs of multicollinearity.

Grain amaranth market participation decision (Grain mkt)

This is a dummy variable that represents the probability of market participation of the household in the grain amaranth market that is regressed in the first stage of two stages estimation procedure. For the household which participates in grain amaranth market the variable takes the value of one where as it takes the value of zero for a household which does not participate in grain amaranth market.

Proportion of grain amaranth sales (Grain Prop)

It is continuous dependent variable in the second step of the Heckman selection equation. It is measured in percentages and represents the actual supply of grain amaranth by grain amaranth producing farm household to the market which is selected for regression analysis and takes positive values.

3.11 Independent Variables

Household head gender

It is a dummy variable and it is anticipated that the gender of the household head shall have a mixed impact on both the participation and the value of sales from the market because in Uganda, household production is segregated by gender, with women mainly producing cereal food crops (Nkonya *et al.*, 2004). It is thus hypothesized that in this study women will be more involved in production and hence marketing of grain amaranth since grain amaranth is a pseudo cereal. Other studies have found that women headed households were less likely to be associated with higher levels of market participation (Makhura *et al.*, 2001; Govereh and Jayne, 2003).

Farm size

Farm size is expected to have a positive impact on production, and thereby directly influencing market participation and the value of sales from the market. The influence on the amount of land cultivated is expected to be enterprise specific (Warning and Nigel, 2002). Evidence from various studies have found that farm size positively motivated participation in- and the value of sales from the market, for high value, fresh produce, contract farming Masakure and Henson (2005), dual food and cash crop (maize) sales Makhura *et al.*, (2001) and cotton commercialization (Govereh and Jayne, 2003).

Yield of grain amaranth

This is a continuous variable and is measured as amount of kilograms of grain amaranth produced in a year. Higher yields have a positive effect on market participation and marketable surplus sizes. It is thus ascertained that the yield of grain amaranth will positively influence farmers' decision to participate in markets and also increase the level of market participation. A study by Komarek (2010) found out that yield had a positive effect in influencing volumes of banana sold an effect which was more than that of the price in the market participation decision.

Years spent in grain amaranth production

This represents the total number of years that the member has spent producing grain amaranth and is a continuous variable. It is believed that experience teaches and trains members with respect to farming operations. In this study it is hypothesized that farming experience has a positive influence on both participation decision and level of participation. A study conducted by Siziba *etal.*, (2010) on the determinants of cereal market participation among sub Saharan African farmers found a negative effect of farming experience with decision to sell grains this could be due to the fact that older farmers are less inclined to cash crop production and hence marketing.

Participation in promotion activities

This is a continuous variable and is measured as the number of times a farmer had participated in field days in the year 2010. It is believed that participation in promotion activities enables farmers to access market information hence this variable will have a positive influence on market participation decision.

Membership in a farmer group

Higher intensity of social capital factors within farmer groups (such as belonging to groups, paying membership fee, and number of meetings held), is likely to enhance access to markets, through improved economic viability of marketing. However, other studies have reported the contrary (Makhura *et al.*, 2001; Warning and Key, 2002). Hence it is ascertained that farmers who belong to a farmer group participate more in markets and will sell more grain amaranth.

Price of grain amaranth

This is a continuous variable that is measured in Uganda shillings. When grain amaranth price is high in the market in the previous year, farmers would be interested to produce and supply more. Therefore price is expected to have positive effect on both market participation and marketable surplus. Studies such as Ouma *et al.*, (2010) found a positive relationship between prices and the probability of a farmer engaging in sales of their chicken. Similarly, Komarek, 2010 found out that price had a positive effect on both market participation decision and volumes of banana sold in Western Uganda.

Education

It is a continuous variable and refers to the number of year spent by household head in school. Those households that have had formal education can readily accept new ideas and innovations, and easy to get supply, demand and price information and this enhance farmers' willingness to produce more and increase volume of sales. Therefore, formal education was hypothesized to positively influence market participation and marketable surplus. Holloway *et al.* (1999) observed that education

had significant and positive effect on quantity of milk marketed in Ethiopian highlands.

Ownership of bicycle

This is a dummy variable and refers to whether the household owned a bicycle or not. In this study it is used as a means of transport to enable households access distant markets and so it is hypothesized to influence market participation and marketable surplus positively.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Characteristics of grain amaranth farmers and farming system in Kamuli district

This sub section presents characteristics of grain amaranth farmers and farming system in Kamuli district. These included: sex, household size, number of dependents, household type, education status, membership to farmer group, access to extension services and credit, resource ownership

4.1.1 Characteristics of grain amaranth farmers in Kamuli district

Characteristics of the study respondents that are discussed included: sex , household size, number of dependents, household type, education status are presented in table 2., membership to farmer group, access to extension services and credit and resource ownership Over 70% of the surveyed households among the market and non-market participants were headed by men and less than 30% by women. This is consistent with the fact that Uganda is a patriarchal society and therefore it is very common for households to have a man as the head. More results however reveal that over 70% of the women as compared to less than 30% of the men participated in the production and marketing of the grain amaranth. Increased participation of women in grain amaranth marketing is attributed to the fact that grain amaranth is not a high value crop and so there is fewer tendencies for men to be actively engage in its production and hence marketing. Similar results have been reported by (Ohajianya and Ugochukwu, 2011) who found female farmers to be more involved in selling of sweet potatoes compared to their male counter parts.

The level of education of the study respondents among the market and non- market participants varied from no education at all to post-secondary education. From the results in the tables, approximately equal proportion of respondents across the two farmer categories had attained primary (38.8% and 31.4% for the non-market and market participants respectively) and secondary school education (40% and 44.5% for the non-market and market participants respectively). Households that have had

formal education can readily accept new ideas and innovations, and also they are in a better position to access and interpret market information. This enhances their willingness to produce more and increase volume of sales. Previous studies (Makhura *et al.*, 2011) have found farmers with higher levels of education to participate more in output markets due to their ability to understand market dynamics. Note too that average family size was approximately seven persons among both farmer categories. Other studies (Siziba *et al.*, 2011; Makhura *et al.*, 2011) found out that households with larger family size are less likely to participate in output markets due to increased need to first satisfy their consumption needs before selling to the market.

Table 2: Characteristics of grain amaranth farmers

Demographic characteristics	Non –market participants (n=80)	Market participants (n=70)	χ^2	t-value
Household size(n)	7.413	7.527		0.2171
Dependents(people < 5 years +people > 60 years(n)	2.325	2.328		0.0125
Sex of respondent (%)				
• Male	21.2	22.9	0.0562	
• Female	78.8	77.1		
Household type (%)				
• Male headed with a wife or wives	82.5	74.3	1.6453	
• Male headed divorced	1.2	2.9		
• Female headed	16.2	22.9		
Education level (%)				
• Illiterate	5.0	0.0	5.4350	
• Primary	38.8	31.4		
• Secondary	40.0	44.3		
• Post-secondary	16.2	24.3		

Source: Survey data, 2011

Resource ownership of the two farmer categories as presented in table 3 was characterized in terms of ownership of a storage structure, ploughing tools and household assets such as radio, television, mobile phone, water tank, improved stove, bicycle, motorcycle, and animal housing. Households that possess production resources such as ploughs are more likely to participate in output markets due to the ability to cultivate larger pieces of land which results in higher yield surplus that can be marketed. Similarly ownership of transport assets such as bicycles, motorcycles

and vehicles encourages increased participation in output markets due to the ability to access distant markets that are associated with higher selling prices.

The relative importance of storage structures to grain amaranth farmers cannot be underlooked owing to the fact that grain amaranth can be utilised in the form of grains which require storage to facilitate later consumption and sale in speculation of better prices. Such structures were too essential for these farmers especially market participants. They were owned by 48.6 % of this farmer category as compared to only 20 % of non market participants owning the same. These The chi-square test further qualified an association between being a market participant or non market participant and ownership of a storage structure at one % level of significance.

Table 3: Resource Ownership Status for Market and non-Market participants for Grain Amaranth

Resource type	Percentages		χ^2
	Non-Market Participants (n=80)	Market participants (n=70)	
Bicycle	78.8	78.6	0.0007
Motorcycle	16.2	12.9	0.3434
Mechanical plough	12.5	14.3	0.1030
Television	11.2	8.6	0.2976
Radio	82.5	87.1	1.5542
Mobile phones	66.2	67.1	0.0134
Improved storage	20.0	48.6	13.7143***
Animal housing	43.8	65.4	7.2507***

Source: Survey data, 2011: Note*** 1 % significance level

In terms of animal housing ownership, the chi square test was statistically significant indicating that more of the grain amaranth market participants owned animal houses than non-market participants. Ownership of animal housing increases likelihood of farmers participating in grain amaranth marketing since they will be in a better position to safely store their grains for future use including marketing. . Notably ownership of assets such as mobile phones, bicycles and radios was comparable among the farmer proportions. Possession of transport assets eases access to markets by reducing costs associated with accessing distant markets hence increasing participation in marketing.

More results indicate that about 14.3 % of market participants owned mechanical ploughs as compared to 12.5 % of non market participants..Farmers who own productive assets such as mechanical ploughs are able to increase on the area of land under production thereby increasing out puts (Birachi *et al.*, 2011) hence likelihood of participating in marketing of their produce.

Market access factors such as distance to markets, nearest tarmac road, district headquarters, all weather road and extension office are presented in table 4.

Table 4: Market access factors of grain amaranth farmers in Kamuli district

Mean Distance (Km)	Non -Market participants (n=80)	Market Participants (n=70)	t-value
Nearest tarmac road	12.079	16.489	3.2348***
Nearest all weather road	1.466	2.192	1.5505
District head quarters	16.457	20.286	2.6997***
Nearest market	3.037	4.432	2.0257**
Nearest extension office	3.853	4.664	1.0304

Note* 1% significance level, ** 5% significance**

Results indicate that market participants seemed to be located far away from most of the marketing places for instance the mean distance travelled to access nearest tarmac roads was about 16.5 km which is more than the 12km travelled by non-market participants. Further still, the mean distance to access district headquarters and markets was (20.3km and 4.4km) respectively for market participants and (16.5km and 3 km) respectively for non-market participants. These mean distances were significantly different for the two farmer categories as indicated by the independent t -test estimates. These findings contradict those reported in other market participation studies (Holloway and Ehui, 2002; Siziba *et al.*, 2010; Ohajianya *et al.*, 2010) where increased market distances discouraged market participation. The possible explanation for this is due to the direct intervention by Non-governmental organizations in actively engaging in marketing of grain amaranth and so this offsets the transaction cost effects that would result from accessing these distant marketing centers since farm gate was the most commonly used market outlet.

4.2 Farming characteristics of grain amaranth farmers

4.2.1 Land area allocation to production of Grain amaranth and other food crops

Table 5 indicates that there was a significant difference in the mean land allocated to grain amaranth production between the two farmer categories with market participating farmers allocating more land (0.145 ha) as compared to the (0.059 ha) of land allocated by non- market participants. The findings portray commercialization behavior where market oriented farmers tend to increase land under crop production in order to generate marketable surpluses after surpassing subsistence needs. Barret (2008) noted that the degree of households making gross purchases from the market tends to decline with increase in land sizes. Previous market participation studies (Komarek, 2010; Makhura *et al*, 2011) showed that the degree of market participation tends to increase with increased land holdings. More results still indicate that more land is allocated to the production of other food crops (1.293ha) compared to the 0.078 ha allocated to grain amaranth production. The possible explanation for this is due to the fact that grain amaranth is still a newly introduced crop in Kamuli farming system and so it is still not widely grown.

Table 5: Land area allocated to Crop Production

Variables (hectares)	Non-Market Participants (n=80)	Market Participants (n=70)	Total (n=150)	T-test
Mean land owned allocated to food crops	1.337	1.243	1.293	0.4032
Mean land rented allocated to food crops	0.265	0.287	0.276	0.3299
Mean land owned allocated to grain amaranth	0.053	0.108	0.079	2.9700***
Mean land rented allocated to grain amaranth	0.006	0.086	0.043	1.6480
Total land used for amaranth production	0.059	0.145	0.099	4.4010***

Note: * 1% significance level**

4.2.2. Access to credit

Farmers needed credit to purchase the necessary inputs essential for grain amaranth production processes and also to cater for other family needs and consumption expenses. Findings in table 6 revealed that over 88 % of all respondents had access to credit.

Table 6: Access to agricultural credit

Variable	Percentages		Total (n=150)	χ^2
	Non-Market Participants (n=80)	Market participants (n=70)		
Credit access				
• Yes	86.2	91.4	88.7	0.9963
• No	13.8	8.6	11.3	
Credit received				
• Yes	55.0	58.6	56.7	0.1939
• No	45.0	41.4	43.0	

Source: Survey data, 2011

Notably, the proportions of farmers who actually received agricultural credit were comparable among the two farmer categories with 58.6 % and 55% of the market participants and non-market participants receiving agricultural credit respectively. Farmers needed this credit in order to purchase inputs needed for grain amaranth production such as seeds, pesticides and fertilisers and post -harvest materials such as tarpaulins.

Barrett (2008) argues that households which have access to credit transact more in food grain markets due to the fact that liquidity permits these households to invest in higher-yielding, longer cycle crops or seasonal inputs which boosts yields. Alene *et al.*, (2008) also found out that farmers who accessed input agricultural credit were more likely to participate in maize markets in Kenya

The major sources of credit in the area (figure 2) included VSLA, SACCOS and banks. The fact that VSLA is the major source of agricultural credit is not surprising

since agriculture is considered a risky business and farmers can only source credit mainly from informal sources where no collateral is required.

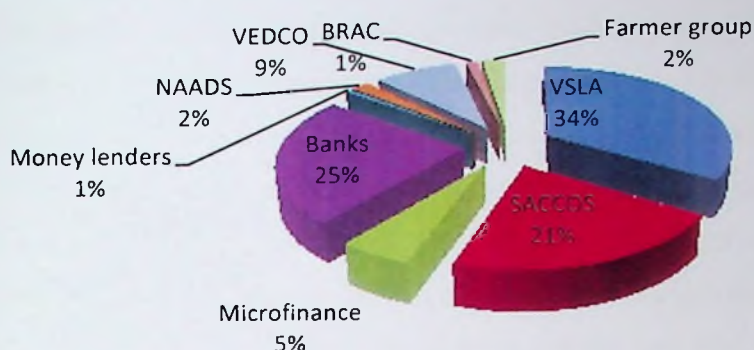


Figure 2: Source of Agricultural Credit

4.2.3 Membership in a Farmer Group and Extension Access

Most of the farmers visited belonged to a farmer group with more market participants (84.3 %) par taking more than the non- market participants (55 %) (Table7).

Table 7: Access to extension and membership in a farmer group

Variable	Percentages		Total (n=150)	χ^2
	Non-Market Participants (n=80)	Market participants (n=70)		
Farmer group membership				
• Yes	55.0	84.3	68.7	14.8818***
• No	45.0	15.7	31.3	
Extension services				
• Yes	92.6	100	98.0	2.6786
• No	3.8	0.0	2.0	

Source: Survey data, 2011: Note*** 1% significance level

The chi square test revealed an association between belonging to a farmer group and being a market participant or not at 1 % level of significance. Membership in a farmer group increases access to information and also ensures efficient flow of information

among members. Group membership also ensures collective purchase of inputs and collective marketing of produce thereby reducing transaction costs associated with individual marketing. Adeoti *et al.* (2014) found membership in farmer organisations to be positively associated with increased market participation due to the ability of farmers in a group to network and have access to up to date information.

Extension services extend from provision of technical advice to facilitating credit delivery, input supplies and market information. Findings revealed that over 98 % of all the respondents received extension services. The major information accessed from extension agents (Table 8) included general agronomic practices, nutritive value of the crop, information related to how to utilize the crop and market information. General agronomic practices emerged as the most important kind of information accessed by grain amaranth farmers from NGO'S with the information being received by 79.5 % of total sampled farmers.

Table 8: Kind of information accessed from extension agents

Variable	Percentages		
	Non-Market Participants (n=80)	Market participants (n=70)	Total (n=150)
General agronomic practices	80.5	78.3	79.5
Nutritional value of amaranth	55.8	55.1	55.5
Utilization (cooking)	44.2	40.6	42.5
Market information	19.5	31.9	25.3
Value addition	5.2	7.2	6.2
Disease and pest control	0.0	4.3	2.1
Proper harvesting	0.0	2.9	1.4
Soil management	0.0	2.9	1.4
Quality specification	0.0	2.9	1.4
Fertilizer application	1.3	0.0	0.7

Source: Survey data, 2011

4.3 Input use in grain amaranth production

Like any other crop in the farming system, grain amaranth requires some inputs to enhance its production. Therefore, in order for farmers to argument their yields and hence farm incomes, farmers have to adopt the use of yield enhancing inputs. The most important inputs used in production of grain amaranth include: manure, pesticides and fertilizers (table 9).

Table 9: Kind of inputs used in grain amaranth production

Variable	Percentages			χ^2
	Non-Market Participants (n=80)	Market participants (n=70)	Total (n=150)	
Seed	97.5	97.1	97.3	0.0183
Manure	37.5	37.1	37.3	0.0020
Pesticide	23.8	17.1	20.7	0.9940
Herbicide	0.0	1.4	0.7	1.1505
Fertilizer	3.8	7.1	5.3	0.8512

Source: Survey data, 2011

Results indicate low use of purchased inputs such as fertilizers, pesticides and herbicides with the results indicating that these are used by 5.3%, 20.7% and 0.7% of total sampled households. From the results in the tables, approximately equal proportion of respondents across the two farmer categories used seeds and manure. For instance 97.5% of non-market participants and 97.1% of market participants used seeds which had mainly been recycled an implication of low use of improved grain amaranth varieties which are usually high yielding. Though grain amaranth does not have a high demand for nitrogen, the crop responds well when moderate rates of fertilisers ranging from 40 to 80 pounds per acre are applied (www.jeffersoninstitute.org). In the absence of nitrogen fertilisers use of animal manure can provide the necessary needed nitrogen requirements this justifies increased use of animal manure especially cow dung by 37.3% of total sampled farmers.

4.4 Constraints faced by farmers in producing grain amaranth

Farmers cited a number of problems faced during production of grain amaranth (table 10). The most commonly cited problem was pests (32%), Aphids were mentioned to be the most important pests. Findings from the focus group revealed that farmers had resorted to the use of trap crops for example onions which were planted in between lines of grain amaranth as a way of scaring pests. Others used locally made pesticides which were sprayed onto the plants.

Table 10: Production constraints faced by farmers

Constraint (%)	Non-Market participants (n=80)	Market Participants (n=70)	Total (n=150)
Pests	31.3	32.9	32.0
Drought	17.5	25.7	21.3
Lodging	11.3	22.9	16.7
High labor requirement	7.5	20.0	13.3
Difficulties in agronomic and post-harvest handling practices	7.5	17.1	12.0
Requires fertile soils	7.5	4.3	6.0
light seed	0.7	3.3	4.0
harvesting requires a lot of gadgets	0.0	5.7	2.7
Low yield	0.7	1.3	2.0
Attacked by chicken when mature	1.2	2.9	2.0
low germination %age	0.0	2.9	1.3
Itchy during harvesting	1.2	1.4	1.3
Does not require intercropping	0.7	0.0	0.7
expensive seed	0.0	0.7	0.7

Source:survey data,2011

Drought was also a serious constraint faced by farmers with the results indicating that about 21.3% of farmers were constrained by drought which made the plants to completely dry up. Owing to its weak stems 16.7 % of farmers were faced with a constraint of toppling down of the plant. Other major constraints cited during production included; high labour requirement during weeding and threshing, difficulty in agronomic and post harvest handling practices such as planting, weeding, harvesting, drying owing to its small seed.

4.5 Marketing strategies for grain amaranth

4.5.1 Grain Amaranth Marketing Channels

Grain amaranth marketing channel is relatively short as depicted in figure 3. Most of the farmers sell their produce directly to consumers at farm gate (73.5 %) with little or no value addition. Fellow farmers who do not produce grain amaranth make up the highest proportion of consumers (65%). Farmers also sell directly to schools and hospitals as another class of consumers and these make up for 1 % of the consumer base. Others sell to processors such as Maganjo Grain Millers Ltd who process grain amaranth and mix it with other cereals such as millet and legumes such as soy bean to

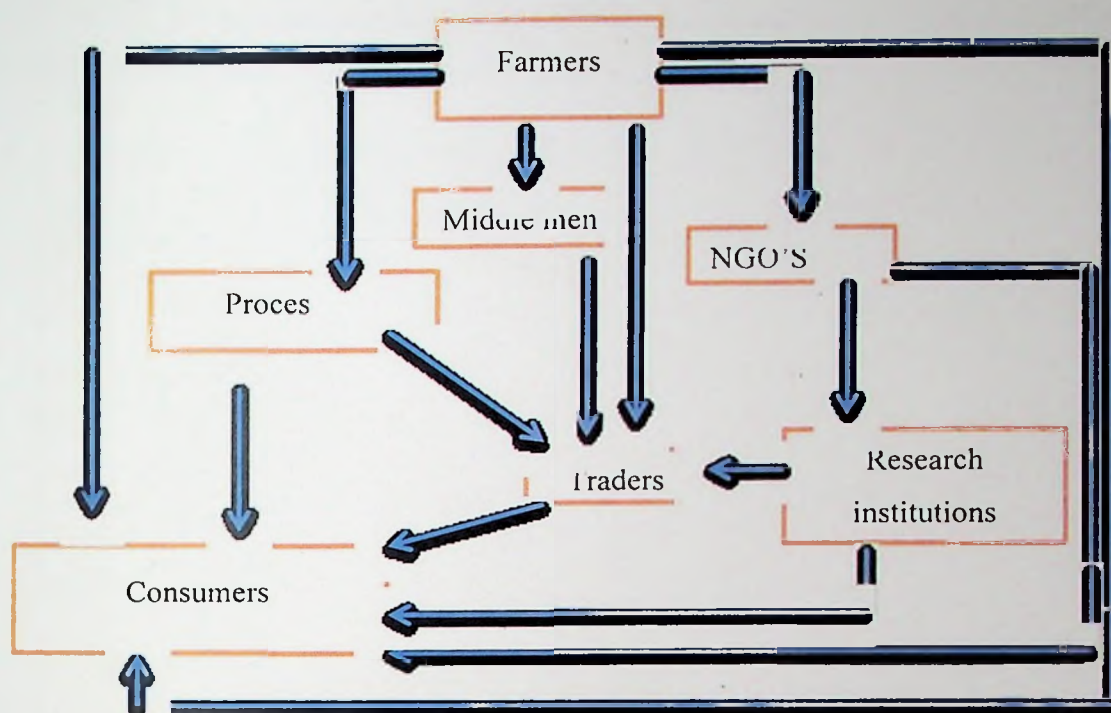


Figure 3: Grain Amaranth Marketing Channels

make composite flours which are directly sold to consumers or to retail traders who then sell to consumers at several market outlets. About 22.2% of farmers market their grain amaranth collectively to local NGO's such as VEDCO these sell to research institutions mainly Makerere University, Department of Food science and Technology which processes grain amaranth into different products that range from pure grain amaranth flour, composite flours for use in diets of weaning babies. These products are later sold directly to consumers through retail outlets such as supermarkets. On the other hand, owing to the nutritive value of grain amaranth NGO's such as PLAN – UGANDA & VEDCO supply grain amaranth products mainly composite flours directly consumers either AIDS patients or malnourished children as a way of promoting consumption among these groups. Lastly, about 15 % of grain amaranth sales are made to middlemen who sell to consumers and these later sell to traders.

4.5.2 Forms of Marketing Grain amaranth

Unprocessed grains emerged out as the most important form in which farmers sell their grain amaranth (81 %) as depicted in figure 4. Though farmers who sell this form of grain amaranth do not carry out any value addition, the grains have the ability to be processed and utilized into different products such as porridge, posho, paste (usually mixed with groundnuts) and pops (Muyonga *et al.*, 2008).

However owing to the fact that grain amaranth is a vegetable crop, about 18 % of farmers sold their grain amaranth as leaves. Such farmers employ strategies such as staggering production, subdividing plots and having separate plots for leaf and grain production.

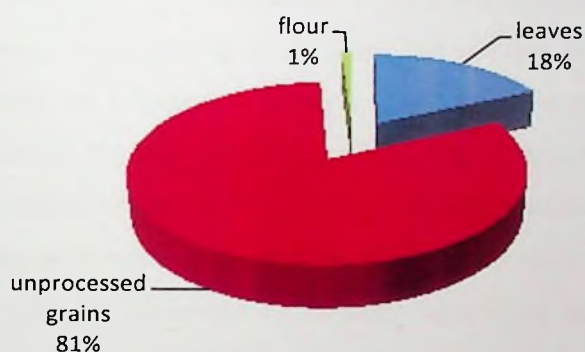


Figure 4: Forms of Marketing Grain amaranth

Such strategies are employed to ensure that farmers have continuous production to meet for night sales. In addition to that, farmers who market leaves are discouraged by the increased number of post-harvest handling activities associated with grains including shelling, drying, winnowing and storage. These activities are time consuming, labour intensive and require specialized equipment like tarpaulins for drying and sieves for winnowing which are relatively expensive to acquire.

Other reasons for marketing leaves include; it is cheap to produce, requires less land for production owing to its vegetative nature when compared to grains, not affected by pests and it is easier to meet the required quality. According to farmers the leaves

are more profitable compared to the grains because of high vegetative growth, however these assumptions by farmers are yet to be verified through research. On the other hand the grains are more nutritive much as they are costly to produce and take long to mature about 2.5 months. The results further indicate that only 1 % of farmers have taken up the initiative of processing their grain amaranth in flour. The flour can be utilized as porridge (a mixture of grain amaranth, soya and maize flour) or a sauce when mixed with other ingredients such as silver fish, soya flour and grain amaranth flour.

4.6 Factors influencing small holder farmer participation in grain amaranth marketing in Kamuli district

In this study factors that influenced farmers' decision to participate in grain amaranth marketing as well as those which influence increased level of participation through sales volume were determined using the Heckman two stage model. The Heckman two stage procedure is used since the volume to be supplied to the market will be preceded by a farmer making a decision of whether to participate or not in the markets. In the first stage the probit model was estimated to identify factors affecting the decision to participate in grain amaranth marketing. In the second stage using the inverse mills ratio (generated from the probit model) to cater for selection bias, an OLS regression is estimated to identify significant factors for level of participation or volumes of grain amaranth sold.

4.6.1 Determinants of grain amaranth market participation decision

The goodness of fit measured by the significant chi square value of 38.00 showed that the model used is more likely than the null model in which probability of market participation is constant. Results in table 16 show that the decision to participate in grain amaranth marketing was influenced by gender of household head, education level of the household head, grain amaranth selling price, membership in farmer group and farm size.

Gender of the household head positively and significantly ($P \leq 0.01$) influenced the decision to participate in grain amaranth marketing. The probability of participating in grain amaranth marketing increases by 25.44% with male headed households. The

possible explanation for this is the tendency for male headed households to be more market oriented when compared to female headed households. This suggests that male headed households are more market orientend when compared to female headed households and so are likely to engage in crops that can be sold to generate income. These findings concur with those Sigei *et al.* (2013) who found out that male headed households were more likely to participate in marketing of pineapples in Kericho county in Kenya.

Table 11: Factors that determine decision of Small holder Farmersto sell grain amaranth

Variable	Marginal coefficient	T-value	P-value
Household head gender (1=Male)	0.000	4.48***	0.000
Education level of house hold head (Years)	0.001	3.39***	0.001
Frequency of participation in extension activities in the year 2010	0.897	0.13	0.897
Experience in grain amaranth production	0.458	0.74	0.458
Bicycle ownership	0.341	0.95	0.341
Land owned (ha)	0.056	1.91*	0.056
Mean Yield	0.680	0.41	0.680
Grain amaranth selling price (Ush)	0.000	3.75***	0.000
Farmer group membership =1; 0 other wise	0.001	3.34***	0.001
Log likelihood	-21.642		
Wald chi ²	38.00		
Prob>Chi ²	0.0001		
Pseudo R2	0.4911		
Number of observations	150		

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

Farmers education level was found to have a positive and significant effect ($P \leq 0.01$) on the decision to participate in the market with a one year increase in the level of formal education increasing the probability of marketing grain amaranth by 2.86%. This is because by being educated farmers become more knowledgeable about the prevailing market situations and so are able to make informed marketing decisions such as where to market and prices. Similar results were reported by Gani and Adeoti. (2011) who found highly educated farmers to be more likely to participate in

marketing of their produce Nigeria. Similarly, these findings are in agreement with those of Adeoti *et al.* (2014) who found out that farmers who had attained formal education were more likely to participate in maize markets in Nigeria compared to those who are illiterate.

Grain amaranth price was found to have a positive and significant ($P \leq 0.01$) effect in influencing the decision to participate in markets. This implies that a one ugandan shilling increase in the price of grain amaranth increases the likelihood of participating in grain amaranth marketing by 0.1%. Komarek (2010) argues that Prices are an important driver of market entry decisions with a rise in price viewed as a fall in marketing costs or a change in economic conditions such as consumer behaviour. the volumes supplied by market participating households by about 1%.. These findings augment those of Ouma *et al.*, 2010 who found out that the selling price of both beer bananas and cooking bananas increased the volumes sold to the market by market sellers.

Farm size in this study was found to have a negative and significant effect ($p \leq 0.1$) in influencing market participation decisions contrary to apriori expectations with a one hectare increase in farm size decreasing the likelihood of participating in grain amaranth marketing by 1.74%. The possible explanation for this is the tendency for farmers to shift to the production and marketing of widely known cash crops such as maize following an increase in farm sizes with less land being allocated to crops that are considered to be of low value and where farmers are not certain of the markets. Barret (2008) argues that households with least amounts of land tend to be gross purchasers in the market, with the probability of making gross purchases declining steadily as households land holdings increase. Similarly, Komarek. (2010) argues that households which are well endowed with agricultural land are more likely to be commercially oriented, however being endowed with agricultural land has no explanatory power in predicting market participation decision. The findings in this study deviates from a number of market participation studies such as (Makhura *et al.*, 2001; Adeoti *et al.*, 2014).

More results revealed that membership to a farmer group positively and significantly ($p \leq 0.01$) influenced the decision to participate in grain amaranth marketing. Farmers who belong to a farmer group are 23.22% more likely to engage in marketing of grain amaranth than those who do not belong to any group. The possible explanation for this is that working in a group creates synergy among the farmers and enables them to access market information as well as sharing experiences thereby removing fixed transaction costs faced by farmers when entering output markets. These findings concur with those of Adeoti *et al.*, (2014) who found out that belonging to a farmer group increased likelihood of participating in maize markets in Nigeria. Ohajianya and Ugochukwu. (2010) also found out belonging to a farmer group influenced households to be more of sellers than being autarkic in sweet potato markets in Nigeria.

4.6.2 Determinants for increased level of sales in grain amaranth markets

Table 12 presents factors that influence the level of participation in grain amaranth markets. Education level of the household head, frequency of participation in extension activities, grain amaranth yield, ownership of bicycle statistically influence the levels of grain amaranth supplied to the market. The high R^2 value of 66% shows that the explanatory variables jointly explain 66% of the variation in the dependent variable.

The literacy level of a farmer is related to the way he/she makes marketing decisions and reads market signals. Farmer's education level in this study was found to have a positive and significant ($P \leq 0.1$) effect in influencing the level of participation in grain amaranth markets. A one year increase in the education level increases the proportions of grain amaranth supplied to the market by 0.95. This is because with higher education levels, farmers can easily get and accurately interpret market information and read market signals like prices and frequency of buyers before they sell their produce into the market. The findings of this study concur with those of (Tesfaw, 2014; Adeoti *et al.*, 2014) who found highly educated farmers to be more involved in marketing in output markets.

Further still, higher levels of grain amaranth output positively and significantly ($p \leq 0.01$) influenced the level of participation by grain amaranth farmers in the market.

The results show that a one kilogram increase in grain amaranth produced increases the proportions of grain amaranth marketed by 3.65%. The possible explanation for this is due to the ability of these households to produce a marketable surplus after surpassing their consumption needs.

Table12: Factors influencing the level of participation in grain amaranth marketing

Variable	Coefficient	T-value	P-value
Household head gender (1=Male)	-4.4769	1.06	0.290
Education level of household head	0.9471	1.70*	0.090
Experience in grain amaranth production	0.5982	0.66	0.512
Number of extension visits in past year (2010)	-13.9151	2.06**	0.041
Farm size	-0.0247	0.08	0.936
Grain amaranth yield	0.0365	3.29***	0.001
Grain amaranth price	0.0017	0.49	0.623
Farmer group membership (1=Member)	-5.3059	0.97	0.336
Ownership of bicycle	-7.4397	1.47	0.144
Mbulamuti	14.5574	2.81*	0.006
Namasagali	0.7456	0.14	0.887
Inverse mills ratio	-16.0337	7.38***	0.000
Constant	26.04716	2.08	0.040
F-value	30.40		
Prob>F	0.0000		
R –squared	0.66		
Number of observations	150		

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

These findings concur with those of (Komarek (2010) who in a study on the commercialization of bananas, found that its yield positively influenced the quantities of bananas traded the author further goes ahead to argue that yields realized help to explain market participation decision. Similarly (Tesfaw, 2013) also found amount of pepper produced to be a major factor in determining the extent of market participation in Ethiopia. Rios et al (2008) in a study on linkages between market participation and

productivity reported that households with higher productivity tended to participate more in agricultural markets regardless of market access factors.

Furthermore, the number of times a farmer participated in field days in the past year as a dissemination activity negatively and significantly ($p \leq 0.05$) influenced the level of participation in grain amaranth markets. The possible explanation for this could be as a result of the information disseminated to be inclined more on the utilisation and nutrition aspects of the crop and less on the marketing hence this reduces on the volumes supplied to the market in favour of utilising the crop for nutritional purposes. These findings contradict those of Gebremedhin *et al.*, (2009) who found a positive and significant effect of extension access on the volume of teff sold.

The results also show that farmers who are located in Mbulamuti sub –county significantly ($P \leq 0.1$) supplied more grain amaranth to the market compared to those from other sub counties such as Namasagali and Butansi. This could be an indicator of increased commercialization behavior of these famers.

The coefficient on the inverse mills ratio was negatively significant implying that there are un observed factors that affect market participation decision and level of participation in grain amaranth markets and that selectivity bias would have resulted had the grain amaranth sales been estimated without consideration of the decision to sell grain amaranth.

4.7 Marketing constraints

The major marketing constraint faced by farmers was low prices (table 13), low prices act as a barrier to grain amaranth market participation where farmers are better off consuming their grain amaranth at home owing to its nutritive properties that have facilitated its use in children's diets and HIV/AIDS patients.

Table 13: Marketing constraints faced by grain amaranth farmers

Constraint (%)	Non-Market participants (n=80)	Market Participants (n=70)	Total (n=150)
Lack of market	10.0	63.8	34.9
Low prices	10.0	46.4	26.8
poor storage facilities	1.3	4.0	5.4
High transport costs	1.3	8.7	4.7
Poor roads to markets	0	1.3	1.3

Source: survey data,2011

Grain amaranth being a relatively new crop farmers are faced with a problem of lack of market this justifies the findings by Muyonga *et al*, (2008) of absence of a clear market for grain amaranth. Constraints associated with low prices coupled with lack of markets have deterred farmers from increasing production , therefore one way of increasing production is by creating demand. This demand can be created through awareness promotion campaigns for grain amaranth products through trade and agricultural shows. Other constraints include lack of storage facilities and high transportation costs which makes farmers to resort to farm gate market outlets as these are not associated with any transportation costs thereby failing to tap better prices.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary

Grain amaranth represents one of the upcoming crops that have a high potential of improving household nutrition and economic status. The main objective of this study was to establish the determinants for participation of small holder farmers in grain amaranth marketing and suggest strategies to enhance promotion of the crop. The study specifically focused on identifying factors which contribute towards farmer participation in grain amaranth marketing and those which influence the level of sales supplied to the market.

The descriptive statistical analysis revealed that over 70% of the surveyed households among the market and non-market participants were headed by men and less than 30% by women. Furthermore, over 70% of the women as compared to less than 30% of the men participated in the production and marketing of the grain amaranth. Note too that average family size was approximately seven persons among both farmer categories with at least two persons as dependents in each of the households.

Similarly farmers allocated relatively small pieces of land averaging 0.08ha acres to the production of grain amaranth as compared to the 1.29 ha acres of land allocated to the production of food crops the reason for this is that grain amaranth is not a major crop in Kamuli farming systems.

Out of the 150 sampled farmers about 53.3 were non- market participants due to the need for self -sufficiency. Grain amaranth marketing channel is relatively short with most of the farmers selling their produce directly to consumers at farm gate (73.5 %) with little or no value addition. Farmers can also sell directly to schools and hospitals as another class of consumers and these make up for 1 % of the consumer base. Others sell to NGO's as a group with about 22.1 % of farmers tapping into this group market. un processed grains emerged as the commonest form in which farmers sell

their grain amaranth (81%) followed by leaves (18%); with no value addition thus resulting into low prices offered for their produce.

The decision to participate in grain amaranth marketing was positively influenced by; Gender of household head, Education levels of the household head, Grain amaranth yield, grain amaranth selling price, membership in a farmer group while farm size decreased the likelihood of selling grain amaranth. The results further reveal that the education status of the household head and yield positively influenced households to sell more grain amaranth with farmers who had participated more in field days as a promotion activity marketing less grain amaranth.

5.2 Conclusions

Grain amaranth is a newly introduced crop in Kamuli district. However efforts are underway to promote its production and utilization in Kamuli district in particular and other districts in the country at large due to its amazing properties that are nutritional, medicinal and economical. This makes it a prominent crop that can readily be utilized in many forms thereby increasing its marketability. This study established the determinants of small holder farmer participation in grain amaranth marketing by identifying factors that drive farmers to market their grain amaranth and further more to establish factors that determine the volumes that are sold in the market.

However, to gain an insight into the marketing behavior of grain amaranth by small holder farmers, it's imperative to draw important conclusions from major findings of the study.

Findings from the study indicated that male headed households were more likely to participate in marketing of grain amaranth due to the need to generate cash to meet household needs,

Similarly, since production of grain amaranth requires relatively small land acreages, due to its vegetative nature this makes it an important crop for poor farmers who are constrained by resources especially land and so farmers who are constrained by land should be encouraged to grow the crop.

In addition, by realizing higher production surpluses households will decide to participate in marketing of their grain amaranth after surpassing consumption needs. Therefore technology and policy options that would enhance incentives to increase production would have a great, though indirect impact in influencing market participation.

Price of grain amaranth is one of the major incentives for market participation due to its direct effect with volumes traded therefore focus should be channeled in creating favorable price incentives.

Membership in farmer group also increased the probability of participating in grain amaranth marketing due to its direct effect in encouraging collection action among members.

Farmers with higher levels of education were more likely to participate in grain amaranth marketing since by being educated they can readily accept new ideas and innovations and this enhances their willingness to produce more and hence participate in marketing after generating a marketable surplus.

5.3 Recommendations

Households headed by men are more likely to participate in marketing due to their greater advantage in negotiating a sales transaction and searching for buyers therefore these should be used as change agents in encouraging female headed households to participate in markets. Similarly in order to encourage increased participation of women headed households Government organizations such as the Ministry of Gender, Ministry of Agriculture, Animal Industry and Fisheries should design well focused and articulated programs that will encourage female headed households which are usually resource constrained to participate in marketing.

Small holder collective action should be encouraged through Organisation of farmers into groups this will ensure that farmers improve on their economies of scale in input and output markets through joint purchase of inputs, improved information flow and collective marketing. Collective action encourages small holder farmers market participation through increased lobbying, bargaining power and reduction of

transaction costs associated with search for market information. Such roles can be enhanced by NGO's such as VEDCO, Uganda National Farmers Federation and Abi trust since these directly support the farmers, but for these NGO's to achieve this there is need for an enabling policy environment.

In order to encourage increased market participation favorable price incentives focusing on availing market information through collective marketing will play an upper hand in encouraging non market participants to start marketing. In addition value addition is one of the ways by which farmers will be able to realize higher prices since with value addition farmers will be able to come up with a number of highly differentiated products on the market which have different attributes and prices. Therefore farmers should be trained on basic aspects of grain amaranth value addition.

There is need to build capacity of farmers through adult literacy programs and more still farming households should be empowered by sensitizing them about the importance of education. The public sector has a critical role to play by increasing the capacity of small holder farmers to pay school fees this can be achieved by increasing funding for subsidized education programs such as Universal primary education and Universal secondary education. This will better enhance adoption of modern farming techniques that will invariably lead to increased output and incomes for the farmers.

Yield improvements are critical if increased market participation is to be realized. Therefore, research efforts should be directed towards generation and dissemination of grain amaranth varieties that are superior in production, consumption and nutrition attributes in order to stimulate massive production of the crop that will lead to higher production surpluses being realized.

Extension agents should focus more on promoting growing of grain amaranth as a way of stimulating marketing rather than focusing on promotion of marketing since increased production will derive consumption.

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Appendix 1: K-density graph for household size



Appendix 2: Heckman two stage model showing generation of 1st Stage Probit
model used to explain Factors that influence small holder farmers’
decision to participate in grain amaranth marketing

```
heckman rsnpdn hhgend educ_hhd grain_yrs field_2010 ownland_acc avghstseed grain_price
farm_group bicycle, noconstant twostep select(per_sol
> = hhgend educ_hhd grain_yrs field_2010 ownland_acc avghstseed grain_price
farm_group bicycle mbulamuti namasagali, noconstant) rhosigma first nshazard(mills)
```

Probit regression

Number of obs = 150

Wald chi2(11) = 38.00

Prob > chi2 = 0.0001

Log likelihood = -21.642249

per_sol	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]	
hhgend	.5552399	.5391105	1.03	0.303	-.5013973	1.611877
educ_hhd	-.0953077	.0612162	-1.56	0.119	-.2152893	.024674
grain_yrs	-.1889309	.2053844	-0.92	0.358	-.5914768	.2136151
field_2010	2.218392	.7774867	2.85	0.004	.6945464	3.742238
ownland_acc	.0069765	.0754973	0.09	0.926	-.1409955	.1549485
avghstseed	.0398025	.0187936	2.12	0.034	.0029678	.0766372
grain_price	.0043588	.0010174	4.28	0.000	.0023647	.0063529
farm_group	1.377317	.5614338	2.45	0.014	.2769269	2.477707
bicycle	.3512051	.6156524	0.57	0.568	-.8554515	1.557862
mbulamuti	-1.642301	.6439557	-2.55	0.011	-2.904431	-.3801709
namasagali	-.3601866	.4442032	-0.81	0.417	-1.230809	.5104356

Note: 0 failures and 23 successes completely determined.

```

Heckman selection model -- two-step estimates      Number of obs      =      150
(regression model with sample selection)          Censored obs       =      79
                                                  Uncensored obs     =      71

                                                  Wald chi2(9)       =     1128.83
                                                  Prob > chi2        =      0.0000

```

	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]	
rsnpdn						
hhgend	.254479	.056846	4.48	0.000	.1430629	.3658952
educ_hhd	.02863	.0084488	3.39	0.001	.0120707	.0451893
grain_yrs	.0098205	.0132209	0.74	0.458	-.0160919	.035733
field_2010	-.009252	.0713729	-0.13	0.897	-.1491402	.1306363
ownland_acc	-.017359	.009067	-1.91	0.056	-.03513	.000412
avghstseed	.0000968	.0002345	0.41	0.680	-.0003629	.0005564
grain_price	.0001006	.0000268	3.75	0.000	.000048	.0001532
farm_group	.2323421	.0696006	3.34	0.001	.0959274	.3687567
bicycle	.0651359	.068361	0.95	0.341	-.0688493	.1991211
per_sol						
hhgend	.5552399	.5391105	1.03	0.303	-.5013973	1.611877
educ_hhd	-.0953077	.0612162	-1.56	0.119	-.2152893	.024674
grain_yrs	-.1889309	.2053844	-0.92	0.358	-.5914768	.2136151
field_2010	2.218392	.7774867	2.85	0.004	.6945464	3.742238
ownland_acc	.0069765	.0754973	0.09	0.926	-.1409955	.1549485
avghstseed	.0398025	.0187936	2.12	0.034	.0029678	.0766372
grain_price	.0043588	.0010174	4.28	0.000	.0023647	.0063529
farm_group	1.377317	.5614338	2.45	0.014	.2769269	2.477707
bicycle	.3512051	.6156524	0.57	0.568	-.8554515	1.557862
mbulamuti	-1.642301	.6439557	-2.55	0.011	-2.904431	-.3901709
namasagali	-.3601866	.4442032	-0.81	0.417	-1.230809	.5104356
mills						
lambda	.044033	.067582	0.65	0.515	-.0884253	.1764913
rho	0.19264					
sigma	.22857446					
lambda	.04403296	.067582				

Appendix 3: Marginal effects

```

mfx
Marginal effects after heckman
y = Linear prediction (predict)
= .80081564

```

variable	dy/dx	Std. Err.	z	P> z	[95% C.I.]		X
hhgend	.254479	.05685	4.48	0.000	.143063	.365895	1.20667
educ_hhd	.02863	.00845	3.39	0.001	.012071	.045189	8.86667
grain~s	.0098205	.01322	0.74	0.458	-.016092	.035733	2.46409
field~0*	-.009252	.07137	-0.13	0.897	-.14914	.130636	.12
ownlan~c	-.017359	.00907	-1.91	0.056	-.03513	.000412	3.49213
avghst~d	.0000968	.00023	0.41	0.680	-.000363	.000556	27.5151
grain~e	.0001006	.00003	3.75	0.000	.000048	.000153	636.133
farm_g~p	.2323421	.0696	3.34	0.001	.095927	.368757	.686667
bicycle*	.0651359	.06836	0.95	0.341	-.068849	.199121	.786667
mbulam~i	0	0	.	.	0	0	1.57333
namasa~i	0	0	.	.	0	0	1.72667

(*) dy/dx is for discrete change of dummy variable from 0 to 1

Appendix: 4 OLS Estimation results for Factors influencing the level of participation in grain amaranth marketing

```
. regress per_sol hhgend educ_hhd grain_yrs field_2010 ownland_acc avghstseed
grain_price farm_group bicycle mbulamuti namasagali mills,vce(
> robust)
```

linear regression

Number of obs = 150
F(12, 137) = 30.40
Prob > F = 0.0000
R-squared = 0.6607
Root MSE = 18.691

per_sol	Coef.	Robust Std. Err.	t	P> t	[95% Conf. Interval]	
hhgend	-4.476981	4.218108	-1.06	0.290	-12.818	3.864037
educ_hhd	.9471565	.5555179	1.70	0.090	-.1513419	2.045655
grain_yrs	.5981708	.9089681	0.66	0.512	-1.199251	2.399093
field_2010	-13.91511	6.74595	-2.06	0.041	-27.25476	-1.5754579
ownland_acc	-.0246702	.3197249	-0.08	0.939	-.6569041	.6075638
avghstseed	.0364561	.0110954	3.29	0.001	.0145156	.0583966
grain_price	.0017448	.0035405	0.49	0.623	-.0052563	.0087459
farm_group	-5.305885	5.493233	-0.97	0.336	-16.16837	5.556605
bicycle	-7.439742	5.057312	-1.47	0.144	-17.44023	2.560745
mbulamuti	14.5574	5.186575	2.81	0.006	4.3013	24.81349
namasagali	.7456804	5.243554	0.14	0.887	-9.623096	11.11445
mills	-16.03371	2.171678	-7.38	0.000	-20.32805	-11.73936
_cons	26.04716	12.54057	2.08	0.040	1.249045	50.84525

Appendix 5: VIF test for Multicollinearity

Variable	VIF	1/VIF
mills	2.62	0.382399
mbulamuti	2.47	0.404968
grain_price	2.23	0.449319
namasagali	1.93	0.518089
farm_group	1.80	0.554379
grain_yrs	1.54	0.651192
field_2010	1.32	0.760260
educ_hhd	1.25	0.801922
bicycle	1.17	0.853368
ownland_acc	1.17	0.855783
avghstseed	1.15	0.867277
hhgend	1.09	0.920326
Mean VIF	1.64	

Appendix 6: Questionnaire

FACTORS INFLUENCING FARMER INNOVATIVE CAPACITY TO ENGAGE IN THE PRODUCTION AND MARKETING OF GRAIN AMARANTH IN KAMULI DISTRICT

Introduction

We are a team from Makerere University, Department of Agribusiness and Natural Resource Economics conducting a study to identify factors that promote farmer innovative capacity to engage in the production and marketing of grain amaranth in Kamuli district. The results of the study will assist the farmers and other persons in government related ministries on devising feasible strategies on how farming communities can promote the production of grain amaranth.

Section 0: Interviewer and Supervisor Information

County				
Sub county				
Parish				
Village				
	Name	Code	Date (d/m/y)	Signature
Interviewer	_____	[____]	____ / ____ / ____ FLDDAY, FLDCODE FLDMTH,FLDYEAR	_____
Supervisor		[____]	____ / ____ / ____ ____	

Section I: - Household Respondent and Type

Ideal respondent: household head and/or spouse. Most of these questions can be completed without having to question the respondent directly. Be sensitive about the way you gather this information.

1. Name of household head

- a. First name (more than 1 if needed)
- b. Last name

2. Name of Main respondent

- a. First name (more than 1 if needed)
- b. Last name

3. Sex of the respondent (01=Male, 02=Female)

[]

4. What is the relationship of main respondent to household head

[]

00=Head, 01=Spouse, 02=Parent,
03=Child,04=Grandchild,
05=Nephew/Niece, 06=Son/daughter-in-law,
07=Brother/sister,96=Other related (specify), 97=Other un related (Specify)

[]

5. Household type

- 01=Male headed, with a wife or wives,
- 02=Male headed, divorced, single or widowed,
- 03=Female headed, divorced, single or widowed,
- 04=Female headed, husband away, husband makes most household/agricultural decisions,
- 05=Female headed, husband away, wife makes most household/agricultural decisions,
- 06=Child headed (age 16 or under)/Orphan
- 96=Other, specify

Section 2: - Demography

6. How many people, including yourself and other adults, are in your household?

[]

7. How many people in your household are under the age of 5yrs?

[]

8. How many people in your household are over the age of 60yrs? []
9. What is the level of education obtained by household in years? []

Section 3: - General Description of the Farming System

10. Mention the major crops that are grown on your farm and their uses to the household.

Types of Food Crops Grown		Any produced your own farm? (01=Yes, 00=No) PROD	Any consumed by household ? (01=Yes, 00=No) CONS	Any sold for cash? (01=Yes, 00=No) SOLD
Cereals	Maize	[]	[]	[]
	Sorghum	[]	[]	[]
	Millet	[]	[]	[]
	Rice	[]	[]	[]
Legumes	Beans	[]	[]	[]
	Soybean	[]	[]	[]
	Cowpea	[]	[]	[]
	groundnuts	[]	[]	[]
Roots	Other specify	[]	[]	[]
	Cassava	[]	[]	[]
	Irish potato	[]	[]	[]
	Sweet potato	[]	[]	[]
Traditional Cash Crops	Yam	[]	[]	[]
	Other specify	[]	[]	[]
	Coffee	[]	[]	[]
	Cotton	[]	[]	[]
Others	Sugar cane	[]	[]	[]
	Other specify	[]	[]	[]
	Grain Amaranth	[]	[]	[]
	Fruits	[]	[]	[]
	Banana (cooking)	[]	[]	[]

11. Mention the major animals that are reared on your farm and their uses to the household.

Types of Animals Kept		Any reared on your own farm?	Any consumed in household or used on farm?	Any sold for cash?
		(01=Yes, 00=No) PROD	(01=Yes, 00=No) CONS	(01=Yes, 00=No) SOLD
Large Livestock	Local Bulls	[____]	[____]	[____]
	Local Cows	[____]	[____]	[____]
	Exotic Bulls	[____]	[____]	[____]
	Exotic Cows	[____]	[____]	[____]
	Others (specify)			
	Others (specify)			
Small Livestock	Goats	[____]	[____]	[____]
	Sheep	[____]	[____]	[____]
	Chicken	[____]	[____]	[____]
	Ducks	[____]	[____]	[____]
	Turkeys	[____]	[____]	[____]
	Pigs	[____]	[____]	[____]
	Others (specify)	[____]	[____]	[____]
	Others (specify)	[____]	[____]	[____]

Section 4: Description of the Grain Amaranth Cropping System

12. How much grain amaranth you produce **on average** per year (in kgs)?

a. What **percentage** is sold?

PSOLD _____

b. What **Percentage** is consumed?

PCONS _____

13. Is grain amaranth **important** in your daily diet?

MIMPT _____

14.

Mention the amount of land that you allocated to grain amaranth with respect to the total land under crops for the current cropping season

	Owned OWND (acres)	Rented RENT (acres)
How much land did your household have access to?	[____ . ____]	[____ . ____]
How much is dedicated to food crops?	[____ . ____]	[____ . ____]
How much is dedicated to grain amaranth production?	[____ . ____]	[____ . ____]
What area of your land is degraded or unproductive?	[____ . ____]	[____ . ____]

15. Area planted to grain amaranth for the past **two seasons of 2011**.

Season	Source of seed ¹ (See codes below)	Area (acres)	Planted	Amount harvested (kgs)
	SOURCE	SEEDAREA		
First season	[____ . ____]	[____ . ____]		[____ . ____]
Second season	[____ . ____]	[____ . ____]		[____ . ____]

1= recycled (own saved seed), 2= stockiest, 3= farmer exchange, 4= grain from market or shop, 5= local seed markets, 6= research (such as NARO), 7= Agricultural extension service, 8= seed companies, 9= NGOs/development project, 10= other (specify) _____

16. What are the 3 main constraints faced during grain amaranth production

Section 5: Driver for Production of GRAIN AMARATH

Criteria	GRAIN AMARATH
	<i>1=very poor</i> <i>2=poor</i> <i>3=fair</i> <i>4=good</i> <i>5=very good</i>
CRITERIA	SCORE
Germination	[____ . ____]
Plant vigor	[____ . ____]
Resistance to drought	[____ . ____]
Resistance to field pests	[____ . ____]
Resistance to storage pests	[____ . ____]
Resistance to disease	[____ . ____]
Early maturity	[____ . ____]
Yield	[____ . ____]
Easy of cooking	[____ . ____]
Taste of green Grain Amaranth,	[____ . ____]
Taste of Grain Amaranth flour,	[____ . ____]
Taste of dry Grain Amaranth	[____ . ____]
General cooking qualities	[____ . ____]
Income generation	[____ . ____]
To improve family nutrition	[____ . ____]
Influence of training	[____ . ____]
Group/other farmer influence	[____ . ____]
Supplement starchy foods	[____ . ____]

SECTION 6: RESOURCES USED IN AMARANTH PRODUCTION AND UTILISATION

Input	Source	Qty last season	Unit price	Total value
Land	[_____]	[_____]	[_____]	[_____]
Seed	[_____]	[_____]	[_____]	[_____]
Manure	[_____]	[_____]	[_____]	[_____]
Pesticides	[_____]	[_____]	[_____]	[_____]
Herbicides	[_____]	[_____]	[_____]	[_____]
Fertilisers	[_____]	[_____]	[_____]	[_____]
Labour ¹	[_____]	[_____]	[_____]	[_____]

¹ 1= family; 2= hired; 3= both

Post-Harvest Handling

17. Number of Days it takes Grain Amaranths to mature? [_____]
18. How long does it take an individual to harvest your Grain Amaranths garden? [_____]
19. Mention three important products that you can derive from grain amaranth? How many people in your household are over the age of 60yrs? [_____]

Section 7: Participation in GRAIN AMARATH Promotion

20. Have you ever participated in GRAIN AMARATH transfer/promotion activities?

(1=Yes; 0=No)

QPMPRO _____

21. List the transfer/promotion activities in which you participated and the number of times (in the year 2008 and 2009)

Activity	Number of times in 2010	Number of times in 2011

HHID _____

		(for none, write 0)	(for none, write 0)
PROMACT		PRTIME08	PRTIME09
Field assessment	days/farmers 1		
On trials/demonstrations	farm 2		
Surveys	3		
PRAs	4		
Seminars/meetings/worksh ops	5		
Sensory evaluations	6		
Others(specify)_____	7		

22. a. Have you received any GRAIN AMARATH promotional materials? (1=Yes; 0=No)

QPMAT _____

- b. If yes, describe: (1=leaflet; 2=T-shirt; 3=cap)

PROMAT _____

23. a. Have you ever seen a poster promoting GRAIN AMARATH?(1=yes; 0=No)

QPMPOST _____

- b. If yes, where?

POSTLOC _____

Section 8: Infrastructure Access Questions

24. What is the distance (in kilometers) from your home to the nearest:

- a. Tarmac Road

DTMRDKM _____

- b. All weather (motorable) road

DTMRDKM _____

- c. District town (Headquarters)

DIST_KM _____

- d. Market center

MKT_KM _____

- e. School

SCH_KM _____

HHID_____

f. Clinic
CLNIC_KM_____
g. Water supply
H2O_KM_____
h. Extension office
DEXTN_KM_____
i. Research station
DRESEACH_____

25. a. Have you ever consulted development agent? (1=Yes, 0=No)

DEVAG_____

b. If yes, how many times did you consult the development agent during the last 12 months?

TIMDEV_____

26. In what from do you sell Grain Amaranth

1=leaves, 2= unprocessed grains, 3= flour, 4=others (specify)

27. Where do you mostly sell your Grain Amaranth?

PRODSAL_____

(1= at farm gate; 2= roadside 3=at near markets; 4= shop; 5= major market; 6= group market; 7= others (specify)_____)

28. How far from the place of residence to the selling point (in miles)?

KMSAL_____

29. At what price do you sell your grain amaranth?

30. Who are your customers?

1= fellow farmers, 2= middlemen, 3=NGO 9specify) 4= shop, 5= schools, 6=hospital, 7=other (specify)

31. What challenges do you face in the marketing of grain amaranth?

1=low prices ,2=lack of market 3=poor roads to markets, 4=poor storage facilities, 5=long distances to the market, 6=high transport costs, 7=other (specify)

32. a. Are there programs that promote Grain amaranth production in this area?

PROPROM_____

1= Yes (list names); 0 = No

b. If yes above, list names of two main programs.

PROG1_____

PROG2_____

33. a. How do you access agricultural extension information on Grain Amaranth production?

1. *NGOs*
2. *NAADS*
3. *Local extension/ veterinary officers*
4. *Farmer groups and associations*
5. *National Agricultural Research Centres(eg, NARO,SARI)*
6. *Stockists*
7. *Radio*
8. *Newspaper*
9. *Television*

b. What kind of information do you access?

c. What kind of information would you have liked to access?

34. Do you belong to farming group 1 = Yes; 2 = No
 FGRP _____

35. Do you have access to agricultural credit? 1= Yes 2= No
 ACESCRD _____

36. (a) What are the two main sources of agricultural credit sources that exist in your district?

1. -----
2. -----

(b) Have you ever received credit from any of these organizations? (1=Yes, 0=No)

RCRDT__

(c) If no to (b) above, why?

1. -----
2. -----

Section 11: Household Welfare

Type of dwelling (*from enumerator's observation*).

37. (a) Type of walls (main house):

MNWALL _____

1. Wood and mud 2. Mud/bricks 3. Concrete bricks 4. Stones/blocks; 5. Wood;
6. Other (specify _____)

(b) Type of roof (main house):

MNROOF _____

1. Grass thatched 2. Iron Sheets 3. Tiles 4. Wood covered with mud or dung
5. Other (specify _____)

(c) Type of toilet used by the household most of the time:

MNTOIL _____

1. Traditional pit 2. Improved pit latrine 3. Flush/ modern toilet 4. Community owned latrine
5. None (bush); 6. Other (specify _____)

36. Do you have the following assets in your (1= yes; 0=no)

- | | |
|----------------------|----------|
| a. Radio | [____] |
| b. Television | [____] |
| c. Cell phone | [____] |
| d. Bicycle | [____] |
| e. Motorcycle | [____] |
| f. Mechanical plough | [____] |
| g. Improved stove | [____] |

37. Which of the following structures/utilities does your household have? (01=Yes,

- | | |
|--|----------|
| a. Improved storage facility for crops (food or feed) | [____] |
| b. Water storage tank (for domestic water, > 500 litres) | [____] |
| c. Well/borehole (for household water) | [____] |
| d. Electricity from UMEME | [____] |
| e. Improved housing (e.g. concrete, bricks, etc.) | [____] |
| f. Improved roofing (e.g. tin, tiles, etc.) | [____] |
| g. Separate housing for farm animals | [____] |