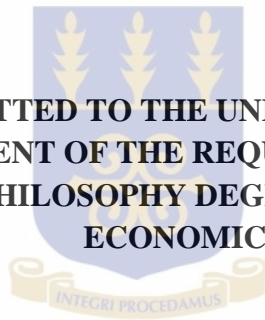


**MARKET PARTICIPATION OF SMALLHOLDER FARMERS IN
THE UPPER WEST REGION OF GHANA**

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**THIS THESIS IS SUBMITTED TO THE UNIVERSITY OF GHANA, LEGON
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LEGON**

JULY 2013

DECLARATION

I, Abu Benjamin Musah, do hereby declare that except for the references cited, which have been duly acknowledged, this thesis titled *“Market Participation of Smallholder Farmers in the Upper West Region of Ghana”* is the product of my own research work in the Department of Agricultural Economics and Agribusiness, University of Ghana from July 2012 to July, 2013. I also declare that this thesis has not been presented either in whole or in part for another degree in this University or elsewhere.

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.....
Date

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

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(Co-Supervisor)

Date.....

Date.....

DEDICATION

I dedicate this work to my inspiring parents: Mr and Mrs Abu Emmanuel Musah and all my family. It is also dedicated to my dearest fiancée, Margaret Mahamudu Nasonaa, who inspires and encourages me all the time.



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ABSTRACT

This study assesses the levels of market participation by smallholder maize and groundnut farmers in the Upper West Region by estimating the factors that influence the probability and intensity of participating in the maize and groundnut markets and then identifying and ranking the constraints to marketing maize and groundnut. A multi stage random sampling procedure was employed to select 400 farmers (200 maize and 200 groundnut farmers) from four agricultural districts in the region. A semi-structured questionnaire was used to collect household survey data during the 2011 farming season. The Household Commercialisation Index was used to estimate the levels of market participation and the Double Hurdle Model was used to estimate the factors influencing both market participation and intensity of participation. The Garrett ranking technique was used to rank the constraints to marketing. The results indicated that about twenty-four percent and fifty-three percent of maize and groundnut respectively are sold in the region within a production year which implies low and moderate commercialisation indices for maize and groundnut respectively. The results also indicated that farmer characteristics (such as age, gender, education, household size); private assets variables (such as farm size, output, experience); public assets variables (such as credit, extension contact, price); and transaction cost variables (such as market information and point of sale) significantly influenced the probability and intensity of market participation behaviour in the region. With respect to the constraints to marketing, unfavourable market prices was the most pressing constraint faced by farmers while lack of government policy on marketing was the least constraint. The study concludes that maize is produced as a staple for household consumption while groundnut is produced as a cash crop for the market. Based on the findings, the study recommends that government through MoFA should institute productivity enhancing measures to increase the productivity of maize and groundnut as this would subsequently increase marketable surplus of farm households. It is also recommended that MoFA should establish rural finance schemes to address the credit needs of smallholders. The Statistics, Research and Information Directorate (SRID) of MoFA should create a department responsible for the delivery of agricultural market information to make market information delivery effective.

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LIST OF ABBREVIATION

ADB	Agricultural Development Bank
ASFG	African Smallholder Farmers' Group
CAADP	Comprehensive Africa Agriculture Development Programme
CDFO	Commercial Development for Farmer-Based Organization
DHM	Double Hurdle Model
FASDEP	Food and Agriculture Sector Development Policy
FBO	Farmer Based Organisation
GCAP	Ghana Commercial Agriculture Project
GCI	Groundnut Commercialisation Index
GPRS	Growth and Poverty Reduction Strategy
GSS	Ghana Statistical Service
GSSP	Ghana Strategy Support Program
HCI	Household Commercialisation Index
ICT	Information Computer Technology
IFAD	International Fund for Agricultural Development
IFPRI	International Food Policy Research Institute
IMR	Inverse Mills Ratio
MCA	Millennium Challenge Account
MCI	Maize Commercialisation Index
MFI	Microfinance Institution
MiDA	Millennium Development Authority
MoFA	Ministry of Food and Agriculture
Mt	Metric tonnes
NAFCO	National Food Buffer Stock Company
NGO	Non-Governmental Organisation
OA	Operational Area
OLS	Ordinary Least Squares
PPMED	Project Planning, Monitoring, and Evaluation Division

PSIA	Poverty and Social Impact Analysis
SIDA	Swedish International Development Agency
SPSS	Statistical Package and Software System
SRID	Statistics, Research and Information Directorate
USA	United States of America
VIF	Variance Inflation Factor
VIP	Village Infrastructure Project

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CHAPTER ONE

INTRODUCTION

1.1 Background

Agriculture continues to be a strategic sector in the development of most low-income nations. It employs about 40% of the active labour force globally. In sub-Saharan Africa, Asia and the Pacific, the agriculture-dependent population is over 60%, while in Latin America and high income economies the proportions are estimated at 18% and 4% respectively (World Bank, 2006).

Ghana has a largely agrarian economy. Area under cultivation in 2010 stood at 7,846,551 hectares representing 57.6% of the total agriculture land area (MoFA, 2011). Agriculture is however dominated by smallholder farmers who are predominantly rural dwellers, with about 90% of farm holdings less than 2 hectares in size (MoFA, 2011).

The implication of this dominance of smallholders is that no meaningful policy to enhance the development of the agricultural sector can overlook these farmers. As a result, many authors (such as Siziba *et al.*, 2011, Denise, 2008, Chamberlin *et al.*, 2007), policy documents (such as GPRS II, FASDEP II, CAADP) and institutions (such as MoFA, 2007 and the World Bank, 2007) have emphasised the reorientation of policies towards access to markets by smallholder farmers as a means of improving their livelihoods and development. In line with this, the Government of Ghana in 2009 recognised that strategies to improve agricultural performance should include investments that improve and enhance market access. Siziba *et al.* (2011) noted that a leap that African agriculture needs to make to reduce poverty and hunger is to

transform from the low productivity semi-subsistence farming to high level commercial production. Therefore, any pathway that can lift large numbers of the rural poor out of poverty will require some form of transformation of smallholder agriculture into a more commercialized production system (Olwande and Mathenge, 2012).

The increased emphasis on market access relates to its potential to smallholder farmers in poverty reduction in particular. Several studies (e.g. Al-Hassan *et al.*, 2006, Omiti *et al.*, 2009, Jari and Fraser, 2009, and Siziba *et al.*, 2011) highlight better incomes and prospects of reducing poverty, sustainable livelihoods, creation of the necessary demand, offering of remunerative prices, expanded production, the attendant adoption of productivity enhancing technologies and increased economic diversification as some of the benefits to small scale farmers. Delgado *et al.* (1998), Haggblade *et al.* (2007), and Southgate *et al.* (2007) noted that agricultural intensification and commercialisation may offer solutions to food insecurity in rural areas through increased income from farm and non-farm sources.

Northern Ghana, which includes the Northern, Upper West and Upper East regions, is poorly endowed with natural resources and the income per capita of its population falls well below the national average (Marchetta, 2011). IFAD-IFPRI (2011) identifies such factors as holding size, fewer marketed crops and geography to be responsible for the variation in market participation rates by smallholder farmers in Ghana and that participation tends to be lowest in northern Ghana. The Upper West region is among the poorest and least developed regions in Ghana having the least average annual per capita income of GH¢130 as against the national average of

GH¢400 (GSS, 2008). The Ghana Poverty Reduction Strategies I & II, indicate that nine out of ten people in the region are poor and almost 90% of its population depends on farming in rural areas.

In the Upper West Region, maize and groundnut are two of the major crops grown (MoFA, 2011) and are of high commercial value. Maize accounts for 50-60% of the total cereal production in Ghana and represents the second largest crop commodity in the country after cocoa (MiDA, 2010). IFAD-IFPRI (2011) shows that maize is grown by over three-quarters of farmers nationally with two-thirds being grown in the Upper East and Upper West Regions. Groundnut represented the highest cropped area of 127,490 hectares and yielded 196,676 metric tonnes after yam in 2010 in the region (MoFA, 2011).

The implication is that increased production of maize and groundnut in the Upper West Region presents opportunities to promote smallholder income growth and hence reductions in poverty levels and also enhance achievement of food security.

1.2 Problem Statement and Research Questions

In Ghana, many policy documents (GPRS II; FASDEP II; CAADP) emphasise the integration of smallholder farmers to markets. For instance, MoFA's FASDEP II includes broad objective of promotion of smallholder integration into domestic and international markets to enhance the incomes of these farmers. Further, MoFA's Ghana Commercial Agriculture Project (GCAP) emphasizes the importance of graduating from a subsistence-based smallholder system to a sector characterized by a stronger market-based orientation based on a combination of productive smallholders.

Consistent with this, Siziba *et al.* (2011) observed that markets are the pivotal point in the agricultural transformation process.

Despite this growing emphasis, agricultural commercialisation is low (IFAD-IFPRI, 2011). They indicated that the national average of marketed surplus ratio which defines the level of commercialisation is 33%, which is observed as low. This problem is highlighted by the Swedish International Development Association (SIDA) (cited in Siziba *et al.*, 2011) that only 10% of Sub-Saharan African smallholders produce enough marketable surpluses. While there are significant differences of market commercialisation across regions, the Upper West Region has one of the least average marketed surplus ratio of 18% only better than the Upper East Region which has 15% (IFAD-IFPRI, 2011).

Maize and groundnut which have potentials for increasing incomes are still widely produced as staple crops (MiDA, 2010). Why are maize and groundnut not making transition from staple to commercial crops in view of the potentials they present? And why is the level of commercialization of smallholder farmers in the Upper West Region so low?

The low level of commercialisation is partly explained by small farm sizes, crop-mix, low productivity per hectare and high household size (IFAD-IFPRI, 2011). Chamberlin *et al.* (2007) noted poorer access to input and output markets as well as credit and advisory services as responsible for the low commercialisation.

It is against the question raised about the lack of transition of maize and groundnut to commercialised scale that this study seeks to provide responses to the primary question: What is the state of maize and groundnut market participation by smallholder farmers in the Upper West Region of Ghana? The following sub-questions are also raised to address or answer the key question.

1. What are the levels of maize and groundnut market participation by smallholder farmers?
2. What factors influence the intensity of maize and groundnut market participation by smallholder farmers?
3. What are the key constraints that smallholder farmers face in accessing market for maize and groundnut?

1.3 Objectives of the Study

The overall objective of the study is: to analyse market participation by smallholder maize and groundnut farmers in the Upper West Region.

The specific objectives are:

1. To estimate and analyse the level of maize and groundnut market participation by smallholder farmers.
2. To identify, estimate and discuss the magnitude and effects of factors that determine the intensity of smallholder farmers' participation in the maize and groundnut markets.
3. To identify and analyse the constraints of farmers in accessing market for maize and groundnut.

1.4 Research Hypothesis

Transaction costs in reaching output markets and low output are responsible for the lack of transition of maize and groundnut to commercialised scale.

1.5 Justification of the Study

The Commercial Development for Farmer-Based Organization (CDFO) component of the Millennium Challenge Account (MCA) programme in Ghana seeks to encourage smallholder farmers to become market-oriented. The Food and Agriculture Sector Development Policy (FASDEP) II seeks to increase competitiveness and enhance integration of farmers into domestic and international markets. The aim is to enhance Ghana's comparative advantage and translate it into competitive advantage in producing the needed volumes and quality of commodities on a timely basis.

Also, the Ghana Commercial Agriculture Project (GCAP) and the national development plan emphasize the importance of graduating from a subsistence-based smallholder system to a sector characterized by a stronger market-based orientation. The overarching objective of the second phase of the Ghana Strategy Support Program (GSSP) is to answer the "how to" question of agricultural transformation. As a result, one of the key strategic policy research areas is markets and competitiveness. In line with the long term vision of developing an agro-based industrial economy stated in the GPRS II, the policy objectives and strategies have been identified as ensuring proper integration of the nation's production sectors into the domestic market and improve agricultural marketing.

This study would be useful to these various commitments by the various actors by providing empirical evidence on the factors that influence market participation and intensity of participation by smallholder farmers which is vital in informing priority setting in policies geared towards transforming smallholder farmers especially in the area of responding to market incentives for improved farm incomes and subsequent reduction in poverty and enhanced food security.

To the field of academics, the empirical evidence from this study would serve to add to the scanty literature on market access of agricultural commodities while also providing a blueprint to guide further research.

To farmers, this study would provide evidence on farmer specific characteristics that affect market participation and intensity of participation that would be useful to farm households for their decision making. For example, membership in farmer based organisation is a choice that farmers make. Evidence from this study about the effect of membership on marketing behaviour is useful to farm households to make decision.

1.6 Organisation of the Thesis

The rest of the thesis is organized as follows. Chapter Two is devoted to literature review which encompasses extensive work of authorities and individual contributions on market participation of smallholder farmers. Chapter Three presents the methodology employed in the study while Chapter Four contains the results and discussions of the study. Chapter Five presents the major findings, conclusions and policy recommendations of the study.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter presents literature on the concept of smallholder farmers, the concept and measurement of market participation, empirical review of market participation and challenges of market participation. The objective is to present the theoretical and empirical models and concepts and extract methods and lessons for this study.

2.2 The Concept of Smallholder Farmers

The concept of smallholder farmers does not lend itself to a precise delineation. Vermeulen and Cotula (2010) note that, the definition of smallholders differs between countries and between agro-ecological zones. They view those who cultivate less than 1 hectare of land in areas of high population densities or cultivate 10 hectares or more in semi-arid areas as smallholders. According to Ekboir *et al.* (2002) a small-scale farmer in any region of Ghana has less than 5 hectares of land. MoFA (2011) maintains that smallholders have less than 2 hectares in size. The central crust of these views is that smallholder farmers farm small plots of land.

However, there are other perspectives of the definition of smallholder farmers considering the extensive work of Chamberlin (2007) on smallholder farmers in Ghana. He categorised the definition of the concept based on holding size, wealth, market orientation and levels of vulnerability to risk. In line with this, Dixon *et al.* (2004) view smallholder farmers in terms of their limited resource endowments relative to other farmers in the sector while Jordan views smallholder farmers as particularly vulnerable to climatic and economic shocks (ASFG, 2010). Also, the

Ghana Poverty and Social Impact Analysis (PSIA) conducted by Asuming-Brempong *et al.* (2004) recommended that defining Ghanaian smallholder farmers based on different resource and risk conditions is a better definition than simple measures of landholdings.

It is evident from the above literature that the definition of smallholder farmers based on the size of land cultivated is dominant. The possible reason is that, defining smallholders based on landholding is relatively the easiest and less controversial way of characterising them in empirical works. Following from the lessons from the literature, this study principally defines a smallholder farmer based on landholding. The MoFA standard of about 2 hectares is used to characterise a smallholder farmer in this study since MoFA is an authoritative institution in Ghana.

2.3 The Concept and Measurement of Market Participation

This section deals with the review of literature on the concept of market participation and the measurement of market participation.

2.3.1 The Concept of Market Participation

The concept of market participation has been defined and interpreted in various ways. Based on the work of Barrett (2008), two basic interpretations can be inferred. He asserts that households can participate in the market either as sellers or buyers. Both the decision to enter the market as a seller or a buyer is motivated by the theory of optimisation where the household seeks to maximise utility subject to the cash budget and available non-tradable resources. In line with this, Goetz (1992), Key *et al.* (2000), and Holloway *et al.* (2005) view market participation as a two stage

phenomenon: in the first stage households decide whether to be net buyers, net sellers, or autarchic in the market for that commodity and in the second stage, net buyers and net sellers determine the extent of market participation. The similarity of this view to Barrett's is in the second stage. Therefore market participation has a demand side; households participating as buyers, and a supply side; households participating as sellers.

In empirical studies, the supply side of market participation is emphasised as studies tend to focus on that side of the equation. Based on the supply side, 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 which includes annuals and perennials, locally-processed and industrial crops, fruits and agro-forestry. Some literature (e.g. Cazuffi and McKay, 2012, Makhura *et al.*, 2001) suggests that generally market participation can be referred to as commercialisation of agriculture. That is, market participation is often used as a proxy for commercialisation or the two terms are basically used interchangeably. For example, Cazzuffi and McKay (2012) assert that commercialisation can be conceived of and measured in a number of ways and often understood in terms of market participation. Makhura *et al.* (2001) in consistency with Cazzuffi and McKay (2012) assert that, commercialisation of subsistence agriculture implies an improved ability to participate in the output market. The definition of market participation therefore borders on the definition of agricultural commercialisation.

Agricultural commercialization involves the transition from subsistence farming to increased market-oriented production (Omiti *et al.*, 2009, Goletti, 2005, Pradhan *et*

al., 2010). Govereh *et al.* (1999) define agricultural commercialization as the proportion of agricultural production that is marketed. They stress that commercialization can be measured along a continuum from zero (total subsistence-oriented production) to unity (100% of production is sold). Pingali and Rosegrant (1995) argue that apart from marketing of agricultural outputs, it includes product choice and input use decisions based on the principles of profit maximization while Moti *et al.* (2009) argue that commercialization strengthens linkages between input and output sides of a market.

However, the use of market participation as a proxy to commercialisation has been observed to possess some inadequacies. According to Pingali (1997), agricultural commercialization has more to offer than marketing agricultural outputs. The argument he poses is that agricultural commercialization is attained when households' product choice and input use decisions are made based on the principles of profit maximization. Also, Moti *et al.* (2009) assert that commercialization is not merely about producing significant amount of cash commodities and supplying the surplus to the market. In support to Pingali's and Moti's assertions, Dawit *et al.* (2006) contend that commercialization entails significantly three pillars: input versus output, sales versus purchases, and the type of commercial activity (cash crops versus other crops) while Moti *et al.* (2009) insist that commercialisation considers both the input and output sides of production, and the decision-making behaviour of farm households in production and marketing simultaneously.

The implication of these arguments made by Pingali, Moti *et al.* and Dawit *et al.* is that market participation cannot adequately measure commercialisation. Following

from their arguments, market participation turns out to be a subset of commercialisation. Hence, in measuring market participation using commercialisation, one must clearly indicate which aspect of commercialisation is being used as a proxy for market participation. Therefore, based on the commercialisation literature, market participation in this study has to do with the pillar of commercialisation that strictly deals with increased output market orientation of households. With respect to the output market participation, this study takes a truncation of households' output market participation for sales only and excludes output market participation for purchases. Market participation in this study does not also include households engaging in the market to buy inputs. Therefore, the main indicator of this pillar of commercialisation that this study adopts is households engaging in the market to sell their produce. This dimension of commercialisation has been used extensively in empirical works (e.g. Olwande and Mathenge, 2012, Martey *et al.*, 2012, Siziba *et al.*, 2011, Reyes *et al.*, 2012, Boughton *et al.*, 2007, Omiti *et al.*, 2009).

2.3.2 The Measurement of Market Participation

According to Moti *et al.* (2009), there is no common base for measuring the degree of household commercialization. Scholars tend to measure commercialisation and hence market participation based on their point of view or the situation at hand.

Govereh *et al.* (1999) and Strasberg *et al.* (1999) in their attempt to measure commercialisation used an index referred to as Household Commercialisation Index (HCI). They measure the HCI as the ratio of the gross value of crop sales by

household i in year j to the gross value of all crops produced by the same household i in the same year j expressed as a percentage as:

$$HCI_i = \left[\frac{\text{Gross value of crop sale}_{hhiyearj}}{\text{Gross value of all crop production}_{hhiyearj}} \right] * 100$$

This index measures the extent to which household crop production is oriented toward the market. A value of zero would signify a totally subsistence-oriented household; and a household with an index value of 100 is completely commercialized (Govere *et al.*, 1999). Some definition or measurement of commercialisation is captured by the HCI. For example, Haddad and Bouis (1990) argue that market participation is commonly measured as the ratio of percentage value of marketed output to total farm production. IFAD-IFPRI (2011) argues that a standard measure of agricultural commercialization is the marketed surplus ratio, defined as the value of crop sales as a percentage of the value of crop production while Omiti *et al.* (2009) measure market participation as the observed percentage of output that is actually sold in the market.

Several studies (e.g. Govere *et al.*, 1999, Strasberg *et al.*, 1999, and Martey *et al.*, 2012) have applied the HCI in studies on commercialisation of agriculture. However, one criticism of the HCI is provided by Moti *et al.* (2009) who argue that it fails to incorporate the livestock subsector, which could be more important than crops in some farming systems. In support, Gebreselassie and Kay (2008) note that the HCI neglects other components of farm output (such as livestock), the degree of market reliance for inputs, and broader dimensions of commercialisation such as profit motivation and engagement. They further illustrated that the index value itself could be misleading, since a farmer who grows only one bag of maize and sells that bag

(HCI = 100) would appear more commercialised than one who grows 50 bags and sells 30 (HCI = 60).

Despite these criticisms of the HCI, Govereh *et al.* (1999) note that it is still relevant to use it in practice especially in developing countries where it is less likely to get smallholders selling all of their output and very large farmers selling none of their output. Since this study focuses on crops (maize and groundnut) the use of the HCI will be appropriate. More so, the HCI is suitably applicable to the definition of market participation in this study. It is therefore used as a proxy for market participation.

2.4 Empirical Review of Market Participation

In this section, empirical models applied to studies of market participation and empirical evidence on determinants of market participation are presented.

2.4.1 Models Employed in Studies of Market Participation

In empirical studies of market participation, several econometric models have been applied. In general, these studies typically adopt a two-step analytical approach (Omiti *et al.*, 2009, and Olwande and Mathenge, 2012) though some studies adopt a one-step approach.

The reason for the application of two step analytical approach is that market participation is seen to embody two decision processes (Goetz, 1992, and Bellemare and Barrett, 2006). The first decision process has to do with the question of whether a farm household would participate in the market or not. The second decision process deals with the level of output with which to participate if the farm household affirms

participation in the first stage. The econometric models in view of these two separate decisions are formulated to take them into consideration. However, some empirical studies (e.g. Omiti *et al.*, 2009, and Martey *et al.*, 2012) have considered only a one step approach. Such studies concentrate on the second decision process.

According to Alene *et al.* (2008), and Olwande and Mathenge (2012), econometric models in these two-step approaches include Heckman's sample selection model (e.g. Goetz, 1992, Makhura, *et al.*, 2001, Boughton *et al.*, 2007, Alene *et al.*, 2008, and Siziba *et al.*, 2011), the two-tier/double hurdle models (e.g. Olwande and Mathenge, 2012, and Reyes *et al.*, 2012) and switching regression model (e.g. Vance and Geoghegan, 2004). The one step approaches include Tobit regression (e.g. Holloway *et al.*, 2005, and Martey *et al.*, 2012).

The Heckman Sample Selection Model

The Heckman sample selection model was introduced by Heckman (1979) based on wage offer functions given that some wage data was missing due to the outcome of another variable – labour force participation. It is a relatively simple procedure for correcting sample selectivity bias. Wooldridge (2002) argues that the selection bias is viewed as an omitted variable in the selected sample which is corrected by the Heckman model.

The Heckman model consists of two equations to be estimated in two steps. The first equation is referred to as the selection equation. It is estimated using a Probit model which predicts the probability that an individual household participates or does not participate in the market. It also estimates what is known as the Inverse Mills Ratio

(IMR). The purpose of the IMR is to account for sample selection in the study so that the estimates would be unbiased. The second equation is referred to as the outcome equation. It is estimated using the Ordinary Least squares (OLS). The OLS estimation is done with the inclusion of the IMR as a regressor. The first and the second models incorporate the same variables except that the second model includes some other variables suggested by Wooldridge (2006) as exclusion restriction variables.

The weaknesses of the Heckman selection model have been identified as that, the exclusion restriction of the model which is identified solely on distributional assumptions (Sartori, 2003) and also observed to be very sensitive to the assumption of bivariate normality (Winship and Mare, 1992). It is also observed that the rho parameter is also very sensitive in some common applications (Sartori, 2003).

The Two-tier/Double Hurdle Models

The two-tier/Double Hurdle Model was developed by Cragg (1971). According to Lijia *et al.* (2011), Cragg first proposed the double hurdle model as a generalization of the Tobit model by allowing the possibility that a factor might have different effects on the probability of acquisition and the magnitude of acquisition. Olwande and Mathenge (2012) hold the view that the two-tier/hurdle models are a type of corner solution outcome sometimes referred to as censored regression model.

The application of the model to any empirical study divides the study into two steps/stages: an initial discrete probability of participation model and condition on participation, a second decision is made on the intensity of participation (Olwande and Mathenge, 2012). The first step in a two-tier model involves a Probit estimation

while the second stage can take different functional distributions. While the simplest two step models assume lognormal distribution in the second stage, Cragg's double hurdle assumes a truncated normal distribution. The main advantage of the truncated normal distribution over the lognormal is that it nests the usual Tobit Model thus allowing the testing of the restrictions implied by the Tobit hypothesis against the two step model (Olwande and Mathenge, 2012). This makes the double hurdle model theoretically more applicable than other two-tier models. The difference between the Heckman model and the double hurdle model is in the second stage where the Heckman estimates an OLS equation while the double hurdle model estimates a censored regression usually a truncated regression.

The two-tier models also possess a fundamental weakness: they require all observations to be producers of a particular crop (Burke and Jayne, 2011). However, in empirical studies, a random sample might include households who are not producing that crop. They further argue that the models may under-estimate the effects of a given policy on marketing behaviour if policy affects the decision to produce.

The Tobit Model

Studies that apply the Tobit model (introduced by Tobin, 1958) in a one-step approach only differ from the double hurdle model in the sense that they do not consider the first stage binary choice that deals with the participation decision. The limitation therefore of considering only the Tobit model in a one-step approach is that of the assumption that the same set of parameters and variables determine both the

probability of market participation and the intensity of participation (Alene *et al.*, 2008, and Wan and Hu, 2012).

The Switching Regression Model

This model is also a two-stage model designed to overcome the restriction of the Tobit model by an estimation procedure that allows variables to influence the two decisions in different directions (Alene *et al.*, 2008). It can also be used to account for the potential simultaneity bias arising from the existence of some variables (Vance and Geoghehan, 2004).

2.4.2 Determinants of Market Participation

Empirical evidence of smallholder farmers' participation in the market has been extensively considered for variety of agricultural products especially in agrarian economies. Evidence shows that the factors that affect market participation are in respect to broad categorization of these factors into household (farmer) characteristics, private assets, public assets/social capital and transaction cost variables. Cazzuffi and McKay (2012) have however noted that literature has focused primarily on understanding the role of transactions costs and market failure in smallholder decision making. They also inferred from studies by Key *et al.* (2000); Barrett (2008) that differential asset endowments, together with differential access to those public goods and services that facilitate market participation, are identified as important factors underlying heterogeneous market participation among smallholders.

With respect to the transaction cost variables affecting market participation, Goetz (1992) observed that transaction costs affect market participation behaviour through

the labour-leisure choice. He explained that in small or less developed markets it is costly to identify trading opportunities while poor market access due to lack of transport, distance, and/or barriers such as ethnicity or language increase a household's cost of observing market prices to make transaction decisions, thus reducing the household's leisure time. In general, as noted by Cazzuffi and McKay (2012), many evidences found strong positive associations between market participation and low levels of transactions costs especially transport costs and information costs (Heltberg and Tarp, 2002, Alene *et al.*, 2008, and Ouma *et al.*, 2010).

However, specific findings reveal some contradictions among various studies. Siziba *et al.* (2011) found that three of the transaction cost variables they measured; ICT index, distance to output markets and market information (price information) were positively related to market participation. They argued that the positive effects of the ICT index which measured the number of mobile phone subscriptions per 100 people and price information underscored the positive impact of public infrastructure and services in promoting market participation while the positive effect of distance to output market was due to higher prices offered by distant markets. Randela *et al.* (2008) in support also observed a positive relationship between distance to market and market participation and also between access to market information and market participation. However, Omiti *et al.* (2009), Martey *et al.* (2012), and Olwande and Mathenge (2012) found negative effect of distance to market and market participation of cassava; maize, milk and kales; and milk and fruit respectively. The argument backing this observation was that distance to market is an indicator of travel time and cost to the market and hence a longer distance serves as a disincentive to participate in

the market. Martey *et al.* (2012), and Omiti *et al.* (2009) also contradicted the finding of Siziba *et al.* (2011) and Randela *et al.* (2008) with a negative effect of access to market information on market participation of cassava, milk and kales.

Empirical evidence of household characteristics/private asset variables and market participation has generally been found to exhibit positive relationship (e.g. Nyoro *et al.*, 1999, Cadot *et al.*, 2006, Boughton *et al.*, 2007, Levinsohn and McMillan, 2007, Stephens and Barrett, 2009, Siziba *et al.*, 2011, and Martey *et al.*, 2012). For example, Siziba *et al.* (2011) observed that off-farm income, ownership of radio and number of livestock owned were highly significant private asset variables positively associated with high volume of cereal grain sales. Socioeconomic characteristics such as age (e.g. Martey *et al.*, 2012 and Randela *et al.*, 2008), education (e.g. Martey *et al.*, 2012, Olwande and Mathenge, 2012, and Omiti *et al.*, 2009), farm size (e.g. Martey *et al.*, 2012) and gender (male headed households participating more in the market than female counterparts) (e.g. Omiti *et al.*, 2009) were observed to have positive effect on market participation of various agricultural commodities. Other dynamics: ownership of some assets (communication instrument, bicycle, productive asset) and membership (e.g. Olwande and Mathenge, 2012, and Reyes *et al.*, 2012), output (e.g. Omiti *et al.*, 2009) had a positive effect on market participation.

However, dependency ratio or household size has been found to have negative effect on market participation (e.g. Olwande and Mathenge, 2012, Omiti *et al.*, 2009, and Randela *et al.*, 2008). In contradiction, Randela *et al.* (2008) observed a negative effect of farm size and ownership of livestock on market participation. Farmers with

access to land had a negative effect on participation in maize market (Martey *et al.*, 2012).

Public assets variables have also been found to have positive relationship with market participation especially with respect to access to credit and insurance (e.g. Cadot *et al.*, 2006, and Stephens and Barrett, 2009) and input use and access to extension services (e.g. Alene, *et al.*, 2008). For example, Olwande and Mathenge (2012), Martey *et al.* (2012), and Omiti *et al.* (2009) observed price to positively affect market participation. Siziba *et al.* (2011) observed that extension training and participation in research have positive effect on market participation. In contradiction, Martey *et al.* (2012) observed extension access to both maize and cassava market to negatively influence market participation.

2.5 Challenges of Market Participation of Smallholder Farmers

This section presents literature on factors that constrain smallholder farmers in participating in the market and the empirical methods applied to the analysis of constraints.

2.5.1 Challenges of Market Participation

Smallholder farmers are constrained with bottlenecks that impede their capacity and potential to produce and market their produce. According to Al-Hassan *et al.* (2006), limited access to guaranteed markets for produce and for the acquisition of inputs is a major problem confronting smallholders. They further argue that local commodity markets are characterized by high volatility, a situation that poses challenges for smallholders to effectively participate in the market. These problems incapacitate

these smallholders in their efforts to expand outputs in the first place and then market these outputs in the second place.

Baumann (2000) also contends that international markets as well as markets offered by agro-industrial firms are relatively more stable but are inaccessible without specific channels such as those provided by predetermined producer-buyer relationships. What is evident from this is that smallholder farmers are not able to keep pace with and exploit the stability of markets offered by international markets and agro-industrial firms probably due to low production and unsustainable supply as well as inability to meet the requirements of these markets. These problems are reinforced by the fact that rural farmers and small-scale entrepreneurs lack both reliable and cost efficient inputs such as extension advice, mechanization services, seeds, fertilizers and credit, as well as guaranteed and profitable markets for their output (Al-Hassan *et al.*, 2006).

Jari and Fraser (2009) observe in South Africa that less developed rural economies and smallholder farmers find it difficult to participate in commercial markets due to a range of technical and institutional constraints. Factors such as poor infrastructure, lack of market transport, dearth of market information, insufficient expertise on grades and standards, inability to have contractual agreements and poor organisational support have led to the inefficient use of markets, hence, commercialisation bottlenecks. This observation stresses technical and institutional bottlenecks as responsible for low market participation of smallholder farmers.

2.5.2 Methods Used in Analysing Challenges

Methods applied in empirical studies to analyse constraints are usually the Kendall's coefficient of concordance and the Henry Garrett ranking method.

The Kendall's coefficient of concordance (W) is a measure of the agreement among several (p) judges who are assessing a given set of n objects (Legendre, 2005). The judges depend on the field of application. In the ranking, the factor with the least score is the most important factor to respondents and hence highly ranked. W ranges between 0 and 1 where 0 implies perfect disagreement in the ranks and 1 implies perfect agreement in the ranks. A weakness of the Kendall's is that it does not take into consideration heterogeneity in the challenges faced by a population at the individual level. The method is suitably applicable in cases of a homogenous group who are affected by similar factors.

The Garrett method was proposed by Garrett and Woolworth (1969). It is operationalised by presenting a number of factors for respondents to rank in the order of their importance. The ranks assigned to the factors are then quantified into percentage positions using the Garrett formula. Out of the percentage positions, mean scores are computed. The mean scores are used to tell which factor is more important or predominant. The criterion is that the factor with the highest mean score is the factor that is predominant in terms of importance and in that order. As opposed to the Kendall's, the Garrett technique is suitably applicable to cases of heterogeneous group. Heterogeneity could be caused by location, ecology or by climatic conditions. The Garrett method has an in-built test of agreement approach, where the mean of scores are found per those who rank the particular factor. Thus, since all respondents

have equal opportunity of identifying and ranking some or all the factors, the final mean score reflects the position of the entire sample. Therefore, the Garrett ranking technique is very useful in making policy recommendations for a diverse population.

2.6 Key Conclusion on Literature Review

From the review, it is evident that numerous studies have been done on market participation of smallholder farmers. Content wise (especially studies in Africa) attention is focused on understanding the role of transaction cost in market participation behaviour of farm households.

Methodologically, current empirical studies on market participation typically adopt two-step analytical approaches. The Heckman and the Double Hurdle Models have been extensively used. The review also shows that the underlying theory of market participation is derived from the Smithian and Ricardian theories of trade. The Garrett technique of ranking is chosen over the Kendall's since the study area deals with various districts in the Upper West region which could be heterogeneous in some characteristics.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This chapter outlines the methodology of the study in six areas: the study area, the data collection approach, the data analysis and presentation, the conceptual framework, the theoretical framework underpinning the study and ranking of constraints.

3.2 The Study Area

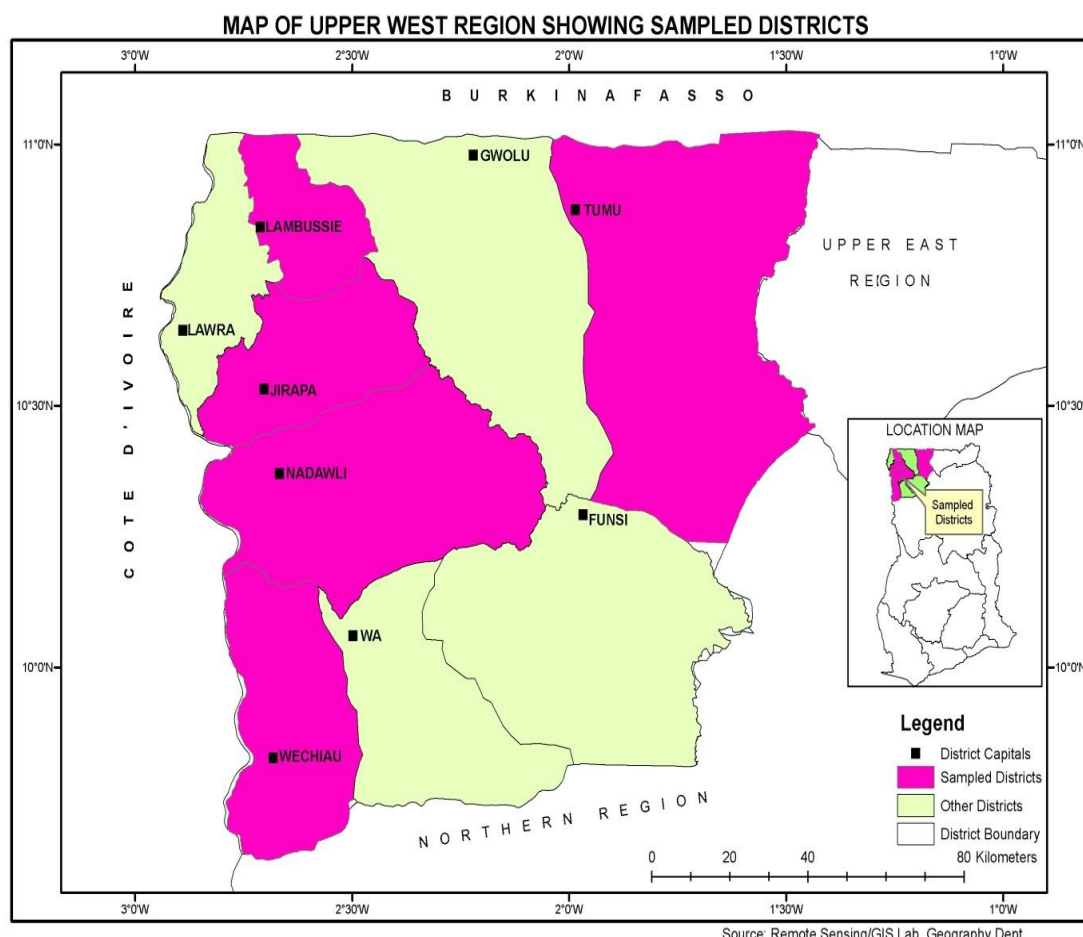
The Upper West Region is among the poorest and least developed regions in Ghana. The population of the region, according to the 2010 census, stands at 702,110 people representing 2.8% of the total population of Ghana. In general, the mainstay of the people in the region is agriculture supported by the fact that 72.2 per cent of the economically active group are engaged in agriculture. They are largely subsistence food crop producers with most of the populace living in rural areas. The major crops grown are maize, rice, millet, sorghum, yam, groundnut, cowpea and soybeans. From the 2011 production data, yam was the highest produced crop representing about 49.1%, followed by groundnut (16.9%), cowpea (8.8%), maize (8.6%), sorghum (8.4%), millet (5.6%), soybean (1.8%) and rice (0.7%), of the total production of the region (961,837 Mt).

The region has nine political/administrative districts: Wa Municipal, Jirapa, Lambussie-Karni, Lawra, Nadowli, Sissala East, Sissala West, Wa East and Wa West and currently eight agricultural districts by MoFA where Jirapa-Lambussie is considered as one district. The study focused on four agricultural districts (five

administrative districts): Jirapa-Lambussie, Nadowli, Wa West and Sissala East.

Figure 3.1 shows the sampled districts.

Figure 3.1: Map of Sampled Districts in the Upper West Region



Source: Remote Sensing/GIS Laboratory, Department of Geography, University of Ghana, 2013

The Jirapa-Lambussie district is located in the North Western part of the Upper West Region of Ghana. The 2010 census indicates a population of 88,402 people representing 12.6% of the region's population. Agriculture is the main economic activity of the district as about 80% of the population is engaged in it. The major cereal crops cultivated in the district include maize, sorghum, millet, groundnuts and rice. In the 2011 production season maize was the 5th produced crop representing

9.1% while groundnut was the highest produced crop representing 34.1% of the total production of the major crops in the district.

The Nadowli district lies within the tropical continental zone. The district's population from the 2010 census stands at 94,388 people representing 13.4% of the region's total population. Agriculture is the mainstay of the people in the district employing about 85% of the population. Food crop production in this sector largely remains subsistence with low output levels. The major food crops grown in the district are maize, sorghum (guinea corn), groundnuts, yam, millet, cowpea and soybean. In the 2011 production season maize was the 4th produced crop representing 8.6% while groundnut was the 3rd produced crop representing 12.8% of the total production of the major crops in the district.

Marketing of farm produce is one of the major problems facing farmers in the district. Farmers in most rural areas are compelled to sell their produce at farm-gate prices because of the lack of access to market centres and or inaccessible farms.

The Wa West district is located in the Western part of the region. The 2010 census results put the district's population at 81,348 people representing 11.6% of the region's population. The vegetation of the district is of the Guinea Savanna grassland. The agricultural economy in the district is basically rural in nature involving over 90% of the population who are subsistent farmers. Crops planted are mostly maize, sorghum, groundnut, cowpea and vegetables. In the 2011 production season maize was the 3rd produced crop representing 6% while groundnut was the 2nd produced crop representing 24.5% of the total production of the major crops in the district.

Yields realized on compound farms are usually not the best due to low yielding varieties coupled with low soil fertility and erratic rainfall.

The Sissala East District falls within the Guinea Savannah vegetation belt. The population of the 2010 census stands at 56,528 people representing 8.1% of the total region's population. The district's economy is mainly agrarian as the agricultural sector generally employs 76% of the population and up to 80% of the people living in rural settlements. The people practice subsistence farming with only a few engaged in commercial cotton farming. The main crops are millet, maize, sorghum, rice, groundnut, cowpea, yam and cotton. In the 2011 production season maize was the 2nd produced crop representing 17.9% while groundnut was the 3rd produced crop representing 17.2% of the total production of the major crops in the district.

3.3 Data Collection Approach

This section deals with the sources of data and the sampling approach.

3.3.1 Sources of Data

Data for the study was completely primary data. These data were gathered through a household survey by the use of a semi-structured questionnaire aided by a face to face interview of smallholder maize and groundnut farmers. The semi-structured questionnaire was used as a sort of an interview guide to fill the spaces provided for the responses from the respondents.

The semi-structured questionnaire was designed to collect a range of data on amounts of maize and groundnut production and the proportion sold, household characteristics

such as age, gender, marital status, farm experience of the household head, household size, etc.; private assets variables such as farm size, off-farm income, ownership of a mobile phone, etc.; public assets variables such as access to credit, extension contact, etc.; transaction cost variables such as access to market information, point of sale of output, etc.

Three research assistants from the Wa Campus of the University for Development Studies were used as enumerators for the collection of data. These people have prior experience in survey work.

3.3.2 Sample Size and Sampling Approach

The target population for the study was smallholder farmers (farmers who cultivated at most 2 ha of maize and groundnut in the 2011 production season). Any maize or groundnut farmer who cultivated more than 2 ha was excluded as land size above 2 ha was not considered as a smallholding. A sample size of 400 farmers (200 maize and 200 groundnut farmers) was used for the study. This sample size was considered partly for statistical reasons and partly for logistical considerations. Statistically, the sample size is large enough to study and make generalisations about the population. Logistically, there was constraint of time to consider the sample size proportionate to the population under study.

A multi-stage sampling was the appropriate procedure adopted considering the nature of the study. The multi-stage procedure was a three-stage, clustered, purposive and randomized sampling approach. The three stages involved selection of: 1. Districts, 2.

Operational areas (OAs) earmarked by MoFA and communities, and 3. Maize and groundnut farmers.

In the first stage, 4 agricultural districts (5 administrative districts) were purposively selected for their highest share in the production of maize and groundnut in the region. These districts have been displayed in Figure 3.1. The choice of the four districts is based on the combined production level of maize and groundnut of these districts in the 2011 farming season. Regional data from MoFA shows that these four districts are the leading producers of maize and groundnut with about 58% of the total production in the region. On district basis, Jirapa-Lambussie produced 14.3%, Nadowli produced 18.3%, Wa West produced 13.5% and Sissala East produced 11.9% of the total output of maize and groundnut in the region. Table 3.1 shows the output of maize and groundnut in the region in 2011.

Table 3.1: Output of Maize and Groundnut in the Upper West Region, 2011

District	Maize (mt)	Groundnut (mt)	Total	% of total production
Wa West	6,528	26,642	33,170	13.5
Wa East	10,476	13,745	24,221	9.9
Wa Municipal	9,475	18,384	27,859	11.4
Lawra	3,766	22,106	25,872	10.6
Sisala East	14,784	14,274	29,058	11.9
Sisala West	12,142	12,560	24,702	10.1
Jirapa-Lambussie	7,420	27,716	35,136	14.3
Nadowli	18,060	26,838	44,898	18.3
Regional Total	82,651	162,265	244,916	100.0

Source: Upper West Regional office of MoFA, Wa, 2012

In the second stage, 21 OAs alongside various communities under the OAs were selected purposively based on the production level of maize and groundnut. The

purposive selection was done in consultation with the various selected district offices of MoFA. This was to prevent a random sample of operational areas where maize and groundnut are not intensively cultivated. The OAs that formed the sampling frame are the same as those used by the Project Planning, Monitoring, and Evaluation Division (PPMED) of MoFA for their statistical reporting. Table 3.2 presents the distribution of OAs and communities selected in the four districts. The advantage of using OAs as sampling unit is that each OA is approximately equal in size. This helps ensure that all farmers have an equal probability of being selected, which is not the case when sampling units consist of towns or villages of unequal size (Morris *et al.*, 1999).

The third and final stage involved randomly selecting respondents from the communities chosen in the second stage. To prevent bias, stratified sampling procedure was considered to create two strata of the population based on gender. The rationale of this stratification was to ensure a proportionate representation of male and female farmers. The actual selection of respondents was made difficult as a result of the unavailability of a comprehensive list of maize and groundnut farmers. To improvise a list, every community visited was divided into four blocks. In each block, a communal place (a place where people sit together) was identified and used as a starting point of preparing a list. People who sat together were asked to supply the names of maize and groundnut farmers within that block. This method identified effectively male farmers rather than the female farmers. The names supplied were then used for the sampling (the lottery method was used). The identification of female farmers was done by finding out female farmers who were responsible for their families. Mostly, widows were identified and then contacted.

Table 3.2: Sampled Districts, Operational Areas, Communities and Sample Size

District	Selected OA	Communities	Sample Size		
			Maize	Groundnut	Total
Jirapa-Lambusie	Duori	Degri	10	10	20
	Gbare	Saawie	10	10	20
	Jirapa	Gallayiri	6	3	9
		Wuoyiri	4	7	11
	Sabuli	Sabuli	10	10	20
	Sigri	Jeffiri	10	10	20
	Tizza	Bachoglo	5	-	5
		Tangzu	2	-	2
		Tizza-Gbare	3	2	5
		Tinkoyiri	-	8	8
Ullo	Ullo-Kpong	10	10	20	
Yagha	Yagha	10	10	20	
Nadowli	Daffiama	Daffiama	10	10	20
	Issa	Duong	5	5	10
	Kaleo	Buu	5	5	10
	Sankana	Chaangu	10	10	20
	Serekpere	Serekpere	5	3	8
		Voggoni	5	7	12
Sissala East	Pieng	Pieng	12	13	25
	Sarkai	Nankpawie	-	2	2
		Sarkai	12	11	23
	Tarsaw	Kulfuo	3	7	10
	Tumu	Kassana	3	2	5
		Pina	10	5	15
Wa West	Dorimon	Dorimon	10	10	20
	Ga	Nyoli	5	5	10
		Samanbo	5	5	10
	Gbache	Guo	6	2	8
		Siriyiri	4	8	12
	Tanina	Polley	2	5	7
Tanina		8	5	13	
Total			200	200	400

Source: Household Survey and District Offices of MoFA, 2012

Based on this comprehensive sampling procedure, the sample can be considered to be highly representative of the overall population of maize and groundnut farmers. Hence, the market participation behaviour of the sample respondents from the four districts can be extrapolated directly to the regional level.

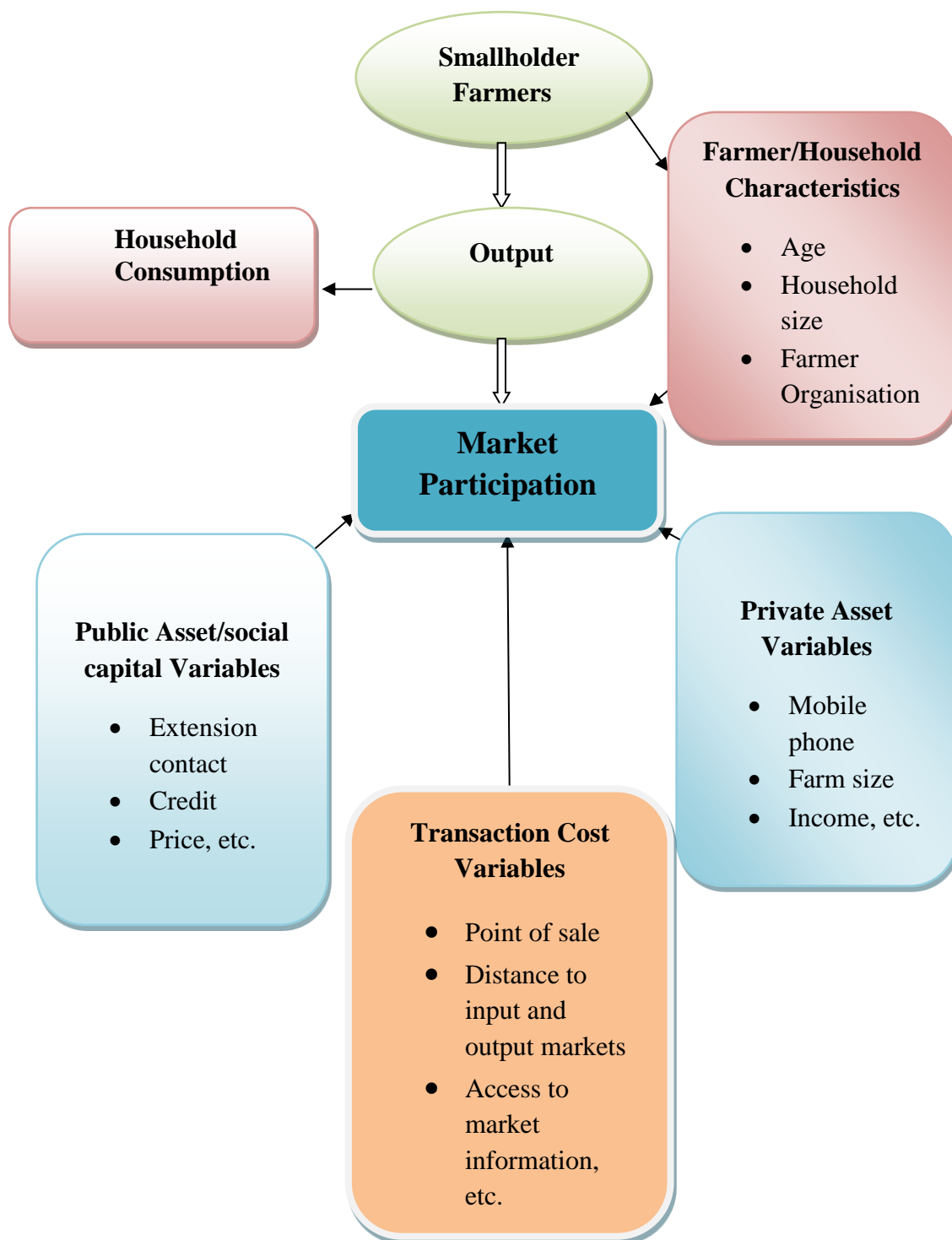
3.4 Data Analysis and Presentation

The Statistical Package and Software System (SPSS) version 20 and Microsoft excel were used for data entry and editing. Stata version 12 was used for the econometric estimations of the DHM as well as performing descriptive statistical analysis. The results are presented in the form of tables and charts in the next chapter for discussion.

3.5 Conceptual Framework of Market Participation

The study of market participation of smallholder farmers is conceptualised in the model presented in Figure 3.2. The conceptual model presents the various relationships that exist between smallholder farmers, market participation and some hypothesised covariates based on literature.

The conceptual model suggests that smallholder farmers produce crops (output) for two main purposes; consumption and marketing. They could entirely consume, entirely market or consume and market at the same time depending on the commodity. If the farm holders entirely consume their produce, it means that they are not market-oriented and can be said to be autarchic. That is they produce just what they need throughout the farm season and do not need to depend on the market. This situation of self-reliance and self-sufficiency has significant implications on the farm holders as well as the development of the agricultural sector in general.

Figure 3.2: Conceptual Model of Market Participation

Source: Author's conceptualisation based on the literature, 2012

Participating in the market either through entire marketing or partial marketing (consumption and marketing at the same time) has been observed to be associated with several potentials. For example, markets have the potential to unlock economic growth and development (Siziba *et al.*, 2011) and commercial orientation leads to a gradual decline in real food prices due to increased competition and lower costs in food marketing and processing (Jayne *et al.*, 1995). Therefore, market participation improves the welfare of smallholder farmers through low food prices and enables the reallocation of limited household incomes to high-value non-food agribusiness sectors and more profitable non-farm enterprises (Omiti *et al.*, 2009). The arrows from *smallholder farmers* to *output* and then from *output* to *household consumption* and *market* summarises what has been discussed above.

The decision to participate in the market by farm holders has been observed to be governed by numerous economic and non-economic factors. These factors in literature have been categorised into household socioeconomic characteristics, private asset variables, public asset variables and transaction cost variables. The conceptual model posits that market participation is influenced by these factors. The arrows from *household characteristics*, *private asset variables*, *public asset variables* and *transaction cost variables* to *market* indicate the dependence of market participation on these variables.

It is however worthy to note that the conceptual model does not deal with a theoretical issue of households being net buyers or sellers in the market. It simply concentrates on the proportion of farmers' output that is marketed and the factors that affect the proportion.

3.6 Theoretical Framework of Market Participation

This section presents the theoretical framework, estimation methods and hypotheses testing.

3.6.1 Theories of Trade and Utility Maximisation

The theoretical basis of the study of market participation of smallholder farmers is derived from the theory of trade in general and the theory of utility as operationalised by the Barrett's stylized household's non-separable market participation behaviour model specifically.

The theoretical underpinnings of why farm households participate in agricultural markets can be found in the trade theory as postulated by Ricardo (Siziba *et al.*, 2011). They note in Ricardo's theory that farmers are essentially driven to enter into trade or markets so that they can enjoy a diverse consumption bundle and exploit welfare gains from trading by concentrating on the production of goods for which they have comparative advantage, and exchange for those they have no comparative advantage, mostly manufactures. However, as a result of the failure of the trade theory to identify determinants of market participation (Siziba *et al.*, 2011), a number of theoretical models (Barrett, 2008, and Boughton *et al.*, 2007) have been developed. Barrett's model is a stylized household's non-separable market participation behaviour model which is premised on utility maximisation.

The basic assumption of the Barrett's model is that a farm household faces a decision to maximise utility. The utility is defined as a function of consumption of a vector of agricultural commodities denoted as Y^c for $c = 1, \dots, C$ and a Hicksian composite of

other tradables denoted as X . The household earns income from production, and sale of any or all of the C crops and from off-farm earning denoted as W . Each crop is produced using technology, $f^c(A_c, G)$ that maps flow of services provided by privately held assets - land, labour, livestock, machinery, *inter-alia* reflected in the vector A , and public goods and services, such as roads, extension services, represented by vector G , into output.

The household faces a parametric market price for each crop, P^{cm} and a vector of crop- and-household-specific transactions costs per unit that depend on public goods and services, G (e.g. radio broadcast of prices that affects search costs and road accessibility to market), household-specific characteristics (e.g. educational attainment, gender and age) that may affect search costs, negotiation skills, among others, reflected in the vector Z as well as the household's assets, A , liquidity from non-farm earnings, W and net sales volumes. The household's decision to participate in the crop markets as seller, is represented by M^{cs} where $M^{cs} = 1$ if household enters the market and $M^{cs} = 0$ if it does not.

Similarly, the decision to enter the market as a buyer, M^{cb} takes values 1 and zero for entering and not entering, respectively. The resulting crop net sales, $NS^c = f^c(A_c, G) - Y^c$, are nonzero if and only if either M^{cb} or M^{cs} equal one. The household's choice can be represented as a constrained optimisation problem where it maximises utility subject to the cash budget and available non-tradable resources.

Taking a truncation of Barrett's model, the decision to participate in agricultural commodity market as sellers (M^{cs}) can be represented in the reduced form as a

function of the exogenous variables (\mathbf{A} , \mathbf{G} , \mathbf{W} , P^{cm} , \mathbf{Z}) capturing private asset stock, public asset stock, transaction costs, off-farm income and commodity price (Siziba *et al.*, 2011). The truncation is in respect to the neglect of households being net buyers or autarchic. This is justified by Boughton *et al.* (2007) that each of the choice variables (being a net buyer, net seller and autarchic) can be represented in reduced form as a function of the exogenous variables indicated by Barrett. This implies that participating in the market as a seller can be a stand-alone model.

The truncated Barrett's household model reflects a fundamental relationship between market participation of households as sellers and some variables which serve as covariates. This relationship is specified as:

Market participation

$$= f \left(\begin{array}{l} \text{private asset stock, public asset stock, transaction cost,} \\ \text{off - farm income and commodity price} \end{array} \right) \quad (3.1)$$

A number of studies (e.g. Martey *et al.*, 2012; Siziba *et al.*, 2011; Omiti *et al.*, 2009; Randela *et al.*, 2008; and Boughton *et al.*, 2007) have included forms of these variables to estimate determinants of commodity market participation or commercialisation. Following from equation 3.1 and the literature, the specific theoretical relationship is represented as:

Market participation

$$= f \left(\text{AGE, GEN, EDUC, MARST, HHSIZE, FEXP, MFBO, FRMSIZE, HHINC,} \right. \\ \left. \text{OFINC, OUTPUT, TEL, ACCRE, EXTCON, PRICE, MKTINFO, POS, FOS} \right) \quad (3.2)$$

The truncated Barrett's stylized non-separable household market participation behaviour model as summarised in equations 3.1 and 3.2 does not explicitly capture the two step approach of market participation as indicated in empirical studies. This study adds to the Barrett's theoretical model by creating the empirical dimensions of the probability of participating in the market and the intensity of participation as follows.

Market Participation model: PART

$$\begin{aligned}
 &= \alpha_0 + \alpha_1 AGE + \alpha_2 GEN + \alpha_3 EDUC + \alpha_4 MARST + \alpha_5 HHSIZE \\
 &+ \alpha_6 FEXP + \alpha_7 MFBO + \alpha_8 FRMSIZE + \alpha_9 HHINC + \alpha_{10} OFINC \\
 &+ \alpha_{11} OUTPUT + \alpha_{12} TEL + \alpha_{13} ACCRE + \alpha_{14} EXTCON \\
 &+ \alpha_{15} MKTINFO + \varepsilon
 \end{aligned} \tag{3.3}$$

Intensity of Participation model: HCI

$$\begin{aligned}
 &= \beta_0 + \beta_1 AGE + \beta_2 GEN + \beta_3 EDUC + \beta_4 MARST + \beta_5 HHSIZE \\
 &+ \beta_6 FEXP + \beta_7 MFBO + \beta_8 FRMSIZE + \beta_9 HHINC + \beta_{10} OFINC \\
 &+ \beta_{11} OUTPUT + \beta_{12} TEL + \beta_{13} ACCRE + \beta_{14} EXTCON + \beta_{15} PRICE \\
 &+ \beta_{16} MKTINFO + \beta_{17} POS + \beta_{18} FOS + \mu
 \end{aligned} \tag{3.4}$$

Equations 3.3 and 3.4 specify the empirical models to be estimated by this study. The estimations are done for maize and groundnut separately. The FOS variable is specific to only groundnut. The description, measurement and expected signs of variables are displayed in Table 3.3. The choice and categorisation of these variables are derived from literature (e.g. Govereh *et al.*, 1999; Strasberg *et al.*, 1999; Heltberg and Tarp, 2002; Randela *et al.*, 2008; and Siziba *et al.*, 2011).

Table 3.3: Description, Measurements and Expected Signs of Variables in the Participation and the Intensity Models

Variable	Description	Measurement	Expected Sign	Model*
Dependent Variables				
<i>PART</i>	Binary variable indicating the decision to participate in the market or not	Dummy: 1 = farmer participates in market (sold maize/groundnut); 0 = otherwise	Nil	PBT
<i>HCI</i>	Percentage of total output sold	Household Commercialisation Index	Nil	TRR
Explanatory Variables				
Farmer Characteristics				
<i>AGE</i>	Age of the farmer	Number of years	+/-	PBT/TRR
<i>GEN</i>	Gender of the farmer	Dummy: 1 = if male; 0 = otherwise	+	PBT/TRR
<i>EDUC</i>	Education level of the household head	Number of years of schooling	+/-	PBT/TRR
<i>MARST</i>	Marital status of farmer	Dummy: 1 = if married; 0 = otherwise	+	PBT/TRR
<i>HHSIZE</i>	Household size of farmer	Number of people in the household	+/-	PBT/TRR
<i>FEXP</i>	Farmer experience in farming	Number of years in farming	+	PBT/TRR
<i>MFBO</i>	Membership of farmer to an FBO	Dummy: 1 = if member; 0 = otherwise	+	PBT/TRR
Private Assets Variables				
<i>FRMSIZE</i>	Total amount of land cultivated to maize or groundnut in the 2011 production season	Hectares (Data collected in acres and then converted to hectares since the farmers are familiar with acres)	+	PBT/TRR
<i>HHINC</i>	Total annual household income	Ghana Cedi (GH¢)	+	PBT/TRR
<i>OFINC</i>	Proportion of off-farm income in total annual household income	Ratio	+/-	PBT/TRR
<i>OUTPUT</i>	Total output of maize or groundnut produced in the 2011 production season	Number of 50kg bags	+	PBT/TRR

Table 3.3 (Continued)

Variable	Description	Measurement	Expected Sign	Model*
<i>TEL</i>	Farmer ownership of a mobile phone	Dummy: 1 = if yes; 0 = otherwise	+	PBT/TRR
Public Assets/Social Capital Variables				
<i>ACCRES</i>	Access to credit by farmer.	Dummy: 1 = if farmer applied and received credit; 0 = otherwise	+	PBT/TRR
<i>EXTCON</i>	Farmer contact with extension officers	Dummy: 1 = if yes; 0 = otherwise	+	PBT/TRR
<i>PRICE</i>	Average price at which each 50kg bag of maize or groundnut is sold	Ghana Cedi (GH¢) per 50kg bag. For groundnut, the price is measured in 50kg bag of unshelled groundnut.	+	TRR
Transaction Cost Variables				
<i>MKTINFO</i>	Farmer access to market information	Dummy: 1 = if yes; 0 = Otherwise	+	PBT/TRR
<i>POS</i>	Point of sale of output	Dummy: 1 = market centre; 0 = farm-gate	-	TRR
<i>FOS</i>	Form of sale of groundnut	Dummy: 1 = unshelled; 0 = otherwise	+/-	TRR
*denotes model in which variable is applied: PBT is Probit model (Participation/hurdle1), TRR is Truncated Regression model (intensity of participation/hurdle2)				

3.6.1.1 *A Priori* Expectation

The *a priori* expectations of the variables in Table 3.3 are presented below in accordance with the categories of the variables.

Farmer Characteristics

The age variable could have a positive or negative effect on the probability of participation and intensity of participation. Martey *et al.* (2012) argued that older and more experienced farmers could make better production decisions and have greater contacts which allow trading opportunities to be discovered at lower cost than younger ones. On the other hand, Enete and Igbokwe (2009) argued that younger heads are more dynamic with regards to adoption of innovations both in terms of those that would enhance their productivity and enhance their marketing at a reduced cost. Randela *et al.* (2008) also observed that younger farmers are expected to be progressive, more receptive to new ideas and to better understand the benefits of agricultural commercialisation. These two opposing arguments render the age variable an indefinite expectation.

Gender is dummied hence measures the probability of participation and differences in intensity of participation between male and female farmers. Cunningham *et al.* (2008) found that men are likely to sell more grain early in the season when prices are still high, while women prefer to store more output for household self-sufficiency. By this, a positive coefficient is expected on the gender variable.

The educational status of a farmer measures the level of human capital and is expected to increase a household's understanding of market dynamics and therefore

improve decisions about the amount of output sold (Makhura *et al.*, 2001). Schultz (1945); Southworth and Johnston (1967); Ofori (1973); and Enete and Igbokwe (2009) argued that education will endow the household with better production and managerial skills which could lead to increased participation in the market. Randela *et al.* (2008) argue that the level of education gives an indication of the household's ability to process information and causes some farmers to have better access to understanding and interpretation of information than others and leads to the reduction of search, screening and information costs.

However, Martey *et al.* (2012) argue that it is also possible that education could increase the chances of the household head earning non-farm income. This could reduce the household's dependency on agriculture and thus commercialization. In line with this, Lapar *et al.* (2003) argued that if there are competing and more remunerative employment opportunities available that require skills that are enhanced by more education market participation would reduce. Therefore, the expectation is not definite.

Marital status is expected to have a positive effect on market participation. Married couples have more responsibilities to meet. This increases their probability to participate in the market through producing more output to generate marketable surplus. This subsequently increases the intensity of participation. The household size explains the family labour supply for production and household consumption levels (Alene *et al.*, 2008). A positive sign implies that a larger household provides cheaper labour and produces more output in absolute terms such that the proportion sold remains higher than the proportion consumed. A negative sign on the other hand

means that a larger household is labour-inefficient and produces less output but consumes a higher proportion, leaving smaller and decreasing proportions for sale (Omiti *et al.*, 2009). Therefore, the directional effect of household size is not definite.

Farm experience is expected to have a positive relationship with market participation. The more experienced the farmer the more output is produced, and hence more is expected to be put on sale.

Membership of a farmer to a farmer based organisation or group increases access to information important to production and marketing decisions (Olwande and Mathenge, 2012). Most farmer groups engage in group marketing as well as credit provision for their members (Martey *et al.*, 2012). Collective action has an additional advantage of spreading fixed transaction costs. This variable is expected to impact positively on market participation (Randela *et al.*, 2008). Collective action as measured by belonging to farmers' organisations strengthens farmers' bargaining and lobbying power and facilitates obtaining institutional solutions to some problems and coordination (Matungul *et al.*, 2001). Based on this the membership variable should have a positive relationship with the probability and intensity of participation.

Private Assets Variables

According to Olwande and Mathenge (2012), farm size may have indirect positive impacts on market participation by enabling farmers to generate production surpluses, overcome credit constraints, where land can be used as collateral for credit, and allow them to adopt improved technologies that increase productivity. This gives a positive expectation of the farm size variable.

Household income is expected to have a positive relationship with the probability of participation and the intensity of participation. The more income a household has the more they are able to farm hence enhancing more marketable surplus. Alene *et al.* (2008) noted that non-farm income contributes to more marketed output if the non-farm income is invested in farm technology and other farm improvements. Otherwise, marketed farm output drops if non-farm income triggers off-farm diversification. The expectation therefore is indefinite.

Output is expected to positively influence the probability and the intensity of market participation. The more the output the more the farmer is able to generate marketable surplus for participation. Ownership of a mobile phone is expected to have a positive effect on market participation and intensity of participation. Farmers with mobile phones can easily source market information than those without phones

Public Assets/Social Capital Variables

Availability of credit and the associated cost of credit according to Sindi (2008) are crucial in the success of the agricultural industry. Also, unavailability of credit inflates transaction costs in both input and output markets (Randela *et al.*, 2008). The availability of credit and the amount of credit devoted to the production of maize and groundnut are expected to lead to increased agricultural productivity and greater commercialization.

Contact with extension officers equips farmers with improved production methods and technology which could lead to increased production and consequently increased

market participation. Extension contact is therefore hypothesised to positively affect market participation.

Omiti *et al.* (2009) note that output price is an incentive for sellers to supply more in the market. From this incentive, it is expected that the higher the price the higher the intensity of engaging in the market.

Transaction Cost Variables

Information costs are often considered to be fixed transaction costs that influence market entry decisions (e.g. Goetz, 1992, Omamo, 1998, and Vance and Geoghegan, 2004). Also, marketing efficiency is hindered by informational bottlenecks which increase transaction costs by raising search, screening and bargaining costs (Randela *et al.*, 2008). Therefore, access to market information is expected to increase market participation.

Point of sale is dummied and used as a proxy for transaction costs. Key *et al.* (2000) and Makhura *et al.* (2001) found that distance to the market negatively influences both the decision to participate in markets and the proportion of output sold. In line with this Omiti *et al.* (2009) observed that the variable transport costs per unit of distance increases with the potential marketable load size. Therefore, point of sale is expected to be negatively associated with the intensity of participation to households who sold in market centres. The form of sale variable does not have a definite sign.

3.6.2 Estimation Methods

The estimation of the market participation models represented in equations 3.3 and 3.4 can be achieved by first estimating the levels of participation for maize and groundnut. This achieves the first specific objective of the study. The Household Commercialisation Index (HCI) is used but modified to estimate the levels of Maize Commercialisation Index (MCI) and Groundnut Commercialisation Index (GCI) separately. The HCI proposed by Govereh *et al.* (1999) and Strasberg *et al.* (1999) estimates a single index for all crops cultivated by a household. Estimating the MCI and the GCI followed a two stage procedure.

1. Estimating individual HCI for maize and groundnut following the modified HCI as:

$$HCI_{im} = \left[\frac{\text{Gross value of maize sale}_{ij}}{\text{Gross value of all maize production}_{ij}} \right] * 100 \quad (3.5)$$

$$HCI_{ig} = \left[\frac{\text{Gross value of groundnut sale}_{ij}}{\text{Gross value of all groundnut production}_{ij}} \right] * 100 \quad (3.6)$$

where HCI_{im} and HCI_{ig} are the i^{th} household commercialisation index for maize and groundnut respectively; the numerator is the total amount of maize or groundnut sold by the i^{th} household in the j^{th} year ($j = 2011$ farming season) and the denominator is the total value of output of maize or groundnut by the i^{th} household in the j^{th} year ($j = 2011$ farming season). The result in the bracket is multiplied by 100 to convert it to percentage.

2. Estimating the MCI and the GCI by finding the average from procedure one.

The results from procedure two can be used to estimate a combined index of participation for both crops. The various indices measure the extent to which the farm households are oriented toward the market (Strasberg *et al.*, 1999). A value of zero would signify a totally subsistence-oriented household; the closer the index is to 100, the higher the degree of commercialization.

The estimation of the HCI sets the tone for estimating equations 3.3 and 3.4. Equation 3.4 suggests that only farmers who sell a proportion of their output are considered while farmers who tend to consume their produce without selling in the market are excluded from the sample. Hence, the HCI (the proxy for market participation) is only observed for a subset of the sample population creating a sample selection problem. The missing observations causes what is referred to as incidental truncation (Greene, 2003).

As a consequence, since the values of the dependent variable in equation 3.4 are zeros and positive values, the Ordinary Least Square method will yield biased and inconsistent estimates (Wooldridge, 2009, and Greene, 2003). There are a number of alternatives to address the selectivity bias and provide unbiased, consistent and efficient estimates. The first is the widely used Tobit model developed to alleviate the problems caused by OLS. Although the Tobit model could be used to estimate 3.4, it is very restrictive by assuming variables which determine the probability of participation also determine the level of participation (Wan and Hu, 2012; Olwande and Mathenge, 2012; Ricker-Gilbert *et al.*, 2011; and Wooldridge, 2002). This implies that the Tobit model ignores equation 3.3. But since it is possible that a variable could

have different effects on the probability and intensity of participation, the Tobit model was not considered.

The second alternative is to employ the Heckman sample selection model which estimates equation 3.3 with a probit model and 3.4 with an OLS after including among the covariates the inverse mills ratio derived from the probit model to account for selection bias. Following from the observation of Ricker-Gilbert *et al.* (2011), the Heckman model is designed for incidental truncation, where the zeros are unobserved values. However, in this study, a zero value in the data would reflect farmers' optimal choice rather than a missing value (Reyes *et al.*, 2012). It would be erroneous to equate these missing observations to zero (Olwande and Mathenge, 2012). Therefore, the Heckman model is not used.

The third alternative is the Double Hurdle Model (DHM). It is a corner solution model just like the Tobit model. The fact that the Tobit and the DHM are corner solution models makes them appropriate to this study than the Heckman model. Considering the restrictiveness of the Tobit model, the DHM is used in this study.

Lijia *et al.* (2011) note that the DHM is a generalization of the Tobit model by allowing the possibility that a factor might have different effects on the probability of participation and the magnitude of participation and hence a variable might have different or even opposite effects in these two decision stages. The DHM therefore relaxes the Tobit model by allowing separate stochastic processes for the participation and intensity of participation (Wan and Hu, 2012; Reyes *et al.*, 2012; and Yen and Huang, 1996).

The DHM enables the modelling of equations 3.3 and 3.4 simultaneously. The model is based on an assumption that these two separate hurdles or stages must occur before a positive level of market participation is observed (Beltran *et al.*, 2011). Equations 3.3 and 3.4 are estimated by the Probit and the Truncated regression models respectively under the DHM.

This study assumes that equations 3.3 and 3.4 are independent. Smith (2003) shows that, assuming dependency between the two equations is not a worthwhile exercise since there is little statistical information available to support dependency in the DHM framework.

3.6.3 Hypotheses Testing

Wooldridge (2002) indicates that the second stage of the DHM is defined by a truncated normal distribution which provides the nesting of the Tobit Model in it. This implies that we can test whether the Tobit model or the DHM best fits the data. According to Humphreys (2010), the DHM can be tested against the Tobit model using a standard likelihood ratio test specified as:

$$LR = -2(LL_{DH} - LL_T) \quad (3.7)$$

where LL_{DH} is the log likelihood value from the DHM and LL_T is the log likelihood value from the Tobit model. This test statistic has a chi-square distribution with degrees of freedom equal to the number of parameter restrictions made to get the Tobit model.

As a result of the weakness of the standard likelihood ratio test to test models of non-nested nature (Humphrey, 2010), Vuong (1989) proposed a modified likelihood ratio test for non-nested maximum likelihood estimators which is based on a transformed value of the log likelihood function, using a simple transformation as:

$$W_n = \left(\frac{1}{n}\right) [LR_1]^2 - \left[\left(\frac{1}{n}\right) LR_1\right]^2 \quad (3.8)$$

where n is the number of observations, LR_1 is the likelihood statistic formed from the difference between the value of the log likelihood function for the DHM evaluated at its maximum and the Heckman model evaluated at its maximum and specified as: $LR_1 = LL_{DH} - LL_{\dot{H}}$ with a test statistic which has a standard normal distribution specified as:

$$\sqrt{n} \frac{LR_1}{W_n} \quad (3.9)$$

The decision rule is that if the test statistic is greater in absolute value than a critical value from the standard normal distribution, then the DHM fits these data better than the Heckman model. If the test statistic is smaller in absolute value than a critical value from the standard normal distribution, then the test cannot discriminate between the two models given the data.

3.7 Ranking of Constraints: Garrett Technique

The task of identifying and ranking the constraints of farmers in accessing market for maize and groundnut is achieved by the identification of problems guided by literature and the Henry Garrett ranking technique. As noted in the review of literature, the

Garrett technique of ranking is chosen over the Kendall's since the study area deals with various districts in the Upper West Region which could be heterogeneous in some characteristics.

The process of operationalizing the ranking procedure starts with respondents ranking the identified problems in order from the most pressing to the least pressing. Numerical values are used to give weights to the problems with 1 being the most pressing, 2 the second most pressing, in that order to the i^{th} problem representing the least pressing to the j^{th} respondent. The orders of merit by the farmers representing the assigned ranks are transformed into percentages using the formula:

$$\text{Percentage Position} = \frac{100(R_{ij} - 0.5)}{N_{ij}} \quad (3.10)$$

Where: R_{ij} is the rank given for the i^{th} factor by the j^{th} individual and N_{ij} is the number of factors ranked by the j^{th} individual.

The percentage position of each rank thus obtained is converted into scores by referring to the Garrett conversion score table. The scores for each constraint are summed up and the average score calculated by dividing the summed scores by the total number of individuals who ranked that particular constraint. The average/mean scores are what determine the order of the constraints. The constraint with the highest (lowest) mean score is regarded as the most (least) pressing.

CHAPTER FOUR

RESULTS AND DISCUSSIONS

4.1 Introduction

This chapter presents the results and findings of the study. A detailed description of demographic and socioeconomic characteristics of maize and groundnut farmers as well as market characteristics in the Upper West Region is presented. Further, results on the levels of maize and groundnut market participation indices, determinants of the decision and intensity of participation in the market of maize and groundnut and the discussion of ranked identified constraints are presented.

4.2 Demographic Characteristics of Surveyed Households

This section discusses demographic characteristics of surveyed maize and groundnut farm households. The characteristics discussed are age, gender, marital status, household size, religion and ethnicity of household heads. The results of these are jointly presented for both maize and groundnut in Table 4.1.

Age Distribution of Household Heads

Table 4.1 shows that age of surveyed household heads ranges from 19 to 90 years. The mean age is about 45 years (46.98 for maize and 42.35 for groundnut). This implies that farm households in the region can be described as relatively young and within the economically active population. This has implication for agricultural development since according to Polson and Spencer (1992) younger household heads are more dynamic with regards to adoption of innovations. Majority (36.3%) of households are within the age bracket of 20-35 years while 16% is above 60 years. This further confirms the youthful distribution of farm households. Generally, 84% of

the sample is within the economically active age range 20-60. This presents prospects for developing agriculture in the region.

Table 4.1 Demographic Characteristics of Surveyed Farm Households

Characteristics/ Grouping	Mean	Min.	Max.	Frequency	Percentage (%)
Age:	44.66	19	90		
• 20-35				145	36.3
• 36-50				130	32.5
• 51-60				61	15.3
• 60+				64	16.0
Gender:	-	-	-		
• Male				331	82.8
• Female				69	17.3
Marital status:	-	-	-		
• Unmarried				33	8.3
• Married				329	82.3
• Divorced				2	0.5
• Separated				1	0.3
• Widow(er)				35	8.8
Household size:	9.83	2	32		
• 1-5				66	16.5
• 6-10				206	51.5
• 11-15				81	20.3
• 15+				47	11.8
Religious Affiliation:	-	-	-		
• Christian				195	48.8
• Islam				145	36.3
• Traditional				57	14.3
• Others				3	0.8
Ethnicity:	-	-	-		
• Wala				56	14.0
• Dagaaba				254	63.5
• Sissala				59	14.8
• Kasena				18	4.5
• Builsa				8	2.0
• Brifo				4	1.0
• Gonja				1	0.3

Source: Computed from Household Survey Data, 2012

Gender of Household Heads

The result of gender distribution is displayed in Table 4.1. About 83% of household heads is male while about 17% is female. This is consistent with the gender distribution in Ghana where 65.3% are male-headed and 34.7% are female-headed (GSS, 2012) and confirms Abatania *et al's* (1999) observation that females become household heads in the absence of an adult male considered capable of being the household head. From the survey, female headed households were those where the female head was either a widow or the man was very weak to carry out responsibilities as the head. This explains the large representation of male heads in the sample.

Marital Status of Households

In Table 4.1, the majority (82.3%) of household heads is married while about 18% is unmarried distributed into unmarried household heads (8.3%), divorced household heads (0.5%), separated household heads (0.3%) and widowed household heads (8.8%). It was found that married heads have the advantage of labour than the unmarried heads. All the married heads stated that their spouses help them in their farming activities. This presents married couples the opportunity of producing more output capable of raising more marketable surplus.

Household Size of Households

Mean household size of farm households in the region is about 10 people (9.81 for maize and 9.84 for groundnut) and ranges from 2 to 32. This average size is about 4 higher than the GSS (2012) average of 6.2 for the region. The reason for this difference is attributed to the composition of the sample. Agriculture related

households especially smallholders are found in the rural areas where the household sizes are large. Majority (51.5%) of households have size between 6 to 10 people while about 12% have sizes over 15 people. One potential for the large size is that it ensures adequate supply of family labour for production (Martey *et al.*, 2012). Also, Al-Hassan (2008) argues that large families enable household members to earn additional income from non-farm activities. However, large household can reduce the amount of marketable surplus a household can raise to participate in the market. This is evident in the observation of Makhura *et al.* (2001) that the decision to sell is preceded by a decision to consume.

Religious Distribution of Household Heads

The majority (48.8%) of household heads profess the Christian faith. This is followed by household heads who are Muslims (36.3%). Household heads practicing the traditional religion are 58 representing 14.5%. Only a small proportion of the sample (0.8%) is not affiliated to any religion.

Ethnic Distribution of Household Heads

In table 4.1, the largest ethnic group in the sample is the Dagaabas representing more than half (63.5%) of the sample. This large representation is expected since the Dagaabas predominantly occupy the rural areas of Jirapa, Lambussie, Nadowli and Wa West districts. Sissalas are the second largest group in the sample (14.8%) who are also predominant in the Sissala East district. Walas represent 14% of the sample. The least representation is Gonjas (0.3%) who are traditionally from the Northern Region.

4.3 Socioeconomic Characteristics of Surveyed Households

This section discusses the socioeconomic characteristics of the sampled farm households. The results are presented in Table 4.2.

Educational Status of Surveyed Households

The majority of households (69.5%) have no formal education. This is followed by heads with primary level of education (13%). The least are heads with technical/vocational education and university education (0.3%) each. The mean years of education also shows that on average the highest level of education attained by a household head is primary education (approximately primary 3). The result is consistent with the finding of the GSS (2008) that about half of adults in Ghana neither attended school nor completed middle school/JSS. This could have some negative influence on agriculture in terms of technology adoption and understanding of market dynamics. Also, according to Minot *et al.* (2006) education is a means of entry into extra employment activities especially in the non-farm sector. With majority of heads in the region without formal education it can be opined that most of these people would not be able to engage in formal non-farm activities especially. The low level of education exhibited by the respondents could affect negatively the prospects of engaging fully in the market.

Farming Experience

Table 4.2 shows that households have on the average 14 years (approximately 13 for maize and 14 for groundnut) of farming experience in maize and groundnut farming. The minimum and maximum farming experience are 1 and 75 years respectively. The mean farming experience is sufficient for farmers to be abreast with the expertise of

farming and quickly adopt improved farming technology despite the fact that majority are without any formal schooling.

Table 4.2 Socioeconomic Characteristics of Surveyed Farm Households

Characteristics/ Grouping	N = 400				
	Mean	Min.	Max.	Frequency	%
Education:	2.47	0	22		
• No schooling				278	69.5
• Primary				52	13.0
• MSLC/JHS				48	12.0
• SHS				15	3.8
• Technical/vocational				1	0.3
• TTC/Polytechnic/Diploma				5	1.3
• University				1	0.3
Household Income (GHS):	1129.70	25	9100		
Farming experience (years)	13.55	1	75		
Farm size (ha):	1.16	0.4	2.0		
• 0.4				71	17.8
• 0.8				123	30.8
• 1.2				68	17.0
• 1.6				51	12.8
• 2				87	21.8
Output (50kg bag):	10.72	0.15	89		
• 0-5				175	43.8
• 6-10				98	24.5
• 11-15				33	8.3
• 16-20				32	8.0
• 20+				62	15.5
Non-farm Activity:		202.77	6800		
• No				282	70.5
• Yes				118	29.5
Access to Credit:		-	-		
• No				321	80.3
• Yes				79	19.8
Membership in FBO:		-	-		
• No				358	89.5
• Yes				42	10.5
Access to Market Information:		-	-		
• No access				91	22.8
• Access				309	77.3
Extension Contact:		-	-		
• No contact				279	69.8
• Contact				121	30.3

Source: Computed from Household Survey Data, 2012

Household Income and Non-farm Income

The study shows that the average annual household income is GH¢1,129.70 and ranges between 25 and GH¢9,100. This is consistent with the estimate of GSS (2008) of GH¢1,217.00. It was revealed that household income basically flows from sales of output of maize and groundnut, other on-farm activities, and non-farm activities. The average income is relatively high and could be a prospect for cultivating large farm sizes and hence increased marketable surplus. However, small proportion of income is invested in farming as a result of high expenditure on other socioeconomic needs such as funerals, health, education and clothing. About 30% of household heads engaged in non-farm income activities in the region in the 2011 farming season. Mean annual non-farm income is GH¢202.77 with minimum and maximum being 0 and GH¢6800 respectively. This implies that GH¢926.92 of the mean annual household income is from on-farm activities. The low participation in especially formal non-farm income activities could be explained by the majority of heads without formal education.

Farm Size and Output

The mean farm sizes cultivated to maize and groundnut are 1.10 ha and 1.22 ha, respectively (overall average of 1.16 ha) with a minimum of 0.40 and maximum of 4.45 ha each. Majority (30.8%) of the size cultivated was 0.8 ha and followed by size of 2 ha (21.8%). Land sizes of 0.4 ha, 1.2 ha and 1.6 ha represented 17.8%, 17% and 12.8% respectively. These distributions confirm the constraints of smallholders in cultivating significant land sizes. Higher landholdings serve as an incentive to produce surplus for market (Martey *et al.*, 2012). Since majority cultivates relatively

small sizes, the prospect of extensively engaging in the market is narrow. This could negatively affect poverty alleviation efforts.

The mean outputs of maize and groundnut cultivated are 11.02 bags and 10.41 bags (unshelled) (overall of 10.72 bags) respectively. These have minimum of 1 bag and 0.15 bags (6 bowls) and maximum of 89 bags and 80 bags respectively. The average yield of maize is slightly higher than groundnut as a result of the use of fertilizer on maize farms. About 43.8% and 24.5% of output of both maize and groundnut produced are within the ranges 0 - 5 bags and 6 – 10 bags respectively. This follows the pattern of land put under cultivation. It was gathered that maize is basically for consumption while groundnut is treated as a cash crop in the region. The mean outputs of both crops are low which could subsequently affect the amount of marketable surplus in the region.

Access to Credit

Table 4.2 presents the results of credit access. Households with access to credit represented only 19.8% (22.5% of the maize sample and 17% of the groundnut sample) of the sample. This confirms the observation by Martey *et al.* (2012) that access to credit is one of the major constraints faced by households. Access was defined by household's proven record of securing both cash and input credit from both formal and informal sources. Out of the 79 households that had access, 14 (17.7%) had input credit (fertilizer, 42.9%, fertilizer and weedicide, 7.1% and ploughing, 50% of input credit) and the 65 (82.3%) had cash credit. Formal sources (representing 31.6% of credit) included rural banks (Sissala and Sonzele rural banks, 20.3% of credit), commercial banks (ADB and Stanbic, 3.8% of credit) and

MFI/NGOs (Pronet and Plan Ghana, 7.6% of credit). Informal sources (representing 68.4% of credit) were groups (Kandabanye, Nubingin, Songtaa and Tietaa, church, 17.7% of credit), market women (3.8% of credit), and friends/relatives (46.8% of credit).

The 80.3% of households who did not have access to credit stated the reasons as (refer to Table A4.7 in appendix): do not need the credit (7.2%), inadequate collateral (55.1%), do not want to pay interest (1.2%), cumbersome/expensive procedures (5.6%), interest too high (1.2%), and others reasons (29.6%). Other reasons stated were: risk aversion (56.8%), no knowledge about collecting loan (26.3%), short repayment schedules (10.5%) and delays in disbursing loans (6.3%).

Membership in Farmer Based Organisation (FBO)

The majority (89.5%) of households were not members of any farmer organisation while 10.5% belonged to FBOs. Those who are members meet on average 2 times a month. The meeting frequency ranges from 1 to 5 times a month. Most meetings (52.4%) are held once a month. The result reveals that membership in farmer based organisation is very poor. In view of the theme of the 2012 farmers' day celebration: "Grow More Food: Strengthening Farmer Based Organisations for Market Place Bargaining Power" the district offices of MoFA in the region and other stakeholders in agriculture have bigger tasks in encouraging farmers to form and belong to groups. Farmers who did not belong to any group stated reasons as (refer to Table A4.6 in appendix): no need of belonging to a group (9.5%), no internal/local leadership in forming group (27.1%), no external drive/force to form group (48.6%) and lack of understanding among community members (14.8%). The majority of households

stating no external drive as a reason for not belonging to a group affirms the fact that stakeholders especially MoFA still require a lot of efforts to ensure that communities have vibrant organisations. Most farmers explained that the formation and functioning of an organisation should be the effort of government. This issue of low participation in farmer based organisations in the region has the potential of negatively affecting market participation as well as the intensity of participation since membership in organisation is a platform for farmers to access information on market dynamics and also as a means of collective bargaining to boost their incomes.

Access to Market Information

Farmers who had access to market information represented the majority (77.3%) shown in Table 4.2. Market information basically constituted market prices and where sharp market is. Access to information was from (refer to Table A4.8 in appendix) friends/relatives (11.3%), market women (23.3%) and radio (35.3%). Other information sources were from combined sources of friends/relatives, market women and radio which together represented 30.1%. The radio is therefore very effective in transmitting market information in the region. Most households indicated that the radio broadcast of prices helps to prevent buyers from dictating prices. However, communities where there are no transmission waves still are deprived from the radio broadcast of prices. Generally, the percentage of households with market information is very high and could stimulate the decision of households to participate in the market in the region.

Extension Contact

In Table 4.2, households receiving agriculture extension services constituted 30.2% of surveyed households while those without contact constituted 69.8%. This implies that extension contact in the region is very low. This is in line with the observation by Martey *et al.* (2012) that majority of the farmers (66%) do not have access to extension services in the Effutu Municipality of Ghana. Mean extension visit was about 3 visits per farming season. The range was from 1 to 20 visits. Extension services rendered were: production only (74.4%), processing only (2.5%), trading only (0.8%) and production, processing, trading and other services (22.3%). The mode of rendering these services revealed by the survey is mostly through public/communal gathering though individual services are also rendered. Most farmers do not attend these communal gatherings explaining that the times for these gatherings are not convenient to them. The low level of extension visits is attributed to logistical constraints of the district offices of MoFA. Some farmers complained that extension agents concentrate their efforts on influential farmers who mostly have animals and farm on large scale.

4.4 Marketing Characteristics of Surveyed Households

This section deals with marketing characteristics of surveyed households. Marketing characteristics considered are participation in the market, point of sale of output, form of sale of groundnut, total quantity sold proportion of output sold and number of times sold. These characteristics are presented in Table 4.3.

Household Participation in the Market

About 48.5% of households participated in the maize market while 51.5% did not.

This implies that about 49% of farmers in the region sold maize output from the 2011 farming season while about 52% did not.

Table 4.3: Marketing Characteristics of Surveyed Households

Variable/Grouping	N = 200			N = 200			N = 400		
	Maize			Groundnut			Overall		
	Mean	Freq.	%	Mean	Freq.	%	Mean	Freq.	%
Participation:	-						-		
• Not Participated		103	51.5		33	16.5		136	34.0
• Participated		97	48.5		167	83.5		264	64.0
Point of sale:	-						-		
• Farm-gate		54	55.7		68	40.7		122	46.2
• Market centre		37	38.1		94	56.3		131	49.6
• Farm-gate/Market centre		6	6.2		5	3.0		11	4.2
Form of Sale:	-								
• Unshelled					124	74.3			
• Shelled					39	23.4			
• Both					4	2.4			
Quantity sold:	10.03			8.89			9.31		
• Farm-gate	12.34			11.54			11.48		
• Market centre	5.41			6.49			5.02		
Market price:	68.55			72.29			70.91		
• Farm-gate	67.03			79.51			73.88		
• Market centre	71.40			117.93			103.84		
Times sold:	1.22			1.63			1.43		
• Farm-gate	1.27			1.66			1.47		
• Market centre	1.16			1.60			1.38		

Source: Computed from Household Survey Data, 2012

This result reflects the fact in Ghana that maize is basically produced as a staple for household consumption. It was revealed that households do not just decide to produce maize for consumption alone. The inability to participate is determined by the quantity produced and the household size. Majority (92.2%) of households did not

participate because their output was not enough while the remaining (7.8%) produced purposely for consumption.

With respect to groundnut, 83.5% of households sold groundnut while 16.5% did not sell. This confirms that groundnut is treated as cash crop in the region. Households produce groundnut basically to sell rather than used as a direct consumption commodity. What supports this finding is that all the 33 (16.5%) households who did not sell attributed their inability to sell to low output due to late planting rather than for consumption. For the two crops, 34% of all respondents did not participate while 64% participated.

In terms of district distribution of participation (refer to Table A4.5 in appendix), 35% and 80% of the 80 maize and groundnut respondents each in the Jirapa-Lambussie District sold maize and groundnut respectively. Also, 42.5% and 72.5%, 47.5% and 100%, and 82.5% and 85% of the 40 maize and groundnut respondents each in the Nadowli, the Wa West and the Sissala East Districts sold maize and groundnut respectively in the 2011 production season.

Point of Sale of Output

Point of sale of output basically defines where the outputs of households were sold. There were three categories: farm-gate, market centre sale and both farm-gate and market centre. Farm-gate sale defines sales in the house or any sale not carried to the market centre either internal market or outside the community while market centre sale defines sale in an organised internal or external market centre. Table 4.3 shows that 55.7% and 40.7% of maize and groundnut sales were done in farm-gate

respectively. Also, 38.1% and 56.3% of maize and groundnut respectively were sold at the market centre. Output sold at both farm-gate and market centre represented 6.2% and 3.0% respectively. These results reveal that more output of groundnut is sold at market centres than maize while more maize output is sold in farm-gate than groundnut. What can be realised from these findings is a reaffirmation of the types of commodities the two crops are in the region: that groundnut is more market oriented than maize such that more households are willing to travel to market centres whether internal ones or external ones to sell. It could also mean that some proportion of maize output initially unintended for sale is sold as a result of households taking advantage of buyers who go house to house to buy. Overall, 46.2% sold at farm-gate, 49.6% sold at market centre and 4.2% sold at both farm-gate and market centre.

Form of Sale of Groundnut

In Table 4.3, about 74% of households who sold groundnut sold in unshelled form while about 23% shelled their groundnut before sale. Those who sold in both shelled and unshelled represent about 2%. The majority selling in unshelled form negatively affects income growth as groundnut sold in that form is less profitable.

Quantity of Output Sold

Total quantity sold of maize is 973 50kg bags by 97 households and that of groundnut is 1,484.65 50kg bags (unshelled) by 167 households. Average quantities of maize and groundnut therefore sold are 10.03 50kg bags and 8.89 50kg bags (unshelled) respectively. Farm-gate average quantities sold are 12.34 50kg bags and 11.54 50kg bags of maize and groundnut while market centre average sales are 5.41 50kg bags and 6.49 50kg bags respectively. The results indicate that on average more maize is

sold than groundnut at the farm-gate while more groundnut is sold than maize at the market centre. In real terms, more groundnut is sold than maize. The average of farm-gate and market centre sales will not equal the average of total quantity sold of both crops due to different denominators. Overall, 9.31 50kg bags of maize and groundnut was sold distributing into 11.48 50kg bags at farm-gate and 5.02 50kg bags at the market centre.

Market Price

The average price received by maize farmers is GH¢68.55 per 50kg bag distributing into GH¢67.03 per 50kg bag at farm-gate and GH¢71.40 per 50kg bag at the market centre. Groundnut average price is GH¢72.29 per 50kg bag (unshelled) making up of GH¢79.51 per 50kg bag at the farm-gate and GH¢117.93 per 50kg bag at the market centre. The distribution of prices of maize and groundnut shows that groundnut farmers faced higher prices both at the farm-gate and market centre than maize farmers. Overall, average of both maize and groundnut is GH¢70.91 per 50kg bag distributing into GH¢73.88 per 50kg bag at the farm-gate and GH¢103.84 per 50kg bag at the market centre.

Number of Times Sold

The average number of times the output of maize and groundnut is sold is 1.22 and 1.63 times respectively. This implies that households sell maize and groundnut once and twice on average respectively. Overall, the number of times both crops are sold is 1.43 times distributing into 1.47 times and 1.38 times at farm-gate and market centre respectively.

4.5 Levels of Market Participation by Households

The levels of market participation or commercialisation of smallholder maize and groundnut smallholder households from the data gathered indicate that the average marketed surplus ratios are 23.77% and 52.56% respectively. These imply that on average 24% and 53% of the output of maize and groundnut respectively are sold by sampled farmers in the Upper West Region within a production season. The results show a moderate commercialisation index for groundnut and a low index for maize. Comparing the two crops, the proportion of groundnut sold is more than half (28.79%) the proportion of maize sold in the region.

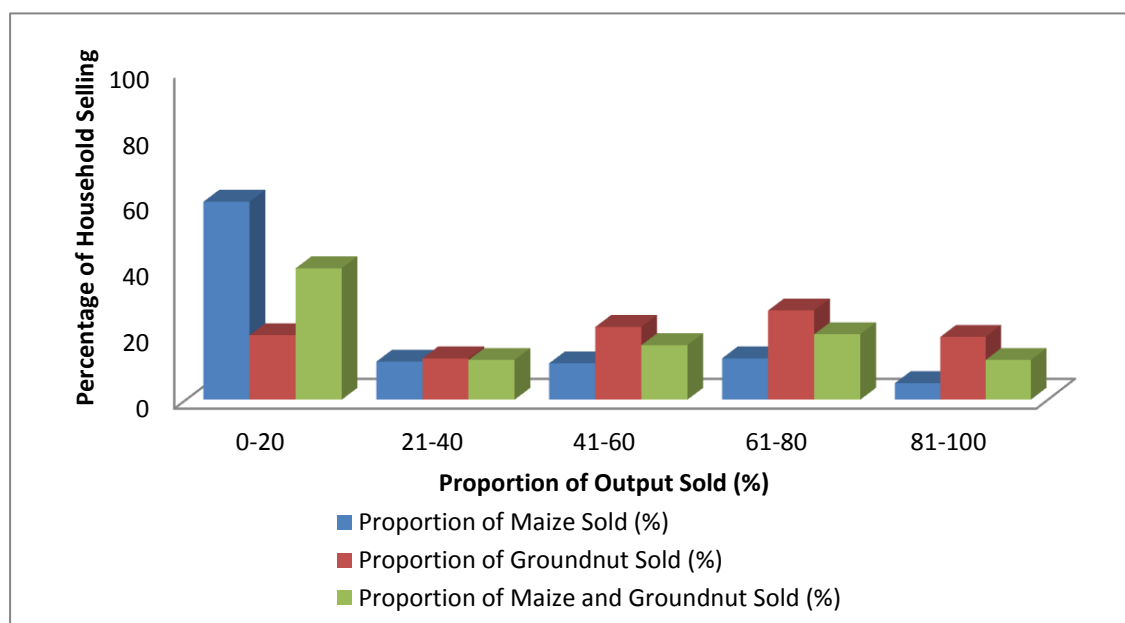
The average marketed surplus ratio for the region for all crops estimated by IFPRI in 2011 was 18%. The surplus ratio estimated for only maize is therefore 5.77% point higher than the average marketed surplus ratio estimated by IFPRI while that of groundnut is 34.56% point higher than the IFPRI estimate. The estimate by Martey *et al.* (2012) for maize as a staple in the Effutu municipality is 53%. That of cassava which was found as a cash crop just like groundnut was 72%. Comparing the indices between the two geographic areas, it is evident that the level of commercialisation is higher in the south than in the north specifically the Upper West Region. This confirms the observation by IFAD-IFPRI (2011) that the north of Ghana has low commercialisation indices as compared to the south. Among maize market participants only (97 households), the level of participation is 49.02%, ranging from 6.90% to 100%. With respect to groundnut market participants only (167 households), the level of participation is 62.95%, ranging from 13.33% to 100%.

Analysis of a combined index of average marketed surplus ratio for the region indicates a value of 38.17%. This implies that on average, about 38% of the output of maize and groundnut (or all crops) is sold within a production season. Therefore, the surplus ratio estimated for the two crops is about 20% point higher than the average marketed surplus ratio estimated by IFPRI. Also, the combined index for maize and cassava estimated by Martey *et al.* (2012) was 66%. The reason for this vast difference is that though the level of participation (average marketed surplus ratio) is estimated in a static manner, it is a moving average phenomenon dependent on a number of factors such as the yield for the period under consideration (the yield also depending on the amount of rainfall in the season, the cultivated land size, the physical condition of the farmer, access to inputs, farming practices for the season, *inter-alia*) and the decision to participate itself regardless of the amount of output. Also, the estimation of the level of participation on only these two crops is bound to be higher than the one for which a number of crops are involved. In terms of only market participants (264 households representing 66%), the combined index of participation is 57.83%, ranging from 6.90% to 100%.

From the analyses of the market participation indices, it is evident that groundnut is a cash crop and hence has higher index of participation than maize which can be regarded as a staple crop cultivated for the purpose of household consumption.

Proportion of Output Sold and Percentage of Households Selling

Figure 4.1 displays in summary the proportion of output sold and the percentage of households selling maize, groundnut and both crops.

Figure 4.1: Proportion of Output Sold and the Percentage of Households Selling

Source: Drawn from Household Survey Data, 2012

Greater percentage (60%) of households sell between 0 and 20% of maize while 19.5% sell groundnut within the same range of output sold. This means that majority of households producing maize sell lower proportions between 0 and 20%. Proportion of output sold ranging between 21 and 40% had 11.5% of maize households selling and 12.5% of groundnut households selling. The trend of percentage of households selling from between 21 and 40% to between 81 and 100% reduces for maize while it increases for groundnut. This reflects the consumption oriented nature of maize where low marketable surplus are raised due to household consumption and the market oriented nature of groundnut where larger marketable surplus are raised. The combined index of participation mimics the trend of groundnut.

Characterisation of Household based on Degree of Participation

The estimates of the levels of participation were used to characterise farmers according to low, medium and high commercial farmers. According to Abera (2009),

households who sell at most 25% and below of their output are low commercial farmers, those who sell between 26 and 50% are medium commercial farmers and above 50% are high commercial farmers. Following these categorisation, sampled households in the Upper West are characterised. Table A4.1 (in the appendix) presents the characterisation of the degree of participation of households.

In Table A4.1, 24.7% and 7.8% of maize and groundnut farmers who participated in the market are characterised as low commercialised farmers respectively. This implies that more maize market participants are low commercial farmers than groundnut farmers and lends sufficient evidence to the observation that maize is cultivated basically for household consumption while groundnut is cultivated for commercial purpose.

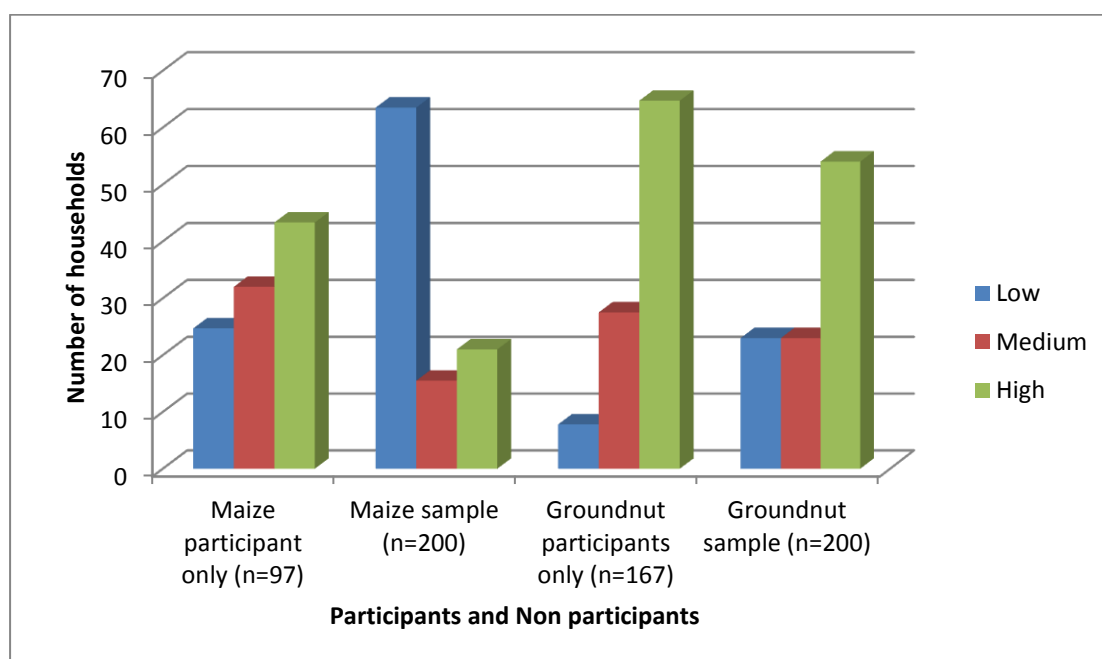
With respect to the whole sample, 63.5% and 23% respectively are low commercial farmers. Further, 32% and 27.5% of maize and groundnut market participants are characterised as medium commercial farmers respectively. For all sample, 15.5% and 23% respectively are medium commercial farmers. With respect to high commercial farmers, 43.3% and 64.7% of maize and groundnut market participants are characterised as high commercial farmers respectively. For all sample, 21% and 54% of maize and groundnut households respectively are identified as high commercial farmers. Figure 4.2 gives a pictorial view of the categorisation of households.

The observation for groundnut shows that for market participants only and for the whole sample, more households are high commercial farmers than medium farmers and more medium commercial farmers than low commercial farmers except for the

latter where the whole sample has the same percentage of medium and low commercial farmers.

This near consistency shows that groundnut is a commercial commodity in the region. On the other hand, consistency of expectation is achieved only for maize market participants only. For all sample, there are more low commercial farmers than high and then more high commercial farmers than medium. This confirms the observation by Olwande and Mathenge (2012) that majority of the smallholder farmers are locked in subsistence production.

Figure 4.2: Characterisation of Degree of Participation by Households



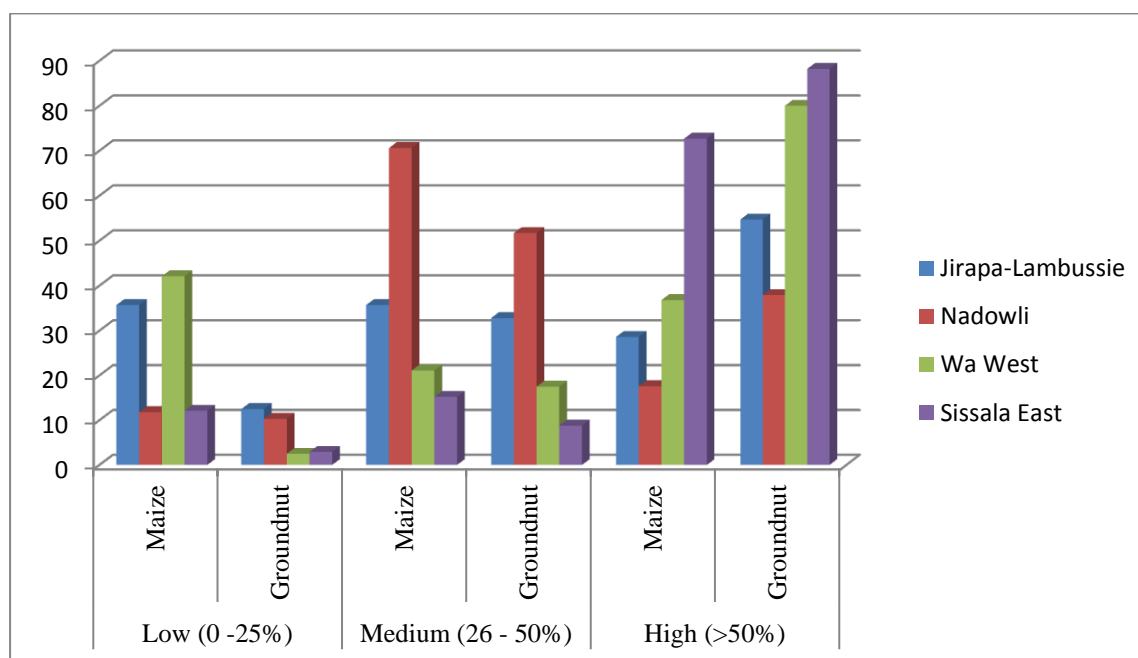
Source: Drawn from Household Survey Data, 2012

In terms of the characterisation of households based on districts, Figure 4.3 shows that Wa West District has the highest of low commercial maize farmers followed by the Jirapa-Lambussie while the Nadowli and the Sissala East Districts have the lowest low commercial maize farmers. With respect to groundnut, the Jirapa-Lambussie

District has the highest low commercial farmers followed by the Nadowli District, the Sissala East and the Wa West Districts.

With the medium scale commercial farmers, the Nadowli District has the highest maize and groundnut medium commercial farmers followed by the Jirapa-Lambussie District, the Wa West District and the Sissala East District.

Figure 4.3: Characterisation of Degree of Participation by District



Source: Drawn from Household Survey Data, 2012

The Jirapa-Lambussie District has the highest high commercial maize and groundnut farmers. However, the Wa West District is the second with high commercial maize farmers while the Nadowli District is the second with high commercial groundnut farmers. The Nadowli District has the least high commercial maize and groundnut farmers.

The reasons for these variations in the results are not certain as the study did not take a look at that. However, it can be speculated that differences in such characteristics such as soil fertility, cultural practises, level of development of certain infrastructure critical to production and marketing *inter-alia* are responsible for the variation in the marketing behaviour.

4.6 Determinants of Market Participation and Intensity of Participation of Smallholder Households

Stata version 12 was used to estimate the magnitude and effects of factors that determine the probability and intensity of smallholder farmers' participation in the maize and groundnut markets. The user written command, '*craggit*' by Burke (2009) was used for the estimation. This command estimates the first and second hurdles of the DHM simultaneously.

Before the estimation, diagnostic test for multicollinearity which is a common problem in any regression analysis was conducted based on variance inflation factor (VIF) to identify any potential misspecification problems that may exist in the estimated models. The presence of such a problem leads to estimates that are unstable and have high standard errors resulting in the insignificance of most or all the explanatory variables. The test indicated that the largest VIFs in the participation models are 2.09 and 3.14 and that of the intensity models are 3.11 and 3.47 for maize and groundnut respectively. These values are well below the maximum value of 10 that is used as a rule of thumb to indicate the presence of multicollinearity (Shiferaw *et al.*, 2008). This implies that multicollinearity is not a problem in the estimated models.

Heteroscedasticity is identified as a common problem with typical cross-section data. The established procedure for the correction of heteroscedasticity is to estimate the models using robust standard errors. Therefore, all the models are estimated using robust standard errors to correct for heteroscedasticity. Tables A4.2 and A4.3 in the appendix display the summary statistics of variables used in the maize and groundnut models respectively.

The test of hypothesis between the DHM and the Tobit models to identify which of them best fits the data shows that the DHM best suits the data. From Table A4.4 (in the appendix), the test values of 108.47 and 65.80 for the maize and groundnut models respectively outweigh the critical value of 30.58. This implies that the null hypothesis of Tobit specification is rejected confirming the superiority of the DHM over the Tobit model. Also, the test between the DHM and the Heckman model as displayed in Table A4.4 shows that the DHM is best applicable to the data and hence suitable than the Heckman model in both the maize and groundnut models. The estimates of the Tobit and Heckman models are presented alongside the estimates of the DHM. However, discussions of results are done with the DHM estimates.

4.6.1 Determinants of Market Participation of Smallholder Farm Households

The results for the determinants of market participation (estimated by the Probit model, hurdle one) are displayed in Table 4.4. The Wald chi-square values of 88.83 and 30.89 for the maize and groundnut models respectively are statistically significant at 1% indicating that the explanatory variables in both models jointly explain the probability of participating in both markets.

The decision to participate in the maize market is significantly determined by 10 of the 15 variables. Specifically, age of the household head, number of years in school (educational status) of the household head, household size, membership in farmer based organisation, farm size, annual household income, proportion of off-farm income in total annual household income, output of maize, access to credit and market information are the significant determinants. With respect to the decision to participate in the groundnut market, 10 of the 15 variables are statistically significant determinants. These are age of the household head, gender of the household head, household size, farming experience, membership in farmer based organisation, annual household income, proportion of off-farm income in total annual household income, output of groundnut, access to extension contact and access to market information.

The significant variables determining the decision to participate in the maize and the groundnut markets are well distributed over the categorisation of the covariates: household characteristics, private assets, public assets and transaction cost variables.

The coefficients of the age variable in the maize and groundnut market participation models are statistically significant at 1% and 10% respectively and have negative effect on the probability to sell maize and groundnut. The interpretation is that older farmers are less likely to participate in the market of these crops as compared to younger ones. This is consistent with the finding of Boughton *et al.* (2007) who estimated a negative coefficient for maize market participation in Mozambique. Other literatures that support a negative estimated coefficient are Siziba *et al.* (2011), Olwande and Mathenge (2012), and Reyes *et al.* (2012). In the case of maize farm households especially, this finding probably means that older farmers might be more

concerned about being food secured and would not want to take the risk of draining their maize banks as against the younger farmers who might want to enhance their quality of life hence would engage in the market to achieve their objectives. The fact that maize is a consumption commodity or staple in Ghana supports this explanation.

Another plausible reason supporting this finding in the case of both crops might be such factors as the ability of younger farmers to produce more output raising larger marketable surplus and the tendency of having smaller household sizes permitting them to have a higher likelihood of selling than older farmers. Also, Enete and Igbokwe (2009) argued that younger heads are more dynamic with regards to adoption of innovations both in terms of those that would enhance their productivity and enhance their marketing at a reduced cost. Randela *et al.* (2008) also observed that younger farmers are expected to be progressive, more receptive to new ideas and to better understand the benefits of agricultural commercialisation.

The gender variable has a positive coefficient only for the groundnut probability model and is statistically significant at 5%. This means that male headed households are more likely to sell groundnut than female headed households. This observation is consistent with Boughton *et al.* (2007); Olwande and Mathenge (2012) and Siziba *et al.* (2011). The reason for this finding is attributable to the fact that males are more accessible to land and are able to cultivate large tracts of land as compared to their female counterparts. Also, males often receive the support of the females on their farms more than the females do. Moreover, most of the female headed households are such households where the head is a widow with less economic and physical power to farm intensively.

Table 4.4: Estimates of Determinants of Market Participation and Intensity of Participation

Variable	Double Hurdle Estimates				Tobit Estimates		Heckman Estimates			
	Hurdle/Tier1 Probability of Participating in the Market (Probit Regression)		Hurdle/Tier2 Intensity of Participating in the Market (Truncated Normal Regression)				Participation Stage (Probit Regression)		Intensity Stage (Ordinary Least Squares)	
	Maize	Groundnut	Maize	Groundnut	Maize	Groundnut	Maize	Groundnut	Maize	Groundnut
	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient
CONSTANT	1.4578** (0.7373)	-4.6473*** (1.6001)	29.0423*** (10.4511)	37.5811*** (9.1133)	29.5434*** (9.8231)	35.7121*** (9.0199)	1.260 (0.7846)	-5.5171*** (1.6127)	31.2674***	45.6703*** (11.4825)
AGE	-0.0408*** (0.0100)	-0.0323* (0.0189)	-0.5130*** (0.0991)	-0.2205** (0.1069)	-0.5015*** (0.0957)	-0.2102* (0.1076)	-0.0420*** (0.0106)	-0.0174 (0.0156)	-0.6159*** (0.1159)	-0.1383 (0.1027)
GEN	-0.1662 (0.3860)	1.8360** (0.8418)	-10.4799** (4.6090)	-5.7587 (3.6187)	-9.9195** (4.2956)	-6.3040* (3.6114)	0.0809 (0.4262)	1.2435* (0.6985)	-10.7437** (4.5775)	-6.5025* (3.6507)
EDUC	-0.0751** (0.0357)	-0.0111 (0.0760)	0.2644 (0.2719)	0.3268 (0.3063)	0.2343 (0.2694)	0.3166 (0.3090)	-0.0886** (0.0353)	0.0349 (0.0683)	0.1289 (0.2764)	0.3352 (0.2912)
MARST	-0.3491 (0.3800)	-0.2087 (0.5969)	-3.0830 (3.5305)	6.1499* (3.2247)	-3.1854 (3.5978)	6.3588** (3.1542)	-0.3203 (0.3556)	0.7914** (0.3818)	-2.3284 (3.5356)	7.7230** (3.2351)
HHSIZE	-0.1580*** (0.0337)	-0.1692*** (0.0602)	0.6033*** (0.2052)	0.1147 (0.2297)	0.5757*** (0.2027)	0.0979 (0.2461)	-0.1601*** (0.0362)	-0.0924** (0.0360)	0.4153 (0.2566)	0.0775 (0.2204)
FEXP	0.0010 (0.0103)	0.1980*** (0.0648)	0.0991 (0.0996)	0.2085* (0.1140)	0.1260 (0.0887)	0.2165* (0.1174)	-0.0002 (0.0118)	0.1552** (0.0601)	0.1304 (0.1150)	0.1020 (0.1103)
MFBO	1.2002*** (0.4260)	-2.0883** (0.8432)	0.1742 (3.7230)	-0.8118 (3.5734)	0.2856 (3.6572)	0.4083 (3.5128)	0.7710 (1.9623)	-2.5022*** (0.8112)	1.6844 (4.0612)	-0.3301 (3.6423)
FRMSIZE	0.7742*** (0.2835)	1.0242 (1.2760)	0.6515 (2.3759)	1.8551 (3.3957)	0.4776 (2.2686)	-1.7769 (4.1595)	0.8280*** (0.3053)	2.6654*** (0.5195)	2.9214 (2.6727)	-1.4165 (3.2682)
HHINC	0.0005** (0.0002)	0.0123*** (0.0034)	0.0028*** (0.0006)	0.0016** (0.0007)	0.0029*** (0.0006)	0.0013* (0.0008)	0.0004** (0.0002)	0.0086*** (0.0030)	0.0031*** (0.0008)	0.0013 (0.0009)
OFINC	3.4399*** (1.0801)	-1.7575* (1.0144)	-10.6958** (4.4348)	-0.9165 (5.4294)	-9.6625** (4.4430)	-0.4401 (5.3038)	3.8325*** (1.0791)	-2.4183*** (0.6919)	-6.3284 (5.5296)	-2.0718 (5.1641)
OUTPUT	0.0780** (0.0350)	0.5446** (0.2486)	0.1824*** (0.0692)	0.5023** (0.2120)	0.1835*** (0.0662)	0.8964*** (0.3411)	0.0690*** (0.0240)	-0.0381 (0.1595)	0.2204** (0.0945)	0.6557*** (0.2003)

Table 4.4 (Continued)

Variable	Double Hurdle Estimates				Tobit Estimates		Heckman Estimates			
	Hurdle/Tier1 Probability of Participating in the Market (Probit Regression)		Hurdle/Tier2 Intensity of Participating in the Market (Truncated Normal Regression)				Participation Stage (Probit Regression)		Intensity Stage (Ordinary Least Squares)	
	Maize	Groundnut	Maize	Groundnut	Maize	Groundnut	Maize	Groundnut	Maize	Groundnut
TEL	0.0349 (0.2819)	0.5048 (0.8898)	-1.8071 (2.6761)	9.9103*** (3.1951)	-1.7760 (2.6225)	9.0427*** (3.2043)	0.0893 (0.2972)	-0.0481 (0.5699)	-1.2151 (2.6292)	10.1609*** (3.0152)
ACCRES	0.9644** (0.3765)	-0.7400 (0.6710)	8.2491*** (3.1061)	8.1894** (3.2540)	8.3355*** (3.0654)	7.3766** (3.5982)	1.5546*** (0.5121)	-0.9869 (0.6040)	10.4812*** (2.8588)	8.5297** (3.6250)
EXTCON	-0.0090 (0.2844)	-1.4721** (0.6967)	-2.8364 (2.4777)	0.8704 (2.9165)	-2.7625 (2.3818)	0.9721 (3.0683)	0.0415 (0.2810)	-0.1745 (0.5100)	-2.9669 (2.3719)	1.3118 (2.8209)
PRICE			0.4491*** (0.0705)	-0.0804 (0.0731)	0.4451*** (0.0722)	-0.0287 (0.0768)			0.3827*** (0.0726)	-0.0535** (0.0268)
MKTINFO	0.5263* (0.2683)	1.7338** (0.6824)	11.1541*** (3.8656)	13.3630*** (3.6014)	9.7552*** (3.5579)	12.6113*** (3.3731)	0.5911* (0.3040)	2.2264*** (0.8346)	9.7208*** (3.2516)	12.2965** (5.9657)
POS			-9.1329*** (2.5478)	-4.5787* (2.3941)	-8.2468*** (2.4810)	-4.8528* (2.4909)			-8.0109*** (2.4336)	-4.4716* (2.5175)
FOS				6.0617* (3.3157)		7.5118** (3.4447)				-3.2346 (5.8257)
No. of observations			200	200	97	167			200	200
Wald chi2(15), (18) for Heckman			88.83	30.89	--	--			380.48	211.42
Prob > chi2			0.0000	0.0091	--	--			0.0000	0.0000
F (19, 150)			--	--	48.43	21.29			-	-
Prob > F			--	--	0.0000	0.0000			-	-
Pseudo R ²			--	--	0.1818	0.0984			-	-
Log pseudo likelihood			-417.9167	-693.1641	-363.6839	-660.2632			-418.6152	-687.5412

Values in parentheses are robust standard errors for DHM and Tobit but standard errors for Heckman

***p < 0.01, **p < 0.05 and *p < 0.10

Source: Regression Estimates from Household Survey Data, 2012

These dimensions relatively favour the males with respect to the output subsequently leading to higher probability of participating in the market. Cunningham *et al.* (2008) found that men are likely to sell more grain early in the season when prices are still high, while women prefer to store more output for household self-sufficiency.

Number of years spent in school by the household head has a negative coefficient only for the maize probability model and is statistically significant at 5%. This means that a higher level of education is associated with a reduction in the probability of participating in the maize market. This observation contradicts the expectation of Makhura *et al.* (2001), Enete and Igbokwe (2009), Randela *et al.* (2008), Southworth and Johnston (1967), Schultz (1945) and Ofori (1973) who argued that education will endow the household with better production and managerial skills which could lead to increased participation in the market. It is however consistent with the estimate of Boughton *et al.* (2007) for maize market participation. The possible explanation for this is that farmers with a higher level of education engage in farming on a part time basis while they commit to their full time jobs. Since maize is a staple, more of the output is stored for household consumption. However, farmers with low level of education farm as full time farmers since they do not have any qualification for white collar jobs. This provides the potential for higher outputs and hence ability to participate.

Household size has negative coefficient for both the probability to participate in the maize and the groundnut markets and are all statistically significant at 1%. The meaning is that households with larger sizes are less likely to sell their maize or groundnut output. This result is consistent with the *a priori* expectation and confirms

the finding of Siziba *et al.* (2011) that households with large family sizes fail to produce marketable surplus beyond their consumption needs. It also confirms the finding of Olwande and Mathenge (2012) who estimated a negative significant coefficient of dependency ratio since households with larger size are more likely to have higher dependency ratios and the finding of Makhura *et al.* (2001) that households decide to sell, when they cannot consume all they have produced and hence, the more members the household has, the more likely that most of the produce will be consumed thereby decreasing the possibilities for selling. For groundnut producing households in particular, larger sizes might constrain the ability to farm larger farm sizes leading to lower marketable surpluses rather than consumption constraint.

The coefficient of farming experience for the groundnut probability of participation model is positive and significant at 1%. This implies that households with more experience in groundnut farming have higher probability of selling groundnut than households with low experience. One possible reason is that households with higher experience in groundnut farming have over time developed some understanding of market dynamics and therefore improve decisions about participating (Makhura *et al.*, 2001). Such farmers might also have developed low cost avenues or channels of sale thereby providing an urge to participate over households with less farming experience.

The coefficients of membership in farmer based organisation are statistically significant at 1% and 5% and have positive effect and negative effect on the probability to participate in the maize and the groundnut markets respectively. The α

priori expectation for the maize probability model is therefore met while that of the groundnut probability model is counter-intuitive. The result on maize market participation is consistent with Olwande and Mathenge (2012) who argued that membership of a farmer to a farmer based organisation or group increases access to information important to production and marketing decisions while Matungul *et al.* (2001) observed that collective action as measured by belonging to farmers' organisations strengthens farmers' bargaining and lobbying power and facilitates obtaining institutional solutions to some problems and coordination. A reason for the contradiction of the groundnut coefficient might be attributable to the observation that most groundnut farmers' groups were tagged as not vibrant and hence were not effective in providing the necessary support that can influence participation by members.

The coefficient of farm size has a positive effect on only the probability of participating in the maize market and statistically significant at 1%. This means that farmers with larger farm sizes are more likely to sell maize. This finding is consistent with *a priori* expectation as well as confirms the observation of Makhura *et al.* (2001), Boughton *et al.* (2007), Siziba *et al.* (2011), and Olwande and Mathenge (2012). This highlights the constraints smallholder farmers, majority of who happen to be poor, face in accessing markets probably due to their inability to produce marketable surplus. The finding could also be associated with the fact that a larger farm size provides a greater opportunity for surplus production. In the case of maize, farmers in the region make extensive use of fertilizer to increase output as the fertility of the land has declined over the years. Therefore, the size of the land induced by the use of fertilizers is significant in the output achieved.

Annual household income is significantly associated with a higher probability of participating in both the maize and the groundnut markets at 5% and 1% respectively. The possible reason is that households with larger incomes are able to cultivate larger parcels of land than those with lower incomes. Consequently, larger parcels of land result in the ability to produce marketable surplus to participate in the market.

The proportion of off-farm income in total annual household income has positive and negative coefficients for the maize and the groundnut probability of participation models and is significant at 1% and 10% respectively. In the case of the maize model, households with higher proportion of off-farm income in total annual household income are more likely to sell maize while in the groundnut probability model households with higher proportion of off-farm income in total annual household income are less likely to sell their outputs. The possible implication for the positive coefficient in the maize model is that maize farming and off-farm activities in the region are to some extent complementary. Maize farm households who engage in off farm activities invest the income in the production of maize. The complementarity could be explained by the fact that maize is a staple and has to be produced for consumption to sustain livelihoods. The possible implication for the negative coefficient in the groundnut probability model is that groundnut farming and off-farm activities in the region are to some extent substitutes instead of being complements. If groundnut farm households earn more income from off-farm activities, they tend to shift their attention from intensive groundnut farm activities hence low marketable surplus to participate in the market. This implies that there is a trade-off in farm and off-farm engagements with respect to the cultivation of groundnut. This result confirms the finding of Martey *et al.* (2012) that off-farm income triggers off-farm

diversification a situation that reduces the probability of farm households from participating in the market.

The output of maize and groundnut are significantly associated with higher probability of participating in both markets which is consistent with expectation since a higher output ensure marketable surplus. The estimates are all statistically significant at 5%. This finding is consistent with Reyes *et al.* (2012) and underscores the importance of increased output by smallholders to enhance their chances of stepping out of poverty and improving their livelihood through increased income from increased participation in the market.

The access to credit coefficient is statistically significant at 5% and has a positive influence on only the probability of selling maize. This result indicates that farmers with access to credit are able to produce enough marketable surpluses. One supporting argument is that access to credit gives the farm households the economic power to cultivate on large scale. Also, the obligation of paying back the loan together with the interest provides incentive for producing beyond consumption decision to a market oriented production to meet these obligations.

The coefficient of access to extension contact is negative for only the groundnut probability of participation model and significant at 5%. This finding is rather inconsistent with expectation and the explanation in support of it is not apparent. Perhaps, farmers with extension contact did not strictly adhere to the improved farm practices and since extension agents are reported to be constrained in embarking on effective supervision no corrective measures were taken. Also, the result may be

attributed to lack of effective monitoring in ensuring effectiveness in utilization of improved technology passed on to the farmers (Martey *et al.*, 2012).

Access to market information has a positive effect on both the probability of selling maize and groundnut and is statistically significant at 10% and 5% respectively. This is consistent with expectation and confirms the finding of Siziba *et al.* (2011) who argued that access to information reduces risk perceptions. Another possible explanation for this result could be that farmers with access to market information might be easily persuaded to sell than those without such information.

From the analysis of these significant variables, key factors in determining the probability of participating in the maize market in terms of the magnitude of such factors are: membership in farmer based organisation, farm size, proportion of off-farm income in total annual household income, output of maize access to credit and access to market information. Key ones for the probability of participating in the groundnut market are: groundnut farming experience, membership in farmer based organisation, proportion of off-farm income in total annual household income, output of groundnut, access to extension services and access to market information. These factors provide key information for policy interventions in enhancing the probability of selling maize and groundnut.

4.6.2 Determinants of the Intensity of Market Participation of Smallholder Farm Households

The results for the determinants of the intensity of market participation (estimated by the Truncated regression model, hurdle two) are also displayed in Table 4.4.

The intensity of participation in the maize market is significantly determined by 10 of the 17 variables. The determining factors are age of the household head, gender of the household head, household size, annual household income, proportion of off-farm income in total annual household income, output of maize, access to credit, average price of maize output sold, access to market information and point of sale of maize output. With respect to the intensity of participation in the groundnut market, 10 of the 18 variables are statistically significant determinants. These are age of the household head, marital status of the household head, experience in groundnut farming, annual household income, output of groundnut, ownership of mobile phone, access to credit, access to market information, point of sale of groundnut output and form of sale of groundnut.

The coefficient of age is negative for both the maize and the groundnut intensity models and statistically significant at 1% and 5% respectively. For both intensity models, conditioned on participation in the market, older farmers tend to sell less maize and groundnut than the younger ones. For an additional year of a farmer, the quantity of maize and groundnut sold decreases by 0.51% and 0.22% respectively. One possible explanation is that the older farmers are more concerned with food security and therefore livelihood. However, younger farmers apart from the issue of livelihood might be interested in improving their quality of life through acquisition of life-enhancing materials. This possible drive for such materials causes them to sell more than the older farmers.

Another reason backing the finding is the observation from the data that younger farmers farm more than the older ones hence have a relatively more marketable

surplus. Farmers within the age range of 20 to 40 produced 1275 bags and 1449 bags of maize and groundnut representing 57.8% and 69.6% of total output of 2205 bags and 2083 bags respectively. Farmers within the age range of 41 to 60 produced 589 bags of maize representing 26.7% while those above 60 produced 341 bags representing 15.5%. This result contradicts the finding of Martey *et al.* (2012) that older farmers are able to increase in the extent of maize commercialization due to the fact that they have more contacts to allow trading partners to be discovered at lower cost relative to younger household heads.

The gender variable has a negative coefficient and is statistically significant at 5% for only the maize intensity model. This means that male headed households sell less maize than their female counterparts. Female farmers sell 10.48% more maize than male farmers. This finding is unconditional on the probability of participation in the maize market. The negative estimate contradicts the *a priori* expectation and the observation of Cunningham *et al.* (2008) that men are likely to sell more grain early in the season when prices are still high, while women prefer to store more output for household self-sufficiency. A possibility for this rather unexpected finding is informed by the observation that female household heads were either widows or had their husbands incapacitated to act as heads. The implication emanating from this observation is that female headed households would have to sell more maize in order to shoulder social and economic responsibilities as heads. Also, the data showed female headed households with very small household sizes providing the ability of raising enough marketable surpluses. This finding strengthens the debate in favour of making productive assets accessible to women since it is argued that they are equally productive.

The coefficient of marital status statistically significant at 10% is positively associated with only the quantity of groundnut sold. This means that married household heads sell more quantity of groundnut (6.15% more) than unmarried heads. While marital status does not influence the probability of participation, it significantly positively influences the amount of groundnut sold. This implies that the quantity of groundnut sold by household heads who are married is unconditional on participation. This perhaps is due to the fact that married farmers are able to raise enough marketable surpluses. Also, married farmers have more economic and social responsibilities to meet and hence have to sell more groundnuts to cater for such needs. This finding is supported by the observation in the region that married heads collectively engage in farming activities and receive the full support of their spouses as though they are operating a partnership kind of venture. This influences large production and hence large quantity of groundnut sold.

Household size is positively associated with only the quantity of maize sold and is significant at 1%. While the probability of selling maize is significantly negatively associated with the household size, conditional on selling, the quantity sold is positively associated with the household size. An increase in the household size by 1 person increases sale of maize by 0.60%. This implies that though households with larger sizes are less likely to participate in the maize market as sellers, they sell more maize when they participate. This confirms the finding of Makhura *et al.* (2001) that an increase in the household size increases the amount of maize sold. Also, perhaps, households with larger sizes aside their consumption needs have other socio-economic needs that drive them to sell more maize to prop them up financially to meet those needs. Another possibility is that, households with larger household sizes

and their participation decision is an indication of relative large production in the farm season.

The coefficient of farming experience is positively correlated with only the amount of groundnut sold and is statistically significant at 10%. Conditioned on participation, households with more experience in groundnut farming sell 0.21% more groundnut than those with less experience. This is consistent with the finding of Martey *et al.* (2012) that experienced household heads are able to take better production decisions and have greater contacts which allow trading opportunities to be discovered at lower cost. Also more experienced farmers over time have acquired some understanding of market dynamics and therefore improve decisions about the amount of output sold (Makhura *et al.*, 2001).

Conditioned on participation in both the maize and the groundnut markets, household income is positively correlated with the amount of maize and groundnut sold and is significant at 1% and 5% respectively. This implies that, considering the probability of participation and the quantity sold in both markets, households with higher income are more likely to participate and then sell more maize and groundnut than those with lower income. A GH¢1 increase in annual household income increases the quantity of maize and groundnut sold by 0.003% and 0.002% respectively. One possible explanation for this is that higher household income presents the opportunity for cultivating large farm sizes and purchasing productivity enhancing inputs leading to high output and then large marketable surpluses.

While the proportion of off-farm income in total annual household income is positively related to the probability of participating in the maize market, it is negatively related to the quantity of maize sold, significant at 5%. This implies that conditioned on participation, households with higher proportion of off-farm income in total annual household income sell 10.70% less maize. This is consistent with the findings of Martey *et al.* (2012), Alene *et al.* (2008) and Omiti *et al.* (2009) and implies that maize market participants do not invest off-farm income in farm technology and other farm improvement activities and tends to trigger off-farm diversification. It however contradicts the finding of Siziba *et al.* (2011) who estimated a positive effect and argued that farmers who were more liquid (from off-farm income) were able to finance production and produced more marketable surplus.

Outputs of both maize and groundnut are associated with more sales of both crops conditioned on participation in both markets and are significant at 1% and 5% respectively. For every extra 50kg bag of maize and groundnut produced, 0.18% and 0.50% respectively would be sold. This confirms the finding of Reyes *et al.* (2012) that farmers who have greater production have more surpluses they could sell and Martey *et al.* (2012) that households with higher value of crop produced sell higher proportion of their produce. Surplus production serves as incentive for a household to participate in market (Omiti *et al.*, 2009; Rios *et al.*, 2008; and Barrett, 2008).

Ownership of telephone unconditioned on the probability of selling groundnut has a positive effect on only the quantity of groundnut sale. The estimate which is statistically significant at 1% implies that groundnut farm households who owned mobile phone sold 9.91% more groundnut than their counterparts without mobile

phones. This finding is consistent with expectation as well as the finding of Olwande and Mathenge (2012) who found that the ownership of communication equipment such as radio, television and/or phone has positive and significant influence on the amount sold of maize. The possible reason for this finding is that ownership of a mobile phone by a farmer provides the potential of sourcing market information from diverse sources which boosts the quantity sold. This finding buttresses the importance of market information in the marketing behaviour of households.

The coefficient of access to credit is positively associated with the intensity of participation in both the maize and groundnut markets and is statistically significant at 1% and 5% respectively. This means that households with access to credit sell 8.25% and 8.19% more maize and groundnut respectively than households without access. Access to credit is unconditional on the probability of participating in the groundnut market but conditional on the probability of participating in the maize market. This result is expected since access to credit provides the financial strength for households to engage in intensive farming leading to more marketable surplus. Another plausible reasoning could be that households with access to credit need to raise enough money to pay back their debts/loans. Also, it is possible that lenders might be interested in lending to farmers who are market-oriented consistently in order to redeem their funds hence those who had access to credit are noted for their high degree of sales.

The coefficient of the average price of the output of maize, significant at 1%, is positively associated with the quantity of maize sold implying that households who were faced with higher prices sold 0.45% more maize than those who had relatively lower prices. This finding is consistent with expectation and reflects the selling

behaviour (selling at their times and at different prices) of the farmers in the region. This finding confirms the assertion from economic theory that output price is an incentive for farm households to supply more produce for sale (Martey *et al.*, 2012). It also confirms the findings by Omiti *et al.* (2009) and Olwande and Mathenge (2012) that output price is an incentive for sellers to supply more maize in the market.

Access to market information has a positive association with both the quantity of maize and groundnut sold all conditioned on participation in the maize and groundnut markets and all are significant at 1%. Households who had access to market information sold 11.15% and 13.36% more maize and groundnut respectively than those who did not have access. This confirms the finding of Siziba *et al.* (2011), Omiti *et al.* (2009), and Olwande and Mathenge (2012). Siziba *et al.* explains that this finding underscores the positive impact of public infrastructure and services in promoting market participation while Omiti *et al.* gathered that formal information sources enhance the intensity of market participation. According to Martey *et al.* (2012), market information guarantees producers flow of insights on market requirements and opportunity sets that enable farmers to plan effectively.

The point of sale of output (which sort to capture the effect of transaction cost in marketing behaviour of farm households) negatively influences the quantity of both maize and groundnut sold. The estimates are statistically significant at 1% and 10% respectively. Households who sold maize and groundnut travelling to market centres sold 9.13% and 4.58% less maize and groundnut respectively as compared to those who sold at farm-gate (in their houses). This finding is expected and confirms the findings of Omiti *et al.* (2009) and Martey *et al.* (2012). According to Martey *et al.*

(2012), distance to market is an indicator of travel time and cost. Once it is more costly and time consuming to travel to especially bigger market centres as compared to farm-gate sale, farmers are rational to choose to sell more at farm-gate even though big market centres in bigger and more developed communities offer higher prices. The average price of farm-gate sale of maize and groundnut are GH¢67.03 and GH¢71.40 per 50kg bag respectively while the market centre average are GH¢79.51 and GH¢115.40 per 50kg bag respectively. Given that higher prices prevail in market centres and yet more output is sold at the farm-gate, it can be opined that transaction cost has a role to play in explaining why more output of maize and groundnut are sold at the farm-gate. To explain further the role of transaction cost, 68.3% and 64.4% of maize and groundnut households respectively indicated that they sold at the farm-gate to avoid paying transportation fare or incurring other costs to get to market centres that offer higher prices. This implies that some households are not able to sell at market centres that offer higher prices as a result of transaction cost associated with reaching such markets.

The form of sale variable has a positive effect on the quantity of groundnut sold and is statistically significant at 10%. This means that, households who sold groundnut in the unshelled form sold more groundnut (6.06%) than those who shelled the groundnut before sale. A reason supporting this finding is that, shelling of groundnut is a labour intensive, time consuming and tedious activity. Therefore, households turn to sell without shelling if they have a larger marketable surplus in order to avert the effort and time to spare for shelling. This suggests that larger marketable surplus of groundnut serves as a disincentive to shelling owing to the burden involved.

Households with smaller surpluses find it comparatively easier to shell the few quantities they have.

Key factors determining the quantity of maize sold in terms of the magnitude of such factors are: proportion of off-farm income in total annual household income, access to credit, price of a bag of maize, access to market information, point of sale of maize. Key ones for the quantity of groundnut sold are: output of groundnut, access to telephone, access to credit, access to market information, point of sale of groundnut and form of sale of groundnut. These factors provide key information for policy interventions in enhancing the quantity of maize and groundnut sales.

Overall key determinants on both the probability and intensity of participation in the maize market are: access to credit, access to market information, price of maize and point of sale of maize. Overall key determinants of both the probability and intensity of participation in the groundnut market are: output of groundnut, access to market information, point and form of sale of groundnut. These factors provide key policy information for interventions in the maize and groundnut subsectors.

4.7 Ranked Constraints to Marketing

The identification of constraints of marketing was done through review of existing literature on marketing issues peculiar to the region. Despite empirical dimensions of the constraints to commercialisation of smallholder farmers outlined in the literature review, specific constraints to commercialisation were identified from the Wa regional office of MoFA. Ten major constraints were identified and presented for ranking. These constraints were presented to each respondent to identify those that

affected him or her before ranking these factors. Therefore, it has an in-built test of agreement approach, where the mean of scores are found per those who rank the particular factor and useful in making policy recommendations for a diverse population. The ranking of these marketing constraints faced by farm households in the Upper West Region using the Garrett ranking technique is presented in Table 4.5. The constraints were presented for maize households, groundnut households and a combination of the two crops. However, the discussion of the constraint is done using the aggregated constraints. The ranking included households who did not participate in the market. Though they did not participate, they also would face these constraints when they decide to participate. The discussion of the constraints is done in a decreasing order of merit considering the order of the constraint, the meaning, the reason why the constraint persists and the consequence of the constraint.

Unfavourable Market Prices

Unfavourable market prices according to the Garrett mean score (62.25) was found to be the most pressing constraint in marketing of maize and groundnut in the region. Unfavourable market price reflects low prices of maize and groundnut faced by households. The reason for the prevalence of this problem is explained by economic theory of demand and supply. In the harvesting season, there are gluts of maize and groundnut as well as other crops. This phenomenon forces prices downwards from the lucrative levels they were during the dry season. The problem actually remains in the inability of most households to store the produce in wait of lucrative prices. The consequence of this constraint is reduced incomes. This stifles efforts to break free from the cycle of poverty and make farming ill rewarding.

Table 4.5: Ranked Marketing Constraints of Farm Households

No	Constraint	Mean Garrett Score			Rank		
		Maize	Groundnut	Pooled	Maize	Groundnut	Pooled
1	Unfavourable market prices	60.84	63.67	62.25	1	1	1
2	Long distances to market	51.62	48.03	49.82	5	4	2
3	Poor roads to marketing centres	52.94	44.36	48.51	4	7	3
4	Market Uncertainties	44.66	55.04	47.96	8	3	4
5	Poor storage facilities	46.33	47.83	47.05	7	5	5
6	Inadequate market infrastructure	55.75	43.00	45.22	3	8	6
7	Inadequate access to means of transport	56.33	54.50	45.09	2	2	7
8	Buyers dictating prices	42.13	45.71	44.02	9	6	8
9	Taxes on marketing	47.00	42.58	43.29	6	9	9
10	Lack of government policy on marketing	39.29	41.46	40.72	10	10	10

Source: Compiled from Household Survey Data, 2012

Long Distances to Market

This constraint is the second most pressing in the region with a Garrett mean score of 49.82. The problem describes long distances to markets that offer lucrative prices. Most of the communities have small market centres but face poor prices in those internal markets. In pursuit of bigger markets mostly in large communities such as district capitals, centre of MoFA operational areas etc., farmers have to travel relatively long distances in order to exploit these markets.

The problem therefore persists because of the need to sell at higher prices. The consequence of this constraint is that farmers who happen to reach these bigger markets have to pay high transportation costs escalating overall marketing costs. Also, as a result of the high transportation costs, farmers are compelled to sell at farm-gate or in the internal markets at low prices.

Poor Roads to Marketing Centres

This constraint scored a mean of 48.51 representing the third most pressing constraint. The poor and deplorable nature of rural roads has been identified in Ghana as one of the country's developmental challenges especially in view of accessibility of these roads to health care, business (trade) and safety. Once the region has a chunk (83.7%; GSS, 2011) of its populace leaving in the rural areas, this problem cannot be over emphasised. The quest for better prices in bigger markets causes this problem to prevail. The consequences of this constraint are the disincentive to travel to bigger markets to pursue higher prices and the escalation of transportation cost by vehicle owners.

Market Uncertainties

With a Garrett mean score of 47.96, market uncertainties is the fourth pressing constraint to marketing in the Upper West Region. Market uncertainty is described in here as the instability of market prices. Farmers complained about the volatility of prices during the harvesting and processing periods. The cause of the volatility could be due to the complex interplay of market forces. Some consequence of this constraint is its potential to reduce the incomes of market participants and discourage farmers from participating.

Poor Storage Facilities

This constraint has a mean score of 47.05 and the fifth most pressing constraint. Farmers complained that they do not have proper storage facilities to keep their produce in wait for higher prices. It is therefore clear that this constraint persists because of poor prices during harvesting period. Some farmers also explained that they do achieve some bumper harvest that they could have stored in wait of better prices. Due to the lack of such modern storage facilities they have no option than to dole out the output at cheaper prices.

Inadequate Market Infrastructure

This constraint is the sixth ranked with a mean Garrett score of 45.22. Inadequate market infrastructure reflects the poor state of rural markets in terms of the physical structures constructed with thatch. Farmers who identified this as a constraint explained that these markets become very bad during the raining season when they are supposed to be engaged in it.

Inadequate Access to Means of Transport

Access to means of transport has a mean score of 45.09 becoming the seventh ranked constraint. This constraint affects more of households who have their communities far away from main roads. As a result, they find it difficult to access means of transport such as trucks and 'motor king.' The poor nature of roads reinforces the constraint of means. The consequence is that households without any option are forced to sell at farm-gate where they are exposed to low prices thereby reducing their income.

Buyers Dictating Prices

This constraint was ranked eighth with a mean score of 44.02. The constraint describes situations where buyers impose prices on sellers. This often happens in farm-gate sale where the buyer travels into the community. This constraint according to households used to be very serious but as a result of the broadcast of market prices on radio recently, it has reduced. This implies that buyers who still have the opportunity to dictate price information do so when the farmer has no option.

Taxes on Marketing

Tax on marketing is the ninth ranked constraint with mean score of 43.29. This constraint is a community specific issue. Not all communities charge taxes on marketing. This is probably the reason why only 31 households ranked it. This implies that it is not a very serious constraint in the region. In communities where taxes are charged, sales at farm-gate are not allowed since such sales can elude the community authority to charge tax. Therefore, households are mandated to sell in the market where taxes would be charged.

Lack of Government Policy on Marketing

This constraint is the least ranked with mean score of 40.72. Households who saw this to be a problem (132 households) complained that government does not help them in any way to sell their output especially in the areas of boosting prices (price control), constructing storage facilities and constructing roads. The consequence of this constraint is that households tend to lose confidence in some government policies not even related to marketing.

CHAPTER FIVE

MAJOR FINDINGS, CONCLUSION AND RECOMMENDATION

5.1 Introduction

This chapter presents the major findings, the conclusions and the policy recommendations arising from the conclusions of the study. Limitation of the study and suggestions for future research are also presented.

5.2 Major Findings of the Study

Based on the analysis carried out in this study, the following major findings are presented.

- On average 23.77% and 52.56% of the output of maize and groundnut respectively are sold in the Upper West Region within a production season. These show a high commercialisation index for groundnut and a low index for maize.
- About 64%, 16% and 21% of maize farm households are characterised as low, medium and high commercial households while 23%, 23% and 54% of groundnut farm households are characterised as low, medium and high commercial households.
- The decision to participate in the maize market is significantly determined by age of the household head, number of years in school (educational status) of the household head, household size, membership in farmer based organisation, farm size, total annual household income, proportion of off-farm income in total annual household income, output of maize, access to credit and market information.

- The decision to participate in the groundnut market is significantly determined by age of the household head, gender of the household head, household size, farming experience, membership in farmer based organisation, total annual household income, proportion of off-farm income in total annual household income, output of groundnut, access to extension contact and access to market information.
- The intensity of participation in the maize market is significantly determined by age of the household head, gender of the household head, household size, total annual household income, proportion of off-farm income in total annual household income, output of maize, access to credit, average price of maize output per 50kg bag sold, access to market information and point of sale of maize output
- The intensity of participation in the groundnut market is significantly determined by age of the household head, marital status of the household head, experience in groundnut farming, total annual household income, output of groundnut, ownership of mobile phone, access to credit, access to market information, point of sale and form of sale of groundnut output.
- Unfavourable market price is the highest marketing constraint encountered by farm households while lack of government policy on marketing is the least constraint to marketing in the region.

5.3 Conclusions of the Study

Based on the major findings of this study, the following conclusions are drawn.

- A strong case can be made in favour of the fact that maize is a household consumption commodity mainly produced as a staple. It has not gained the status of a cash crop while groundnut is produced as a cash crop in the region.
- The study confirms that farmer characteristics, private and public asset characteristics and transaction cost variables are the determinants of the probability and intensity of market participation of smallholder farm households.
- Unfavourable market price for maize and groundnut is among the major factors that limit intensity of market participation and hence smallholder income growth. This constraint stifles not only income growth but also poverty reduction efforts.

5.4 Policy Recommendations

Based on the conclusions of this study, the following recommendations are distilled.

- It has been shown that maize is a household consumption commodity. Therefore, productivity enhancing mechanisms such as making fertilizer and other agro-inputs both physically and financially available should be put in place by MoFA through the regional and district offices to increase production of maize in the region. The fertilizer subsidy programme should be strengthened by effectively targeting smallholders.

- To ensure increased production and productivity of maize, there should be the delivery of effective and proactive extension service alongside effective monitoring and supervision to ensure that what is delivered to farmers is effectively implemented by them. Extension agents should be well motivated through the provision of adequate fuel and field allowances to regularly visit and monitor the progress of farm households. For groundnut, these policy measures would increase the potential of increased income and hence broad-based poverty reduction.
- Based on the findings that access to credit is an influencing factor to maize participation and the intensities of participation in maize and groundnut markets, MoFA and other stakeholders should establish rural agricultural finance scheme aimed at addressing the credit needs of smallholder farmers. The development of the informal credit market should also be considered.
- The Statistics, Research and Information Directorate (SRID) of MoFA should create a department solely for providing agricultural market information to make information delivery effective.
- The finding that reveals that more output is sold at the farm-gate indicates the constraint of transaction cost in preventing farmers from reaching out to bigger marketing centres. Policy action emanating from this finding is to promote public investments in the development of modern market centres at vantage communities by the Village Infrastructure Project (VIP). The department of feeder roads and the Ghana Highways Authority should target the upgrading of rural roads as this would reduce transportation cost and hence stimulate the desire of farm households to participate in marketing centres.

- The National Food Buffer Stock Company (NAFCO) should intensify an effective buffer stock management system necessary to establish guarantee prices for smallholders at the peak of the harvesting season when prices are low.
- Farmers should effectively support the efforts by government and other stakeholders to form and maintain effective farmer groups to take advantage of credit facilities offered by microfinance and other credit institutions available. Microfinance institutions are willing to offer credit to groups because of the characteristic of joint liability which minimises their risk. Credit acquired should be invested directly in farm activities instead of diversions. Such effective groups can also better influence market prices for their products through their collective bargaining power.
- Farmers should invest in mobile phones and radio sets in order to acquire market information and establish effective linkage with marketing centres.
- Farmers are advised to participate in extension programmes and take advantage of the services rendered by extension agents on production and productivity enhancing measures. This would improve their production levels for greater market engagements.

5.5 Limitation of the Study

The key limitation of the study is identified considering the underlying theory provided by Bellemare and Barret (2006), and Barrett (2008). According to their theory, market participation outcome is divided into three distinct categories: net buyer (households whose net sales are negative), autarchic (households whose net sales are equal to zero), and net seller (households whose net sales are positive). This

study does not follow the division of market participation into the classes they provided. This limitation is technical but does not pose analytical consequences since they showed that each of the divisions of market participation can be made to stand alone.

5.6 Suggestions for Future Research

It is suggested for future research to consider market participation outcome in three distinct categories: net buyer (households whose net sales are negative), autarchic (households whose net sales are equal to zero), and net seller (households whose net sales are positive). This would give more detailed dimension of market participation. Further research could examine input market participation decisions of farm households alone or alongside the output market participation decision. Finally, further studies could also examine market participation over time. This would require panel data for that matter such a study would be more challenging.

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APPENDICES

APPENDIX 1: QUESTIONNAIRE FOR HOUSEHOLD SURVEY

DEPARTMENT OF AGRICULTURAL ECONOMICS AND AGRIBUSINESS
COLLEGE OF AGRICULTURE AND CONSUMER SCIENCES
UNIVERSITY OF GHANA, LEGON

QUESTIONNAIRE FOR HOUSEHOLD SURVEY

This questionnaire is to solicit information on Market Participation of Smallholder Farmers in the Upper West Region of Ghana. All information provided will be treated confidential and will be used solely for the purpose of the study.

Interviewer _____ Date of interview ____/____/2012
District _____ EA _____

Community/Village _____ Questionnaire Number _____

Farmer: Maize [] Groundnut []

SECTION A: HOUSEHOLD DEMOGRAPHIC/SOCIO-ECONOMIC CHARACTERISTICS

Responses to be provided by household head/primary decision maker

Household Information					
Name of respondent	Gender	Age (years)	Marital status	Level of Education	Telephone No.
Household size (total number of people in the household) _____					
No. of children (0 – 17 years) _____ No. of adults (18+ years) _____					
No. of dependents (below 18 and above 64 years) _____					
No. of people who worked on the maize/groundnut farm (excluding the head) _____ Adults _____ Children _____					
Years spent to reach his/her level of education _____					

- Number of years engaged in farming (in general up to 2011 season) _____
- How many years have you been farming maize/groundnut on your own (up to the 2011 season)? _____
- Were you a member of any farmers' organization (**an organisation that exists to build capacity and enforce collective bargaining power**) in the 2011 crop year? 01 Yes [] 02 No [] (**If no move to Q6**)
- If yes, give the name of the FBO _____
- How often did your association meet to discuss issues related to maize/groundnut? 01 Weekly [] 02 Fortnightly [] 03 Monthly [] 04 Quarterly [] 05 Annually []
- If no, why _____
- Ethnicity 01 Wala [] 02 Dagaaba [] 03 Sissala [] 04 Chakali [] 05 Lobi [] 06 Others [] (specify) _____

8. Religion 01 Christian [] 02 Islam [] 03 Traditional [] 04 Other [] (specify) __

Farm Size			
Total amount of arable land available for farming in the 2011 season (in acres) _____			
Amount of land cultivated to maize/groundnut in the 2011 season (in acres) _____			
Do you own the land devoted to maize/groundnut cultivation? Yes [] No []		If no, how did you pay for it? Cash [] portion of produce [] other [] (specify) _____	
Non-maize/groundnut farm income			
Did you engage in other crop farming aside maize/groundnut during the 2011 crop season? 01 Yes [] 02 No [] (If no move to Q17)			
If yes, indicate the crops _____			
If you engaged in the other crop activities for income indicate below			
No.	Tick	Farm Income Activity	Amount (GH¢)
1		<i>Food Crops:</i> e.g. cassava, yam, millet, sorghum, rice, pepper, tomato, beans, etc.	
2		<i>Cash crops:</i> e.g. soybeans, cotton, tobacco, etc.	
3		<i>Natural Resource:</i> e.g. hunting, fishing, fire wood collection, etc.	
4		<i>Livestock:</i> e.g. goat, sheep, chicken, cattle etc.	
5		Farm wages: e.g. labourer in other farms, etc.	
Total Amount GH¢			

Non-farm income			
9. Did you engage in any non-farm activity in the 2011 season? 01 Yes [] 02 No [] (If no move to Q22)			
10. If yes, what were the sources of your non-farm income? Indicate below.			
No.	Tick	Non-farm income Activity	Amount (GH¢)
1		Non-farm wage income e.g. security etc.	
2		Self-employed income: e.g. trading, artisan, carpentry, pito brewing etc.	
3		Others e.g. pension, capital earnings etc.	
Total Amount GH¢			
11. Did you receive remittance in the 2011 season? 01 Yes [] 02 No []			
12. If yes, indicate the total amount you received _____			

SECTION B: PRODUCTION, MARKETING AND PURCHASING INFORMATION

Production	
13. What was the total quantity of maize/groundnut you harvested (50kg bags) in the 2011 season? _____	
14. If the harvesting was in plots or a number of farmlands, indicate below:	
Plot/farmland	Quantity harvested (50kg bags)
Plot/farmland 1	

Plot/farmland 2							
Total							
Marketing							
15. What is the nearest market centre (s) to the community? _____							
16. What is the distance (in miles) to the market? _____							
17. What do you travel on to the nearest market centre 01 Road [<input type="checkbox"/>] 02 Footpath [<input type="checkbox"/>] 03 Other [<input type="checkbox"/>] (specify) _____							
18. If road, what is the nature of the road to the nearest market centre? 01 Tarred [<input type="checkbox"/>] 02 Untarred [<input type="checkbox"/>]							
19. If untarred, is it good or bad? 01 Good [<input type="checkbox"/>] 02 Bad [<input type="checkbox"/>]							
20. Did you sell maize/groundnut from your 2011 season harvest? 01 Yes [<input type="checkbox"/>] 02 No [<input type="checkbox"/>] (if no move to Q40)							
21. If yes, was the sale through a guaranteed market (arranged market)? 01 Yes [<input type="checkbox"/>] 02 No [<input type="checkbox"/>] (if no move to Q34)							
22. If yes (sold through guaranteed market) was all the output sold? 01 Yes [<input type="checkbox"/>] 02 No [<input type="checkbox"/>] (if no move to Q33)							
23. If yes (all output sold), what was the price per bag/bowl? GH¢ _____							
24. If all output was not sold, how many bags/bowls were sold? _____							
25. If sale was not through a guaranteed market, what was the source of sale? 01 Farm-gate [<input type="checkbox"/>] 02 Market centre [<input type="checkbox"/>] 03 Other [<input type="checkbox"/>] (specify) _____							
26. If farm-gate, who did you sell to? 01 Other households/traders within community [<input type="checkbox"/>] 02 Traders from outside the community [<input type="checkbox"/>] 03 Established enterprises (e.g. state or private cooperatives) [<input type="checkbox"/>] 04 Other [<input type="checkbox"/>] (specify) _____							
27. If farm-gate, why did you sell at the farm-gate? _____							
28. If market centre, who did you sell to? 01 Traders/market women [<input type="checkbox"/>] 02 Established enterprises (e.g. state or private cooperatives) [<input type="checkbox"/>] 03 Other [<input type="checkbox"/>] (specify) _____							
29. If market centre, why did you sell at the market? _____							
30. If sale was not through a guaranteed market, but specifically at any market centre or farm-gate (reference to Q27) indicate the following:							
Total quantity sold (in bags/bowls) _____							
No. of sale (only 2011 harvest)	Sales						
	Farm-gate			Market centre			
	Q sold (bags/bowls)	Price/bag/bowl	Q sold (bags/bowls)	Price/bag/bowl	Market	Distance to market (miles)	Nature of road to the market
1 st Sale							T[<input type="checkbox"/>] U[<input type="checkbox"/>]:
2 nd Sale							T[<input type="checkbox"/>] U[<input type="checkbox"/>]:
3 rd Sale							T[<input type="checkbox"/>] U[<input type="checkbox"/>]:
Total							
31. What quantity (in bags/bowls) of the amount harvested: (if farmer did not sell,							

skip Q41 and move to Q42)			
Was self-consumed?	Used as seed	Was given as gift?	Was lost due to post harvest losses?
32. If you did not sell at all (in reference to Q29), why did you not sell? 01 Output not enough [] 02 price not good for me [] 03 could not access market [] 04 Purposely for eating [] 05 other [] (specify) _____			
Assets of Transport			
Did you own any of the following assets in the 2011 season? (Multiple response possible)			
Asset	Tick	Condition	
Bicycle		Good []	Bad []
Donkey		Good []	Bad []
Motor bike/Motor King		Good []	Bad []
Vehicle (Specify)		Good []	Bad []
Other (specify)		Good []	Bad []
Means of transport of maize/groundnut to market (Only for those who sold maize/groundnut in the market centre)			
33. (If farmer had asset of transport) Did you use any of your means to transport maize/groundnut to the market? 01 Yes [] No []			
34. If yes which one (s)? _____			
35. If no why? _____			
(If farmer does not have asset of transport) What means of transport did you use? _			
How much did you pay for the means? _____			

Purchasing				
36. Did you purchase foodstuffs in the 2011 season? 01 Yes [] 02 No [] (If no move to next section, Q48)				
37. If yes, indicate the types of foodstuffs you purchased and amount below:				
Foodstuff	Tick	Quantity (bag/bowl)	Price per bag/bowl	Amount (GH¢)
Yam				
Millet				
Rice				
Maize				
Beans				
Groundnut				
Cassava				
Total				

38. Did you have access to market information for the sale of maize/groundnut in the 2011 season? 01 Yes [] 02 No [] (**if no move to 52**)
39. If yes, what kind of information? 01 Price [] 02 Other [] (specify) _____
40. Who provided the information? (Multiply response possible) 01 Friends [] 02 Relatives [] 03 Market women [] 04 Extension agents [] 05 Radio [] 06 Television [] 07 Other [] (specify) _____
41. Did you use any of this information to sell maize/groundnut? 01 Yes [] 02 No []

42. Did you have a mobile phone in the 2011 season? Yes [] No [] (if no move to Q55)
43. If yes, did you use it to access market information on maize/groundnut? Yes [] No []
44. If no, why didn't you use it to access information? _____
45. If no, why don't you have a mobile phone? _____

SECTION C: PUBLIC ASSETS CHARACTERISTICS

Access to credit				
46. Did you request for credit in the 2011 season? 01 Yes [] 02 No [] (If no move to Q62)				
If yes, what was the form of the credit? 01 Agricultural inputs [] 02 Cash [] 03 Both [] 04 Other (specify) _____				
48. If agricultural inputs, did you receive the inputs? 01 Yes [] 02 No []				
49. If yes, indicate the inputs _____				
50. If in cash did you receive the cash credit? 01 Yes [] 02 No []				
51. If yes, indicate the source and amount of the credit below:				
Source (Multiple responses possible)	Tick	Amount requested (GH¢)	Amount received (GH¢)	Amount devoted to maize/groundnut production
Neighbour/Relatives/Friends				
Group (ROSCA)				
Rural bank				
NGOs/MFI (specify)				
Commercial banks (specify)				
Others (specify)				
Total				
52. If no, provide reason (s) why you did not request for the cash credit. Select from these options: 01 Do not need [] 02 Involves paying bribe [] 03 Inadequate collateral [] 04 Do not want to pay interest [] 05 Cumbersome/expensive procedure [] 06 Lenders too far away [] 07 Interest rate too high [] 08 Others [] (specify) _____				
53. Did you have contact with any extension officer in the 2011 season? 01 Yes [] 02 No [] (if no move to Q57)				
54. If yes, how many working visits did you have with the extension officer (s)? _____				
55. Which type of services did you receive from the extension officer (s)? Production service [] Credit service [] Processing of agricultural produces [] Trading [] Other [] (specify) _____				
56. Did you have access to inputs? 01 Yes [] 02 No []				
57. If yes, did you actually get the inputs? 01 Yes [] 02 No []				
58. If yes, how did you get the inputs? 01 Bought [] 02 Credit [] 03 Gift 04 Other [] (specify) _____				
59. What was the distance to the input market if not within the community (in miles)?				
60. Specify the inputs you got access to 01 Fertilizer [] 02 Seed [] 03 Pesticides [] 04 Weedicides [] 05 Other (specify) _____				

SECTION D: CHALLENGES OF ASSESSING MARKET

61. Please identify and rank the constraints you face from the most to the least pressing (**1 means most pressing in that order**). If a constraint is not applicable to you don't rank it.

No.	Constraint	Tick	Rank	No. of constraint ranked
1	Poor road network to marketing centres			
2	Unfavourable market prices for maize/groundnut			
3	Poor storage facilities			
4	Long distances to market centres			
5	Market uncertainties			
6	Buyers dictating prices			
7	Taxes on marketing			
8	Lack of government policy to promote marketing			
9	Inadequate market infrastructure			
10	Inadequate access to means of transport			

APPENDIX 2: TABLES**Table A4.1: Characterisation of Degree of Participation by Households**

Degree	Maize				Groundnut			
	Participants		All		Participants		All	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Low	24	24.7	127	63.5	13	7.8	46	23.0
Medium	31	32.0	31	15.5	46	27.5	46	23.0
High	42	43.3	42	21.0	108	64.7	108	54.0
Total	97	100.0	200	100.0	167	100.0	200	100.0

Table A4.2: Summary Statistics of Variables used in the Maize Regression Models

Qualitative Variables		Quantitative Variables				
Variable	% sample (n=200)	Variable	Mean	Std Dev.	Min	Max
Participation:		Percentage of output sold	23.77	29.82	0	100
• Yes	48.5					
• No	51.5					
Gender:		Age (years)	46.98	16.09	21	88
• Female	14.0					
• Male	86.0					

Marital status:	No. of years in school	2.56	4.49	0	22
• Married					
• Otherwise					
FBO:	Household size	9.81	5.31	2	32
• Member					
• Otherwise					
Access to telephone:	Farmer experience (years)	12.97	13.58	1	68
• Access					
• Otherwise					
Access to credit:	Farm size (ha)	1.10	0.57	0.40	2.00
• Access					
• Otherwise					
Access to extension:	Household income (GH¢)	1123.80	1636.25	25	6900
• Access					
• Otherwise					
Market Information:	Proportion of off-farm income	0.07	0.20	0	1
• Access					
• Otherwise					
Point of sale (n=97):	Output (50kg bag)	11.02	13.28	1	89
• Farm-gate					
• Market centre					
	Average Price (GH¢) (n=97)	68.55	18.37	35	140

Table A4.3: Summary Statistics of Variables used in the Groundnut Regression Models

Qualitative Variables		Quantitative Variables				
Variable	% sample (n=200)	Variable	Mean	Std Dev.	Min	Max
Participation:		Percentage of output sold	52.56	30.56	0	100
• Yes	83.5					
• No	16.5					
Gender:		Age (years)	42.35	15.44	19	90
• Female	20.5					
• Male	79.5					
Marital status:		No. of years in school	2.38	4.09	0	18
• Married	80.0					
• Otherwise	20.0					
FBO:		Household size	9.84	5.35	2	32
• Member	13.0					
• Otherwise	87.0					
Access to telephone:		Farmer experience (years)	14.12	11.93	1	75
• Access	64.0					
• Otherwise	36.0					
Access to credit:		Farm size (ha)	1.22	0.56	0.40	2.00
• Access	17.0					
• Otherwise	83.0					

Access to extension:		Household income	1135.59	1567.26	35	9100
• Access	19.5	(GH¢)				
• Otherwise	80.5					
Market Information:		Proportion of off-farm	0.17	0.26	0	1
• Access	91.5	income				
• Otherwise	8.5					
Point of sale (n=167):		Output (50kg bag)	10.41	9.94	0.15	80
• Farm-gate						
• Market	41.9					
centre	58.1					
Form of sale (n=167)		Average Price (GH¢)	64.64	17.71	28	130
• Unshelled	74.8	(n=167)				
• Otherwise	25.2					

Table A4.4: Test of Hypothesis among Double Hurdle, Tobit and Heckman Models

Test	Likelihood Ratio Test		Vuong's Test for Model Specification	
Hypothesis	H ₀ = Tobit best fits data H ₁ = Double Hurdle best fits data		H ₀ = No difference between Heckman Model and DHM	
	Maize	Groundnut	Maize	Groundnut
Test statistic	108.47	65.80	4949.74	505.84
Critical value	$\chi_{(0.01,15)} = 30.58$	$\chi_{(0.01,15)} = 30.58$	Z = 2.326	Z = 2.326
Decision	Reject H ₀	Reject H ₀	Reject H ₀	Reject H ₀

Table A4.5: Market Participation by District

Crop	Participation	District							
		Jirapa-Lambussie		Nadowli		Wa West		Sissala East	
		Freq	%	Freq	%	Freq	%	Freq	%
Maize	Participated	28	35.0	17	42.5	19	47.5	33	82.5
	Not Participated	52	65.0	23	57.5	21	52.5	7	17.5
Groundnut	Participated	64	80.0	29	72.5	40	100.0	34	85.0
	Not Participated	16	20.0	11	27.5	0	0.0	6	15.0

Table A4.6: Reasons for not belonging to Farmer Group

Reason	Frequency	Percentage
No need of farmer group	34	9.5
No internal (local) leadership	97	27.1
No external drive/force	174	48.6
Lack of understanding	358	14.8

Table A4.7: Reasons for not applying for Cash Credit

Reason	Frequency	Percentage
Do not need	23	7.2

Inadequate collateral	177	55.1
Do not want to pay interest	4	1.2
Cumbersome/expensive procedure	18	5.6
Interest too high	4	1.2
Others	95	29.6

Table A4.8: Sources of Market Information

Source	Frequency	Percentage
Friends/Relatives	35	11.3
Market women	72	23.3
Radio	109	35.3
Others	93	30.1

APPENDIX 3: DHM, TOBIT AND HECKMAN REGRESSION RESULTS FROM STATA

3.1 DHM Regression Results of Maize Market Participation and Intensity of Participation

```
craggit PART AGE GEN EDUC MARST HHSIZE FEXP MFBO FRMSIZE HHINC OFINC OUTPUT TEL ACCRE EXTCON MKTINFO,
second(HCIP AGE GEN EDUC MARST HHSIZE FEXP MFBO FRMSIZE HHINC OFINC OUTPUT TEL ACCRE EXTCON PRICE
MKTINFO POS) vce(robust)
```

Estimating Cragg's tobit alternative

Assumes conditional independence

```
Number of obs = 200
Wald chi2(15) = 88.83
Prob > chi2 = 0.0000
Log pseudolikelihood = -417.91674
```

	Coef.	Robust Std. Err.	z	P> z	[95% Conf. Interval]	

Tier1						
AGE	-.0408447	.0099728	-4.10	0.000	-.060391	-.0212985
GEN	-.1662017	.3860113	-0.43	0.667	-.92277	.5903665
EDUC	-.0750786	.0356956	-2.10	0.035	-.1450406	-.0051166
MARST	-.349057	.3800358	-0.92	0.358	-1.093913	.3957995
HHSIZE	-.1579925	.0337197	-4.69	0.000	-.2240818	-.0919031
FEXP	.000957	.0102544	0.09	0.926	-.0191414	.0210553
MFBO	1.200172	.4259625	2.82	0.005	.3653006	2.035043
FRMSIZE	.7741793	.2835041	2.73	0.006	.2185214	1.329837
HHINC	.0004603	.0002219	2.07	0.038	.0000253	.0008952
OFINC	3.439909	1.0801	3.18	0.001	1.322951	5.556867
OUTPUT	.0780446	.0349914	2.23	0.026	.0094627	.1466265
TEL	.0348982	.2818556	0.12	0.901	-.5175287	.5873251
ACCRE	.964389	.3765186	2.56	0.010	.2264261	1.702352
EXTCON	-.0090041	.2843903	-0.03	0.975	-.5663988	.5483907
MKTINFO	.526264	.2682744	1.96	0.050	.0004557	1.052072
_cons	1.457815	.7372935	1.98	0.048	.0127459	2.902883

Tier2						
AGE	-.5130323	.099133	-5.18	0.000	-.7073294	-.3187352
GEN	-10.47987	4.609035	-2.27	0.023	-19.51341	-1.446323
EDUC	.2643508	.2718734	0.97	0.331	-.2685113	.7972129
MARST	-3.083005	3.530453	-0.87	0.383	-10.00257	3.836557
HHSIZE	.603284	.2051659	2.94	0.003	.2011663	1.005402
FEXP	.0991356	.0995869	1.00	0.320	-.0960511	.2943223
MFBO	.174198	3.723047	0.05	0.963	-7.122841	7.471237
FRMSIZE	.6514885	2.375867	0.27	0.784	-4.005125	5.308102
HHINC	.0028326	.0005777	4.80	0.000	.0017003	.0039648

OFINC	-10.6958	4.434765	-2.41	0.016	-19.38778	-2.003817
OUTPUT	.1824102	.069186	2.64	0.008	.0468081	.3180124
TEL	-1.807121	2.676061	-0.68	0.499	-7.052105	3.437863
ACCRE	8.24907	3.106124	2.66	0.008	2.161178	14.33696
EXTCON	-2.836393	2.477697	-1.14	0.252	-7.692591	2.019804
PRICE	.4491058	.0704658	6.37	0.000	.3109953	.5872163
MKTINFO	11.1541	3.865622	2.89	0.004	3.577624	18.73059
POS	-9.13285	2.547767	-3.58	0.000	-14.12638	-4.139319
_cons	29.04228	10.45109	2.78	0.005	8.558527	49.52603

sigma						
_cons	10.74012	.8325344	12.90	0.000	9.10838	12.37185

3.2 DHM Regression Results of Groundnut Market Participation and Intensity of Participation

craggit PART AGE GEN EDUC MARST HHSIZE FEXP MFBO FRMSIZE HHINC OFINC OUTPUT TEL ACCRE EXTCON MKTINFO, second(HCIP AGE GEN EDUC MARST HHSIZE FEXP MFBO FRMSIZE HHINC OFINC OUTPUT TEL ACCRE EXTCON PRICE MKTINFO POS FOS) vce(robust)

Estimating Cragg's tobit alternative
Assumes conditional independence

Log pseudolikelihood = -693.16409

Number of obs	=	200
Wald chi2(15)	=	30.89
Prob > chi2	=	0.0091

	Coef.	Robust Std. Err.	z	P> z	[95% Conf. Interval]	

Tier1						
AGE	-.0323351	.0188511	-1.72	0.086	-.0692825	.0046123
GEN	1.835975	.8417715	2.18	0.029	.1861334	3.485817
EDUC	-.011123	.0760477	-0.15	0.884	-.1601739	.1379278
MARST	-.2086925	.5968547	-0.35	0.727	-1.378506	.9611213
HHSIZE	-.1691739	.0602428	-2.81	0.005	-.2872476	-.0511002
FEXP	.1979977	.0648069	3.06	0.002	.0709785	.3250169
MFBO	-2.088292	.8431629	-2.48	0.013	-3.740861	-.4357234
FRMSIZE	1.024183	1.276031	0.80	0.422	-1.476791	3.525158
HHINC	.0123263	.0033594	3.67	0.000	.0057421	.0189105
OFINC	-1.757508	1.014411	-1.73	0.083	-3.745716	.2307007
OUTPUT	.5446138	.248616	2.19	0.028	.0573353	1.031892
TEL	.5048173	.8898267	0.57	0.570	-1.239211	2.248846
ACCRE	-.740008	.6710178	-1.10	0.270	-2.055179	.5751627
EXTCON	-1.472095	.6966949	-2.11	0.035	-2.837592	-.1065983
MKTINFO	1.733833	.6824026	2.54	0.011	.3963484	3.071317
_cons	-4.647341	1.60013	-2.90	0.004	-7.783539	-1.511144

Tier2						
AGE	-.2205057	.1068604	-2.06	0.039	-.4299482	-.0110631
GEN	-5.758742	3.618668	-1.59	0.112	-12.8512	1.333718
EDUC	.3268034	.3063468	1.07	0.286	-.2736253	.9272321
MARST	6.14985	3.22473	1.91	0.057	-.1705045	12.4702
HHSIZE	.1147301	.229682	0.50	0.617	-.3354383	.5648986
FEXP	.2085245	.1140293	1.83	0.067	-.0149688	.4320178
MFBO	-.8117689	3.573426	-0.23	0.820	-7.815554	6.192016
FRMSIZE	1.855121	3.395746	0.55	0.585	-4.800419	8.510661
HHINC	.0016492	.0006685	2.47	0.014	.000339	.0029595
OFINC	-.9165367	5.42936	-0.17	0.866	-11.55789	9.724813
OUTPUT	.5022908	.2120436	2.37	0.018	.086693	.9178886
TEL	9.910291	3.195143	3.10	0.002	3.647925	16.17266
ACCRE	8.189396	3.254007	2.52	0.012	1.811659	14.56713
EXTCON	.8703805	2.916466	0.30	0.765	-4.845788	6.586549
PRICE	-.0803925	.0731016	-1.10	0.271	-.223669	.0628841
MKTINFO	13.36298	3.601431	3.71	0.000	6.304303	20.42165
POS	-4.578673	2.39405	-1.91	0.056	-9.270925	.1135784

FOS	6.061656	3.315707	1.83	0.068	-.4370102	12.56032
_cons	37.58113	9.113333	4.12	0.000	19.71932	55.44293

sigma						
_cons	14.22757	.6865281	20.72	0.000	12.882	15.57314

3.3 Tobit Regression Results of Maize Intensity of Participation

tobit HCIP AGE GEN EDUC MARST HHSIZE FEXP MFBO FRMSIZE HHINC OFINC OUTPUT TEL ACCRE EXTCON PRICE
MKTINFO POS, ll(0) ul(100) vce(robust)

Tobit regression

Number of obs	=	97
F(17, 80)	=	48.43
Prob > F	=	0.0000
Pseudo R2	=	0.1818

Log pseudolikelihood = -363.68389

HCIP	Coef.	Robust Std. Err.	t	P> t	[95% Conf. Interval]
AGE	-.501495	.0956717	-5.24	0.000	-.6918879 - .3111022
GEN	-9.919502	4.29559	-2.31	0.024	-18.468 -1.371006
EDUC	.2343311	.2693723	0.87	0.387	-.3017369 .7703991
MARST	-3.185424	3.597768	-0.89	0.379	-10.34521 3.974362
HHSIZE	.5757081	.2026548	2.84	0.006	.1724122 .979004
FEXP	.1259678	.0887147	1.42	0.160	-.0505801 .3025156
MFBO	.2856157	3.657207	0.08	0.938	-6.992458 7.56369
FRMSIZE	.4775959	2.2686	0.21	0.834	-4.037061 4.992253
HHINC	.0029082	.0005669	5.13	0.000	.0017801 .0040363
OFINC	-9.662455	4.443023	-2.17	0.033	-18.50435 -.8205568
OUTPUT	.1834612	.0662433	2.77	0.007	.0516329 .3152895
TEL	-1.776004	2.622451	-0.68	0.500	-6.994849 3.44284
ACCRE	8.335549	3.065359	2.72	0.008	2.235291 14.43581
EXTCON	-2.762534	2.381793	-1.16	0.250	-7.502454 1.977385
PRICE	.445062	.0721622	6.17	0.000	.3014546 .5886694
MKTINFO	9.755206	3.557908	2.74	0.008	2.674743 16.83567
POS	-8.246843	2.481019	-3.32	0.001	-13.18423 -3.309457
_cons	29.54341	9.823104	3.01	0.004	9.994807 49.09201

/sigma	10.60005	.7984499			9.011081 12.18901

Obs. summary: 0 left-censored observations
96 uncensored observations
1 right-censored observation at HCIP>=100

3.4 Tobit Regression Results of Groundnut Intensity of Participation

tobit HCIP AGE GEN EDUC MARST HHSIZE FEXP MFBO FRMSIZE HHINC OFINC OUTPUT TEL ACCRE EXTCON PRICE
MKTINFO POS FOS, ll(0) ul(100) vce(robust)

Tobit regression

Number of obs	=	167
F(18, 149)	=	21.29
Prob > F	=	0.0000
Pseudo R2	=	0.0984

Log pseudolikelihood = -660.26323

HCIP	Coef.	Robust Std. Err.	t	P> t	[95% Conf. Interval]
AGE	-.2101681	.1076258	-1.95	0.053	-.4228382 .002502
GEN	-6.303993	3.611366	-1.75	0.083	-13.4401 .8321145
EDUC	.3166437	.3089672	1.02	0.307	-.2938796 .9271671
MARST	6.358828	3.154228	2.02	0.046	.1260316 12.59163
HHSIZE	.0979401	.2461205	0.40	0.691	-.3883973 .5842775
FEXP	.2164924	.1174414	1.84	0.067	-.0155734 .4485581
MFBO	.4082664	3.512752	0.12	0.908	-6.532978 7.349511
FRMSIZE	-1.776908	4.159507	-0.43	0.670	-9.996148 6.442331
HHINC	.0013264	.0007762	1.71	0.090	-.0002075 .0028602
OFINC	-.4400752	5.303793	-0.08	0.934	-10.92044 10.04029

OUTPUT	.8964158	.341146	2.63	0.009	.2223068	1.570525
TEL	9.042697	3.204289	2.82	0.005	2.71098	15.37441
ACCRE	7.376574	3.598225	2.05	0.042	.2664335	14.48671
EXTCON	.9721219	3.068296	0.32	0.752	-5.090872	7.035115
PRICE	-.0286765	.0767724	-0.37	0.709	-.1803797	.1230266
MKTINFO	12.61125	3.373081	3.74	0.000	5.946	19.2765
POS	-4.852811	2.490904	-1.95	0.053	-9.77487	.0692475
FOS	7.511757	3.444704	2.18	0.031	.7049767	14.31854
_cons	35.71211	9.019935	3.96	0.000	17.8886	53.53562

/sigma	14.42963	.7401494			12.96708	15.89217

Obs. summary: 0 left-censored observations
 160 uncensored observations
 7 right-censored observations at HCIP>=100

3.5 Heckman Regression Results of Maize Market Participation and Intensity of Participation

heckman HCIP AGE GEN EDUC MARST HHSIZE FEXP MFBO FRMSIZE HHINC OFINC OUTPUT TEL ACCRE EXTCON PRICE
MKTINFO POS, select(PART = AGE GEN EDUC MARST HHSIZE FEXP MFBO FRMSIZE HHINC OFINC OUTPUT TEL ACCRE
EXTCON MKTINFO) rhosigma

Heckman selection model	Number of obs	=	200
(regression model with sample selection)	Censored obs	=	103
	Uncensored obs	=	97
	Wald chi2(17)	=	380.48
Log likelihood = -418.6152	Prob > chi2	=	0.0000

	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]	

HCIP						
AGE	-.6159288	.115887	-5.31	0.000	-.8430632 -.3887945	
GEN	-10.74367	4.577456	-2.35	0.019	-19.71532 -1.77202	
EDUC	.1289096	.276396	0.47	0.641	-.4128166 .6706357	
MARST	-2.328436	3.535594	-0.66	0.510	-9.258072 4.6012	
HHSIZE	.4153325	.256581	1.62	0.106	-.0875571 .918222	
FEXP	.1304102	.1150229	1.13	0.257	-.0950306 .355851	
MFBO	1.684384	4.06118	0.41	0.678	-6.275383 9.644151	
FRMSIZE	2.921374	2.672731	1.09	0.274	-2.317083 8.159831	
HHINC	.0030675	.0007949	3.86	0.000	.0015095 .0046255	
OFINC	-6.32838	5.529635	-1.14	0.252	-17.16626 4.509504	
OUTPUT	.2204195	.0944545	2.33	0.020	.0352922 .4055469	
TEL	-1.215117	2.629237	-0.46	0.644	-6.368326 3.938092	
ACCRE	10.48116	2.858799	3.67	0.000	4.878013 16.0843	
EXTCON	-2.966894	2.371939	-1.25	0.211	-7.615809 1.682021	
PRICE	.3826984	.0725772	5.27	0.000	.2404497 .5249471	
MKTINFO	9.720839	3.251626	2.99	0.003	3.347768 16.09391	
POS	-8.010904	2.433645	-3.29	0.001	-12.78076 -3.241047	
_cons	31.2674	9.642903	3.24	0.001	12.36766 50.16714	

PART						
AGE	-.0420323	.0105681	-3.98	0.000	-.0627455 -.0213192	
GEN	.080948	.4261929	0.19	0.849	-.7543748 .9162707	
EDUC	-.0886003	.0352717	-2.51	0.012	-.1577315 -.019469	
MARST	-.3202502	.3556096	-0.90	0.368	-1.017232 .3767317	
HHSIZE	-.1600769	.0361623	-4.43	0.000	-.2309536 -.0892002	
FEXP	-.0001853	.0118253	-0.02	0.987	-.0233624 .0229918	
MFBO	.7709993	1.962344	0.39	0.694	-3.075124 4.617123	
FRMSIZE	.8279923	.3053128	2.71	0.007	.2295903 1.426394	
HHINC	.0004331	.0001704	2.54	0.011	.0000992 .000767	
OFINC	3.832488	1.079138	3.55	0.000	1.717418 5.947559	
OUTPUT	.0690327	.0239638	2.88	0.004	.0220644 .1160009	
TEL	.089274	.2972479	0.30	0.764	-.4933213 .6718692	
ACCRE	1.554638	.5121107	3.04	0.002	.5509198 2.558357	
EXTCON	.0415128	.2810458	0.15	0.883	-.5093268 .5923524	
MKTINFO	.5910625	.3040022	1.94	0.052	-.0047709 1.186896	

_cons	1.259975	.7846496	1.61	0.108	-.2779102	2.79786
/athrho	.8987045	.4812074	1.87	0.062	-.0444446	1.841854
/lnsigma	2.4082	.0888638	27.10	0.000	2.23403	2.58237
rho	.7156665	.2347433			-.0444154	.9509728
sigma	11.11394	.9876274			9.337423	13.22845
lambda	7.953875	3.080215			1.916765	13.99099

LR test of indep. eqns. (rho = 0): chi2(1) = 2.59 Prob > chi2 = 0.1072

3.6 Heckman Regression Results of Groundnut Market Participation and Intensity of Participation

heckman HCIP AGE GEN EDUC MARST HHSIZE FEXP MFBO FRMSIZE HHINC OFINC OUTPUT TEL ACCRE EXTCON PRICE
MKTINFO POS FOS, select(PART = AGE GEN EDUC MARST HHSIZE FEXP MFBO FRMSIZE HHINC OFINC OUTPUT TEL ACCRE
EXTCON MKTINFO) rhosigma

Heckman selection model Number of obs = 200
(regression model with sample selection) Censored obs = 33
Uncensored obs = 167
Wald chi2(18) = 211.42
Prob > chi2 = 0.0000
Log likelihood = -687.5412

	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]
HCIP					
AGE	-.1383345	.1026533	-1.35	0.178	-.3395312 .0628622
GEN	-6.50251	3.650742	-1.78	0.075	-13.65783 .6528132
EDUC	.3352234	.2912125	1.15	0.250	-.2355427 .9059895
MARST	7.72302	3.235128	2.39	0.017	1.382286 14.06375
HHSIZE	.0774732	.2204489	0.35	0.725	-.3545986 .5095451
FEXP	.1020429	.1103454	0.92	0.355	-.11423 .3183158
MFBO	-.3300982	3.642323	-0.09	0.928	-7.468919 6.808723
FRMSIZE	-1.416547	3.268191	-0.43	0.665	-7.822083 4.988988
HHINC	.0012623	.000929	1.36	0.174	-.0005585 .0030832
OFINC	-2.071767	5.164132	-0.40	0.688	-12.19328 8.049746
OUTPUT	.6556796	.2003117	3.27	0.001	.2630758 1.048283
TEL	10.1609	3.0152	3.37	0.001	4.251213 16.07058
ACCRE	8.529669	3.624986	2.35	0.019	1.424827 15.63451
EXTCON	1.311751	2.820923	0.47	0.642	-4.217156 6.840657
PRICE	-.0535141	.0267941	-2.00	0.046	-.1060296 -.0009985
MKTINFO	12.29651	5.965738	2.06	0.039	.6038809 23.98914
POS	-4.471648	2.51752	-1.78	0.076	-9.405896 .4625997
FOS	-3.234552	5.825686	-0.56	0.579	-14.65269 8.183582
_cons	45.67032	11.48253	3.98	0.000	23.16497 68.17566
PART					
AGE	-.017365	.0156086	-1.11	0.266	-.0479572 .0132272
GEN	1.24353	.6985019	1.78	0.075	-.1255086 2.612569
EDUC	.0349398	.0683451	0.51	0.609	-.0990142 .1688937
MARST	.7913615	.3817506	2.07	0.038	.0431441 1.539579
HHSIZE	-.092379	.0360312	-2.56	0.010	-.1629989 -.0217592
FEXP	.1551889	.0601189	2.58	0.010	.037358 .2730197
MFBO	-2.50224	.8111535	-3.08	0.002	-4.092072 -.9124085
FRMSIZE	2.665443	.5194653	5.13	0.000	1.64731 3.683576
HHINC	.0085753	.0030019	2.86	0.004	.0026917 .0144588
OFINC	-2.418295	.6919165	-3.50	0.000	-3.774426 -1.062163
OUTPUT	-.038142	.1595041	-0.24	0.811	-.3507642 .2744803
TEL	-.0480561	.5699039	-0.08	0.933	-1.165047 1.068935
ACCRE	-.9869363	.6039764	-1.63	0.102	-2.170708 .1968356
EXTCON	-.1745145	.5100056	-0.34	0.732	-1.174107 .8250781
MKTINFO	2.226371	.8346083	2.67	0.008	.5905684 3.862173
_cons	-5.517067	1.612677	-3.42	0.001	-8.677856 -2.356277
/athrho	-15.29875	116.2343	-0.13	0.895	-243.1138 212.5163

/lnsigma	2.655489	.0547613	48.49	0.000	2.548159	2.76282
rho	-1	2.40e-11			-1	1
sigma	14.23195	.7793607			12.78355	15.84446
lambda	-14.23195	.7793607			-15.75947	-12.70443

LR test of indep. eqns. (rho = 0): chi2(1) = 10.14 Prob > chi2 = 0.0015

APPENDIX 4: Variance Inflation Factors for Regression Models

4.1 VIF for Maize Participation

Variable	VIF	1/VIF
HHINC	2.09	0.478687
OUTPUT	1.98	0.506321
FRMSIZE	1.60	0.624953
ACCRE	1.56	0.641904
AGE	1.45	0.689149
MFBO	1.40	0.711876
OFINC	1.31	0.763896
GEN	1.29	0.775136
MKTINFO	1.28	0.780427
FEXP	1.24	0.809314
TEL	1.22	0.821380
EDUC	1.19	0.841488
MARST	1.14	0.875557
HHSIZE	1.10	0.908135
EXTCON	1.09	0.917000
Mean VIF	1.40	

4.2 VIF for Maize Intensity

Variable	VIF	1/VIF
PRICE	3.11	0.321833
HHINC	2.18	0.459273
OUTPUT	1.98	0.505130
FRMSIZE	1.75	0.572613
ACCRE	1.66	0.600841
AGE	1.58	0.631293
POS	1.47	0.679819
MFBO	1.43	0.697081
OFINC	1.40	0.714187
MKTINFO	1.33	0.754085
GEN	1.29	0.775015
FEXP	1.24	0.803579
EDUC	1.22	0.816438
TEL	1.22	0.817691
HHSIZE	1.19	0.836875
MARST	1.14	0.874660
EXTCON	1.10	0.912114
Mean VIF	1.55	

4.3 VIF for Groundnut Participation

Variable	VIF	1/VIF
OUTPUT	3.14	0.318000
FRMSIZE	2.79	0.359002
AGE	1.81	0.551633
HHINC	1.77	0.564425
TEL	1.68	0.593944
GEN	1.62	0.617257
FEXP	1.50	0.664872
ACCRE	1.44	0.696074
MARST	1.32	0.759054
OFINC	1.22	0.820634
EDUC	1.20	0.830388
MKTINFO	1.16	0.865616
HHSIZE	1.15	0.866439
MFBO	1.13	0.885867
EXTCON	1.12	0.896095
Mean VIF	1.60	

4.4 VIF for Groundnut Intensity

Variable	VIF	1/VIF
OUTPUT	3.47	0.288337
FRMSIZE	2.95	0.338731
FOS	2.81	0.356243
PRICE	2.30	0.433972
AGE	1.92	0.522119
HHINC	1.84	0.544220
TEL	1.77	0.564089
GEN	1.67	0.597063
FEXP	1.59	0.628881
ACCRE	1.49	0.671070
POS	1.48	0.676449
MARST	1.34	0.744902
OFINC	1.23	0.810893
EDUC	1.22	0.821301
MKTINFO	1.21	0.827190
HHSIZE	1.18	0.844353
MFBO	1.18	0.844606
EXTCON	1.14	0.879630
Mean VIF	1.77	

APPENDIX 5: GARRETT RANKING CONVERSION TABLE**GARRETT RANKING CONVERSION TABLE****The conversion of orders of merits into units of amount of “soces”**

Percent	Score	Percent	Score	Percent	Score
0.09	99	22.32	65	83.31	31
0.20	98	23.88	64	84.56	30
0.32	97	25.48	63	85.75	29
0.45	96	27.15	62	86.89	28
0.61	95	28.86	61	87.96	27
0.78	94	30.61	60	88.97	26
0.97	93	32.42	59	89.94	25
1.18	92	34.25	58	90.83	24
1.42	91	36.15	57	91.67	23
1.68	90	38.06	56	92.45	22
1.96	89	40.01	55	93.19	21
2.28	88	41.97	54	93.86	20
2.69	87	43.97	53	94.49	19
3.01	86	45.97	52	95.08	18
3.43	85	47.98	51	95.62	17
3.89	84	50.00	50	96.11	16
4.38	83	52.02	49	96.57	15
4.92	82	54.03	48	96.99	14
5.51	81	56.03	47	97.37	13
6.14	80	58.03	46	97.72	12
6.81	79	59.99	45	98.04	11
7.55	78	61.94	44	98.32	10
8.33	77	63.85	43	98.58	9
9.17	76	65.75	42	98.82	8
10.06	75	67.48	41	99.03	7
11.03	74	69.39	40	99.22	6
12.04	73	71.14	39	99.39	5
13.11	72	72.85	38	99.55	4
14.25	71	74.52	37	99.68	3
15.44	70	76.12	36	99.80	2
16.69	69	77.68	35	99.91	1
18.01	68	79.17	34	100.00	0
19.39	67	80.61	33		
20.93	66	81.99	32		